MIDLAND PLANT

CONSUMERS POWER COMPANY

JOB NO. 7220

SOILS INVESTIGATION AND TESTING REQUIREMENTS

Addendum No. 2

Technical Provisions

Bechtel Company
January 20, 1969

1.0 GENERAL

This addendum to specification No. 7220-C-1 covers additional soils investigation for the Midland plant area and the cooling pond dikes. All of the provisions of specification No. 7220-C-1 shall apply unless specifically modified herein.

Explorations under this addendum shall be the basis for the preparation of the final design drawings and specifications and shall supplement earlier soils investigation programs.

The previous investigations have shown that the site is underlain by a deep deposit of very dense clayey glacial till, but depressions in the surface of the till exist and are filled with much looser and more variable materials, including soft silt, clay, and uniform sand. The purpose of these explorations shall be to investigate the properties of such surficial deposits where these occur in the locations of the structures, to determine the surface level of the very dense till, and to locate and prove a source of sand suitable for use in the embankment.

2.0 SCOPE OF WORK

2.1 General

The work included under this addendum consists of furnishing all supervision, labor, equipment, materials, and accessories, and performing all operations required for drilling boreholes, sampling, performing tests, and reporting of the investigation findings.

2.2 Work Included

The major portions of work include the following:

2.2.1 At the plant area, the Contractor shall make borings and tests and perform other explorations to supplement the earlier soils investigations.

2.2.2 Additional borings shall be made at several locations along the cooling pond dike to determine the surface level of the very dense till.

2.2.3 Borings and tests shall be made to locate and prove suitable sand sources.

2.2.4 Borings shall be made to site the spillway structure.

2.2.5 At the railroad embankment and bridge sites, borings and tests shall be made to determine foundation requirements.

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3.0 SCHEDULE

The work shall commence as soon as possible upon notification by the Engineer to the Contractor to proceed. The sequence of drilling and exploration work shall be approved by the Engineer. Because the information is urgently required, results should be forwarded to the Engineer as soon as they are available. The final report shall be submitted on or before March 15, 1969.

4.0 DRAWINGS

4.1 Two copies each of the following drawings are enclosed with marked up locations of borings:

Drawing No. SK-7220-C-97 - Supplementary Bore Hole Locations

Drawing No. SK-7220-C-98 - Access Railroad Bore Hole Locations

4.2 Two copies of the following drawing are included for information only:

Drawing No. SK-7220-C-99 - Foundation Elevations and Soil Pressures

5.0 SURVEYING

The Contractor will be responsible for all survey work required for this investigation. Boreholes shall be located with reference to the Dow Chemical Company coordinate system. Elevations shall be to the U.S.G.S. datum (similar to previous investigations).

6.0 FIELD WORK, DRILLING AND SOIL SAMPLING

6.1 In the plant area, the selection of final borehole locations, selection of samples, and the interpretation of the results of the exploration shall be the responsibility of the Contractor.

6.2 Under the cooling pond dikes, at the railroad bridge and embankment, at the spillway structure, and in the potential sand borrow areas, final borehole locations and the interpretation of the results of these explorations shall be the responsibility of the Engineer. The selection of samples for strength, permeability and compaction tests will also be the responsibility of the Engineer and will be made on the basis of borehole logs transmitted to the Engineer by the Contractor's field personnel. However, the Contractor shall conduct all laboratory tests as required by the Engineer. The Contractor shall also select samples and conduct classification tests to confirm field classifications.

6.3 Plant Area Foundations

The reactor buildings and related structures have been relocated approximately 150 feet easterly and 60 feet northerly of the location used in the June, 1968, exploration program. The present locations, including foundation elevations and loadings, are shown on Drawing No. SK-7220-C-99.

The Contractor shall be responsible for determining and obtaining all necessary information required to interpret soil conditions at the plant area. It is anticipated that approximately 8-10 boreholes be made, and shall extend into the very dense clayey till material beneath the site. It is further suggested that alternating undisturbed samples and standard penetration tests be taken at minimum depth intervals of 2-1/2 feet for the first fifteen feet and every five feet thereafter. Sampling and testing program shall be similar to the earlier program conducted by the Contractor at the plant area.

6.4 Cooling Pond Dike Alignment

Additional explorations shall consist of 7 borings located as shown on Drawing No. SK-7220-C-97. The borings should extend to a depth such that they penetrate into a dense stratum a minimum distance of 10 feet. Standard penetration tests should be taken at minimum depth intervals of 2-1/2 feet for the first fifteen feet and five feet thereafter. All penetration tests made in this program shall be done in accordance with the requirements of Penetration Tests and Split-barrel Sampling of Soils, ASTM Designation D-1536 (latest issue).

6.5 Spillway Foundation

A study of boreholes on the centerline of the cooling pond dike adjacent to the proposed location of the structure should provide the most suitable location for the structure. Unless otherwise directed by the Engineer, six boreholes shall be made as shown on Drawing No. SK-7220-C-97. The holes should establish the depth to very dense clayey till, its in-situ density, and grading. Penetrations tests shall be made in accordance with the requirements set out for the Cooling Dike Alignment.

6.6 Sand for Use in the Dike

A study of existing borehole information and aerial photographs indicates three possible sand sources as shown on Drawing No. SK-7220-C-97. This drawing also shows the proposed layout of boreholes in these areas. It is estimated that about 19 holes will be required to determine the extent of the sand deposits but this number may be reduced or increased according

to field conditions, and as directed by the Engineer.

An estimated 200,000 cubic yards of sand is required for use in the embankment and 300,000 cubic yards of suitable material should be proven in the field. Any satisfactory sources other than those shown on the drawings which can be economically used for sand borrow may be investigated, following approval by the Engineer to proceed.

The depth of the drill holes shall be the minimum necessary to establish the bottom of the sand layer. If in any hole clean sand is not encountered within five feet of the surface, the hold shall be abandoned.

At least two representative bulk samples shall be taken from each hole and tests carried out as described below.

6.7 Railroad Bridge and Embankment

Unless otherwise directed by the Engineer, the Contractor shall provide one borehole at each abutment and each pier location of the railroad bridge to determine the pile requirements and one borehole under the railroad embankment to determine the nature of the foundation. The location of the proposed boreholes is shown on Drawing No. SK-7220-C-98. The boreholes for both the railroad bridge and embankment shall penetrate a minimum depth of 20 feet into firm glacial till. Undisturbed samples and standard penetration tests shall be taken alternately at minimum depth intervals of two and a half feet for the first fifteen feet and every five feet thereafter.

7.0 TESTING

Laboratory tests shall be made on the samples as follows:

7.1 Railroad Bridge and Embankment Foundations

Classification tests such as unit weight, moisture content, gradation, and Atterberg limits shall be made to confirm the field classification of soils. On the basis of these tests, samples will be selected by the Engineer for testing to determine engineering properties. These tests will include shear strength and consolidation tests.

7.2 Cooling Pond Dike Foundation and Spillway Foundation

Classification tests will be required to identify the materials and confirm the field classifcations. Other tests will be made only at the direction of the Engineer.

7.3 Sand for Use in the Dike as Selected by the Engineer

Sieve analysis shall be made on samples to cover the range of gradations encountered. Relative density tests on selected samples shall be made in accordance with the current ASTM Designation D-2049. Permeability tests shall be made on selected samples of the sand compacted to a density equal to or greater than 70 percent relative density.

7.4 Plant Area

The Contractor shall conduct tests as necessary to make foundation recommendations for the proposed structures in the plant area.

8.0 ANALYSIS AND REPORT

All information obtained from the explorations and laboratory testing program shall be analyzed and presented in report form. This report shall be considered the final soils report and shall supersede the preliminary report submitted earlier. The final report shall include, but not necessarily be limited, to the following items:

8.1 Soil boring logs and sub surface profiles. This would include information on ground water levels at the time of drill.

8.2 Results of soil tests.

8.3 Furnish the following foundation Design Criteria:

8.3.1 Allowable bearing pressure of shallow spread foundations on the compated plant fill as a function of width for an allowable total settlement of 3/4 inch.

8.3.2 Lateral earth pressure against structure walls as a function of depth. The water table for this should be for the maximum probable flood which is assumed to be at El. 632 feet and the top of plant fill at El. 634 feet. For normal conditions, the ground water level should be taken as El. 627 feet, the reservoir water surface elevation.

8.3.3 Recommended foundation type for the reactor building. The total settlement and maximum differential settlement should be given.

8.3.4 Recommended foundation type for the turbine building and for the turbine-generator foundations. The total settlement and maximum differential settlement should be given.

8.3.5 Recommended foundation type for the auxiliary building which is located between the two reactor buildings. Its structure and foundation will be separate from those of the adjacent three buildings to allow for possible differential settlement which must, however, not be allowed to exceed 3/4 inch. The total settlement should be given.

8.3.6 Differential settlements between auxiliary building, reactor, and turbine buildings under the loading conditions given.

8.4 Review the following items included in the preliminary report:

8.4.1 Recommended excavation slopes in natural soils and in plant fill.

8.4.2 Control of groundwater in excavations for the reactor and turbine buildings.

8.4.3 Compaction requirements for the plant fill (i) beneath structure, and (ii) adjacent to structures.

8.4.4 Minimum depths of footings in compacted soil for frost protection or other reasons.

SUMMARY OF ESTIMATED BORING
AND SOIL SAMPLING IN AREAS
OTHER THAN PLANT AREA
WORK UNDER ADDENDUM NO. 2, P. O. 7220-C-1

Borings

Cooling Pond Dikes	7 holes @ 25'
Sand Borrow Area	19 holes @ 10' (average)
Spillway Structure	6 holes @ 30'
Railroad Bridge	8 holes @ 40' (3 appear to be in river)
Railroad Embankment	1 hole @ 25'

Moisture Tests and Density Tests

190 samples

Strength Tests (Triaxial)

Foundation Material	5 speciments (3points per test by stage loading)

Classification Tests

50 grading analysis, including hidrometer analysis where required

12 Atterberg Limits

Permeability Tests

10 tests on sand compacted to 70 percent relative density

Relative Density on Sand (Borrow)

10 tests

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SK-7220-C-4 Foundation Loading Sequence

SK-7220-C-26 Preliminary Site Plan Bore Hole Location

Sequence of Work

The construction will begin with the Containment Building foundations but will be followed in a very short time with the other structures and all will be brought up concurrently. Plant fill will be brought up concurrently with structures.

Design Requirements

The gross loads applied by the structures under normal conditions are shown on the drawings.

Exploratory Borings

This exploration will consist of six (6) borings, one (1) of which should extend to the bedrock. The other borings should be made as deep as necessary to make possible a satisfactory analysis of the foundation conditions for the plant. The six borings are located on Drawing SK-7220-C-26.

In addition to the exploration of the plant site, the contractor shall make very preliminary explorations and testing to check the availability and quality of five (5) million cubic yards of fill material for the cooling water pond dikes, plant fill, access dike, etc. It is intended that the material would be obtained from the cooling water pond area which will be excavated to El. 603'; therefore, the investigation would involve exploration of that area and drilling of nine (9) shallow exploratory borings to El. 598' to obtain representative bulk samples of the material for laboratory testing.

Contractor's Supervision

Field and laboratory work should be carried out under the direct supervision of a qualified soil engineer in the Contractor's employ.

Drilling -- General

Borings shall be drilled with a rotary machine, equipped with an hydraulic feed capable of securing satisfactory samples of the required diameters to the required depths. All accessories for drilling such as casing, drill rods, piping, pumps and other materials or supplies necessary for the contract and all manpower required to supervise and perform the drilling shall be furnished by the Contractor. Any equipment which, as determined by the Engineer, is unsatisfactory for performing the contract shall be removed from the work site and replaced with satisfactory equipment.

All equipment which the Contractor proposes to use in the contract shall be modern equipment in good condition. All personnel shall be competent and experienced in drilling and sampling work. Such equipment and personnel shall be subject to approval by the Engineer.

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[illegible] samples shall be [illegible] to protect them against loss of moisture. All samples shall be clearly marked, and their containers and labels shall be protected against exposure and damage.

Where coarse grained cohesionless soils are encountered, a 2-1/2 inch split barrel sampler shall be used. These samples should be taken at not more than 10 foot intervals or change in strata. The driving resistance of [illegible] 2-1/2 in. I.D. split spoon [illegible] number of blows required to advance the sampler 1 foot. All samples taken with this equipment shall be placed immediately in sealed jars, to prevent moisture loss.

Each sample shall be labelled to show plainly the number of the boring, the sample number, description, depth below the surface from which the sample came and, where applicable, the resistance to penetration of the sampler. All samples should be protected from freezing, exposure or other damage.

The Contractor shall deliver all undisturbed samples in steel [illegible] and all disturbed samples in jars. All tubes and jars shall be transported in cases packed with [illegible] or other [illegible] material to minimize disturbance.

[illegible]

The exploration in the Cooling Water Pond borrow area is intended [illegible] to establish the suitability of the material and the availability of 2 million cubic yards for dike construction sufficiently for [illegible] design requirements. Test holes may be drilled with a [illegible] auger or excavated with a backhoe or other suitable equipment.

Bulk samples, representative of the materials encountered, shall be taken for laboratory testing.

All test holes shall be logged and their location and the location of the bulk samples shall be recorded.

Drilling Logs

The Contractor shall keep and, at completion of each drill hole, furnish to the Engineer an accurate log of each drill hole. Such log shall show the description of all materials of whatever character encountered in the drilling, their locations in the hole, the results of standard or other penetration tests, the location of all samples, the ground water levels encountered, water loss and any other items of interest in connection with the exploratory drilling.

Ground Water Observations

Ground Water Observations. The Contractor shall [illegible] of the ground water [illegible] completion of drilling. [illegible] shall be flushed thoroughly with clean water at the completion of [illegible]

the boring for the purpose of observing ground water levels. Observations of the water levels in each boring shall be made daily until the completion of the exploratory drilling.

Laboratory Soil Testing

Laboratory tests should be made on the samples as follows:

a. Split Spoon -- Classification tests such as unit weight, moisture content, gradation and Atterberg limits shall be made to confirm the field classification of soils. On the basis of these tests, samples shall be selected for testing to determine engineering properties. These tests shall include shear strength, consolidation tests and permeability tests.

b. Bulk or Auger Samples -- Classification tests shall be made on all samples [illegible]. These should include gradation and Atterberg limits. Following this, the compaction characteristics shall be determined by [illegible] Proctor Test. Permeability tests shall be performed on representative samples of the [illegible] material compacted to [illegible] moisture content to [illegible] maximum dry density as obtained in the compaction test.

Handling of Soil Samples. Undisturbed soil samples shall be protected [illegible] so that they will not be dumped, jarred or vibrated. [illegible] sampling tubes shall be kept sealed and not subjected to freezing or high temperatures. If a portion of a sample is used, the remainder shall be [illegible] with a microcrystalline wax to avoid loss in moisture content.

All samples shall be stored in cardboard containers which are properly [illegible]. All jars shall be kept sealed to avoid changes in moisture content until they are required for testing.

Testing Procedures

1. Moisture Content and Unit Weight of Undisturbed Samples. The volume of a sample of undisturbed soil shall be determined by measurement or displacement. It shall then be weighed and the wet unit weight determined. The soil shall then be dried at 105°C for 24 hours and shall be weighed again to obtain the dry weight of soil and the loss of moisture during the drying process. The water content shall be computed and expressed as a percentage. The dry unit weight shall be computed from the dry weight of soil and the original volume of the sample. This test shall be made on each undisturbed sample.

2. Atterberg Limits. The liquid limit, plastic limit and plasticity index shall be determined in accordance with [illegible] and [illegible]. This test shall be carried out on selected samples of cohesive soil.

3. Grain Size Analysis. This shall be determined by the [illegible] on samples selected by the Engineer.

4. Direct shear tests. These tests shall be carried out on undisturbed samples obtained by the Contractor as tested in accordance with accepted procedures. Direct shear tests shall be carried out at natural moisture content and under a surcharge pressure approximately equal to the effective overburden pressure from which the angle of internal friction of undisturbed samples shall be determined under at least three different surcharge pressures.

5. Unconfined. This shall be carried out on undisturbed samples of cohesive soils obtained by the Contractor. The procedure shall be generally in accordance with Designation [illegible] of the U.S. Bureau of Reclamation. The sample shall be loaded until unconfined by incremental loads.

6. Consolidation. This shall be carried out on bulk samples of potential [illegible] obtained by the Contractor. The procedure shall follow [illegible].

7. [illegible].

i) Laboratory permeability tests shall be made on selected undisturbed samples representative of the major soil strata encountered at the site.

ii) Laboratory permeability tests shall also be made on representative samples of pervious zoning borrow material prepared at optimum moisture content and compacted to 95% of Modified Proctor (ASTM D1557-66T).

Core Drilling

Core drilling in bedrock shall be done in NQ-size holes extending to be met with a rotary machine, equipped with hydraulic feed, capable of obtaining NQ cores at all drilling depths and equipped with all necessary equipment and supplies. Unless specifically authorized, drilling mud shall not be used when coring rock.

Core drilling shall be done with double tube, ball bearing, swivel type core barrels. Rotation discharge core bits shall be used. Core drilling shall begin at the bedrock surface and shall extend to a depth of 20 feet unless otherwise approved by the Engineer. Drilling shall be stopped and the core barrel shall be removed from the hole whenever necessary to prevent loss of or damage to the core. If the core barrel has become blocked, drilling shall be stopped and the blocked core barrel shall be removed from the hole irrespective of the interval drilled. The use of wedges or any tools on the outside of the core barrel or rods will not be allowed.

Wooden core boxes with inner partitions shall be furnished by and at the expense of the Contractor, who shall be responsible for properly preserving all cores in good conditions and carefully placing the cores in boxes properly labelled at drilling site and from which cores shall be protected from [illegible] weather and from [illegible] and shall be delivered to the Engineer, together with core logs, on completion of the Contract.

