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EVALUATION OF SUBSIDENCE
CONSUMERS POWER COMPANY
MIDLAND NUCLEAR POWER PLANT
UNITS 1 AND 2

GENERAL ANALYTICS, INC.
CONSULTING ENGINEERS
MONROEVILLE, PENNSYLVANIA

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EVALUATION OF SUBSIDENCE
CONSUMERS POWER COMPANY
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UNITS 1 AND 2

INTRODUCTION

This report presents the results of a study conducted to evaluate the effect, if any, of surface subsidence on the area of Consumers Power Company's Midland Nuclear Power Plant, Units 1 and 2 as a result of:

1. Solution mining of salt in the Detroit River Group at a depth of about 4100 feet.
2. Future solution mining of salt in the Salina Group at a depth of about 3000 feet.
3. Extraction of brine from the Sylvania Sandstone at a depth of 5100 feet.

Data on the geology of the site, location and production of the salt and brine wells, and the use of wells to reinject waste brine back into the rock strata are presented. The effects of each well type on subsurface conditions and resultant surface movements are discussed in light of current rock mechanics and petroleum engineering theory.

This study was authorized by Bechtel Corporation, San Francisco, California.

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SITE LOCATION AND TOPOGRAPHY

The site of the Midland Nuclear Power Plant is located about one mile south of the city of Midland, in Midland County, Michigan. The topography as shown on Figure 1 is generally flat and the ground surface elevation varies from a low of 590 feet at the Tittabawassee River to elevation 635 about 12 miles south of the site. The proposed plant is located along the Tittabawassee River near the Dow Chemical Company's salt and brine well fields.

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GEOLOGY

Midland County is located in an area which contains thick deposits of glacial drift These materials are composed of clay, silt, sand, and gravel. The glacial deposits vary in thickness from 250 feet to 350 feet in the vicinity of the plant. Ground water is found in thin (5-10 feet) lenticular sands which occur in the surficial deposits up to 50 feet below the ground surface. Artesian waters have been reported in the deep glacial sand and gravels overlying the top of rock.

Underlying the glacial soils are sedimentary rock strata ranging in age from Pennsylvanian to Cambrian and having a total thickness of approximately 19,000 feet. The rock surface is composed of the Pennsylvanian age Saginaw Formation. A generalized geologic section is shown on Figure 2.

Salt beds are first encountered in the Devonian age Detroit River Group at a depth of about 4100 feet. The salt occurs as thin beds separated by thicker layers of dolomite, anhydrite, and limestone in a zone approximately 200 feet thick.

Brine is extracted from the Devonian Sylvania Sandstone at a depth of 5100 feet. Bromine and iodine are extracted from the brine before it is reinjected back into the Sylvania.

The next salt zone of commercial importance occurs in the Silurian age rocks of the Salina Group. Aggregate salt thicknesses of up to 1500 feet occur in this group. However, according to the records of the Dow Chemical Company, the greatest salt thickness (400 feet) occurs at a depth of

7700 feet. Very limited mining of the Salina salt has occurred in the Midland area.

Detailed information on the solution mining of the Detroit River Group salt beds and brine extraction from the Sylvania Sandstone are given in the Wells section of this report.

Structural Geology

Midland County is located in the central portion of the Michigan Basin, a structural feature in which the bedrock dips towards the center. Figure 3 shows the location of Midland County in the Michigan Basin by structure contours on the basal dolomite of the Detroit River Group. The rock strata display a gentle dip of 50-100 feet per mile. No faults have been indicated by the extensive drilling of deep wells in the Midland area. One fault has been suggested about 55 miles from the site but its presence has not been generally accepted.

Glacial Deposits

The proposed power plant site is underlain by glacial deposits of Pleistocene age varying in thickness from 250 to 350 feet. The glacial material is composed of clay, silt, sand, gravel and boulders, and has been subdivided into four zones based on test borings drilled at the site. The four zones as classified by others are:

(a) An upper layer of brown sand which has a maximum thickness of 40 feet.

(b) An extremely compact blue-gray clay having a maximum thickness of 190 feet.

(c) A fine grained brown sand to sandy gravel which underlies the blue-gray clay. This stratum ranges

in thickness from 30 to 45 feet and contains water under artesian pressure.

(d) White sand and gravel having a maximum thickness of 85 feet. The ground water in this zone is also under artesian pressure.

Stratigraphy

Rock strata of interest in this study are of Pennsylvanian, Mississippian, Devonian, and Silurian age. A generalized geologic section is shown in Figure 4, and is summarized as follows.

Pennsylvanian System

Saginaw Formation - Composed mainly of shales and sandstones it varies in thickness from 380 to 510 feet.

Mississippian System

Includes the Bayport-Michigan, Marshall, Coldwater, Sunbury, Berea-Bedford, and Antrim Formations consisting mainly of limestone, sandstone, and shale. The total thickness of Mississippian age strata varies from 2150 to 2250 feet.

Devonian System

Contains the Traverse Group, Rodger City-Dundee Formations, Detroit River Group, Sylvania and Bois Blanc Formations which are composed mainly of limestone, shale, dolomite sandstone, and salt. The Devonian age strata are about 2500 feet thick. Salt is solution mined from a 200 foot zone in the upper portion of the Detroit River Group. Brine is extracted from the underlying Sylvania Sandstone.

Silurian System

Includes the Bass Island, Salina and Niagaran Groups which are composed mainly of dolomite. Only one well near the plant has penetrated into the Silurian strata and it was drilled into the salt deposits of the Salina Group.

Salt Beds

The salt beds which are solution mined by the Dow Chemical Company occur in an interval 4100 to 4300 feet below the ground surface. As many as eleven individual salt beds occur in this 200-foot zone. The salt is interbedded with anhydrite, dolomite, and limestone and has a total aggregate thickness of from 33 to 68 feet and averages about 50 feet. Table 1 indicates the production zone in salt wells located within two and one-half mile radius of the plant. Figure 5 is a portion of the log from the Dow Chemical Company Salt Well 10, showing the relationship and distribution of the salt to the interbedded anhydrite, dolomite, and limestone.

WELLS

Figure 6 shows the locations of deep wells within a two and one-half mile radius of the proposed nuclear plant site. These include:

(a) 30 wells for solution mining of salt, six of which have been abandoned and plugged.

(b) 19 wells which extract connate water (brine) from the Sylvania Sandstone.

(c) 12 disposal wells - five of which inject waste brine into the Dundee Formation at a depth of about 3800 feet while the remaining seven reinject waste brine into the Sylvania Sandstone at a depth of about 5100 feet.

Only Salt Wells 10 and 17 are located within 1000 feet of the proposed nuclear plant. The Dow Chemical Company operates the only deep wells within several miles of the plant. There are no gas or oil wells in the vicinity.

Salt Solution Mining

Salt solution mining is conducted by pumping fresh water through wells into the salt strata of the Detroit River Group. The salt solution which forms is then brought to the surface. Of the 30 wells used for salt solution mining, all but Well 8 produce from the Detroit River Group salt beds located at a depth of about 4100 feet beneath the ground surface. Well 8, having a total depth of 8600 feet, was used to extract salt from the Salina Group at a depth of 7700 to 8550 feet. The logs of Salt Wells 1-27 are contained in Appendix A. Table 2 summarizes pertinent information for each well, such as: the date drilled, elevation, depth to and elevation of

top of rock, depths to the top and bottom of the horizon containing salt, aggregate thickness of salt, total depth of the well, depth to bottom of casing, and well status. Table 3 contains details on the number of salt beds encountered in each well and their thickness. There are generally seven or more beds of salt in a 200-foot interval which are mined in the Detroit River Group. The thickness of the beds varies from 1 to 20 feet with an average thickness of about 5 feet. In the Detroit River salt beds, the overburden pressure, assuming 1.0 psi per foot of depth, is approximately 4100 psi, and the hydrostatic pressure is approximately 1900 psi, assuming 0.46 psi per foot of depth. The temperature is 105°F.

Older wells (Numbers 1 through 20) were generally operated as single units and well spacing was relatively wide to avoid developing large cavities which could result in subsidence of the ground surface. Minimum spacing of these wells is more than 1000 feet except for Wells 12 and 15 (370 feet) which were interconnected in 1960, and Wells 19 and 20 (648 feet). Recent practice is to develop well pairs (Numbers 21 through 30) which are located 300 feet apart and worked to form an interconnection by dissolving the salt. Once interconnection is acheived, the two wells are operated as a single unit. Both bottom and top injection have been used at various times in the same well. Bottom injection involves the pumping of fresh water through a central well tubing and the extraction of the dissolved salt through the annulus between the tubing and the bottom string of casing as shown schematically in Figure 7. Top injection is the reverse of this operation; that is, fresh water is sent down the casing and the resulting salt solution is brought up the inner tubing. Where two wells are interconnected, they are operated as a unit as indicated in Figure 8. Fresh

water is pumped down one well and the salt solution extracted from the other well. This operation is reversed at various times.

As indicated on Figure 6, seven of the wells, Nos. 1, 2, 3, 4, 5, 8, and 10 have been abandoned and plugged. Wells 6 and 9 are shut down and no longer used. Wells 7, 11, 12, 13, 14, 15, 19, and 20 are on a standby basis. A standby well is one in which the cavity, due to salt solutioning, is nearly as large as can be economically developed and the well is operated only in emergency situations such as when other operating wells are shut down for repairs and production is required for a few days. It is understood that Well 17 has been abandoned and will be plugged. Wells 16 and 18 are only used intermittently. Future production will be mainly from Wells 21 through 30.

Dow Chemical Company has kept records of the amount of water injected and salt removed by solution mining from each well. The age of each well and its materials balance, that is the amount of salt dissolved and extracted from each well, is given in Table 4. Independent field and laboratory checks on the computed volume of salt removed using a materials balance agree within 10 per cent.[22,36] Also, although the total thickness of the various salt beds averages about 50 feet, Dow's experience indicates that only 25 feet is removed. Bays[2] substantiates this by indicating that in many operations the open cavity at the top of a 200-foot salt bed rarely exceeds 20 to 25 feet. Using this height, the quantity of the salt extracted from each well, and assuming a cylindrical cavity, (a valid assumption where bottom injection is used)[9,36,45] the diameter of the cavity around each

well has been estimated. The estimated cavity diameter is also given in Table 4 and shown in plan on Figure 9. Using a 25-foot height of cylinder results in a realistic estimate of the cavity diameter. Assuming a height of cylinder equal to the average total, 50 feet of salt in the mined section results in a cavity having a diameter substantially less than that for the 25-foot height. Generally, the time to connect adjacent well pairs by solutioning has verified Dow's calculations of cavity size. Dow obtains about 10 per cent of the salt present within the mined area. This is consistent with other solution mining operations which recover 8 to 15 per cent of the salt in place.[2]

It is possible to ascertain what wells are interconnected by variations in pressure during pumping operations. The interconnections between salt wells are also indicated on Figure 9. Hydraulic fracturing to develop interconnections has been used to connect Wells 12 and 15. All other interconnections shown on Figure 9 are due to dissolution of the salt. Wells 7, 11, 16, 18, 19, and 20 are all interconnected. However, it appears that the interconnections do not occur in the same salt bed as they are not continuous between more than two wells. This is reasonable due to the large number of thin salt beds which are present in the Detroit River Group.

Brine Extraction and Injection

As indicated above, nineteen wells which extract brine (connate water) from the Sylvania Sandstone at a depth of about 5100 feet are located within a 2-1/2 mile radius of the plant. In most geologic environments where fresh water overlies saline water (brine), little or no mixing

and little dilution of the brine occurs. The chemistry of most brines cannot be attributed to the leaching of salt beds and, therefore, brines in confined reservoir rocks are thought to be the product of the concentration of ancient sea waters (connate water) which were trapped in the sediments upon deposition.[14]

There are also 12 disposal wells, seven (Wells 7, 8, 9, 10, 20, 21, and 22) of which reinject processed brine into the Sylvania Sandstone and five (Wells 1, 2, 3, 4, and 15) which inject brine into the Dundee Formation at a depth of about 3850 feet. The logs of Wells 1, 3, 7, 28, 29, and 30, which extract brine from the Sylvania Formation are contained in Appendix B. Logs of disposal wells which are representative of wells into the Sylvania Sandstone (Disposal Well 8) and Dundee Fromation (Disposal Well 1) respectively, are contained in Appendix C.

It is understood that upon initiation of brine extraction from the Sylvania Sandstone in 1938, the static level of the brine was at the ground surface (approximately elevation 600). By 1950, the reservoir static level fell about 2500 feet below the ground surface. Since 1950, reinjecting the processed brine into the Sylvania Sandstone for disposal purposes has raised the static level to about 1000 feet below the surface.

The Sylvania Sandstone, a fine to medium grain quartzose rock, is relatively flat lying with its top at a depth of about 5000 feet and bottom at a depth of about 5150 feet. Although it has a total thickness of approximately 150 feet, only about 70 feet of the sandstone has effective porosity and permeability. The porosity of these zones varies between 12 and 15 per cent and the average permeability is 70 millidarcies. The Sylvania Sandstone occurs in an area about 150 miles long and 50 miles wide

and pinches out in all directions from Midland which is near the center of the Michigan Basin. The local brine operations in the Midland area cover an area of about 26 miles by 16 miles. Dow plans to continue reinjecting brine and maintaining the static level about 1000 feet below the ground surface.

The Dundee brine disposal reservoir is generally a thin, 10-20 feet, porous zone which occurs in a dolomite. However, occasionally the porous zone will increase in thickness to 100 feet. Prior to initiation of brine disposal in the Dundee, the static fluid level was about 650 to 750 below the ground surface. Disposal of brine into this formation has raised the static level to 400 to 500 feet below the ground surface. It is anticipated by Dow that there will be no future significant increase of the static fluid level in the Dundee waste brine reservoir.

The cap rock above the Sylvania Sandstone is the massive limestone, dolomite and anhydrite section of the basal Detroit River Group which is approximately 1000 feet thick. The permeability of this section is effectively zero. An indication of the low permeability is that in the open hole completion of wells to the Sylvania Sandstone using cable tools, Dow has had to add water to remove the drill cuttings in the cap rock. In addition, the different initial static levels in the Sylvania Sandstone and the Dundee Formation are indicative of the lack of interconnection between these two reservoirs through the Detroit River Group. Querio and Hultin,[36] in reporting on the development of an ethylene storage cavity in the Detroit River salt beds north of Midland, estimated no loss of gas based on

permeability and pressure tests. This has been verified by operations since 1959.

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SURFACE EFFECT OF BRINE WELLS

The nature of the rock-interstitial fluid system is a critical factor in determining the order of magnitude of settlement in an area where there is a substantial withdrawal of fluids from reserovir rocks. In areas of incompetent clastic rocks, generally of Cenozoic Age such as make up the oil fields in California and the Gulf Coast Region of Louisiana and Texas, fluid (oil, gas, and water) withdrawals from petroleum reservoirs in which abnormally high formation pressures exist have resulted in substantial amounts of subsidence. Subsidences of up to 29 feet have occurred in Long Beach, California,[4] and in excess of three feet in the Galveston Bay area of Texas.[10] In both areas, the interstitial fluids carry a large part of the overburden pressure. The extraction of the fluids causes a reduction of pore pressure resulting in the consolidation of the reservoir rock and settlement of the ground surface. In Long Beach, California, consolidation has been halted by recharge of salt water into the reservoir rocks. However, the rock strata and reservoirs from which fluids are extracted in these areas are different from those underlying the proposed nuclear power plant site.

The competent Paleozoic Age reservoir rocks of the central United States, including the Dundee Formation and the Sylvania Sandstone, generally have normal or lower than normal formation pressures. Elastic or semi-elastic deformation of these well-cemented reservoir rock occurs rather than consolidation upon withdrawal of the interstitial fluids.

The pressure relationships for the two brine reservoirs under consideration, the Dundee Formation and the Sylvania Sandstone which

respectively, overlie and underlie the Detroit River Group (see Figure 4), were presented in the previous section. Briefly, the injection of waste brine into the Dundee Formation has raised the static fluid level from about 700 feet to about 450 feet below the ground surface. The static fluid level in the Sylvania Sandstone has varied from the ground surface in 1938 to a level 2500 feet below the surface prior to the initiation of injection of waste brine back into the reservoir in 1950. The reinjection of brine has raised the static fluid level to about 1000 feet below the ground surface. Dow Chemical Company's reservoir engineers are of the opinion that the static fluid levels are stabilized in the Dundee Formation and Sylvania Sandstone brine reservoirs under current production rates and will not change significantly even after the wells are abandoned.

Pressure Relationships

Pressures exerted in any rock mass within the uppermost ten miles of the earth's crust may be resolved into two or three components: (1) the total overburden pressure caused by the weight of the materials overlying any particular depth point in the earth, (2) the formation pressure which is the pressure of the fluids (oil, gas, water) which exist in pores of the rock, and (3) tectonically exerted pressures which may exert directionally oriented stresses within the rock mass.

Tectonic stresses do not appear to be a major factor in the Michigan Basin as it has been a stable area for a considerable length of geologic time. The isostatic adjustments following the Pleistocene glaciations probably have not materially affected the stress conditions of the rocks.

Overburden pressures are caused by the weight of the mineral matter and the fluids contained in the pores of the rocks overlying a point in the earth. Assuming a specific gravity of the average rock forming minerals of 2.7 (quartz = 2.65, calcite = 2.72, dolomite = 2.85, clay minerals group = 2.70) an average rock porosity of 10 per cent and an average fluid specific gravity of 1.07, a pressure gradient of about 1.1 psi per foot of depth may be calculated. Field measurements in oil wells have generally yielded pressures of nearly 1.0 psi per foot of depth. Due to the variable nature of the rock strata and the lack of precise data on this subject, an overburden pressure of 1.0 psi per foot of depth is generally used in rock mechanics and petroleum reservoir engineering calculations. Therefore, the total overburden pressure on the Sylvania Sandstone is approximately 5100 psi. The total overburden pressure in the Dundee Formation waste brine reservoir at a depth of 3850 feet is approximately 3850 psi.

Formation pressures within reservoir rocks are classified as normal or abnormal depending upon their relationship to a hydrostatic head of water extending from the point in the rock mass to the top of the ground water table. Abnormally high formation pressures indicate a condition where the fluids within the pore spaces are considerably in excess of the product of the fluid density and the head measured from the water table. Abnormally low formation pressures occur when the pore water pressures are lower than that of a column of fresh water extending to the ground water table. Both abnormally high and low formation pressures are the result of impermeable rock strata overlying porous and permeable reservoir rocks.