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under maximum seismic loading and none greater than 2 inches under maximum static loading. The total settlement and maximum differential settlement should be given for this building.

f. Differential settlements between reactor building, reactor containment and turbine building under the loading conditions given above.

g. Acceptability of excavation slopes in natural soils and in plant fill.

h. Control of groundwater in excavations for the reactor and turbine building.

i. Compaction requirements for the plant fill (i) beneath structures, and (ii) adjacent to the structures.

j. Minimum depth of footings in compacted soil for frost protection or other reasons.

k. Liquefaction potential of soils at the site shall be reported.

Bechtel Corporation

Inter-office Memorandum

To J. H. Blasingame

Date November 10, 1969

Subject Consumers Power Company
Midland Plant Units 1 and 2
Job 7220-001
Cooling Pond Dikes

From H. H. Burke

Of H & T - Soils

Copies to J. G. Thon
P. A. Martinez
R. L. Kulesza

At 50 Beale Street

We have reviewed the results of earthwork control tests performed by W. H. Flood & Co. between October 6 and 24, 1969. We have also further considered the question of excessive moisture content of fill, which was again raised by John Eden, in his letter to M. J. Mitchell dated October 31, 1969.

Regarding the test data, we observe that in 6 out of 7 cases, the moisture content of the fill was below the optimum; in 2 cases it was lower than the minus 2 percent of optimum permitted by the specification C-10. In earlier tests performed by Michigan Testing Engineers, Inc., in 24 out of 48 tests the moisture content was also below the optimum, including 10 cases of more than the allowed 2 percent below the optimum. Thus, a considerable proportion of the tested materials (over half) was below the optimum moisture content. This seems to indicate that it is quite practicable at this site to construct fill meeting the specified moisture criteria.

Difficulty with moisture content of fill can be reduced by proper selection of materials and by taking suitable precautions against excessive wetting of soils by rainfall. As an example, the broadly graded sandy, silty till characterized by a maximum dry density exceeding 130 pcf, can be expected in its natural state to be at a suitable moisture content to meet the specification for Zone 1 with a minimum of moisture-conditioning. The subcontractor should consider scheduling his work so as to use this type of soil under adverse atmospheric conditions, when he finds it difficult to meet the moisture criteria for Zone 1 using the more clayey soils possessing a higher natural moisture content. When the wetter soils cannot be used in Zone 1, they of course can still be used in Zone 2, which does not have an upper limit on permissible moisture content other than the requirement that rutting by 50-ton rubber-tired roller should not exceed 6 inches.

In order to minimize the effect of rainfall, the borrow areas should be sloped and drained to prevent the ponding of rain water, and the dike construction surface should be sloped to drain as required by the specification, and rolled by smooth-wheeled roller prior to expected rainfall. These requirements are emphasized in the Design Report.

Regarding the quality of work produced by W. H. Flood & Co., we observe that some of the dry density - moisture content curves get further away from the zero voids line at increasing moisture content. This implies increased air content at increased moisture content, which is contrary to what is normal. The attention of the laboratory should be drawn to this, and the test points on the wet side of the optimum should be repeated if such anomaly is indicated. In particular, the result of the test performed on October 6, 1969 should not have been accepted.

Also, we recommend that the procedure employed by the laboratory to determine the moisture content of fill should be reviewed to check if the material is being dried to constant weight and that the method is compatible with ASTM Designation D-2216. Although the results produced by W. H. Flood & Co. may be quite in order, a need for such a check was suggested by the fact that in as many as 7 out of 9 cases the moisture content reported was below the optimum, while earlier tests by Mi[illegible] Testing Engineers, Inc. showed only about half of the results at b[illegible] the optimum water content.

Harris H. Burke

HHB:RLK:ab

bcc: H. Wahl
K. Wiedner
S. Afifi
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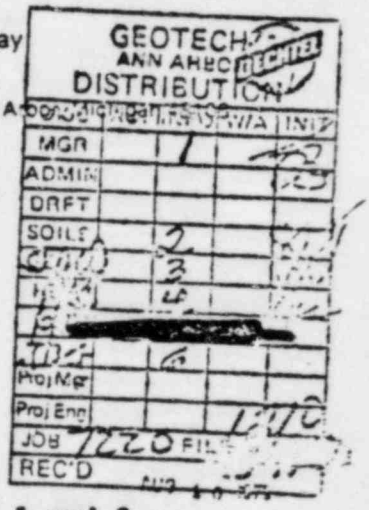


August 15, 1979

Mr. G.S. Keeley
Project Manager
CONSUMERS POWER COMPANY
1945 W. Parnall Road
Jackson, Michigan 49201

Subject: Midland Units 1 and 2
Consumers Power Company
Bechtel Job 7220
DIESEL GENERATOR BUILDING
REMOVAL OF SURCHARGE
File: 0614/2501

References:
1) BLC-6301 dated 11/16/78, P. Martinez to G. Keeley
2) Meeting Notes of Consultants Meeting on 5/10/79
3) Meeting Notes of Consultants Meeting on 6/13 and 6/19/79
4) Meeting Notes of Consultants Meeting on 6/20/79, Denver, Colo.
5) Summary of Presentation to NRC dated 8/10/79
6) BLBC-3176 (teletype) dated 8/13/79, R.L. Castleberry to J.F. Keugen

Dear Mr. Keeley:

The purpose of this letter is to advise you that the intent of the preload program has been achieved, and the surcharge can now be removed. On November 16, 1978, we advised you in a letter (Reference 1) of our

intent to carry out our consultants' recommendation to preload the diesel generator building and equipment foundations. The placement of surcharge inside and around the diesel generator building was completed in April 1979. The surcharge consisted of sand as shown in Drawing 7220-C-1141 issued for construction on January 10, 1979.

During the meeting with the consultants on May 10, 1979 (Reference 2), the surcharge depth of 20 feet was considered adequate. It was recommended by the consultants that the surcharge be maintained at that level for approximately 6 additional weeks to allow prediction of long-term settlement.

In the first part of June 1979, additional instrumentation was installed to obtain precise settlement data and measurement of rebound. During a mid-June meeting (Reference 3), the consultants concluded that on the basis of available data at that time, prediction of future settlement could not be made, and it was requested that the settlement readings be continued to improve the data base.

During a late June 1979 meeting (Reference 4), the consultants concluded that the surcharge could be removed in August, provided that the settlement trend continued after proper temperature corrections have been made. The temperature correction devices were developed by the staff of Goldberg-Zoino-Dunnicliff & Associates. The adequacy of the surcharge program has been confirmed by R.B. Peck, one of the consultants at the presentation to the NRC on July 10, 1979, as follows (Reference 5).

> "The results of the preload procedure have been convincing. The observed pore pressures were smaller than actually anticipated, and they dissipated rapidly. Hence, primary consolidation was accomplished quickly, and the curve of settlement as a function of the logarithm of time became linear shortly after the completion of placement of the fill. Therefore, it is possible to forecast the settlement that would occur at any future time by simple extrapolation, on the assumption that the surcharge will remain in place. Even this amount of settlement would be acceptable. However, the projected settlement determined on this basis is an upper bound because the surcharge will be removed, and the real settlements will certainly be smaller."

It was R.B. Peck's judgment that foregoing circumstances eliminate any uncertainties concerning the settlement behavior of the diesel generator building resulting from the underlying clay fill.

On August 2, 1979, consultants R.B. Peck and A.J. Hendron, Jr. were provided with the latest precise settlement data and calculations for establishing residual settlement. On August 10 and 13, 1979, A.J. Hendron concurred, in a telephone conversation, with Bechtel's findings that the rate of settlement has decreased to such an extent that for the last 6 weeks there has been essentially no settlement, and that sufficient data have been obtained to allow prediction of long-term settlement by extrapolating the available settlement data. Calculations based on present data indicate that the residual settlement over a period of 40 years due to secondary consolidation of clay will be less than 1 inch. A copy of this confirmation letter from the consultants will be provided as soon as it is received. Because of the favorable settlement characteristics of the surcharge, the design intent of the PSAR in regard to prediction of long-term settlement has been met.

In conclusion, the preload operation has been successfully completed. The acceptance criteria have been met by providing a reliable residual settlement prediction. Structures, components, and utilities will be designed to accommodate the long-term settlement. Removal of surcharge will commence on August 15, 1979. Construction has been instructed accordingly (Reference 6).

Very truly yours,

S

P.A. Martinez
Project Manager

AG/bm
8/15/1

cc: D.B. Miller
T.J. Sullivan
B.W. Marguglio
W. Bird
T.C. Cooke

canonie CONSTRUCTION COMPANY / P.O. BOX 509 / U.S. 31 & M-43 / SOUTH HAVEN, MICHIGAN 49090 / (616) 637-1171

May 17, 1974

Bechtel Power Corporation
P. O. Box 2167
Midland, Michigan 48640

Attention: Mr. E. E. Felton, Project Superintendent

Subject: Midland Project Contract

Gentlemen:

At the request of your jobsite personnel, consider this correspondence our request for a meeting to discuss the problems that have been, and are being, encountered with attempting to place Zone 1 fill on the subject project.

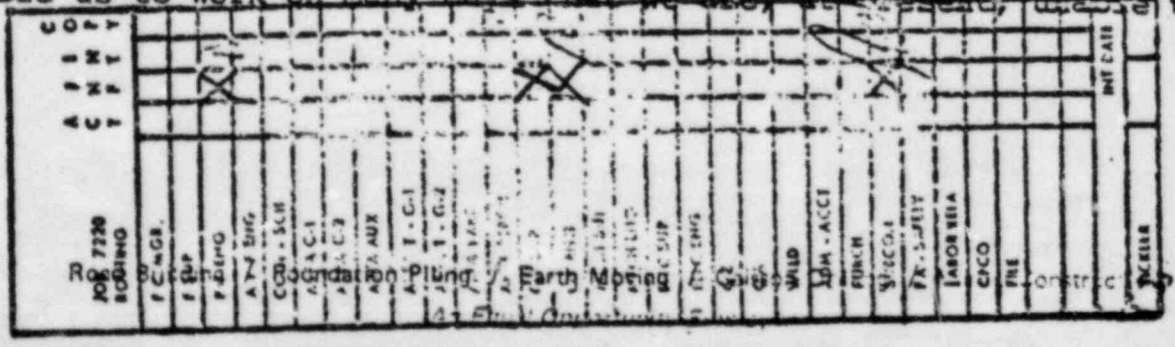
The difference in characteristics of the fill material, from that on which our proposal was based necessitating the change in specification as per Change Notice #6F, has resulted in the following:

1. Because of the finer gradation of the material, it has been necessary to exert significantly more effort in order to get the material within the specification requirement on moisture, resulting in higher cost.

2. This also results in our not being able to place fill on many days because it is impossible to dry the material to the specification requirement prior to receiving additional rainfall, resulting in delay time on our equipment and personnel as well as schedule.

We feel a meeting could be significantly beneficial from both a schedule and financial standpoint. Possibly something can be done to initiate a more workable specification that will enable the job to progress much more rapidly and economically.

Because of the finer material encountered in the borrow area, we are looking at a significant cost differential which could result in a large claim if the present specification has to be adhered to. If the moisture requirement can be relaxed, we feel that the required densities can still be attained with a minimum of additional compactive effort lessening the possible claim very significantly. It would also enable us to work on many days that we are, at present, unable to work.



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resulting in an earlier completion date and thereby significantly lessening the possible claim due to standby charges.

We feel that it would be beneficial to all parties concerned to hold a meeting as soon as possible in order to come to an early solution to our mutual problems.

We await your earliest reply.

Very truly yours,

CANONIE CONSTRUCTION COMPANY

Jack McKane

Jack McKane, Vice President
Earthmoving Division

JM:jkb

Bechtel Associates Professional Corpor

Inter-office Memorandum

To J. Allen
T. Valenzano
J. Connolly

Date July 2, 1974

From P. A. Martinez

Of Engineering

At Ann Arbor

Subject Midland Plant Units 1 & 2
Job No. 7220
Responsibility for Soils Work in Field

Copies to File: 0294

M. M. Krout
E. Felton
Z. Tucker
J. C. Hink

Today I met with C. A. Hunt of Consumers Power Company to clarify his understanding of the responsible parties for soils work on the Midland Project. Following is my understanding of the roles of the various parties involved, as discussed with Chuck Hunt:

1. Field Engineering under the Field Project Engineer has prime responsibility for implementation of the engineering design in the area of soils, as in all other areas. Besides maintaining their own records, Field Engineering provides Project Engineering with soil boring data as it becomes available.

2. Field QC has the responsibility for reviewing and passing on all soil test data. The soil test data is provided by the Materials Testing Subcontractor in accordance with the design specifications. Field QC maintains a file of all soil test data.

3. Project Engineering has the responsibility for design. Project Engineering also has the responsibility for keeping Consumers Power Company informed about engineering matters relating to soils.

4. Geotech provides design assistance to Project Engineering and through their representative in the field, provides assistance to both Field Engineering and QC. Geotech has the responsibility for being cognizant of all phases of the soils work in both engineering and construction. It

is their responsibility to be assured that the design is properly interpreted, construction properly performed, and the specified testing requirements properly implemented and if they are not satisfied, to advise appropriate management personnel. Geotechs other role is to provide timely advice to both Field Engineering and Project Engineering where design changes, or new design, may be needed for any reason.

Please advise me if you disagree with the above.

P. A. Martinez
Project Engineer

PAM/cd

Bechtel Corporation

Interoffice Memorandum

To P. A. Martinez

Date July 25, 1974

Subject: Job 7220 Midland Project
Structural Backfill
Specification 7220-C-211, Rev. 0
BCBE-370

From E. E. Felton

Of Construction

At Midland, Michigan

Copies to
M. M. Krout
K. A. Lewes
J. C. Hink
[redacted]
J. F. Newgen

On July 23, 1974, R. Grote contacted R. Rinford for clarification of structural backfill requirements per Specification 7220-C-211, Rev. 0. The following discussion confirms that conversation and outlines how the field will proceed with construction.

The structural backfill material required by Specification 7220-C-211, Revision 0, is required to be placed only within three feet of the exterior wall of any plant area structure. This material is not required under a structure. Beyond the three feet line and under Class 1 structures, Zone 2 material at 95% compaction is all that is required. This does not prevent the field from placing the cohesionless material required by C-211 beyond the three feet line if we choose to do so. It would be permissable to use the cohesionless material for all backfill, however, it is not required.

Specification 7220-C-211 is to be followed for placing all backfill within three feet of exterior walls of all plant area structures. This requirement, however, does not make all structural backfill Q-Listed. Only backfill against Class 1 structures is "Q" Listed.

Outstanding items requiring project engineering action are as follows:

1. Drawing SK-C-355 which is referenced in Section 7.0 of Specification 7220-C-211 has not been transmitted to the field.

2. Response to BCBE-319 is required. (Letter transmitted 6/5/74.)

3. ~~Is the 95% compaction required in the plant area to be 95% of Bechtel Modified or 95% of ASTM 1557, Method D?~~

SB800243

Please reply by July 31, 1974 if you have any questions on the above. We have been attempting to resolve this matter for many months and hope this letter serves that end.

E. D. Melton

EDF/RAG/al

Bechtel Associates Professional Corporation

Inter-office Memorandum

To S. S. Afifi

Date 22 July 1974

Subject Midland Nuclear Plant
Job 7220
Trip Report

From [redacted]eck

Of Geotechnical Services

Copies to J. H. Allen
J. Church
E. Felton
P. A. Martinez
1310,3120

At Ann Arbor - E

This transmits my trip report to the above job site July 15-19, 1974.

J. O. Wanzeck

JOW:lab

Attachment

SB800245

Bechtel Associates Professional Corporation

Inter-office Memorandum

To P. A. Martinez

Date 22 March 1974

Subject Procedures for Dry Density Tests
Job 7220

From S. S. Afifi

Of Geotechnical Services

At Ann Arbor - E

Copies to J. H. Allen
[redacted]
1320, 3410

Bob Rixford asked me to prepare a simple procedure for running dry density tests since there is no ASTM Standard suitable for the QA tests to be run shortly at Midland.

Samples will be extracted from the in situ soil using Shelby tubes. Representative samples four- to six-inches long should be cut evenly with suitable equipment. The cut should be uniform and square. The cut portion should be extruded carefully, using a jack with diameter equal to inside diameter of the Shelby tube. The extrusion should be vertical. Assuming that the sample is not deformed, the inside diameter of the Shelby tube will be adequate to express the sample diameter. Then, the overall volume of the sample can be computed from the sample cross-sectional area and an average of four height measurements. The wet density is the ratio between the overall weight of the extruded sample and the overall volume as calculated. The dry density is the ratio between the weight after oven drying for 24 hours at 105°C and the overall volume as calculated.

Extreme care is required in handling these samples between the boring location and the laboratory. Extrusion and weight and height measurements should be made by a qualified technician under the supervision of an engineer. Weight should be measured to the nearest 0.1 gm and dimensions should be measured to the nearest 0.01 inch.

We will be happy to discuss this procedure further with you at your convenience.

S. S. Afifi

SSA:mbh

SB800284

is made to extend the slurry trench to intercept such a limited sand lens. Such verification would conclusively prove or disprove the need to extend the slurry trench to that depth through the very dense till, which has proven to be very difficult to excavate. Similar conditions exist in the area of boreholes C-112 and C-120, where one-foot-thick sand layers were indicated at 11- and 16-foot depths respectively, the material above being a till, and on this basis a slurry trench was requested by the Field in that area.

I also suggested that a further boring should be put down to the east of the deep sand deposit centered on boring C-122, because the nearest easterly boring was terminated at a depth of 23 feet, and did not reach the level of bottom of sand at 43 foot depth in borehole C-122 nor the level of the apparent sand layer at 28 foot depth in borehole C-121.

The Field drawing presently shows borehole C-122 terminating in sand at 43 foot depth. Dick Karl stated that impervious soil below the sand was in fact reached and the drawing will be corrected to show this.

3. Borehole Drilling

A new mobile drill purchased by the earthwork subcontractor, Canonie Construction Co. arrived a few days earlier. It is a very good machine, employing a hollow stem auger through which it is possible to take standard penetration tests and to obtain 2-inch Shelby tube samples without withdrawing the continuous auger, which acts as casing.

The guide rod for the standard penetration test hammer permits a free fall of more than 30 inches, and I discussed with Dick Karl and with the driller the need for great care to ensure a consistent 30-inch drop. The driller was aware of this requirement.

Boreholes were being put down for the determination of soil conditions in the area of the pipeline from the emergency cooling water reservoir, which is a Class I structure with respect to seismic design. These borings were in locations requested by P & I, and were intended to determine the depth and density of possible sand. I advised the Field that it is sufficient to terminate these borings when the hard clay till is reached and that there is no need to continue them to reach the lower-lying sandy till, as was done on several earlier boreholes in this series.

Standard penetration test results obtained to determine the density of sand in dike foundation areas were reviewed. The tests were made using the earlier drill rig and were limited to near ground surface since casing could not be used with that machine. It was agreed with Dick Karl that further tests will be made using the new machine in areas where sand was indicated. I suggested standard penetration tests at 2½ foot intervals throughout the sand deposit.

I recommended that the locations of the new boreholes, presently shown only on profiles, should also be plotted in plan view in order to facilitate review. Boreholes performed during the earlier site investigation should be included on the profiles. Dick Karl intends to sort out many such things on "rainy days" when he is less occupied with earthwork control.

4. Inspection Trench

I referred to the requirements of the Design Report and my recommendations made during earlier visits that a log of the soil conditions encountered in the dike inspection trench should be kept for record purposes. The dike profile drawings showing the boreholes are suitable for this. Dick Karl intends to make such a log from his notes, but I emphasized that it should be done before the trench is backfilled, so that the descriptions of the soil conditions can be checked back in the field. I again suggested that a comprehensive photographic record be kept of conditions encountered in the trench.

5. Sand in Bottom of Pond

A borehole put down in the area of the emergency cooling water reservoir terminated at the limit of drilling equipment at 63 feet without reaching the bottom of a sand deposit. This discovery raises a fear that pockets of sand may exist in the cooling pond area connecting with the deep aquifer, which so far was believed to be confined by the glacial till. If uncorrected, such a condition could lead to unacceptable water losses. Sealing of the sand will be necessary if it is found to connect with an aquifer. Canonie will be asked to provide additional drilling equipment to permit a greater depth of drilling, and new boreholes will be put down to define the depth and the horizontal extent of this particular sand deposit.

I discussed with John Eden what measures can be taken to investigate the possible occurrence of sand pockets in various areas of the 880-acre pond connecting with an aquifer. John believes that the most practical way is to treat the pond bottom with a sealing compound such as Soil Sealer 13 manufactured by S. S. 13 Sales Co. of Phoenix, Arizona. The compound could be added to the water during initial filling of the pond. Possibility of criss-crossing the portion of the pond which will not be excavated to el. 615 with backhoe trenches supplemented by boreholes was also discussed. John Eden estimated that a 12-foot deep trench would cost about $1 per linear foot. On this basis, the total cost of trenching over 100-foot grid may be about $250,000, which would be similar to cost of borings on a 50-foot grid, assuming 6 to 8 probe borings per day at the current price of $300 per day which is being paid to Canonie for the drill rig. The cost of borings on a 100-foot grid may be about $75,000. Consideration could be given to using geophysical survey methods, in conjunction with boreholes, to investigate occurrence of sand.

6. Fill Compaction Control

Results of tests were examined in connection with the Field's request to broaden the moisture control limits required by the specification for Contract C-10. The average dry density in 20 tests on Zone 1 was 95.7 percent of maximum, and the average dry density in 27 tests on Zone 2 was 95.0 percent. In 11 out of 20 cases in Zone 1 and in 12 out of 27 cases in Zone 2, the density was below the minimum average of 95 percent required in accordance with the Design Report. In a number of cases these low values were associated with moisture content either dry or wet of the specified limits.

In view of the marginal compaction being achieved in the field (average only just over 95 percent), I told John Eden and Dick Karl that there is no justification for relaxation of the moisture limits: On the contrary, there is a need for more effort to ensure suitable placement moisture content of the fill to facilitate proper compaction. John Eden felt that it may be impossible to ensure the specified moisture limits and at the same time to complete the fill scheduled for the remainder of this year.

I pointed out that the field density test reports still do not give information regarding the roller type, number of passes and layer thickness. John Eden stated that the thickness of layers is 6 to 8 inches when a sheepsfoot roller is used. I told John that we still have not received specifications of the actual rollers used by Canonie, which we were asked to approve.

7. Field Laboratory

W. H. Flood & Co. of Kalamazoo, Mich. have now taken over the field-testing. They have two technicians and a small trailer stationed next to the Bechtel field office. The trailer is well equipped, exceptthat I thought the floor not sufficiently solid for compaction tests. An annex is to be built, and will include a base for compaction equipment.

8. Outlet Structure

Five lengths of the 48-inch pipe in the downstream section of the conduit have been placed on concrete bedding, and concrete at the end wall was being constructed. As was anticipated, the excavation revealed very dense, sandy, silty till. The outlet channel between the structure and the river was excavated except for a plug at river's edge. The material through which the channel passes is the very dense till, except near the river bank where sandy, clayey silt was encountered. John Eden does not plan to protect the excavated slopes with gravel and riprap this year.

According to Dick Karl, grade below the slab at the outlet of the conduit was overexcavated by some two feet, and the material was replaced with concrete.

It is planned to backfill over the downstream portion of the conduit at least to ground level this year, and then to move an existing road serving the County Farm which now passes over the location of the upstream part of the conduit. Excavation for the upstream part will not be commenced until that time.

9. Bridge Construction

Casing for the pile bents on the west side of the river was being driven. Fill was being pushed into the river from the west bank to form a platform for pile construction.

The pile casing is required to penetrate two feet into glacial till to cut off seepage from the overlying sand and gravel so that the cast-in-place piles can be built in the dry. Because the bridge was moved south of the earlier position where the subsoil at the bent locations was investigated by boreholes, the till elevation of the present locations is unknown. High

resistance to driving may be due to either dense gravel or till. The design requires the piles to penetrate to el. 562 and at least ten feet into the till, whichever is lower. I recommended that the drill rig should be used to find the level of the till at all the bent locations.

10. Sealing of Oil Well

The Field informed that the abandoned oil well which was accidentally discovered within the cooling pond area was sealed by Dow. The well apparently was 1500 feet deep and the sealing took 1½ weeks.

11. Plant Access Road

The plant access road south of the plant is on a curve in order that the dike should bypass the channel of Bullock Creek. However, the brine pond to the west of Bullock Creek is now abandoned and being backfilled. Consequently, consideration could be given to moving the Bullock Creek channel to the west, so that the dike and the access road could run on a north-south line, eliminating the presently shown curve.

12. Drained Triaxial Tests on Zone IA

I reminded the field that it will be required to verify the effective angle of friction of the Zone IA material (broadly graded sandy till) before it can be used in the portion of dike between the west end of plant fill and Bullock Creek, where a 2 horizontal to 1 vertical outer slope is shown on the drawings. A 50-pound sample of the till from the area proposed as borrow for this material should be sent to a laboratory capable of accurately performing this test. The design assumes that the compacted Zone IA material will have an effective angle of friction of at least 35 degrees.

13. Railroad Embankment

The railroad embankment on the east side of the river has been completed. The slopes are grassed and the structure presents a good appearance.

R.L. Kulesza

R. L. Kulesza

Bechtel Corporation

Inter-office Memorandum

To	J. H. Blasingame	Date	October 28, 1969
Subject	Consumers Power Company Midland Plant Units 1 & 2 Job 7220-001	From	H. H. Burke
		Of	H & T
Copies to	J. G. Thon P. A. Martinez	At	50 Beale St.

Enclosed is Rick Kulesza's report on site visit on October 7 and 8, 1969. The following points particularly merit your attention:

1. Slurry Trench

The slurry trench in the plant fill area over a length of about 50 feet had a width of as much as 15 feet, apparently caused by caving and inadequate slurry. Such a large width of slurry trench would be unacceptable under the retaining dikes because of inevitable major subsidence of dike fill. It is important that the slurry should have the proper consistency at all times. Strict control is essential, and the subcontractor should be required to correct the situation immediately after deficiency of the slurry is discovered. If blasting causes the caving of excavation, then it should not be permitted.

Also, we suggest that greater effort is warranted in the determination of the need for extending the slurry trench through the very dense till, in cases where thin lenses of sand were indicated at depth only on the basis of driller's judgment. Such cases are quoted in the site visit report. The occurrence and perviousness of the sand should be verified by sampling and testing, before it is decided to extend the slurry trench to intercept deep sand lenses. It is possible that such further testing may show that the sand contains silt and is not really pervious, or that the sand lens is fully confined so that water losses in it are minimal. In such cases, it would be unnecessary to extend the slurry trench through the dense till, and some hard excavation would be avoided.

2. Dike Inspection Trench

The inspection trench should be fully logged for record purposes before it is backfilled. The requirement for such logging is included in the Design Report, and was repeated by Rick Kulesza during his previous site visits.

3. Sand in Bottom of Pond

The discovery of sand extending to a depth of at least 63 feet in the emergency cooling pond area raises a serious concern that sand deposits

may exist in the pond area connecting with a deep aquifer. In such case, it would be necessary to seal the pond bottom to prevent major seepage losses. Both horizontal and vertical extent of this particular sand deposit should be determined by further boreholes.

We suggest that the possibility of occurrence in the pond area of sand deposits connecting with a deep aquifer should be thoroughly explored. Please advise if you wish us to prepare an exploration program, which we would do in cooperation with H & T's Geology Section. Surface trenching, boreholes and geophysical survey method would be considered.

4. Earthwork Control

Examination of earthwork control test results disclosed that in the majority of cases the moisture content of Zone I fill was outside the specified limits. The average fill density for Zones I and 2 only barely meets the required compaction standard. Consequently, there is no justification for relaxing the moisture limits given in the specification, and John Eden's request to this effect should be denied. In fact, the subcontractor must be compelled to pay greater attention to the moisture content requirements to ensure adequate compaction of the fill.

5. Plant Access Road

Since Dow Chemical's brine pond is being backfilled, consideration could be given to relocating the east to north bend in Bullock Creek channel to the northwest of its present position. The dike carrying the plant access road could then run on a north to south line, eliminating the present curve shown in this dike which protrudes into the cooling pond. This would require arrangements with Dow Chemical since the relocated bend in Bullock Creek would infringe on land associated with Dow's abandoned brine pond.

Harris H. Burke/a.c.f.

Harris H. Burke

HHB:RK:ja

Bechtel Power Corporation

Interoffice Memorandum

To John Church

Date September 11, 1973

Subject Job 7220 Midland Project
Compaction Characteristics
of Site Soils

From Tom Buchanan

Of Construction Geotechnical

Copies to

At Midland, Michigan

Basically there are four families of soils on the site, as follows:

1) SAND (Fine Sands & Silty Fine Sands) - Occurs widely over the site, but is mostly shallow, overlying clay.
2) SILT (Silts & Clayey Silts) - Was encountered mostly near Sasse Road south of Stewart Road, is shallow and overlies clay.
3) CLAY (Clays & Silty Clays) - Exists almost everywhere over the site but is covered in most places by a veneer of sand or silt.
4) MIXTURE - (sand-silt-clay) - Exists mostly in and near the north end of the emergency cooling pond.

Table 1 lists the compaction curves used to date.

Figure 1 shows the plot of the peaks of all curves at each Maximum Dry Density (MDD) and Optimum Moisture Content (OMC). The figure shows an individual trend for each family which is shown in a different color. All four families merge at an MDD of 122 pcf and an OMC of 11%.

The mixture family curve goes upward in dry density, from the merge point, paralleling the curve of 100% saturation. The percent passing #200 sieve decreases as the maximum dry density increases, until only 42% passes #200 sieve for the soil having the highest maximum dry density so far obtained.

The sand family curve, from the point of merging, drops steeply downward in maximum dry density, while diverging away from the curve of 100% saturation. The maximum dry density decreases from 122 pcf to 105 pcf as the percent passing #200 sieve decreases from 29% to less than 5%. The 105 pcf value is near the maximum relative density by dry method for the clean sand of 104.6 pcf. Compaction curves for the four tested clean sands exhibit two peaks. Each MDD - OMC point shown is for the larger peak which is also farthest toward the right.

The clay family curve, from the point of merging, drops in MDD parallel to the curve of 100% saturation to a value of 103.9 pcf for the pink clay, which is the most plastic clay yet encountered on the site. The MDD apparently decreases with increasing plasticity and/or clay fraction.

SB800172

The silt family curve, from the point of merging, falls between the the sand family curve and the clay family curve.

The most nearly pure clay and the most nearly pure sand have the lowest MDD's in their respective families, while the sand-silt-clay mixture with about 40% passing the #200 sieve has the highest MDD. A pure sand has many voids between grains, resulting in a relatively low MDD, while for a silty sand the silt grains fill many voids between the sand grains, resulting in a higher MDD. A properly proportioned sand-silt-clay mixture has a still higher MDD because the clay particles occupy spaces between silt grains which in turn occupy the spaces between sand grains.) Yes!

Zone 1A material belongs to the mixture family. The materials on which test COL-11, COD-8, COL-7, and COD-1 were performed, will probably pass the specification for Zone 1A, after relevant tests results are finished. In addition, all the material in the silt family, in the clay family, and in the mixture family pass specifications for Zone 1, since the 60% specification on #200 sieve has been relaxed. Even sample COL-9 in the sand family passes for Zone 1 material. Therefore, Zone 1 material is plentiful on the site. There have been no problems in designating material for Zone 1 fill.

Tom Buchanan

Tom Buchanan

TB/al

TABLE 1 LIST OF COMPACTION CURVES

CURVE	DESCRIPTION	FAMILY	MDD	OMC	% PASSING #200 SIEVE
COB-1	Light Brown Fine Sand	Sand	105.8	12.0	4
COB-2	Gray Brown Fine Sandy Silty Clay	Mixture	122.5	11.8	80
COB-3	Light Brown Silt	Silt	117.4	12.7	94
COB-4	Brown Fine Sand (Dune)	Sand	105.0	14.6	3
COD-1	Light Brown Fine Sandy Silty Clay	Mixture	124.7	10.3	54
COD-2	Pink Brown Silty Clay	Clay	110.4	16.4	98
COD-3*	Light Brown Coarse to Fine Sand	Zone 3	120.7	11.2	1
COD-4	Gray Brown Silty Clay	Clay	122.0	11.2	71
COD-5	Brown Slightly Clayey Silt	Silt	121.1	11.2	96
COD-6	Pink Slightly Silty Clay	Clay	103.9	20.5	94
COD-7	Brown & Gray Mottled Silty Clay	Clay	113.7	14.7	82
COD-8	Brown Clayey Silty Sand	Mixture	128.2	9.4	43
COL-5	Brown & Gray Mottled Silty Clay	Clay	119.7	12.2	-
COL-7	Brown Clayey Silty Fine Sand	Mixture	128.0	9.1	49
COL-8	Brown Very Silty Clay	Clay	118.9	14.2	-
COL-9	Brown Silty Fine Sand	Sand	122.0	10.3	29
COL-11	Brown Silty Clayey Fine Sand	Mixture	132.5	7.4	42
COL-12	Brown Slightly Silty Fine Sand	Sand	111.2	12.6	18
COL-13	Gray Brown Fine Sand	Sand	108.7	12.9	6
COL-14	Gray Fine Sand	Sand	107.6	12.3	1

* Not Plotted on Figure 1

LABORATORY WORK SHEET

MOISTURE – DENSITY RELATIONSHIP TEST
(See Reverse Side for Calculations)

Client's No: 7220-001 Order No: _____

Date: 9-1-73 Report No: _____

~~Reported To:~~ Plots of Maximum Dry Density & Optimum Moisture Content for Compaction Curves

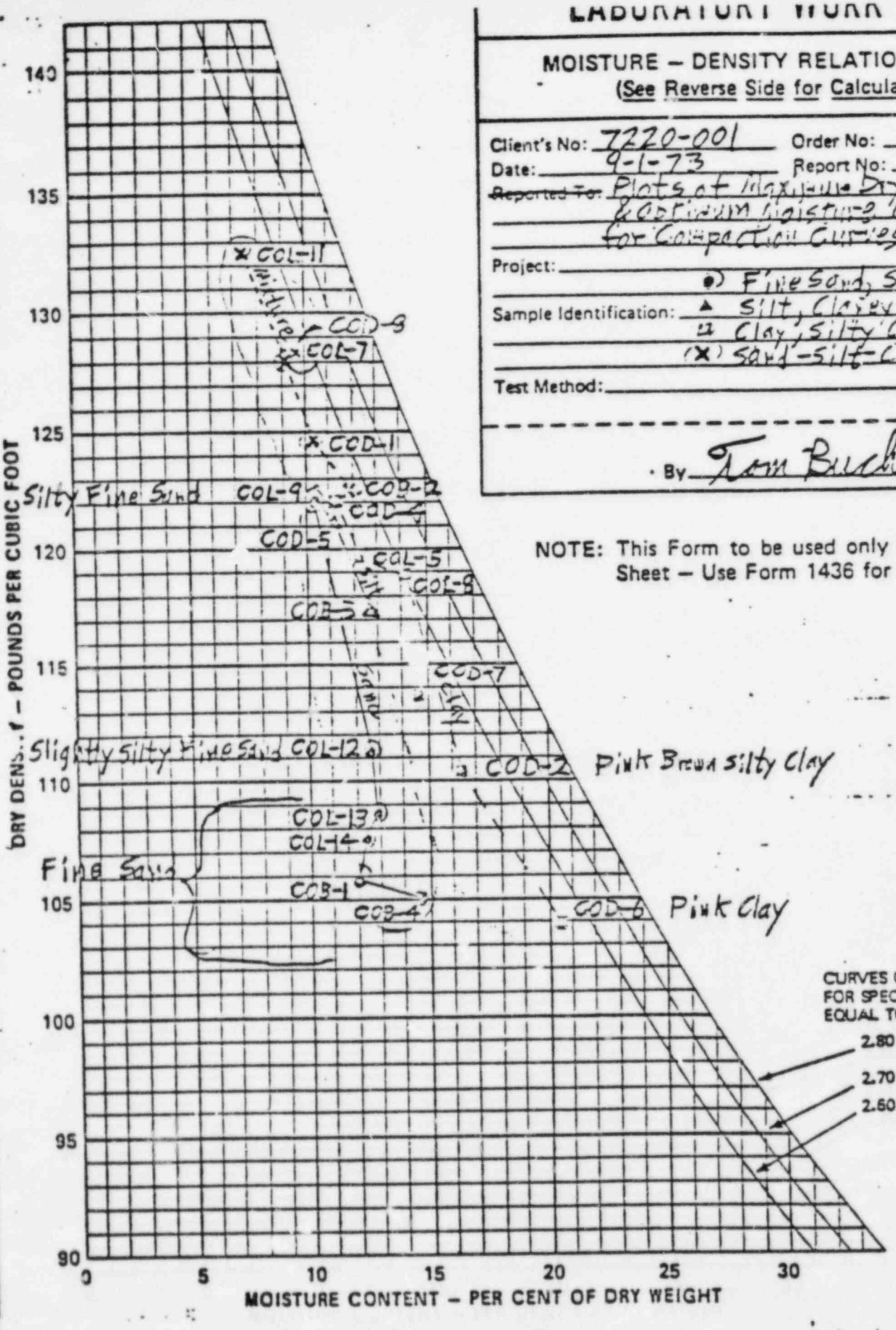
Project: _____

Sample Identification: ● Fine Sand, Silty Fine Sand
▲ Silt, Clayey Silt
□ Clay, Silty Clay
(X) Sand-Silt-Clay Mixture

Test Method: _____

By Tom Buchanan

NOTE: This Form to be used only as a Lab-Work Sheet – Use Form 1436 for Reporting.