Fresh water yields a pressure gradient of 0.43 psi per foot of depth and saline (100,000 ppm dissolved solids - density approximately 1.07) waters of the Gulf Coast region produce a pressure gradient of 0.46 psi per foot of depth.[25] The brine produced at Midland from the Sylvania Sandstone has a density of 1.28 which yields a pressure gradient of 0.55 psi per foot of depth. However, it is believed that a value of 0.46 psi per foot would be more representative of the normal formation pressure gradient in strata of the Midland area.

Utilizing an average depth of 3850 and 5100 feet to the tops of the Dundee reservoir and the Sylvania Sandstone and an average formation pressure gradient of 0.46 psi per foot of depth, the average normal pressures at the tops of these reservoirs has been calculated as approximately 1770 psi and 2350 psi, respectively, prior to the extraction or injection of any brine. However, the static head of the Dundee Formation reservoir, prior to injection, was about 700 feet below the surface indicating a formation pressure of only about 1450 psi*. The static head of the brine in the Sylvania Sandstone was at the ground surface prior to any extraction which resulted in an average formation pressure of 2810 psi. Although higher than the calculated normal formation pressure, due to the higher density of the Sylvania brine (1.28 as compared to the usual interstitial water denstiy of 1.07), this formation pressure should be considered normal. Therefore, the formation pressure in the Dundee reservoir formation was lower than normal prior to brine injection and the formation pressure in the Sylvania Sandstone was normal in 1938 prior to any fluid extraction.

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*Assumed - the density of the interstitial waters in the Dundee Formation is unknown but a pressure gradient of 0.46 (fluid density of 1.07) was used for calculations.

Reservoir Properties and Surface Movements

The factors in the evaluation of the affect of brine extraction and injection on the ground surface, and hence, the proposed plant are:

1. The nature of the reservoir rock-pore fluid system.
2. The elasticity of the reservoir rock.
3. The decline in formation (pore) pressure within the reservoir.

Changes of the pore fluid pressure within the reservoir result in a change in the state of stress on the cemented mineral grain framework and an increase or decrease in the volume of the reservoir rock. Based on the mineralogy and porosity of the Sylvania Sandstone and the Dundee Formation reservoir rock and the range of pore fluid pressures with time, it is believed that deformational behavior of these rocks has been entirely elastic during the operational history of the brine fields.

Measurements of the elastic constants of individual minerals are relatively common in the geological and rock mechanics literature. Less common are measurements on the elastic behavior of rocks, and almost all of these are on a limited number of relatively isotropic standard rock types, none of which resemble the typical reservoir rock. The literature of petroleum engineering contains a relatively substantial body of information on the reduction of porosity in reservoir rocks upon a change in the stress conditions. Most of the literature is theoretical and is concerned with the relationship of (a) the rock matrix compressibility to the (b) rock bulk compressibility and to the (c) pore compressibility.[17]

The rather scanty experimental results obtained from triaxial

testing of rocks indicate that:[10,16]

1. The total change in bulk rock compressibility is equal to the change in pore compressibility.
2. Up to porosities of 25 per cent, compressibility decreases as porosity increases.
3. Compressibilities of consolidated sandstone range between 1. x 10^{-6} to 5. x 10^{-6} per cent reciprocal psi or about 1.0 per cent at 8000 differential psi.

Test results on the compressibility of two sandstones relatively similar to the Sylvania Sandstone are shown in Figure 10. Based on theoretical studies, Geertsma[17] has established that rock core compressibilities measured in the laboratory are approximately twice those actually occurring in confined reservoir conditions.

Based on the Sylvania Sandstone's textural and mineralogical similarity to the intermediate compressible reservoir rocks, its compressibility is about 2.5 x 10^{-6} reciprocal psi.

Assuming a laboratory compressibility for the Sylvania Sandstone of 2.5 x 10^{-6} reciprocal psi, a thickness of 100 feet for the reservoir rock and a pressure differential of 1380 psi corresponding to the lowest static level of 2500 feet below the ground surface in 1950, the maximum settlement of the site due to elastic distortion of the reservoir rock is 3.4 inches. At the current static level of 1000 feet below the ground surface (a pressure differential of 550 psi), the maximum settlement of the original ground surface is calculated to be approximately 1.4 inches. Using Geertsma's data, these values would be halved yielding actual movements of

1.7 and 0.7 inches from the original level in 1950 and 1970, respectively. These numbers are in agreement with calculations made using the compressibilities measured by Carpenter and Spencer (Figure 10). Using the same approach, injection of brine into a 50 foot thick disposal zone in the Dundee reservoir has resulted in a rise of the ground surface of approximately 0.3 inches. All of these movements have been of large areal extent resulting in negligible surface strains.

However, since the static levels in both the Dundee reservoir and the Sylvania Sandstone will undergo no significant change under existing operating conditions or in the future movement of the ground surface will not occur due to extraction or injection of brine.

SURFACE EFFECT OF SALT SOLUTION MINING

The Dow Chemical Company operates its salt wells at Midland to develop a maximum cavity diameter which will not result in significant subsidence of the ground surface. As indicated in Table 4, the maximum estimated cavity diameter assuming a cylinder with a height of 25 feet is 907 feet at Well 6. Well 17, located nearest to the plant has an estimated cylindrical cavity diameter of 705 feet. Figure 11 shows this cavity in relation to the ground surface.

Woodward-Clyde and Associates[49] in a study for the Dow Chemical Company analyzed an open cavity having a diameter of 636 feet and a height of 25 feet at a depth of 4222 feet. Maximum movement of the ground surface assuming elastic distortion of the cavity was only 0.031 inches. However, even with a fluid filled cavity, when the cavity diameter reaches a critical size at a depth of 4200 feet, creep of the salt occurs due to high stress concentrations at the perimeter of the cavity.[42] Although, as indicated by Figure 12, creep rates diminish with time[18,37,38,44] and the interbedded nature of the salt results in a horizontal constraint[29,35] continued operation of the well and dissolution of the salt results in a diameter (span length) such that the roof of the cavity collapses. Terzaghi and Richart[42] report maximum spans of 600 feet for limestone in natural cavities having arched roofs.

Types of Subsidence

The type and amount of subsidence is contingent on various time-dependent and time-independent properties of the rock strata as well as the stress conditions created by the opening and the method of mining.

Four types of subsidence occur as a result of variations in rock types and mining methods.[8,35] These are:

1. Caving
2. Chimneying
3. Subsidence plugs
4. Trough subsidence

Caving results from failures in the rock overlying a mine opening so that the failure zone progresses vertically upward until it breaks through to the surface. Caving occurs in rocks having closely-spaced unbonded fissures and joints or in weak sedimentary rocks.

Chimneying is a type of caving that occurs over a relatively small constant cross-sectional area and progresses rapidly to the ground surface. Such movements are very unpredictable; however, they generally occur only over mining operations using the block caving method in highly jointed or fractured rock.

Subsidence plugs involve a sudden failure of the rock overlying an unsupported mine opening. With this type movement, there is practically no expansion of the rock mass so that the volume of the surface subsidence is approximately equal to the volume of the mine cavity. Subsidence plugs normally occur in weakly-consolidated sediments or closely-jointed rock with decomposed material in the joint planes.

None of the above three types of movements are possible at the Midland plant site due to the competent nature of the sedimentary rock strata between the cavities developed by salt solution mining and the ground surface.

Trough subsidence, which is the most common type, is normally

found over coal and potash mines where thin bedded sedimentary rocks predominate. This type of movement is characterized by roof sag and floor heave as the width of the mine opening increases until the roof touches the floor or the roof fractures and falls. Where the roof consists of brittle rocks such as sandstone, limestone, or dolomite, fracture generally occurs. However, bulking of the fallen rock quickly results in filling of the void and support of the overlying rock strata so that these beds merely sag forming a subsidence trough.[19] Fracture of limestone and dolomite in block caving operations results in an increase in volume of 30 to 40 per cent. Consolidation under the pressure of the overlying rock strata reduces this somewhat but still results in a significant volume increase. For example, a volume increase of 28 per cent was observed in the mining of material which had caved and were reconsolidated by up to 500 feet of rock over-burden. Surface movements, if any, occur almost immediately following subsurface subsidence.[35,48] The surface movements normally terminate with complete closure of the mine opening. The amount of movement to be expected at the ground surface may be estimated from empirical data on trough subsidence in the coal fields of England.[27,31,46] Although the rock strata in the Midland area are substantially different from those overlying the English coal fields, the data has been collected from so many sites and from mines having a maximum depth of about 2500 feet that it can be used to estimate the maximum subsidence which might occur. Based on these conservative assumptions, a cavity diameter of 700 feet at a depth of 4200 feet results in a maximum surface subsidence of 0.7 inches.

Subsidence Experience

The Dow Chemical Company has indicated that the roof of a salt cavity usually falls when the estimated diameter is about 600 feet. This collapse of the roof rock seems to occur up to about 100 feet above the top salt before bulking results in filling of the cavity with competent blocks of rock up to 10 feet in diameter which in turn support the overlying strata. To avoid damaging the casing when the roof rock falls, normally it is set and cemented with its bottom between a depth of 3950 to 4000 feet, while the top of salt generally occurs between a depth of 4100 to 4120 feet. Examination of the core from Well 6 between the depths of 3671 to 4305 feet revealed the top of salt to lie at a depth of 4111 feet. Thin bedded dolomite and anhydrite occurs between 4000 and 4100 feet. Above a depth of 4000 feet, there is about 200 feet of competent, massive strata consisting predominantly of limestone and dolomite which tends to substantiate Dow Chemical's observations on the height of caving above their salt cavities.