TEST RESULTS

SB500.175

MAXIMUM DRY DENSITY _____ Lbs. Cu. Ft.	OPTIMUM MOISTURE _____ %

Figure 1

Form No. 1435-

10 g 35 mg # 200 Sieve

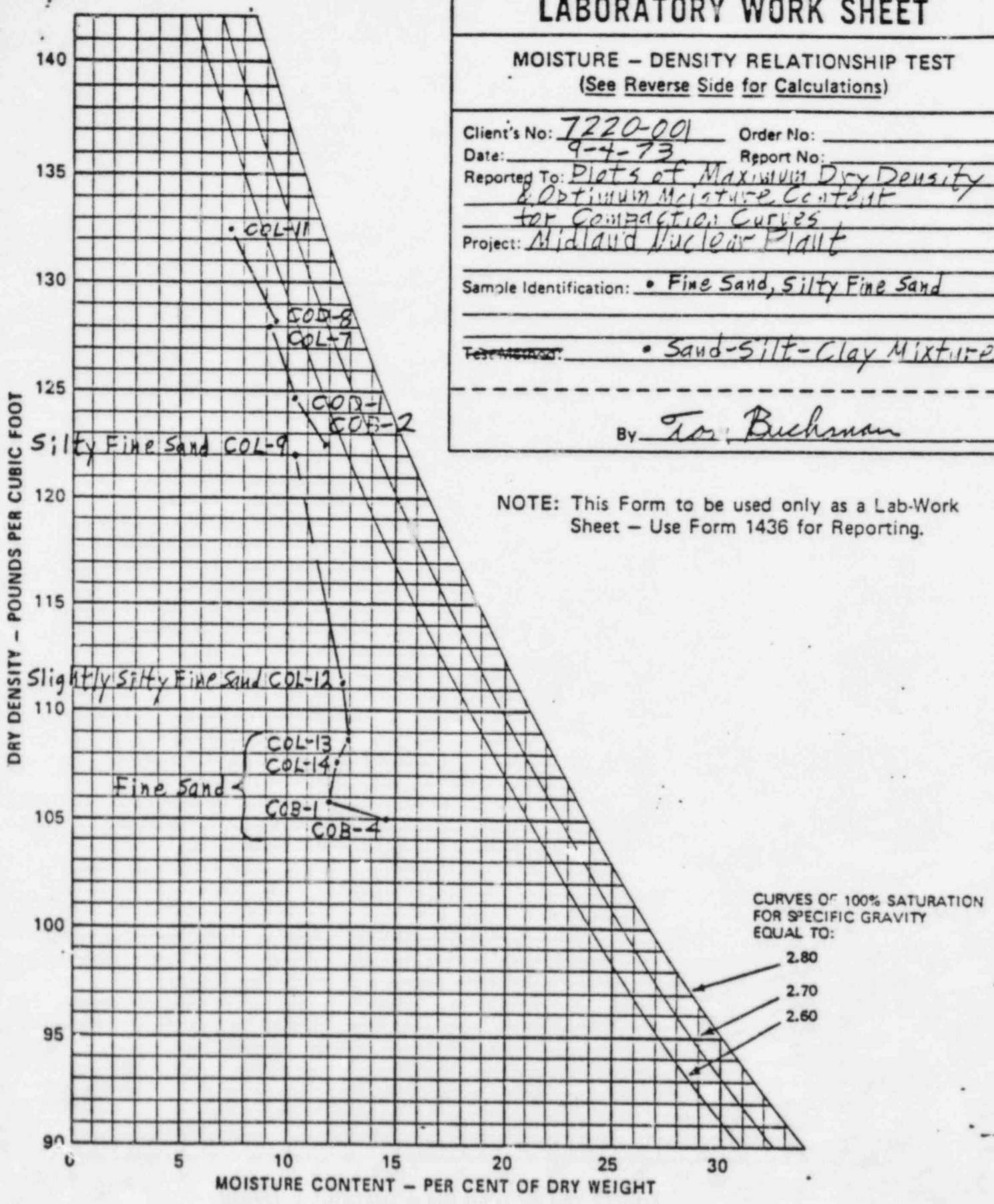
LABORATORY WORK SHEET

MOISTURE – DENSITY RELATIONSHIP TEST
(See Reverse Side for Calculations)

Client's No: 7220-001 Order No:
Date: 9-7-73 Report No:
Reported To: Plots of Maximum Dry Density & Optimum Moisture Content for Compaction Curves
Project: Midland Nuclear Plant
Sample Identification: • Fine Sand, Silty Fine Sand
~~Test Method~~: • Sand-Silt-Clay Mixture

By Tom Buchanan

NOTE: This Form to be used only as a Lab-Work Sheet – Use Form 1436 for Reporting.



TEST RESULTS

SB00-176

MAXIMUM DRY DENSITY _____ Lbs. Cu. Ft.	OPTIMUM MOISTURE _____ %

Form No. 1436-A

REPORT FOR NCR 88

On March 26, 1974, a sampling and testing program for additional moisture and density checks was started under the supervision of a Geotech representative as requested by engineering to respond to NCR 26. Drilling and sampling was started March 26, 1974 and completed on April 5, 1974. Laboratory testing was completed April 11, 1974. The tests were compiled and since 5 percent compaction values fell below 95 percent, NCR 88 was initiated.

The data pertinent to NCR 88 in connection with the existing fill in the west plant dike, north plant dike, and northeast plant dike are discussed herein. The intent of this report is to assist engineering in evaluating and documenting NCR 88.

A total of 59 borings were drilled in the west plant dike, north plant dike, and northeast plant dike. These borings penetrated Zone 1 material and Zone 2 material as indicated on Figure 1 by solid symbols and open symbols, respectively. Boring ground surface elevation, coordinates and depth are shown in Table 1.

From these borings, a total of 356 Shelby tube samples were taken. The samples were cut in the laboratory to lengths of about 6 inches resulting in a total of approximately 451 specimens suitable for testing (338 in the north plant dike, 53 in the west plant dike, and 60 in the northeast plant dike). Another 84 specimens were not considered suitable for testing because of tube damage or excessive stone content, as indicated in the remarks columns of the tables in the attached Appendix A, which contains a tabulation of laboratory test data. Appendix B contains laboratory data worksheets.

Moisture determinations were made according to ASTM Designation D 2216, density determination according to Chapter 1, page 37 of Earth Manual, U.S. Department of Interior.

Test Results

Figures 2 and 3 show plots of percent Bechtel modified compaction (BMC) versus depth for the borings wherein percent compaction below 95 percent were encountered. Test results which were judged unacceptable by the soils engineer on the job were not included in these plots. These were results from samples which came from the sand drain (Zone 3 material), contained stones, or were disturbed. In the case of sand drain or excessive rock, it was judged that samples volume measurements were inaccurate. See remarks, column, Appendix A.

Figure 2 contains data where the percent compaction below 95 percent was either above 94 percent or the samples taken were near the surface ~~(TB-24,-21,-and-4,-NPD)~~. Data between 94 (TB24 NPD & 21, 4 NED) percent and 95 percent, when occurring in the infrequent manner shown in Figure 2, is considered acceptable. The difference between 94 percent and 95 percent is not significant when considering the accuracy range inherent in sampling and testing procedures used in practical soil mechanics. Furthermore, these data were not a part of a trend of reducing density within the fill, as can be seen from Figure 2. This is substantiated further the lines of average percent compaction (Figure 4), which shows that the degree of compaction was above the 95 percent value. Averaging of soil properties, within a reasonable depth range which does not contain significant scatter is a commonly accepted tool exercised by soils engineers. Therefore, all data between 95 percent and 94 percent are considered within the intent of 95 percent BMC compaction and will not be further discussed.

Data near the surface fell within the zone where removal and reconditioning will be required before placement of new fill (only 3 cases: ~~TB-24,-TB-21,-and-TB-2,-NPD~~). The degree of (TB24 NPD & TB21,2 NED compaction should increase after reconditioning and passage of the 50-ton roller equipment.

Figure 3 shows plots where occasional percent compaction less than 94 percent were encountered. The plots also show the 95 percent compaction line and the average percent compaction line. These same borings are indicated with a hexagon on Figure 1 and amount to 10 borings.

All the above 10 cases in Figure 3 were between 90 percent and 95 percent compaction. The values below 95 percent occurred in the form of spikes in the percent compaction versus depth correlation. Further, they represent one value between 90 percent and 95 percent per 5000 cubic yards for northeast dike, 3200 cubic yards for west plant dike, 6350 cubic yards in north plant dike. These occurred at scattered locations as can be seen from hexagons in Figure 1.

Furthermore, lines of average percent compaction for the holes show percent compaction above 95 percnet (Figure 3). Except when soil properties vary within a large range, the soil behavior is more determined by the average pertinent property than by the absolute maximum or the absolute minimum.

It can, therefore, be concluded that the in-place fill tested meets the intent of a 95 percent degree of compaction by the Modified Bechtel Method.

ROUTE	SOILS GROUP	INFO	ACTION	COPY	INITIAL
	BURKE				
	FLACH				
	FEE				
	AMES				
	BIRCH				
	[illegible]				
	[illegible]				
	[illegible]				
	Date				
	[illegible]				
	From				
	GEDDO				
	Of				
(Y)	FILE				

Bechtel Corporation

Inter-office Memorandum

To John Eden

Date November 6, 1969

Subject Consumers Power Company
Midland Plant Units 1 & 2
Job No. 7220
Cooling Pond Earthwork
Files: 0515, C-0515, C-10

From J. H. Blasingame

Of Power & Industrial Div.

Copies to M. J. Mitchell/K. O. Taylor w/a At 50 Beale/9th Floor
H. E. Burke wo/a
R. Kulesza wo/a
R. M. Collins wl/a
B. H. Randolph wl/a

Attached for your action and record is a copy of R. Kulesza's site visit notes of October 7 and 8, 1969.

The following points are particularly drawn to your attention for correction:

1. Slurry Trench

The slurry trench in the plant fill area over a length of about 50 feet had a width of as much as 15 feet, apparently caused by caving and inadequate slurry. Such a large width of slurry trench would be unacceptable under the retaining dikes because of inevitable major subsidence of dike fill. It is important that the slurry should have the proper consistency at all times. Strict control is essential, and the subcontractor should be required to correct the situation immediately after deficiency of the slurry is discovered. If blasting causes the caving of excavation, then it should not be permitted.

Also, we suggest that greater effort is warrented in the determination of the need for extending the slurry trench through the very dense till, in cases where thin lenses of sand were indicated at depth only on the basis of driller's judgement. Such cases are quoted in the site visit report. The occurrence and perviousness of the sand should be verified by sampling and testing, before it is decided to extend the slurry trench to intercept deep sand lenses. It is possible that such further testing may show that the sand contains silt and is not really pervious, or that the sand lens is fully confined so that water losses in it are minimal. In such cases, it would be unnecessary to extend the slurry trench through the dense till, and some hard excavation would be avoided.

2. Dike Inspection Trench

The inspection trench should be fully logged for record purposes before it is backfilled. The requirement for such logging is included in the Design Report, and was repeated by Rick Kulesza during his previous site visits.

3. Earthwork Control

Examination of earthwork control test results disclosed that in the majority of cases the moisture content of Zone 1 fill was outside the specified limits. The average fill density for Zones 1 and 2 only barely meets the required compaction standard. Consequently, there is no justification for relaxing the moisture limits given in the specification. In fact, the subcontractor must be compelled to pay greater attention to the moisture content requirements to ensure adequate compaction of the fill.

J. H. Blasingame

PAM:dl
Encl.

Bechtel Corporation

Inter-office Memorandum

Date: December 4, 1969

ompany
:

From: J. Hink

Of: Power & Industrial Engin.

work-Site Visit

At: 50 Beale Street - 9th Fl.

ecember 4, 1969, R. Kulesza and J. Hink
nd jobsite to provide a progress review,
dit, of earthwork operations to date. The
mmary of this visit:

Consumers

held at the Field office pursuant to
nt under subcontract 7220-C-10. The
e in attendance:

CPCO	J. Eden	Bechtel Constr.
CPCO	R. Earl	Bechtel Constr.
CPCO	R. Kulesza	Bechtel Engin.
	J. Hink	Bechtel Engin.

ns were discussed:

s between Balloon and Sand Cone Tests.

s between the two tests have been noted on
ect to the same compactive effort. Results
cone tests average about 5% higher than
ing balloon test. J. Eden believes possible
error when balloon tests are made by only
lloon equipment possibly rises and thus
est results. Early testing program by
esting was based on balloon tests; however,
ing has been advised to make only sand cone
the present. J. Eden proposed to revise
st results by adding 5% factor to reflect
ow results from balloon tests. Kulesza
ainst applying such a correction to the
ecords, since the results could not be
r validity of the correction.

b) Increasing Moisture Content Above Optimum

Discussed placing wetter material. Consumers is concerned about lack of suitable Zone 1 borrow material to be available in spring. We reviewed curves-there is a sharp dropoff past the optimum moisture content. It was agreed to allow Canonie to place wetter (- 5% above optimum) Zone 1 material as Zone 2 material; Field will control compaction and make tests. If satisfactory results, we will probably approve as an exception to the specification. J. Eden noted that Canonie would probably agree to extra compactive effort at no cost to Bechtel to be allowed to use the wetter material.

c) Rip Rap Size Variance

R. Kulesza explained rip rap problem - in areas of high fetch, we need stones of 10" (100") size; specs say 8"-12" average and Canonie is furnishing mainly 8" size. J. Eden explained that supplier apparently not interested in providing larger stone; also, C. Meader noted that off-loading of larger stone from barges can not be done using existing belt conveyor. Also appears that rip rap submitted by Canonie meets specs. Engineering will study where the present size stone can be used, and also consider adding an additional zone for areas where fetch is greatest. Also, will investigate reducing rip rap blanket thickness if economical.

d) Slurry Trench

Bentonite not setting up properly. Canonie is starting/stopping this operation - no concerted effort to complete. Eden thinks mineral content of soil might be causing problems. Slurry trench between PI 9&10 has been completed and backfill placed. Slurry trench along diagonal in northwest corner of plant will be started shortly.

e) Sand Pockets in Pond

Reviewed deep sand pockets to - 67' noted in emergency cooling pond. Boring #210A verified clay underlying this pocket. Kulesza noted boring only 3' into clay - should be more like 10'. However, it was concluded that there is no apparent connection between the sand pocket and the underlying deep aquifer below. R. Kulesza discussed our proposal to investigate for possible drains into the aquifer by placing monitoring system adjacent

to relatively shallow wells listed in our well summary. Also, Kulesza noted that gradation of sand in boring #210A showed 50.2% passing #200 sieve, and that this material is comparable to Zone 1 material; therefore, this sand pocket is relatively impervious and appears to be no problem.

f) Collector Drain

Meader questioned need for collector drain on north side of plant fill; also if necessary, suggested possible use of pervious concrete pipe (without openings) in lieu of the Zone 4 material. Engineering to review.

g) Placing Sand Material

Meader asked about using vertical section to place Zone 3 material in plant site. Probably difficult to compact, particularly where excavations will approach 20 feet deep. Engineering will review.

2. Reviewed Earthwork Testing and Documentation

Reviewed soils testing records with R. Karl. Due to reduced field activity, there has been little change from earlier reviews of test records. Locations of compaction tests are now plotted on dike drawings to assure adequate coverage over all the dike areas. R. Kulesza suggested summarizing test result information on the same sheet.

R. Karl has also plotted soil profiles of the completed inspection trench.

R. Kulesza reviewed sieve analysis method used by Flood Testing. Flood has erroneously used dry sieve analysis.

In general, although no formal QC documentation has been introduced to date, testing program appears adequate.