The only significant subsidence of the ground surface from solution mining in the Michigan Basin is that which occurred at Windsor, Ontario in 1954.[43] Three levels of salt having an aggregate thickness of 300 feet were present between depths of 975 and 1600 feet. Salt solution mining began in 1902 but development was not intensive until 1922. From 1922 until 1953, 25 wells were used to extract salt. No materials balance was maintained and eventually the wells were working a single large cavity having an estimated form of an inverted cone with a diameter of 2000 feet and a maximum height of 150 feet. Movements were first noted in 1948 over an area having a diameter of 2000 feet and culminated in the development of a depression 500 feet in diameter and 25 feet deep. The small amount of rock overburden

and the lack of control on the salt solutioning operation which resulted in this surface collapse has no relation to the deep, closely controlled operations at Midland.

Surface Observations

Since 1958, the Dow Chemical Company has conducted observations of bench marks in the vicinity of their salt wells. The locations of 36 bench marks and a tabulation of the observed movements are presented on Figure 13. The observed movements are also plotted against time in Figures 14 and 15. As shown, the bench marks exhibit movements varying from an increase in elevation of about 1.6 inches to a decrease of 1.1 inches. The Dow Chemical Company estimates the accuracy of their observations to be plus or minus one inch. Hence, the accuracy of the observations is greater than the estimated maximum surface movements. However, since roof collapse and closing of the salt cavities does occur, these observations verify that the movements at the ground surface are small.

FUTURE SOLUTION MINING OF SALINA SALT

Well 8, drilled in 1952, is the only well to extract salt from the Salina Formation within the vicinity of the plant. It was plugged at the bottom in 1959 and now produces brine from the Sylvania Sandstone. As indicated in Table 4, the estimated diameter of the cavity developed at Well 8 is 603 feet.

Plans for future solution mining of the Salina salt are very indefinite. However, there is no shortage of halite (sodium chloride) and any work in the Salina would be principally to obtain sylvite (potassium chloride) which occurs in three zones averaging 15 per cent sylvite and having a total thickness of 10 feet between depths of 8300 and 8400 feet at Midland. The economics of extracting sylvite from this depth are not good at this time.

In addition, the Salina Formation covers about 16,000 square miles in Michigan and in the Ludington, Michigan, area where Dow Chemical Company has a plant, the Salina salt occurs at a depth of only 3500 to 4000 feet, or about 4000 feet shallower than at Midland. Thus, the Dow Chemical Company would first work the Ludington area. Even if solution mining is conducted in the Salina salt at Midland, it would necessarily be done several miles north of the proposed plant as Dow does not want to drill and set casing through the previously mined Detroit River Group salt beds.

Hence, future work, if any, in the Salina salt at Midland will be well away from the power plant and will have no effect on it.

SUMMARY

This study was undertaken to evaluate the effects, if any, of surface subsidence on the site of the Midland Nuclear Power Plant, Units 1 and 2 of Consumers Power Company as a result of:

1. Solution mining of salt at a depth of about 4100 feet.
2. Future solution mining of salt at a depth of about 8000 feet.
3. Extraction of brine from a depth of 5100 feet.

The study shows that the Dow Chemical Company's estimates of cavity diameter about their salt wells, assuming a cylindrical shape and height of 25 feet, are realistic. Their experience indicates that when cavities reach a diameter of about 600 feet, failure of the roof occurs. Bulking of the broken rock prevents the caved zone from extending more than 100 feet above the top of salt. Observations of surface bench marks in the salt solution well field over a ten-year period indicate no significant movements. Applying empirical data on trough type subsidence results in a conservative maximum estimate of 0.7 inches subsidence at the ground surface over the center of a salt solution cavity 700 feet in diameter at a depth of 4200 feet. This is an upper limit on surface movement and outside the projected limits of the cavity at the ground surface (a circle 700 feet in diameter) the movements are much smaller.

Since the Dow Chemical Company would not drill and set casing through the previously mined Detroit River Group salt beds, future solution mining in the Salina salt at Midland will be well away from the power plant and will have no effect on it.

Extraction of brine from the Sylvania Sandstone and injection of waste brine into the Sylvania Sandstone and the Dundee Formation have resulted in a state where formation pressures no longer vary under present conditions and no significant change is anticipated in the future. Hence, movement of the ground surface will not occur due to extraction or injection of brine.

Respectfully submitted,
General Analytics, Inc.

Richard E. Gray

Project No. 70-123

March 1970

SB600037

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TABLES

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TABLE 1

SALT WELL PRODUCTION ZONES*

Well No.	Elevation	Depth of Salt Section Top	Depth of Salt Section Bottom	Total Depth
1	608 G	4142	4291	4296
2	606.4 G	4135	4215	4299
3	608.2 -	4145	4285	4295
4	605 Est.-	4145	4308	4320
5	610 G	4110	4253	4269
6	606.60 KB	4111	4282	4305
7	615.70 -	4106	4264	4311
8	609.30 KB	4108	4180**	8653
9	623.40 RF	4115.5	4270	4294
10	620 KB	4104	4249	4254
11	621.31 RF	4105	4267.3	4278
12	622.60 RF	4114	4272	4277
13	617.10 RF	4097.8	4259	4263
14	617.63 RF	4105	4264	4271
15	623.52 RF	4118	4276.5	4277
16	619.78 -	4089	4252	4257
17	614.17 -	4052	4261	4275
18	617.07 RF	4032	4249	4260
19	619.50 RF	4101	4247	4257
20	619.97 RF	4105	4253	4263
21	620.23 RF	4131	4286	4310
22	620.21 RF	4128	4287	4306
23	624.08 -	4133.5	4292	4315.5
24	623.99 RF	4129.5	4291	4305
25	629.68 -	4129	4285	4300
26	630.23 RF	4131	4287	4300
27	624.07 RF	4127	4284.3	4313
28	624.05 -	4133	4291	4320
29	630.73 -	4130	4296	4305
30	635.08 -	4141.6	4305	4316

Notes:

* Data from the Dow Chemical Company

** Salt Section in Detroit River Group

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G = Ground Surface
KB = Kelly Bar
RF = Rotary Floor
- = Datum Unknown

TABLE 2

SUMMARY OF SALT WELL DATA

WELL NO.	DATE DRILLED	ELEV. OF WELL FEET (2)	DEPTH TO ROCK FEET	ELEV. TOP OF ROCK	DEPTH TO TOP OF SALT ZONE FEET	DEPTH TO BOTTOM OF SALT ZONE FEET	AGGREGATE SALT THICKNESS FEET	TOTAL DEPTH FEET	DEPTH TO BOTTOM OF CASING FEET	STATUS OF WELL
1	1944	608 G	270	+338	4142	4291	57	4296	3969	ABANDONED AND PLUGGED
2	1945	606 G	264	+342	4135	4215	70	4299	3983	"
3	1945	(—)	(—)	(—)	4145	4285	58	4295	(—)	"
4	1945	(—)	292	(—)	4145	4308	58	4320	4015	"
5	1949	613 G	(—)	(—)	4110	4253	67	4269	3980	"
6	1950	607 KB	(—)	(—)	4111	4282	68	4305	(—)	SHUT DOWN
7	1951	600 KB	250	+350	4106	4264	(—)	4311	3957	STANDBY
8	1952	609 KB	(—)	(—)	4108	4180	73	8653	(—)	PLUGGED AT BOTTOM SEE NOTE 3
9	1955	613 G	340	+277	4115.3	4270	33	4294	3955	SHUT DOWN
10	1955	620 KB	358	+262	4104	4249	34	4254	3950	ABANDONED AND PLUGGED
11	1955	616 G	290	+326	4105	4267.3	33	4278	3950	STANDBY
12	1956	615 G	260	+356	4114	4272	45 - 50	4277	3950	"
13	1956	610 G	200	+410	4097	4259	53	4263	3937	"
14	1957	611 G	260	+351	4105	4264	64 67	4271	3948	"
15	1960	616 G	(—)	(—)	4118	4276.5	45	4277	3950	"
16	1960	612 G	255	+357	4089	4252	73	4257	3914	USED INTERMITTENTLY
17	1961	606 G	355	+251	4052	4261	47	4275	(—)	ABANDONED WILL BE PLUGGED
18	1962	610 G	342	+276	4032	4249	46	4260	(—)	USED INTERMITTENTLY
19	1963	612 G	375	+237	4101	4247	35	4257	(—)	STANDBY
20	1962	612 G	340	+272	4105	4253	38	4263	(—)	"
21	1964	611 G	230	+381	4131	4286	52.5	4310	(—)	ACTIVE
22	1964	611 G	228	+383	4128	4287	47	4306	(—)	"
23	1966	613 G	218	+395	4133.5	4292	46.3	4315	(—)	"
24	1966	613 G	205	+408	4129.5	4291	40.5	4305	(—)	"
25	1967	623 DF	(—)	(—)	4129	4285	53	4300	(—)	"
26	1967	630 DF	(—)	(—)	4131	4287	48	4300	3990	"
27	1968	614 G	(—)	(—)	4127	4284.3	48.2	4313	(—)	"
28	1968	624 DF	(—)	(—)	4133	4291	(—)	4320	(—)	"
29	1968	630 DF	(—)	(—)	4130	4296	(—)	4305	(—)	"
30	1968	635 DF	(—)	(—)	4141.6	4305	(—)	4316	(—)	"