3. Railroad Bridge Piling

As of December 3, 1969, fifty nine of sixty one piles of the east abutment have been drilled/driven to tip elevation 562. Rebar cages were being placed and concrete poured. The remaining two piles of this abutment and about one-half of piles in Bents 3-6 and the west abutment have been delayed by cobbles at elevation 575-577; casings have been crimped. J. Eden is planning to use Small Charge to dislodge cobbles. G. Oja indicated some cobbles were being surfaced with drilling auger. This problem does not appear as serious as first described.

site - some work was being done on the
e found water standing in pile casings
because casing shells have not been
h to intercept water bearing strata.
d J. Eden that water standing in
tened till and would decrease skin
pile and soil. J. Eden was advised
eeper, pump out and dry drilled holes,
nated material, and to place concrete
le after completing drilling of piles.
ted a test pile on one of these piles
skin friction is achieved.

operations severly violates permit
el widening is far from complete and yet
d embankment will proceed shortly.
fill in river for bridge piling work.

ximum slope of 2%; therefore, temporary
wn area 9 elevation 605 will require
n planned.

n with Eden continuing on spur north
ond 7.

ill be gone by 1973; no need to relo-

ne on West boundary probably will not
April, 1970. Might need to divert
property.

ly to start west diversion ditch -
this work pending resolution of
?

ether we need sleeve for radwaste
slat structure.

across brine pond on west side. This
cating brine lines to a more direct

east corner of brine pond 7 to date.
in north east corner. Appears doubtful
g. work will reach the south east

i. Boring 731 no longer needs to be sealed since it is outside of the diagonal cut off wall. No work has been done to try to find remaining borings not sealed.

j. Apparently more topsoil stripping than earlier anticipated - less storage volume lost to spoil operation.

k. J. Eden thinks there still is problem over who will remove County Farm structures, - should send copy of notes directing removal by Subcontractor.

l. Should insure that circ water drain line clear of ARPA-J. Eden wants to use ARPA for field office.

J. C. Hink

JCH/pg

Bechtel Associates Professional Corporation

Inter-office Memorandum

BEBC- 2047

To J. F. Newgen

Subject Midland Plant Units 1 & 2
Job 7220
Administration Building
Foundation Settlement
Investigation
File: 0274, C-1700, C-2600

Copies to C. L. Blue w/o
F. E. Meyer w/o
P. A. Martinez w/o

Date January 13, 1978

From R. L. Castleberry

Of Engineering

At Ann Arbor

RECEIVED

JAN 16 1978

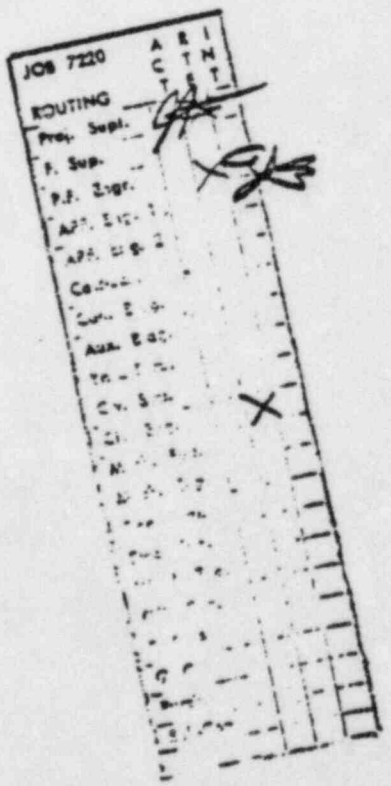
BECHTEL POWER CORP.
JCS 7220
FILE

Attached for your use is a copy of a report on the above subject which was prepared by the Geotechnical Services department. It is Project Engineerings understanding that this completes our participation in the subject investigation.

R. L. Castleberry

GAT/sg

Attachment



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BECHTEL ASSOCIATES PROFESSIONAL CORPORATION

MIDLAND PLANT UNITS 1 & 2

JOB 7220

ADMINISTRATION BUILDING
FOUNDATION SETTLEMENTS
ALONG COLUMN LINE 0.4

Dupe of
~~8405220500~~ 1778.

Prepared by:

GEOTECHNICAL SERVICES
December, 1977.

INTRODUCTION

Early in September, 1977, we were requested by project engineering to assist in reviewing conditions surrounding footing settlements during construction of the Midland Project Administration Building. The foundation location plan for this building is shown in Figure 1. The affected foundations are those along Column Line 0.4.

The following data are presented to enable construction and engineering in evaluating the settlement of these footings.

BACKGROUND

The original ground at the Midland site was at approximately Elevation 608 in the vicinity of the administration building. After ground surface preparation, plant area fill was placed to approximately Elevation 634. An excavation was later made to about Elevation 610 to accommodate construction of the steam tunnel. Figure 2 shows a cross-section of the tunnel and the approximate excavation scheme. After construction of the tunnel, the west side of the tunnel excavation was backfilled to approximate Elevation 620 to construct the foundations along Column Line 0.4 of the administration building. After foundation construction, the remainder of the excavation was backfilled with sand to grade as shown in Figure 2.

During the early part of September, Geotech was made aware of settlements along the Column Line 0.4. The settlement data are given in Table 1.

FIELD OBSERVATIONS

During the week of September 19-23, 1977, several site reviews were made by engineering, construction, and Geotech personnel. These took place before

and after the removal of the subject footings.

Upon removal of Column PA 0.4, it was noted that the soil under and adjacent to it was soft. This was confirmed by pushing a 3/4"$^{\phi}$ steel bar with little effort approximately two feet into the ground, by walking on the soil and noting its spongy characteristics, and by pushing of a shovel with little effort.

Tests taken at that time in and adjacent to PA 0.4 included moisture content, density, and unconfined compression. These tests also were taken at Column LN 0.4.

After these field observations, it was decided that two borings should be taken to further evaluate the conditions along Column Line 0.4.

At that time, Bechtel Construction's decision was that all affected footings be removed.

BORINGS

On September 27 and 28, 1977, two test borings were completed at footings LN 0.4 and HT 0.4. At footing LN 0.4, standard penetration tests (SPT) and shelby tubes (ST) were taken. At footing HT 0.4, standard penetration tests were taken.

Borings included visual inspection and description of soils, Qp tests (compressive strength of soil by the pocket penetrometer method) and any visual observations of water conditions (loss or gain).

Samples for proctor testing were also taken as shown in log of holes, LNA, LNB, and HTA.

The boring logs are shown on Figures 3 through 7.

TESTING PROGRAM

Shelby tubes taken from Boring LN were submitted to U. S. Testing Laboratory for unconfined compressive tests.

Samples taken at foundations PA 0.4 and LN 0.4 were also taken by U. S. Testing personnel and unconfined compression tests were made. Results of testing are given in Table 2.

It was also decided to run Proctor tests on the samples taken directly under and adjacent to footings in order to determine the standard to be used in calculating the in situ percent compaction. These results are found in Figures 8, 9, and 10.

The Proctor curve in Figure 8 was used to calculate the in situ percent compaction using the in situ dry density data reported by the Field. This information is compared in Figure 3 with the percent compaction previously reported. This comparison shows that the percent compaction was in all cases lower than that previously determined.

In order to illustrate the effect of a reduced percent compaction on the strength of soil, the data of California Bearing Ratio (CBR) tests previously made on three identical samples of the Midland soils are presented in Figure 11. The samples were compacted at three levels of compaction effort, which

resulted in compactive energies of 56,000 ft-lb/ft^3, 20,000 ft-lb/ft^3, and 12,400 ft-lb/ft^3, respectively. It is seen that the pressure values for a penetration of 0.1" at the maximum dry density reduced from 94.5 psi to 5 psi by reducing the compactive energy from 56,000 ft-lb/ft^3 to 12,400 ft-lb/ft^3.

CONCLUSION

Based on available data the material under and adjacent to the subject footings, (Elevation 618-622) had insufficient bearing capacity to support the foundations.

The backfilled other than the soil in question (below 618) appears adequate and this conclusion is supported by SPT borings and compression tests.

Administration Building
Anchor Bolts for Col. Line 0.4
Top Bolt Elev. 634' - 2-1/2"
Per Dwg. 901, Rev. 1, Sec. D

The Columns and Grade Beam
For Column Line 0.4 Shows
Settlement Per As Built
Elevations Taken 8-23-77

Column	Elevation	Δ Settlement (ft)
P_A	634.10	0.11
N_K	634.03	0.17
M_P	634.01	0.20
L_N	634.05	0.16
K_P	634.02	0.19
K_B	633.93	0.28
J_F	633.93	0.28
H_T	633.92	0.29

MIDLAND UNITS 1 & 2

ADMINISTRATION BUILDING EXCAVATION

UNCONFINED COMPRESSION TESTS

Sample No.	Sample Location	Sample Elevation	*Unconfined Compression Strength Lbs Per Sq Ft	**Allowable Bearing Value Lbs Per Sq Ft	Percent Strain	Remarks
1	PA - .04	622.0	730	625	20.0	
2	PA - .04	621.0	487	420	20.0	
A	PA - .04	612.0	1984	1709	6.7	
B	PA - .04	611.0	633	546	20.0	
3	LN - .04	622.0	9.4	788	12.0	
4	LN - .04	621.0	2081	1792	5.0	
ST-1	Boring LN	617.5	4241	3653	10.3	
ST-2	Boring LN	615.5	2145	1849	20.0	
ST-3	Boring LN	603.0	5945	5123	9.1	
ST-4	Boring LN	597.5	3137	2704	20.0	
ST-5	Boring LN	588.0	2837	2428	20.0	

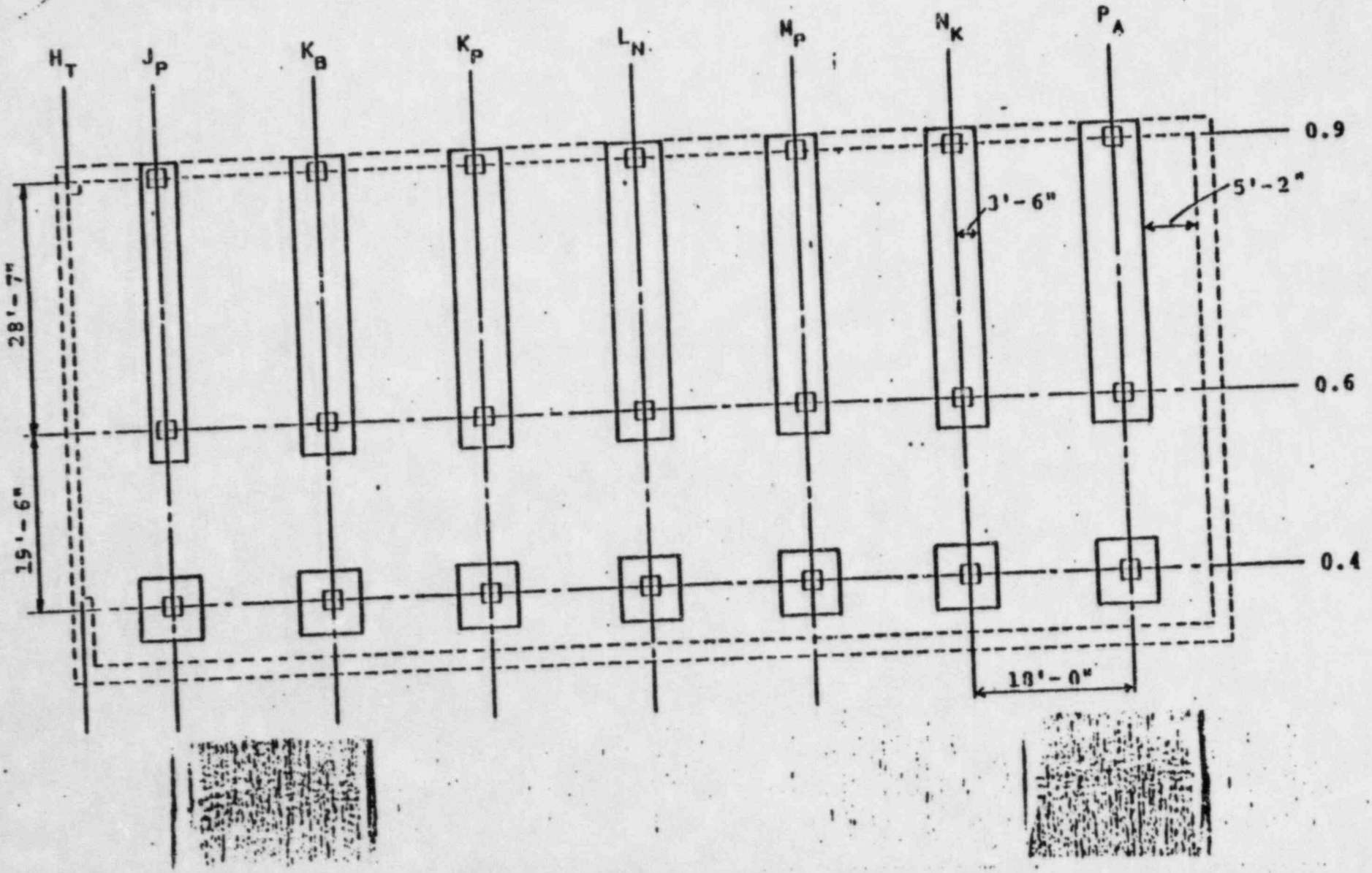
* ASCT/ASTM D 2166-66(72) **1/3 x 5.14 x 1/2 x Unconfined Comp Strength

Figure 1

FOUNDATION LOCATION PLAN

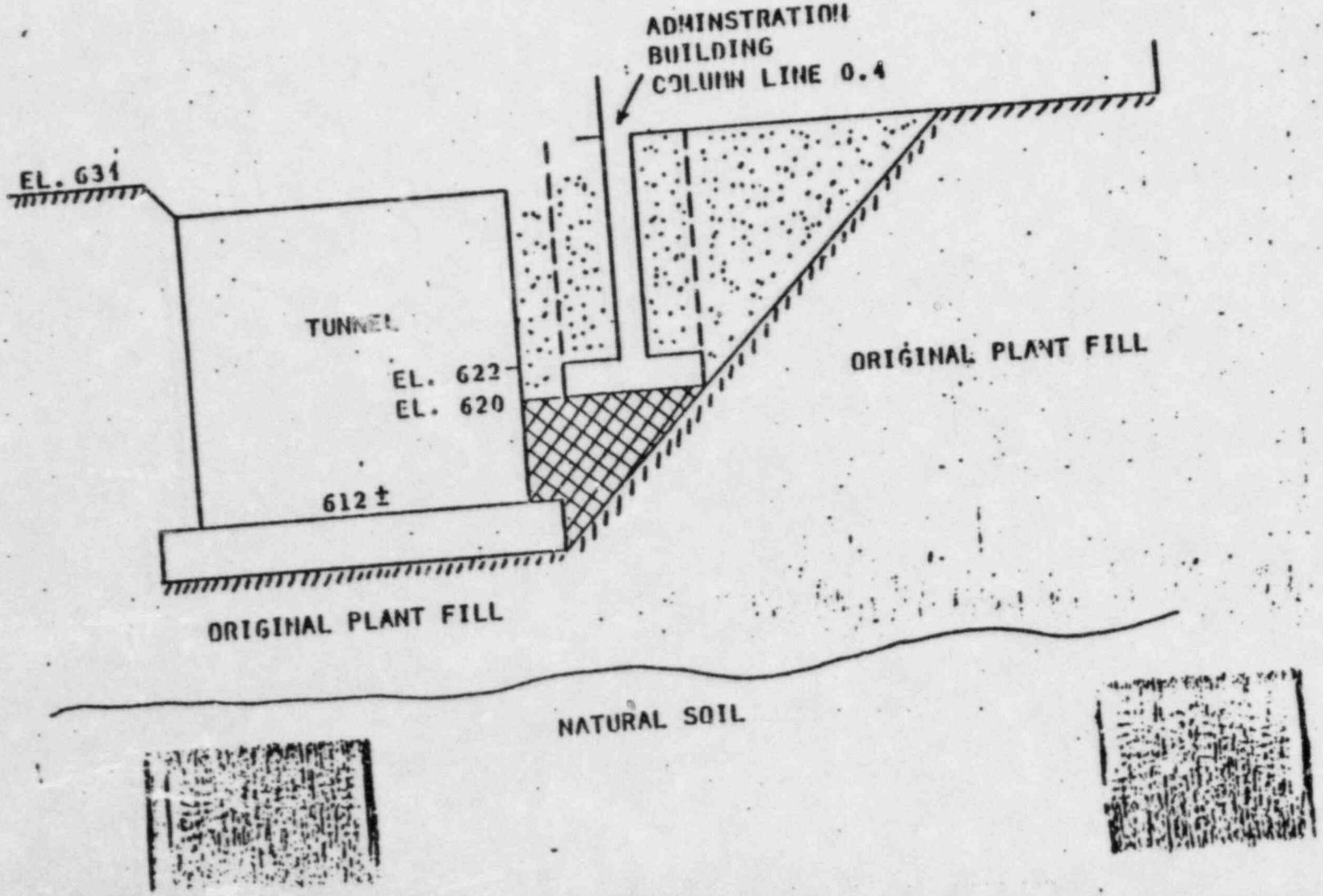
ADMINISTRATION BUILDING

MIDLAND NUCLEAR UNITS 1 & 2



8100230018

Figure 2



BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
MIDLAND NUCLEAR PLANT	7220	1 - 1	LN

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
ADMINISTRATION BLDG.	APPROX. 2' E OF FOOTING & 0.4-LN	90°	—

GROUND	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9/27/77	9/29/77	SINGLETON (ABEL DRIL.)	CME-550	5"	—	—	43.5

CORE RECOVERY (FT./%)	CORE SIZES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
—	—	18	—	622.0	(SEE NOTES COL.)	—