NOTES:

(1) INFORMATION NOT AVAILABLE (—)

(2) G GROUND SURFACE ELEVATION
KB ELEVATION AT KELLY BAR
DF ELEVATION AT DERRICK FLOOR

(3) NOW PRODUCING BRINE FROM SYLVANIA SANDSTONE

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SBSC0045

TABLE 3

SALT BED THICKNESS

WELL	ELEV OF WELL FEET (1)	DEPTH TO TOP OF CORE FEET	TOP SALT BED		SECOND SALT BED		THIRD SALT BED		FOURTH SALT BED		FIFTH SALT BED		SIXTH SALT BED		SEVENTH SALT BED		EIGHTH SALT BED		NINTH SALT BED		TENTH SALT BED		ELEVENTH SALT BED		AGGREGATE
			DEPTH FEET	THICKNESS FEET	DEPTH FEET	THICKNESS FEET	DEPTH FEET	THICKNESS FEET	DEPTH FEET	THICKNESS FEET	DEPTH FEET	THICKNESS FEET	DEPTH FEET	THICKNESS FEET	DEPTH FEET	THICKNESS FEET	DEPTH FEET	THICKNESS FEET	DEPTH FEET	THICKNESS FEET	DEPTH FEET	THICKNESS FEET	DEPTH FEET	THICKNESS FEET	THICKNESS FEET
608 G	NOT CORED	9142	☆																						
606 G	(-)	9135	☆																						57
(-)	(-)	9145	☆																						70
(-)	(-)	9145	☆																						58
613 G	(-)	9110	15	9135	10	9148	15	9175	2	9193	1	9213	4	9233	20										58
607 KB	9078	9111	10	9131	10	9147	8	9171	3	9189	10	9219	2.5	9242	17	9275	8								67
600 KB	(-)	(-)	☆																						68
609 KB	(-)	9108	6	9118	5	9133	9	9198	8	9193	11	9220	6	9245	19	9283	9								(-)
613 G	9100	9115.3	7.9	9132	1.5	9185.5	3	9207	1.5	9229.9	6.6	9238	3	9259	10										73
620 KB	9100	9109	9	9121.3	3.7	9137	6.5	9213	1.5	9219	9.5	9290	9												33
616 G	9090	9105	6.2	9119	7	9129	10	9192.7	1.3	9171.9	0.6	9186	3	9199	1.2	9238.4	3.8	9251.5	5.8						39
615 G	NOT CORED	9139	12	9136	3	9140	4	9149	7	9175	1.5	9190	3	9212	2	9236	3	9243	7	9267	5				45 - 50
610 G	9085	9097	1	9120	12	9121	10	9135	8.5	9178.5	2	9199.7	3.8	9223	1	9229	7.9	9232.6	9.2	9291.5	9.5				53
611 G	NOT CORED	9105	(-)	9143	5	9165	2	9181	3	9203	3	9226	13	9256	8										64 - 67
616 G	(-)	9118	10	9138	5	9149	5	9151	7	9177	1	9194	2	9219	2	9217	1	9238	7	9248	5				45
612 G	(-)	9089	16	9112	9	9127	7	9153	2	9166	7	9189	7	9212	7	9219	1	9220	5	9242	12				73
606 G	(-)	9052	6	9112	8	9127	5	9136	1	9191	6	9200	2	9203	1	9221	12	9250	6						47
610 G	(-)	9032	6	9096	6	9105	6	9120	4	9126	2	9133	8	9172	1	9192	1	9219	2	9218	4	9292	6		4
612 G	(-)	9101	3	9113	7	9129	5	9135	3	9145	3	9201	1	9222	3	9227	4	9249	3	9253	3				35
612 G	(-)	9105	1	9115	4	9130	4	9135	3	9199	8	9202	1	9223	5	9230	4	9252	8						38
611 G	9110	9131	10.5	9143	13	9157	3	9165	6	9203	3	9227	1	9249	7	9257	1	9260	2	9280	6				52.5
611 G	9105	9128	9	9147	6	9159	2	9156	4	9166	1	9202	1	9241	10	9255	7	9280	7						47
613 G	9120	9133.5	7	9152.5	5	9159	4	9167	5	9172	2	9206	3	9228.2	2	9251.5	9.5	9269	6.5	9288.9	2.3				46.3
613 G	9110	9129.5	8	9148	5	9155	2	9169	3	9199.5	7.5	9250	9	9263	3	9284	6								40.5
621 G	9110	9129	11	9149	10	9165	5	9187	1	9201	1	9242	10	9254	6	9275	1	9277	8						53
622 G	(-)	9131	3	9135	4	9142	1	9148	6	9155	3	9165	1	9199	5	9242	7	9254	3	9260	2	9282	5		48
619 G	9115	9127	7	9147	9	9161	5	9201	1	9220.5	9.7	9249	9	9255	7	9279.3	9.7								48.2

NOTES:

(1) G GROUND SURFACE ELEVATION
KB ELEVATION AT KELLY BAR

(2) DATA NOT AVAILABLE (-)

☆ DETAILS OF THE SALT BED THICKNESSES NOT SHOWN ON BELL LOG

TABLE 4

Amount of Salt Extracted and Estimated Cavity Size*
(As of February 28, 1970)

Well	Drilled	Period of Use	Amount of Salt Extracted (Tons)	Estimated Diameter of Cavity** (Feet)	Status of Well
1	1944	1944 - 1954	465,000	617.0	Plugged and Abandoned
2	1945	1945 - 1949	215,000	419.5	" "
3	1945	1945 - 1951	383,000	559.7	" "
4	1945	1945 - 1955	448,000	605.8	" "
5	1949	1949 - 1952	380,000	557.7	" "
6	1950	1950 - 1961	1,008,000	907.5	Shut Down
7	1951	1952	494,000	635.9	Stand - By
8	1952	1952 - 1959	445,000***	603.4	Plugged and Abandoned
9	1955	1955 - 1964	372,000	552.1	Shut Down
10	1955	1955 - 1961	325,000	515.7	Plugged and Abandoned
11	1955	1956	450,000	606.7	Stand - By
12	1956	1956	298,000	493.8	" "
13	1956	1956	603,000	702.4	" "
14	1957	1957	523,000	654.3	" "
15	1960	1960	555,000	673.9	" "
16	1960	1960	374,000	553.3	Used Intermittently
17	1961	1961	607,000	704.7	Abandoned****
18	1962	1962	421,000	587.3	Used Intermittently
19	1963	1963	274,000	473.8	Stand - By
20	1962	1962	354,000	538.3	" "
21	1964	1965	319,000	510.9	Active
22	1964	1965	209,000	413.4	"
23	1966	1966	254,000	455.8	"
24	1966	1966	6,000	70.1	"
25	1967	1967	139,000	337.2	"
26	1967	1967	32,000	161.9	"
27	1968	1969	18,000	121.5	"
28	1968	1969	15,000	110.9	"
29	1968	1968	45,000	192.2	"
30	1968	1968	12,000	99.3	"

Note: All but Well 8 in Detroit River Group Salt Beds, Well 8 in Salina Salt.

* From the Dow Chemical Company

** Assuming a 25 foot high cylinder.

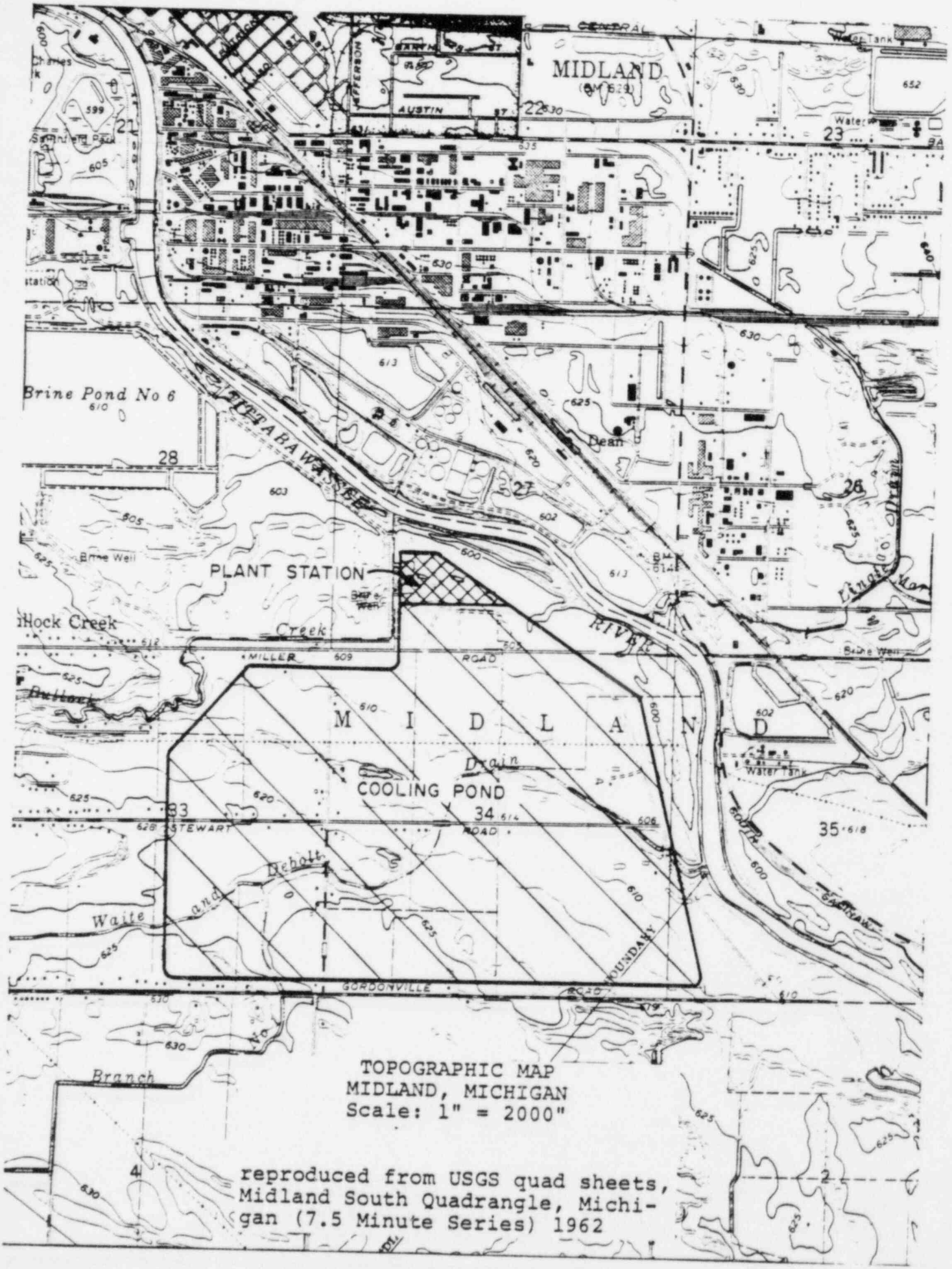
*** Salina Salt - all other wells extract salt from Detroit River Group.

**** It is understood that the Dow Chemical Company has abandoned Well 17 and will plug it.

SB500016

FIGURES

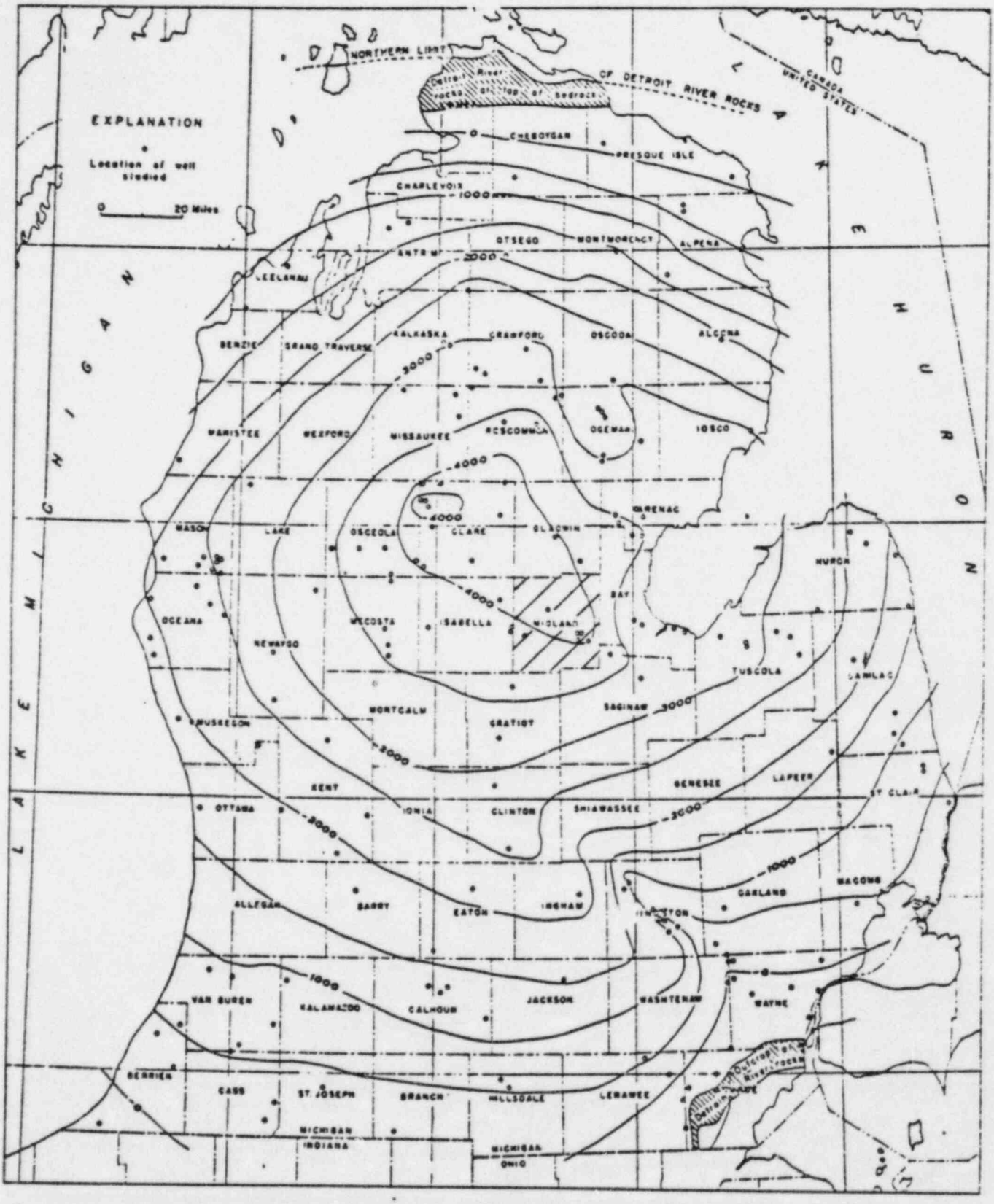
SB500047



TOPOGRAPHIC MAP
MIDLAND, MICHIGAN
Scale: 1" = 2000"

reproduced from USGS quad sheets, Midland South Quadrangle, Michigan (7.5 Minute Series) 1962

FIGURE 1



STRUCTURE CONTOUR MAP OF BASAL DOLOMITE OF THE DETROIT RIVER GROUP

FROM LANDES 1951 PAGE 18

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FIG. 3

GENERALIZED GEOLOGICAL SECTION OF THE MIDLAND AREA

PERIOD	FORMATION OR GROUP	LITHOLOGY	THICKNESS FEET
RECENT		GLACIAL DRIFT SAND, GRAVEL AND CLAY	250 - 350
PENNSYLVANIAN	SAGINAW FORMATION	PREDOMINATELY SHALE WITH SOME SANDSTONE	380 - 510
MISSISSIPPIAN	BAYPORT FORMATION	LIMESTONE & DOLOMITE	± 450
	MICHIGAN FORMATION	SHALE, GYPSUM AND SANDSTONE	
	MARSHALL WHITE FM.	GRAY SANDSTONE	175 - 200
	MARSHALL RED FM.	RED SANDSTONE	
	COLDWATER FORMATION	SHALE, SILTSTONE AND SANDSTONE	± 1000
	SUNBURY FORMATION	BLACK SHALE	± 20
	BEREA BEDFORD FORMATION	SANDSTONE AND SHALE	150-170
	ANTRIM FORMATION	SHALE	350 - 370
DEVONIAN	TRAVERSE GROUP	LIMESTONE AND SHALE	675 - 740
	DUNDEE FORMATION	LIMESTONE & DOLOMITE	±500
		SALT ZONE 200 FT.	
	DETROIT RIVER GROUP		