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./DEPTH	LOGGED BY:
140#/18"	NONE	JERRY B. GIVENS

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE	SAMPLE RECOVERY	CORE RECOVERY	SAMPLE BLOWS "N"	PERCENT CORE RECOVERED	PENETRATION BLOWS 1ST 6"	2ND 6"	3RD 6"	ELEVATION 622'	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF OPERATION, ETC.
													0'-2' SILTY SAND, TAN, LOOSE (BACKFILL) (SP/SM)	5" AUGER TO 8.5'; SET 5" CASING; DRILL W. 4" TRI-CONE ROLLER BIT AND RE-CIRCULATE WATER BELOW 8.5'
									620					
2'ST	2'	.5'	—	—	—	—			619.5	2.5		1	2'-2.5' GREY GRAVELLY CLAY (CL)	
2'ST	2'	2.9'	—	—	—	—				5		2	2.5'-27.5' SANDY CLAY, GREY W. TRACE TO LITTLE GRAVEL, LOW TO MEDIUM PLASTICITY, HARD (CL)	
2'SS	1.5'	1.0'	35	11	13	22				7.5		3	7'-25.5' BROWNISH GREY (FILL)	
2'SS	1.5'	1.2'	37	13	17	20				9.5		4		SLIGHT WATER SEEPAGE AT 2.5'
2'ST	2'	0'	—	—	—	—				12		5	12' LARGE COBBLE (? BENT TUBE)	USED DEWITT GLAZING COMPOUND AND MASKING TAPE TO SEAL TUBES
2'SS	1.5'	0.8'	28	10	14	14				14		6	14.5' INCREASE IN SAND CONTENT	
2'ST	2'	1.0'	—	—	—	—				15.5		7	15.5' 1" STONE	SAVED 33 SAMPLES IN JARS
2'SS	1.5'	0.5'	31	17	16	15				17		8		#1 Qp = 4.5+ TSF
2'ST	2'	1.7'	—	—	—	—				20		9	22' STONE	#2 Qp = 4.5+ TSF
2'SS	1.5'	0.5'	19	6	9	10				23		10	22'-27.5' STIFF TO MEDIUM STIFF 22.5' DECREASE IN SAND CONTENT 25.5'-27.5' MEDIUM PLASTICITY	
2'ST	2'	0'	—	—	—	—			594.5	25		11	27.5'-31' SAND SEAM ? LOOSE? (POOR RECOVERY AREA - TUBE PUSHED EASILY) (FILL)	#3 Qp = 4.5+ TSF
2'SS	1.5'	0.2'	10	4	5	5			591.0	28		12		#4 Qp = 4.5+ TSF
2'ST	2'	1.3'	—	—	—	—			589.0	30		13	31'-33' SANDY CLAY, GREY, STIFF TO MEDIUM STIFF (CL) (FILL)	#5 NO Qp - TUBE BENT BADLY
2'SS	1.5'	0.2'	20	8	9	11				32				#6 Qp = 2.25 TSF
2'SS	1.5'	0.2'	100+	24	100/1"	—			585.0	33		14	33'-37' SILTY SAND, TAN W. LITTLE RUSTY MOTTLED COLOR, FINE TO MEDIUM GRAINED, MEDIUM DENSE (SP/SM) (FILL)	#7 NO Qp - TIP OF TUBE BENT
2'SS	1.8'	0.8'	100+	17	100/1"	—				37		15		#8 Qp = 4.5 TSF
2'SS	2.5'	0.2'	100+	10	100/1"	—			578.5	38.5		16	37'-43.5' SILTY SAND, GREY, FINE TO MEDIUM GRAINED, VERY DENSE, MOIST (SP/SM) 38.5'-43.5' FINE GRAINED	#9 Qp = 3.75, 4+ TSF
													TOTAL DEPTH = 43.5' EL. BOTTOM = 578.5	#10 Qp = 1.1 TSF
														#11 NO Qp - TUBE PUSHED EASILY
														#12 NO Qp - NOT ENOUGH RECOVERY (ABOUT 2 TSF)
														#13 - #18 NO Qp (SAND)
														WATER LEVEL 5.9' AFTER CASING PULLED
														HOLE BACKFILLED WITH SOIL AT COMPLETION

SS = SPLIT SPOON; ST = SHELBY TUBE; C = CONDITIONS; A = AUGER; O = OTHER

SITE	HOLE NO.
ADMINISTRATION BLDG.	LN

10078-1

Figure 4

BECHTEL

BORING LOG

PROJECT: MIDLAND NUCLEAR PLANT | JOB NO. 7220 | SHEET NO. 1 of 1 | HOLE NO. LNA

SITE: ADMINISTRATION BLDG. | COORDINATES: 2' NORTH OF LN | ANGLE FROM HORIZ. 90° | BEARING —

DATE DRILLED: 9/29/77 – 9/29/77 | DRILLER: SINGLETON (ABELDRIL) | DRILL MAKE AND MODEL: CME-550 | HOLE SIZE: 5" | OVERBURDEN (FT.) — | ROCK (FT.) — | TOTAL DEPTH: 5'

WATER OBSERVED (FT./HR.) — | CORE BOXES: — | SAMPLES: 1 | EL. TOP OF CASING — | GROUND EL. 622 | DEPTH TO GROUND WATER (SEE HOLE "LN") | DEPTH TO TOP OF ROCK —

SAMPLE NUMBERS OR VERMIT/FAIA: N/A | CASING LEFT IN HOLE: DIA./LENGTH: NONE | LOGGED BY: JERRY B. GIVENS

SAMPLED TYPE AND DIAMETER	SAMPLER ADVANCE	LENGTH OF CORE RUN	SAMPLE RECOVERY	SAMPLE BLOWS 12"	PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	PENETRATION BLOWS 2ND 6"	PENETRATION BLOWS 3RD 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION
									622				0'-2.5' SAND BACKFILL
									619.5	2.5			2.5'-5' COMPACTED CLAY
BULK	2.5'	2.5'	—	—	—	—	—	—	617	5			TOTAL DEPTH = 5' EL. BOTTOM = 617

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

5" AUGER TO 5'; TOOK BULK SAMPLE FOR COMPACTION TEST FROM 2.5'-5' AND COMBINED IT WITH BULK SAMPLE FROM HOLE LN2

HOLE BACKFILLED WITH SOIL AFTER COMPLETION

REFER TO BORING LOG "LN" FOR MORE INFO. CONCERNING SOIL PROFILE

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

SITE: ADMINISTRATION BLDG. | HOLE NO. LNA

BECHTEL

Figure 5

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
MIDLAND NUCLEAR PLANT	7220	1 - 1	LNB

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
ADMINISTRATION BLDG.	2' WEST OF LNA	90°	—

BEGAN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9/28/77	9/29/77	SINGLETON (ABELDR.)	CME-550	5"	—	—	5'

CORE RECOVERY (FT./%)	CORE HOLE #	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
—	—	1	—	622	(SEE HOLE "LN")	—

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	NONE	JERRY B. GIVENS

SAMPLED TYPE AND DIAMETER	SAMPLE ADVANCE	LENGTH OF SAMPLE RECOVERED	CORE RECOVERY	CORE RQD	PENETRATION RESISTANCE (BLOWS/FT.)	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.
									622					
													0'-2.5' SAND BACKFILL	5" AUGER TO 5'; TOOK BULK SAMPLE FOR COMPACTION TEST FROM 2.5'-5' AND COMBINED IT WITH BULK SAMPLE FROM HOLE LNA
BULK	2.5'	2.5'	—	—	—	—	—	—	619.5	2.5		1	2.5'-5' COMPACTED CLAY	
									617	5			TOTAL DEPTH = 5' EL. BOTTOM = 617	HOLE BACKFILLED WITH SOIL AFTER COMPLETION
														REFER TO BORING LOG "LN" FOR MORE INFO. CONCERNING SOIL PROFILE

83'00"22

SS = SPLIT SPOON; ST = SHELBY TUBE; O = OTHER

SITE	HOLE NO.
ADMINISTRATION BLDG.	LNB

BEGIN

BORING LOG

PROJECT: MIDLAND NUCLEAR PLANT | JOB NO. 7220 | SHEET NO. 1-1 | HOLE NO. HT

SITE: ADMINISTRATION BLDG. | COORDINATES: AT ℄ OF FOOTING 0.4-HT | ANGLE FROM HORIZ. 90° | BEARING —

DATE: BEGUN 9/28 | COMPLETED 9/28 | DRILLER SINGLETON (ABEL DRIL) | DRILL MAKE AND MODEL CME 550 | HOLE SIZE 5" | OVERBURDEN (FT.) — | ROCK (FT.) — | TOTAL DEPTH 50'

CORE RECOVERY (FT.) — | CORE BOXES — | SAMPLES 10 | EL. TOP OF CASING — | GROUND EL. 631 | DEPTH/EL. GROUND WATER (SEE NOTES COL.) | DEPTH/EL. TOP OF ROCK —

SAMPLE HAMMER WEIGHT/FALL 140#/18" | CASING LEFT IN HOLE: DIA./LENGTH NONE | LOGGED BY: JERRY B. GIVENS

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE	LENGTH OF 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.
										631				0'-11.5' SILTY SAND, TAN (BACKFILL) (SP/SM)	5" AUGER TO 8.5' SET CASING DRILLED W 4" TRI-CONE ROLLER BIT USING RE-CIRCULATING MUD
2"SS	1.5'	0.7'	8	2	3	5				619.5			1	11.5'-16' SANDY CLAY, GRAYISH BROWN, GRAVEL TO 1½" SOFT TO MEDIUM STIFF, MEDIUM PLASTICITY, MOIST (CL)	#1 Qp = 1.5 TSF
2"SS	1.5	0.9'	5	1	2	3							2		#2 Qp = 0.8 TSF
2"SS	1.5'	0.9'	25	7	12	13				615			3	16'-28.5' SILTY CLAY, BROWNISH GREY, LITTLE GRAVEL, VERY STIFF TO HARD, MEDIUM PLASTICITY, MOIST (CL)	#3 Qp = 4.5+ TSF
2"SS	1.5'	1.0'	20	8	9	11							4		#4 Qp = 4.5+ TSF
														23.2 INCREASE IN SAND CONTENT	#5 Qp = 3 TSF
2"SS	1.5'	0.5'	18	16	12	6							5		
2"SS	1.5'	2.9'	22	8	10	12				602.5			6	28.5'-47' SANDY CLAY, TANNISH BROWN, VERY STIFF, MEDIUM PLASTICITY MOIST (CL) POCKET OF COAL STRADDLING THIS SAMPLE	#6 Qp = 3.25 TSF (CLAY)
														29.5'-33.5' SEAM OF GREY SILTY FINE TO MEDIUM SAND	
2"SS	1.5'	1.0'	30	10	15	15							7	33.5-38.5 GRAYISH BROWN, SEAMS OF SAND	#7 Qp (NONE, TO SANDY
2"SS	1.5'	1.0'	10	2	5	5							8	38.5-47 STIFF	#8 Qp = 1.75 TSF (BREAKING UP, SANDY)
2"SS	1.5	0.2'	15	5	6	9							9		#9 No Qp (TOO LITTLE REC.)
										564				47-50' FINE SILTY SANDY GREY, VERY DENSE, TRACE ORGANICS, CLAYEY SILT LENSES, SLIGHT MOISTURE (SM)	#10 No Qp (SAM
2"SS	1.5	1.5	111	18	40	71				581			10		
														TOTAL DEPTH = 50' EL. BOTTOM = 581'	WATER LEVEL AT 8' WHILE DRILLING; WE TO 7.1' AFTE DRILLING COM PLETED AND CASING RE-MOVED. HOLE BACKFIL W SOIL AF COMPLETION

SS = SPLIT SPOON; ST = SHELBY TUBE; O = OTHER

SITE: ADMINISTRATION BLDG. | HOLE NO. HT

10078-1

8800123

BECHTEL

BORING LOG

PROJECT: MIDLAND NUCLEAR PLANT	JOB NO.: 7220	SHEET NO.: 1 - 1	HOLE NO.: HTA
SITE: ADMINISTRATION BLDG.	COORDINATES: 1.0' NORTH OF HOLE "HT"	ANGLE FROM HORIZ.: 90°	BEARING: —
BEGUN: 9/28/77	COMPLETED: 9/28/77	DRILLER: SINGLETON/ABELDAIL	DRILL MAKE AND MODEL: CME-550	HOLE SIZE: 5"	OVERBURDEN (FT.): —	ROCK (FT.): —	TOTAL DEPTH: 14.5'
CORE RECOVERY (FT./%): —	CORE BOXES: —	SAMPLES: 1	EL. TOP OF CASING: —	GROUND EL.: 631	DEPTH/EL. GROUND WATER: (SEE HOLE "HT")	DEPTH/EL. TOP OF ROCK: —
SAMPLE HANDLED WITH/BY: N/A	CASING LEFT IN HOLE: DIA./LENGTH: NONE	LOGGED BY: JERRY B. GIVENS				

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE	LENGTH CORE RUN	SAMPLE RECOVERED	CORE RECOVERY	SAMPLE BLOWS	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.
										631					5" AUGER TO 14.5', TOOK BULK SAMPLE FOR COMPACTION TEST FROM 11.5'-14.5'
														0'-11.5' SAND BACKFILL	
U	3'	3'	—	—	—	—	—	—	—	619.5	11.5 / 14.5			11.5'-14.5' COMPACTED CLAY	HOLE BACKFILL WITH SOIL AFTER COMPLETE
										616.5				TOTAL DEPTH = 14.5' EL. BOTTOM = 616.5	REFER TO BORING LOG "HT" FOR MORE INFO. CONCERNING SOIL PROFILE

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

SITE: ADMINISTRATION BLDG. | HOLE NO.: HTA

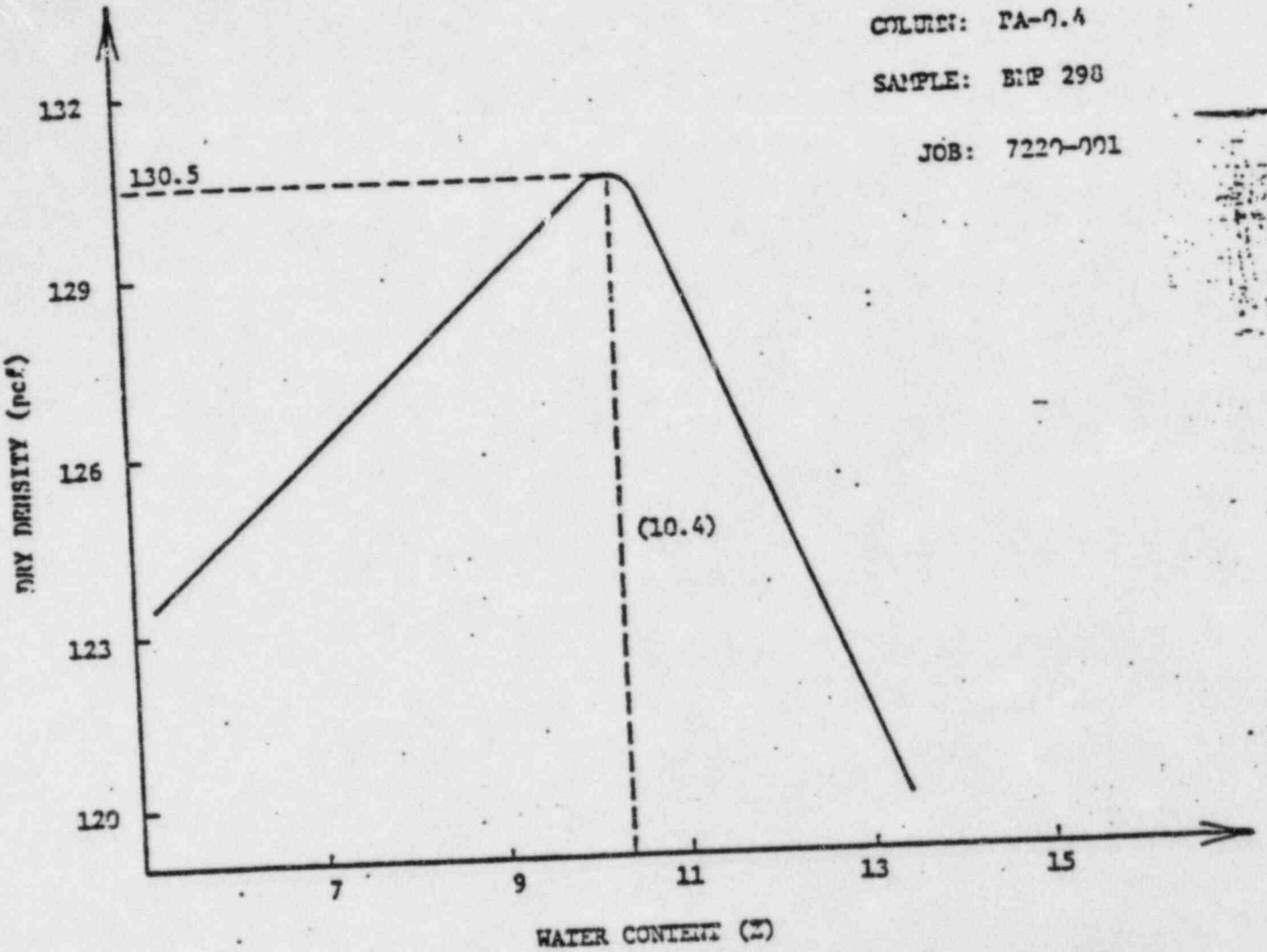
10078-1

LOCATION: Administration Building

COLUMN: FA-9.4

SAMPLE: BMP 298

JOB: 7220-001



Std. Compaction Data Used			Field Data		Original Calculated % Compaction	From Above Data % Compaction
Name	$\gamma_{d(max)}$	Wo	$\gamma_{d(f)}$	Wof		
BMP 262	123.9	11.8	117.5	17.5	94.0	90.9
			120.5	13.8	97.0	92.3
BMP 269	127.3	10.0	127.5	13.3	101.6	97.7
BMP 270	124.6	11.1	118.7	16.7	95.7	91.9
BMP 273	117.0	15.2	108.5	19.5	92.7	83.1