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CORE LOG - SALT WELL 10

CORE NO. 1

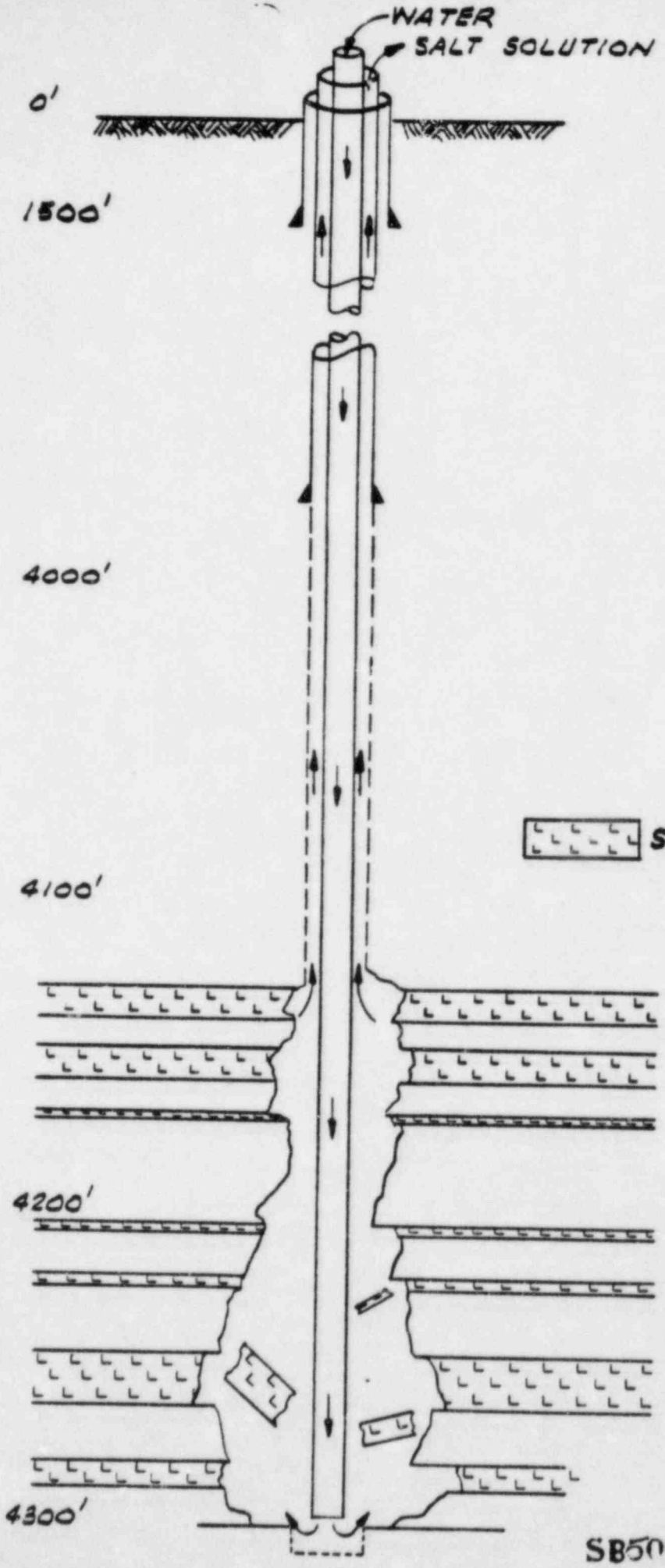
Depth	
	Depth 4100 - 4150 Cut and Recovered 50'
4100 - 4104	Anhydrite, blue-gray
4104 - 4113	Salt, dark with intermingled anhydrite and anhydrous dolomite, in minor amounts. 2" stringer anhydrite between 4106-07. A couple of thin anhydrite partings about 4107 and 4108. Salt becomes clear about 4108. Between about 4112 and 4113 is 8" of anhydrite with salt inclusions which have been washed by fluid. 6" salt, clear at base.
4113 - 4121.3	Anhydrite with small salt inclusions washed in part by fluid. Thin ½" salt streak in first foot.
4121.3- 4125	Salt, translucent, small amounts intermingled anhydrite and brown dolomite. Good salt for most part.
4125 - 4130	Salt, as above with some intermingling dolomite and anhydrite; between 4126-27 is about 6" anhydrite. Also a few thin anhydrite and dolomite partings throughout.
4130 - 4137	Anhydrite, light blue-gray, dense. Scattered small salt inclusions. A little dolomite content.
4137 - 4143.5	Salt, fairly clean with random thin disc like lenses. Anhydrite 2" between 4137-38 and dolomite 6" lense about 4141. (About 1' anhydrite in salt)
4143.5- 4147	Anhydrite, light blue-gray, dense, a little dolomite.
4147 - 4150	Dolomite, light tan, dense and hard

CORE NO. 2

	Depth 4150 - 4200 Cut and Recovered 50'
4150 - 4153	Dolomite, tan, dense to granular-dense, tabular. Numerous small darker crystals in contrast with light dolomite (crystals probably anhydrite)
4153 - 4163.5	Anhydrite, light blue-gray. A little dolomite content within.
4163.5- 4168	Dolomite, variable brown, dense, quite limy - limestone 4166-67 - A few small salt inclusions - some washed.
4168 - 4174	Anhydrite, blue-gray with very little dolomite mottling.
4174 - 4175	Limestone, tan, dense
4175 - 4177	Dolomite, light brown, mostly finely granular. Sweating salt water - tight.
4177 - 4179	Limestone, brown and tan, dense
4179 - 4182	Dolomite, tan dense. A few small anhydrite crystals in last foot - grades into anhydrite nodule at base.
4182 - 4192	Anhydrite, blue-gray. Some dolomite mottling 4185-87. Between 4191-92 is 3" of Clear Salt and plus 6" of Salt and Anhydrite intermixed - odd combination.
4192 - 4195.5	Anhydrite, light blue-gray with salt inclusions in first foot.
4195.5- 4200	Dolomite, light tan, very hard and dense. Scattered tabular, tiny anhydrite