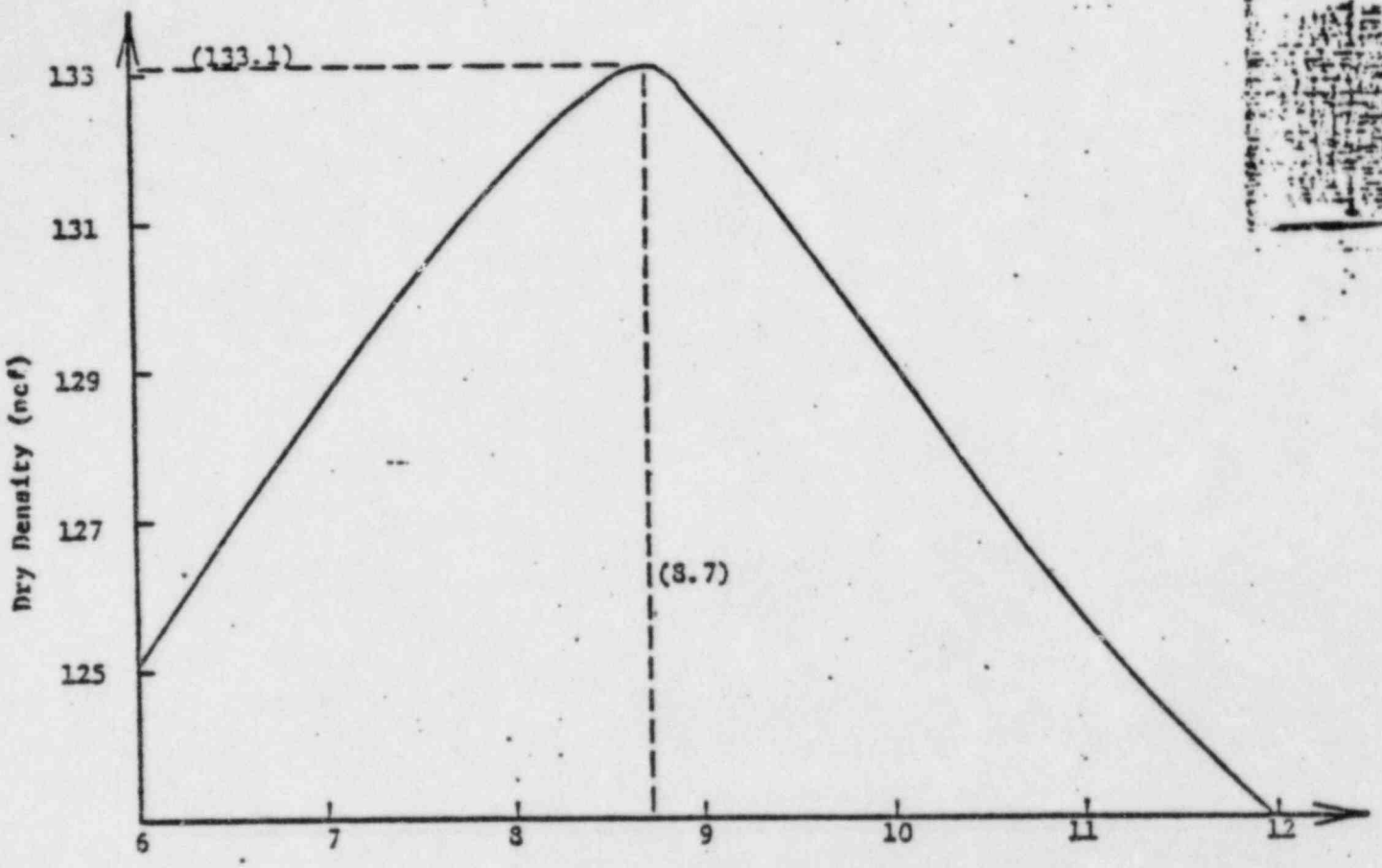
$\gamma_{d(max)}$ = Maximum dry density as determined for a particular compaction test

Wo = Corresponding optimum water content

$\gamma_{d(f)}$ = Field dry density

Wof = Corresponding field moisture content

Figure 9

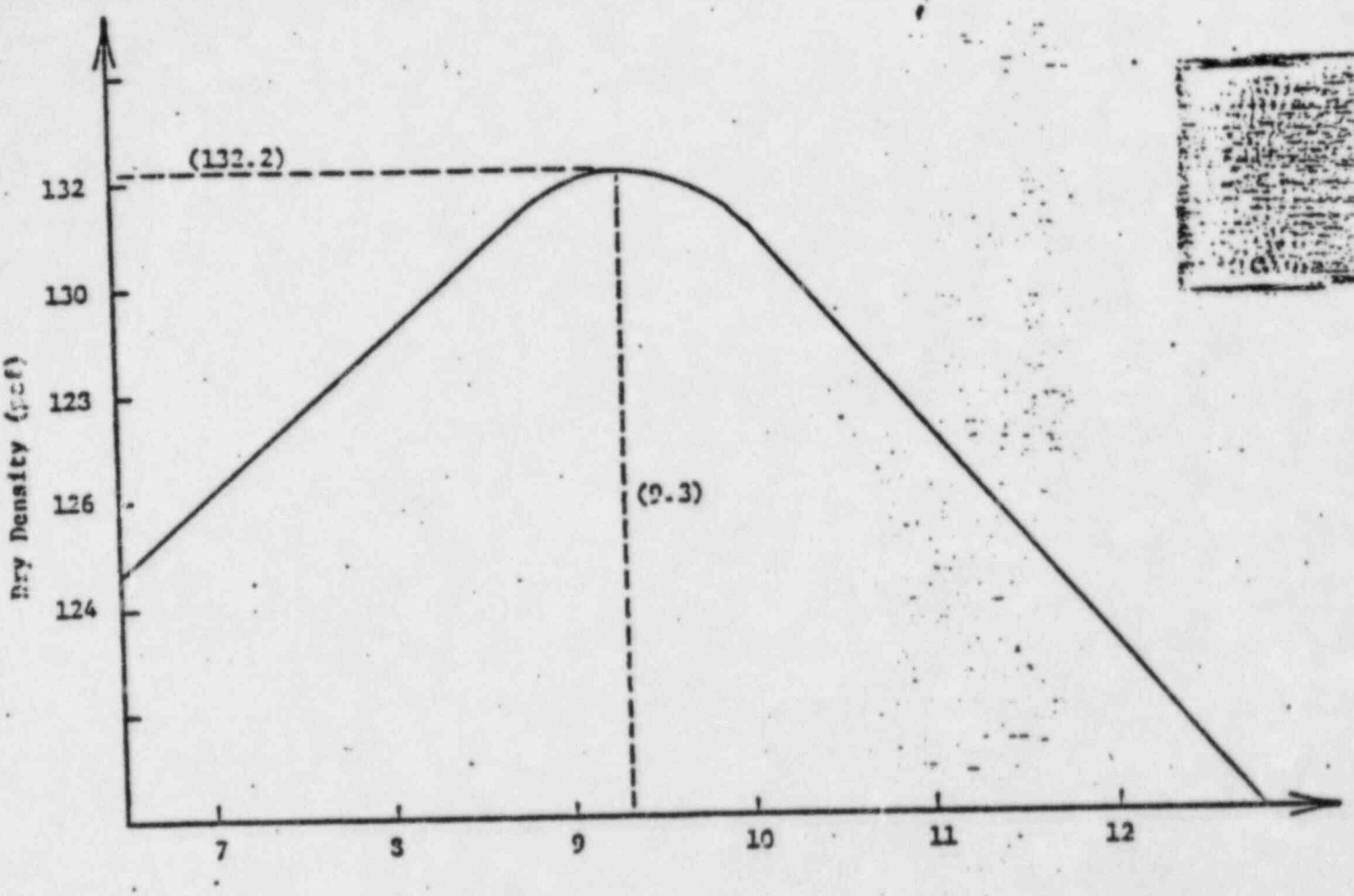


LOCATION: Administration Building

COLUMN: LI-0.4

SAMPLE: BHP-299

JOB: 7220-001



MOISTURE CONTENT %

LOCATION: ADMINISTRATION BUILDING

COLUMN: HT-0.4

SAMPLE: BTP-300

JOB: 7220-001

ATE: 7/3/80

SOILS QA AUDIT

ME:

TY: ANN ARBOR

TENTION: L. H. Curtis

OM: P.J. Corcoran

MBER OF PAGES 15 + Cover

MIDLAND, MI

Stan Blue - Findings 1,* 11+ & 12+ & 13 are the primarily affecting Geotech.

GEOTECH
ANN ARBOR
DISTRIBUTION

DISC	ACT	INFO	W/A	INIT
MGR		1		
ADMIN				
DRFT				
SOILS		2		
GEOL				
H&H				
WT				
QE				
[illegible]				
[illegible]		3		
DKL		4		
Proj Mgr				
Proj Engr				
JOB				
REC'D	JUL			

JOB 7220

	ACT	INFO	CONT
SUPV ENGR		1	
ASST PE DES PROB			
ASST PE T			
ASST PE T			
ASST PE L&S			
ASST PE PHC			
ASST PE MES			
LIC & SAFETY			
MECH			
NUC SYSTEM			
PLANT DES			
ELECT			
CIVIL STR			
CIVIL STR/ST			
ARCH			
QE			
CTR/ENGR PL			
ENGRG MGR			
PROJ MGR			
FIELD			
CONST COORD			
Wm Beck			
ADMIN			
FILE NO.			

86-033-03

2

JUL

SB502390

FINDING NO. 1

PQCI SC-1.05 Rev. 9 - Activity Test 2.2a9 states: "Field density tests resulting in 105 and over of maximum laboratory density of proctors and/or relative densities, retested." This is a witness point. Contrary to this requirement SC-1.05-180 was signed off for activity 2.2a9 on 6/9/80 - 6/13/80 as NA scoped for 6/9/80 through 6/13/80 and test 6182 taken 6/3/80 and test 6184 taken 6/5/80 had 108.1 and 106.6 percent relative density respectively. The Compacted Fill Density Test Report containing test 6/82 and 6/84 was signed off by responsible QC engineer 6/11/80.

INVESTIGATION

A. There is no requirement in the specification for retest at more than 105%.

B. This item was incorporated in the QCI at client QA insistence, based on a 50.54(f) response commitment to this effect.

C. The QCI requirement was overruled by the GeoTech personnel instructing U. S. Testing personnel that retests will not be required. This review was conducted on all tests subsequent to the Rev. 8 of QCI SC-105 from the period of December 3, 1979, through the current period.

D. The GeoTech engineer is reputed to have given his direction to U. S. Dtesting under the authority of Paragraph 8.3.5 of Spec. C-211, which says that all soils work shall be performed under the direction of a qualified soils engineer.

RECOMMENDED SOLUTION

The recommended solution for this item is for QC to implement the existing quality program. That is, when a test is recorded with greater than 105% of the theoretical, a retest will be performed. QC will not accept or approve the U. S. Testing Report that identifies a test of 105 or greater.

CAR will be issued for corrective action. NCR 3041 has been issued to document areas where retests were not performed.

ADDITIONAL ACTION

Since this requirement is not a spec. requirement, a retest that results in 105 or greater would allow acceptance of the area without further test.

FINDING NO. 2

QCIR No. C-1.02-140 dated 1/2/80 for the first shift, Area "E" indicates test 6083 was taken at elevation 626.5. Contrary to this, Compacted Fill Density Test Report for 6083 indicates elevation 627.5.

INVESTIGATION

It has been determined that there was an error in the elevation recorded by U. S. T. personnel. Daily sheet by Q.C. and F.E.R. by GeoTech indicates El. 626.5 for elevation. Referenced density test #6083 was failing. The area was reworked and retested on 1/4/80, by density #6086, which was also at elevation 626.5. The retest exceeded minimum density requirements, and clears #6083.

FINDING NO. 3

Daily Soil Placement Report for C-1.02-140 dated 12/31/79, forst shift, Area "A", indicates coordinates South 5035 to 5056. Contrary to this, it only indicates the width to be 8 feet.

For Area "B", the East coordinates 255 to 295 does not correspond with the length of 36 feet.

Area "C" has East coordinate 295 to 335. Contrary to this, a length of 36 feet is given.

For Area "D" South coordinates are given as 5165 to 5185. Contrary to this, the width indicated is only 12 feet. East coordinates are 345 to 390, but the length indicated is only 32 feet.

For Area "E", South coordinates are 5140 to 5156. Contrary to this, the width is given as 12 feet. East coordinates are 330 to 390. Contrary to this, the length is given as 58 feet.

INVESTIGATION

Sketches and locations of backfill operations, required by Instruction #5 on daily sheets, indicates the approximate work areas. These are showing excavated areas, which are often irregular in shape. The length and width data recorded is used to calculate quantities of fill placed as opposed to extent of excavations.

FINDING NO. 4

Daily Soil Placement Report dated 12/31/79 first shift, QCIR No. C-1.02-14(for Area "A" indicates two lifts were placed and only one series of 8 pass observed. Area "D" indicates two lifts placed and only one series of 8 passes was observed for two pieces of equipment. Area "E" same as area "D" above.

Daily Placement Soil Report dated 1/4/80 for the first shift for QCIR No's C-1.02-140, for area "C" indicates four lifts placed and only one observed for 8 passes. Area "D" same as area "C" above. Cannot tell which lift was observed. Not all lifts were observed for compaction.

INVESTIGATION

Instructions for #8 on the daily sheet says check the method used to compac soil and the number of passes required. That has been followed on all dail soil reports. The instructions say nothing about recording that information per lift of material placed. This was not the intent of the requirement. All lifts placed have complied with the data indicated in #8.

PRELIMINARY

FINDING NO. 5

The Daily Soil Placement Reports do not indicate what elevation the placement began at and what the final elevation of the placement was at the end of each shift.

INVESTIGATION

Block 9 of the daily Soil Placement Report indicates the lift thickness with start and finish elevation of each lift. The finish elevation on the last lift place is the finish elevation of placement after compaction.

All packages (40) reviewed show no deficiencies in this area.

FINDING NO. 6

C-1.02 has not been signed off by Level II in a timely manner.

C-1.02-118 scoped 8/2/79 - 8/4/79 is through.

C-1.02-163 scoped 6/9/80 - 6/14/80 have not been signed off by a Level II.

INVESTIGATION

A. QC recognizes that a number of QCIR's have not been reviewed by a Level II.

B. The daily QC soil placement reports are reviewed and signed off by a Level II. The daily soil test reports include the detail calculations and data of the tests and are supplemental to the IR.

C. Paragraph 8.9 of PSP G-6 indicates that the QC Engineer confirms his acceptance of the activities described in the QCI by initialing and dating the appropriate sign-off blocks in the inspection record. Paragraph 8.10 of the same PSP indicates that completeness and acceptance of the recorded data is accomplished by a Level II in the same disciplines.

D. There is apparently no requirement written for a timely review of the data by a Level II. In addition to the daily soil placement reports being reviewed by the Level II Civil QC Engineer, the U. S. Testing Field Density Report Test results are also reviewed and signed off by the corresponding subcontract QC Engineer, Level II.

SUMMARY

The apparent lack of timeliness of a Level II review of this data does not appear to constitute a quality problem in the acceptability of the soils work, but indicates a lack of available manpower in the Quality Control organization for clearing up quality control inspection records.

FINDING NO. 7

Daily Soil Placement Report for Area "D" dated 1/16/80 first shift for QCIR No. C-1.02-142 states on Line 6, "Subgrade was removed to suitable material, moistened and compacted with 8 passes prior to start of backfill." However, this does not state the elevation at which the subgrade was removed.

INVESTIGATION

The first elevation shown in Block #9 is the starting elevation, or subgrade, for that day's work. As indicated on daily soil report, 1/16/80, subgrade was el. 630'-8", it was moistened and compacted, prior to placement of fill. On report for 1/15/80, the same information is given for an area just west of the 1/16/80 area. This work consisted of backfilling diesel fuel oil lines.

FINDING NO. 7A

QC inspection assignment record for C-1.02-153 on line 3 indicates 3/25/80 through 2/28/80. This should be 3/31/80 through 4/4/80.

INVESTIGATION

Scope of work as shown in Block #6 of QCIR C-1.02-153 shows correct date of work operations. IAR is not a permanent record, is only used to indicate review of inspection criteria.

9 of 15

PRELIMINAR

FINDING NO. 8

Daily Soil Placement Report for 4/14/80 first shift for Area "A", QCIR No. C-1.02-155 on line 5 indicates test frequency required. One per backfill location and indicates the actual as "none taken".

INVESTIGATION

Frequency for referenced area was met on 4/16/80 by test #6142. Frequency per that backfill location or area was 1 test per 3 cubic yards placed. None taken on 4/14/80 as indicated on daily report.

PRELIMINARY

FINDING NO. 9

Daily Soil Placement Report dated 5/2/80 for Area "A"; QCIR No. C-1.02-157 indicates in line 9 that material was placed in two lifts over an area that had test 6160 fail compaction. It should be noted that the test was taken 5/1/80 and results were given to the QC Inspector on 5/2/80 at 9:00.

INVESTIGATION

There is no requirement to stop backfill operation after a density test is taken; however, backfilling operations are stopped when failing results are obtained from U. S. Testing, as they were on 5/2/80 in the A.M. Two feet of material had since been placed and compacted in 4" lifts. A retest was taken at the same elevation, as the failing test and results of 6165 were acceptable. Backfill operations commenced the following Monday in that area.

PRELIMINARY

722

FINDING NO. 10

Field Engineer Report dated 5/14/80 states, in part, "backfill in progress, pipe excevation south of oily waste building and tank from S 4665 E 405 to S 4665 E 500." Contrary to this, the Daily Soil Placement Report for 5/14/80 indicated on line 13 "No 'Q' Backfill Placed Today."

Field Engineer Report dated 5/21/80 indicated soil placement E of Oily Waste @ S 4673 E 510 to S 4673 E 550. Contrary to this, the Daily Soil Placement Report for 5/21/80 indicated soil placement South 4665 ± to 4680 ± East 515 ± to 540 ± Length 25' ± Width 12' ±.

Field Engineer Report dated 5/6/80 indicated soil placement south of Turbine Building bounded by S 5035 to S 5042 E 320 to E 379.

Contrary to this, the Daily Soil Placement Report for 5/6/80 indicated on line 13 "No 'Q' Backfill Placed Today."

INVESTIGATION

A review of the Field Engineers Report Form, and the Daily Soil Placement Report for the days in question shows evidence that the reports are correct as written. The apparent discrepancy is caused when soil is placed in an area, but no tests are taken. This is possible because tests are not required for each placement lift, but rather the frequency of tests is determined by the number of cubic yards of materi al placed, and/or at the discretion of the GeoTech on-site engineer additional tests above the required frequency may be taken.

PRELIMINARY

FINDING NO. 11

Specification C-211 Rev. 10 section 8.6 states:

"8.6 COMPACTION EFFORT

The onsite geotechnical soils engineer shall verify that the equipment used for compacting the backfill material is capable of obtaining the desired results and obtaining the same acceptable compaction effort achieved in the test pad area. This verification shall include, but not limited to, the following:

8.6.1 Number of passes

8.6.2 Speed

8.6.3 Revolutions per minute (frequency)

8.6.4 Overlap per pass

8.6.5 Lift thickness requirements and uniformity."

Contrary to this requirement, there is no evidence in the Field Engineer Reports that this compaction effort has been verified. (The onsite geotechnical soils engineer does not have a copy of the "Test Fill Program.")

INVESTIGATION

Item No. 11 related to the fact that per paragraph 8.6 of Specification C-211, the on-site GeoTech soils engineer shall verify that equipment used for compacting the backfill is capable of obtaining the desired results and obtaining the same acceptance compaction effort achieved in the test pad area. The auditors finding states that contrary to this requirement, there is no evidence int he field engineer records that compaction effort has been verified. The on-site GeoTech soils engineer does not have a copy of the test fill program. Results of Investigation (based on conversations with Jim Wonzak and Rao) follows.

RESULTS OF INVESTIGATION

A. Wonzak and Rao expressed their opinion that the intent of this section of the specification was not to provide document ed evidence that this verification had been accomplished, but rather that the on-site GeoTech engineer was familiar with the soils compaction equipment capabilities and verified that they were properly used. The precise wording in the specification is not being adhered to.

PRELIMINARY

7220

B. It is apparent that the on-site GeoTech soils engineer doe s not have to have the results, the test program, etc., that would be implied to be available to him to verify that the equipment being used is being properly used.

C. It should be noted that J. Wonzak makes frequent trips to the jobsite and reviews the use of the equipment. Jim Wonzak was the original conductor of the qualification testing on the soils compaction equipment.

D. It is also not apparent that the original intent here was to burden a professional GeoTech soils engineer with a degree of recordkeeping which is commensurate with quality control record-keeping in an area where he is assigned because of his training and experience to verify that the process is under control. Resolution of this item indeterminate at this time.

14 of 15

Added in Rev 6 in 5/18/79

PRELIMINARY

7220

FINDING NO. 12

Specification C-211 Rev. 10, paragraph 8.11 states, in part, "The onsite geotechnical soils engineer shall review and approve each soils test report." Contrary to the above, there is no objective evidence that the geotechnical soils engineer "reviews and approves" each soils test report.

① Where did spec say it originate

INVESTIGATION

②

The GeoTech on-site engineer does review and approve each soils test report. There is no procedural requirement for him to sign the report indicating his review and approval. All tests are performed at his, and under his direction, and test results are sent to him for his review. The GeoTech on-site engineer does sign his Field Engineers Report Form in which any tests taken are listed. The report also states that he has observed the soils test to be performed satisfactorily and in accordance with ASTM Specifications.

NO!

PRELIMINARY

FINDING NO. 13

Spec. C-211 Rev. 10, section 8.12, states:

"FAILING TEST

All material represented by failing tests are to be reworked until the specified density and/or moisture is obtained. No material shall be placed on any known failing material until satisfactory tests are obtained."

Contrary to this requirement, it appears the top surface of the existing fill is reworked, but not all the material represented by the failing tests.

INVESTIGATION

Item #13 identified in the audit was that records indicate that for failing tests only the top layer of an area is being reworked. Results of Investigation:

A. This finding is apparently a lack of understanding on the p art of the auditor in that tests are normally conducted one to two feet below the surface of the soil as it is installed. Those additional compaction efforts which are required to rework the soil in the area where the test indicates a failure can, in the opinion of the GeoTech experts, best be accomplished by performing additional compaction effort at the top level of the surface, that is, one to two feet above the level of the tests. The concept of considering that a failed soils test at one level that would indicate all of the compacted soil between that point and the previous acceptable test results to be improperly compacted is incorrect. The concept of using controlled equipment and controlled frequency of tests versus the amount of soil placed and compacted would be destroyed. The failing tests as such represent the material at that elevation and rework can be accomplished by compaction at the existing top surface and subsequently retested. The concept of all soils underneath that being unacceptable is not in context with the soils program, that is, with the use of qualified equipment and controlled procedures.

B. Mr. Rao indicated that intent of this section was for the GeoTech engineer to advise the QCE as to the equipment requirements per Section 8.6 depending upon the location and type of material involved.

The process by which completion?

To the bottom of the lift that failed

SB802403

Bechtel Power Corporation

Interoffice Memorandum

To S. Afifi

File No.

Subject Job 7220 Midland Project
Compaction Test Section
Midland Units 1 and 2
Midland, Michigan

Date November 13, 1978

From D. Henderson
A. Marshall

Of

Copies to S. Blue
P. Martinez
K. Weidner
H. Burke/W. Ferris

At Midland, MI Ext.

A Compaction Test Section was conducted using the clay backfill currently in use at the site.

Results of the test section work, together with the characteristics of the compactor used, are attached.

Compaction Equipment Data:

Machine Type: Tampo
Model No.: RP-28D
Working Weight: 20.55 KIPS
Roller Width: 84 inches
Roller Diameter: 60 inches
Tire Size: 23.1 x 26
Sheepsfeet: 4" deep
Speed: Variable

Jim Betts was informed that, based on the results of this test, heavier equipment would help increase the percent compaction; and that the clays should be compacted in lifts less than 8 inches in loose thickness.

A. Marshall

A. Marshall

AM/smb

GEOTECH
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DISTRIBUTION

DISC	ACT	INFO	W/A
MGR			
ADMIN			
GEOL			
H&H			
EWP			
Proj Eng			

HHB/WF

DENSITY TEST RESULTS

Elevation	Lift Thickness	Number of Passes	% Compaction (ASTM D1557) Test 1	% Compaction (ASTM D1557) Test 2	% Moisture Test 1	% Moisture Test 2	ASTM D1557 Maximum Dry Density (PCF)	ASTM D1557 Optimum Moisture (%) Content
624-6"	4"	4	97.8	91.4	10.1	10.1	134.8	8.3
624-6"	4"	4	92.5	94.4	9.7	9.6	136.5	7.7
624-6"	4"	8	93.3	95.2	10.0	10.0	136.0	7.6
624-6"	4"	8	96.9	96.4	10.5	9.0	134.2	7.8
624-6"	4"	12	86.0	84.6	9.3	9.4	135.6	8.1
624-6"	4"	12	96.4	82.1	10.2	9.9	135.4	8.9
625-0"	6"	4	86.3	90.5	9.1	9.3	137.1	7.3
625-0"	6"	4	96.3	93.5	8.3	9.1	136.8	7.8
625-0"	6"	8	92.3	92.2	10.4	9.8	137.4	7.4
625-0"	6"	8	103.9	88.0	9.6	8.9	137.3	9.5
625-0"	6"	12	94.3	93.5	10.2	8.7	138.5	7.4
625-0"	6"	12	95.8	94.8	8.4	10.3	137.1	7.3
625-8"	8"	4	95.9	96.2	7.7	7.0	137.9	7.3
625-8"	8"	4	97.7	96.1	7.7	8.7	137.6	6.4
625-8"	8"	8	94.9	95.8	8.2	8.8	138.2	6.8
625-8"	8"	8	94.2	98.7	9.1	9.2	135.5	7.4
625-8"	8"	12	94.8	97.0	8.6	8.9	137.8	7.1
625-8"	8"	12	96.7	98.1	10.1	8.2	138.2	7.7
626-6"	10"	4	89.3	91.0	9.1	8.7	135.5	7.8
626-6"	10"	4	100.4	91.9	8.1	9.5	136.4	9.1
626-6"	10"	8	95.5	93.7	8.4	9.6	137.2	6.5
626-6"	10"	8	95.7	77.2	8.4	8.9	138.3	7.2
626-6"	10"	12	94.0	95.9	9.3	8.6	135.8	7.8
626-6"	10"	12	95.7	96.5	9.1	8.4	139.0	7.0
627-6"	12"	4	89.7	93.4	8.4	8.9	138.3	7.5
627-6"	12"	4	93.6	92.2	11.1	11.4	136.2	7.3
627-6"	12"	8	95.0	99.0	9.9	8.3	134.1	9.0
627-6"	12"	8	93.8	92.7	9.1	8.9	136.5	8.3
627-6"	12"	12	93.7	95.8	9.2	9.8	136.5	7.7
627-6"	12"	12	94.0	94.8	10.2	11.0	136.5	8.2

P.K.

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Inter-office Memorandum

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JOB FILE

REC'D JAN 27 1977

To S. L. Blue

Date January 27, 1977

Subject Midland Plant Units 1 & 2
Job 7220
FSAR Problem Areas
File: 0505.1A

From R. L. Castleberry

Of Engineering

At Ann Arbor

Copies to G. LeFevre C. Henne
S. Rankin R. Rixford
G. Tuveson S. Sobkowski
T. Vanvick S. Emerson C. Papadakis all w/a

A meeting was held on January 24, 1977 in response to your memo of January 18, 1977 (Attachment #1). The discussion included the items per attachments 1 and 2. The current SSE value was also discussed as part of item 3, attachment 1. Attachment 3 lists the attendees.

The following points were noted:

A. Soils

1. Evaluation of field QC tests on fill (FSAR Section 2.5.4.5) - Project Civil (S. Sobkowski) will contact the site to determine if there is more data available and to see if the field can separate the data. Geotech estimates roughly 300 mhrs to separate the current data.

2. Liquefaction Analysis (FSAR Section 2.5.4.8) - The section has been written using the methods outlined in the PSAR. However, analysis using current analytical methods has also proceeded. Geotech will include the new analysis in Rev. B of the section in lieu of the current writeup. Project Civil (S. Sobkowski) is to advise on supporting documentation of the drawing requirement to remove "loose ends", i.e. sand, etc. with less than 75% relative density.

3. Settlement prediction of sandy soils (FSAR Section 2.5.4.8) - This also concerns removal of "loose ends".

4. Subsurface Instrumentation (FSAR Section 2.5.4.13) - Project Civil (S. Sobkowski) is to advise on usability of current data and provide J. Hurley on details of specification so that J. Hurley can request Consumers' action.

B. Hydraulics and Hydrology

1. Blowdown discharge diffuser (ER Section 3.4) - The diffuser design and concentrations for discharge are based on blowdown study results. The last study was done in 1973. FSAR Mechanical (S. Emerson) with the Project will resolve as to whether or not the study should be redone. Geotech pointed out that design changes have been made (blowdown cooling tower eliminated) and the 1973 study is based on monthly averages.

2. Erosion Study (FSAR Section 2.4.10) - Discussion was delayed until January 26, 1977. Geotech will arrange details of meeting.

3. Accidental Release of Fluids from Condensate Storage Tanks (FSAR Section 2.14.12) -

   a. The spill paths assumed by Geotech were discussed and were considered appropriate. Other paths would be investigated by Geotech on a low priority basis.

   b. FSAR Mechanical (S. Emerson) will verify that Nuclear Staff is using current source terms and the dilution factor needed to meet regulatory requirements.

   c. Project Civil (S. Sobkowski) will advise if there is a berm or dike around the condensate tanks.

4. Ultimate Heat Sink (FSAR Section 9.2.5) -

   a. Geotech's memo of July 14, 1976 to R. L. Castleberry (Attachment #4) noted the need for 1973-1976 data from Lansing and Saginaw. Geotech was authorized to obtain these. Estimated cost is about $100.00.

   b. FSAR Mechanical (S. Emerson) will advise on the status of the heat load data and the pond data.

C. Geology

1. Salt Mine and Brine Data (FSAR Section 2.5.1.1 & .2) - Additional data is needed from Consumers Power and DOW. Geotech will provide a memo on the details to the Project (P. K. Smith) who will prepare the letter to Consumers.

2. Water Level Observation Wells (FSAR Section 2.4.13) - Geotech withdrew this item since data will be obtained from work being done by the soils group.

3. Subsidence Monitoring Program (FSAR Section 2.5.1.1 & .2) - The program needs Consumers' approval and subsequent implementation. Data probably will not be available at FSAR submittal. Geotech will complete the section based on the program proposed to Consumers and data will be added by amendments.

4. Geological Mapping (FSAR Section 2.5.1.2) - This has not been completed for Midland. Geotech will provide a memo to the Project outlining effort, requirements, estimated costs and schedule.

5. Logs of nearby salt and brine wells (FSAR Section 2.5.11) - Geotech has some logs and will proceed with the section. Concurrently, additional data (believed to be available at DOW) will be requested by the same method as per item C.1 above.

6. SSE Value (FSAR Section 2.5.4.9) - Geotech noted that some jobs (Pilgrim) were being ratcheted on the value for SSE. Geotech will provide a memo to the Project (P. K. Smith) who will prepare a letter to Consumers alerting them to the situation.

D. River Water Chemistry - will also be discussed at the January 26 meeting to be arranged by Geotech.

In conclusion, we suggest a meeting be held on February 9, 1977 to review progress on the above items plus discussion of any other areas that may need similar attention.

for R. L. Castleberry

PKS/csf
Attachments

ATTACH #1

Bechtel Associates Professional Corporation

Inter-office Memorandum

To R. L. Castleberry

Date 18 January 1977

Subject Midland Units 1 & 2 - Job 7220
FSAR Problem Areas

From S. L. Blue

Of Geotechnical Services

Copies to S. S. Afifi
G. T. LeFevre
C. N. Papadakis
P. K. Smith
1320,6910

At Ann Arbor 10(D)5

meeting 8B 3A Mon Jan 24 1PM

In response to your request we are listing certain possible problem areas in preparation of Geotech sections of the FSAR that should be included in your weekly meeting agenda.

1. Soils - A general discussion of work yet to be completed.

2. Hydraulics and Hydrology -

   a) Blowdown discharge diffuser.
   b) Erosion protection of the Tittabawassee bank adjacent to safety related facilities.
   c) Accidental release of liquid effluents from the two condensate storage tanks.
   d) FSAR Section 9.2.5 - Ultimate Heat Sink.

3. Geology -

   a) Salt mining production figures and scope of activity related to Dow brine wells.
   b) Water level observation wells.
   c) Subsidence monitoring program.
   d) Geologic mapping.
   e) Logs of nearby salt and brine wells.
   f) SSE value

It would be appreciated if you would add these items to your weekly meeting agenda. Prior notification will be appreciated so that the responsible Geotech engineer will be available for the meeting.

If you have any questions, please call.

S. L. Blue

SLB:lab

SR 00603

Bechtel Associates Professional Corporation

Inter-office Memorandum

To	R. L. Castleberry	Date	26 January 77
Subject	Midland Units 1 & 2-Job 7220-001 FSAR (Soil Section) Meeting Notes	From	S. S. Afifi
		Of	Geotechnical Services - Soils
Copies to	S. L. Blue [redacted] J. Hurley P. K. Smith 1320, 3130, 6910	At	Ann Arbor 10(D)5 7220-77-15

REFERENCE: Memorandum from S. L. Blue to R. L. Castleberry (January 18, 1977, 7220-77-7)

A meeting was held on January 24, 1977 between the project and Geotech to discuss certain tasks which are needed to complete the FSAR (Soils, Section 2.5.4). Tabulated below are these items:

1. The project will request the field to provide Geotech with the up-to-date and complete quality control tests on compacted fill (plant area and the cooling pond dikes). This subject has been addressed in S. S. Afifi's memorandum to R. L. Castleberry dated December 27, 1976 (7220-76-26). It is estimated that 300 man-hours will be required to sort and compile the data and present the results thereof.

2. Geotech is currently preparing an updated liquefaction analysis and report. This report will be submitted simultaneously to the Chief Soils Engineer and the project for review as soon as it is complete. P. K. Chen stated that one of criteria used in liquefaction analysis is that "all sands under the Category I structures and piping with relative density less than 75% have been removed". This is in accordance with the PSAR commitment. The project will provide the necessary data to backup this fundamental consideration utilized in the analysis. The data should be in the form of insitu density tests in sand, standard penetration tests in sand, and excavation limits to show that loose sands (sands with relative density less than 75%) have been removed, and that existing sands are dense (have relative density greater than 75%).

3. Geotech has already submitted recommendations to the project regarding settlement monitoring of the plant facilities. Steve Sobkowski stated that the project has submitted a proposal to CPCO for the subject matter.

Geotech will provide the project with the piezometers installation and monitoring program on the cooling pond dikes shortly. This plan has been addressed in the FSAR.

S. S. Afifi

PKC/lag