SB500052

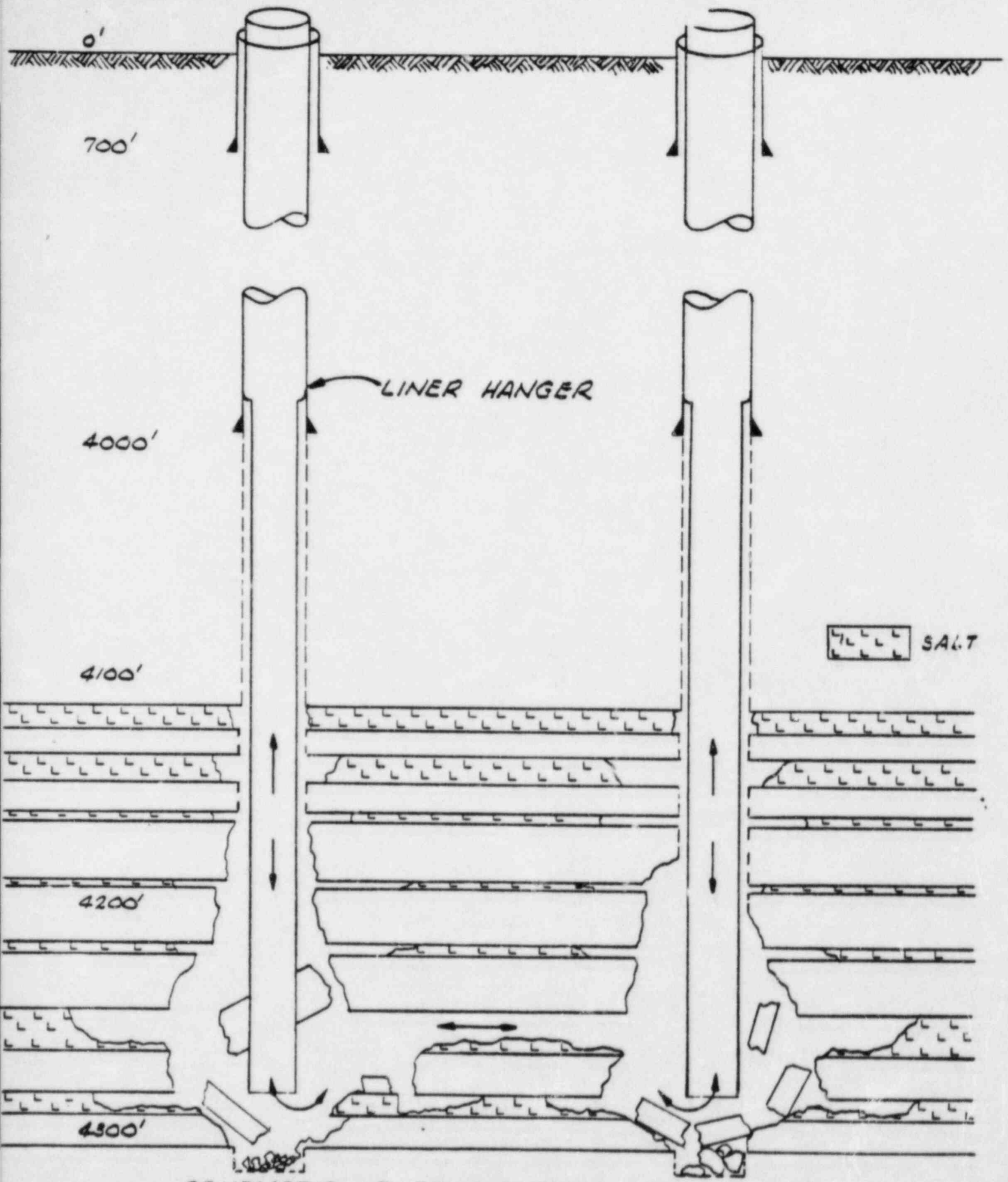
SB500053



SCHEMATIC OF BOTTOM INJECTION PRODUCTION METHOD MIDLAND, MICHIGAN

SB500054

FIGURE 7



SCHEMATIC OF PRODUCTION TECHNIQUES
FOR SOLUTION MINING GALLERY OPERATION
MIDLAND, MICHIGAN

SB500055

FIGURE 8

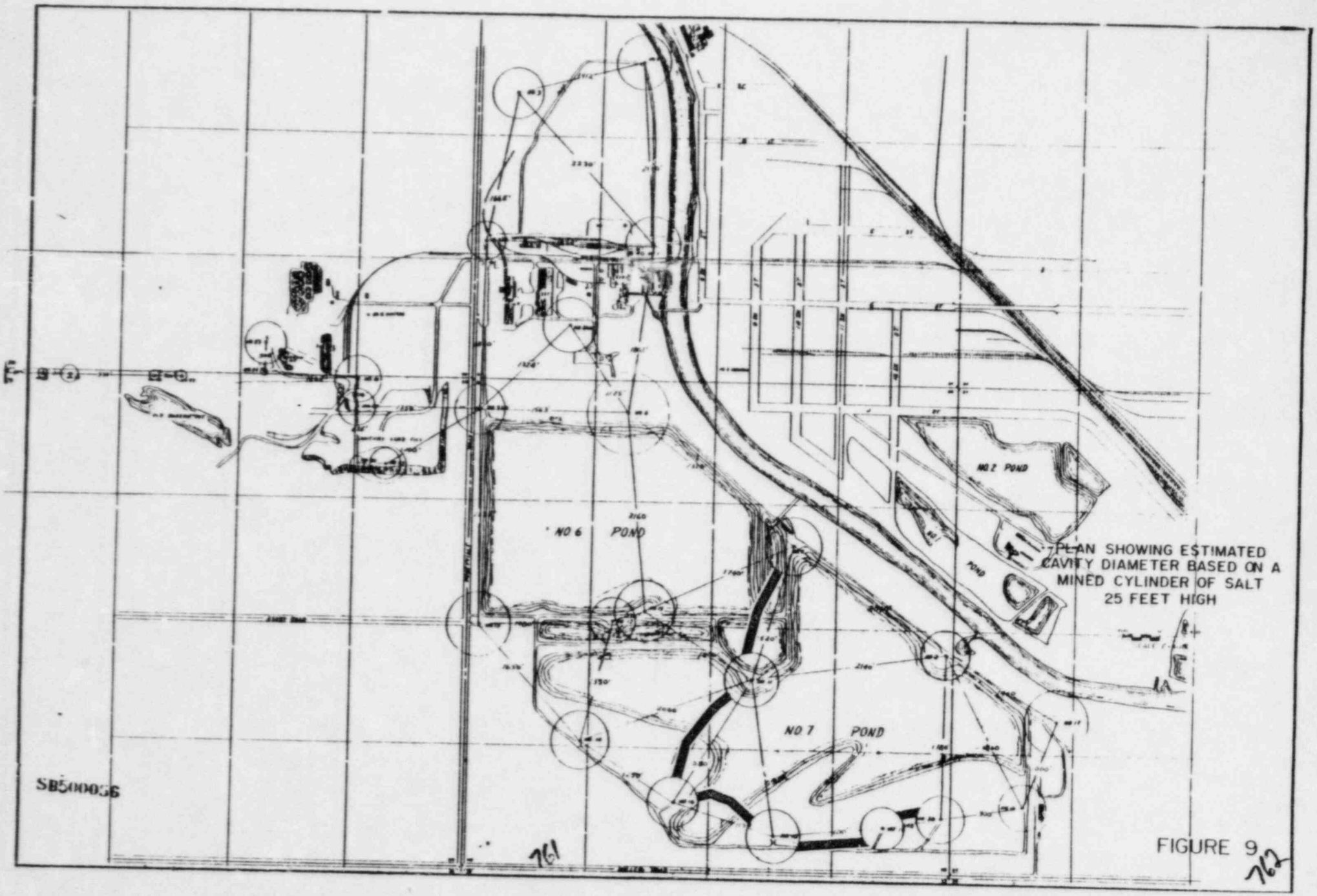
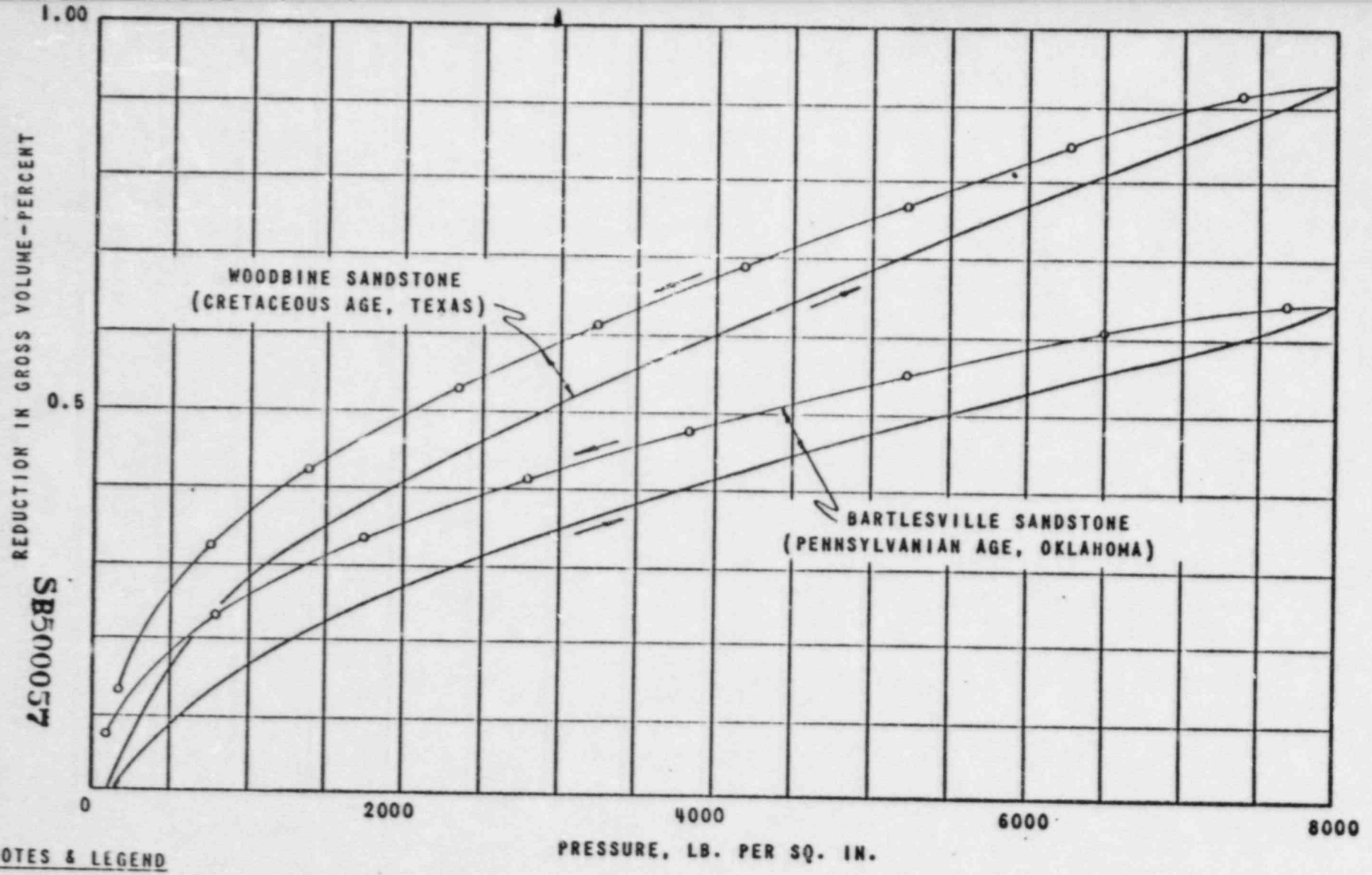


FIGURE 9

761

762



SB5000057

NOTES & LEGEND

1. DATA FROM U.S.B.M. REPORT OF INVESTIGATIONS 3540, MEASUREMENTS OF COMPRESSIBILITY OF CONSOLIDATED OIL BEARING SANDSTONES BY C.B. CARPENTER AND G.B. SPENCER 1940

——— INITAL COMPRESSION

—o— REBOUND

COMPRESSIBILITY OF CONSOLIDATED SANDSTONES

FIG 10

QUALITY ASSURANCE DISCUSSION

MCAR ACTIVITY FOR JUNE 1980

• MCARs written	-	MCAR 39, issued 6/18/80
• MCARs closed	-	None
• MCAR reports issued	-	MCAR 25, IR 8, issued 6/11/80 MCAR 35, IR 4, issued 6/5/80 MCAR 36, IR 3, issued 6/3/80

MCARS WITH PENDING ACTIONS

- MCAR 24: Diesel Generator Building Settlement

  Interim Report 8 was issued October 19, 1979, describing the progress of remedial actions. Interim Report 9 was due February 8, 1980, but was not issued. A CPCo letter to the NRC (Howe-23-80, February 7, 980) stated, ". . . this letter constitutes the Company's final notification regarding the above-described settlement issue pursuant to 10 CFR 50.55(e)." This statement was the result of a December 6, 1979, order modifying the Construction Permits. This action by CPCo changes the mechanism for reporting progress on the resolution of this problem from 10 CFR 50.55(e) reports to FSAR amendments. It does not, however, affect the need to continue the MCAR reports to Bechtel quality assurance and, therefore, to CPCo. A redefinition of future MCAR activities needs to be made by Bechtel and CPCo.

- MCAR 25: Qualification Testing

  Interim Report 8, June 11, 1980, and the attached Qualification Test Status Report, Rev 12, indicate 19 open qualification test reports and 30 nonconformance reports. Training sessions were conducted during June 1980 and procedural provisions have been developed to provide adequate corrective measures to prevent recurrence of this problem. The final report is scheduled for issue by August 31, 1980.

- MCAR 32: States Terminals

  The final report was issued February 28, 1980. Links will be exercised during preoperational testing and unacceptable links replaced. CPCo will continue investigative efforts and, if required, add shunts prior to fuel load. CPCo has forwarded links for testing to Sandia Lab.

- MCAR 34: Drop-In Anchors

  The final report was issued December 14, 1979. Use of drop-in anchors will be discontinued. A field procedure is being developed for testing existing Hilti drop-in anchor bolts. Test results will be forwarded to engineering. A check against design conditions will be performed to determine anchor acceptability.

SB500093

- MCAR 35: Apparent Loss of Adhesion

  Investigation and evaluation activities continued, and included a technical services agreement with KTA-Tator Associates for testing and investigation work. Approximately 17.7% of the walls in Containment 2, coated with System 9, demonstrated insufficient adhesion. Review of application records, analyses, and retained coating batches and random coating samples, and tests of coating application tasks have not, to date, revealed any likely root causes. Interim Report 4 was coordinated with CPCo on May 28, 1980, and was issued June 5, 1980. The next report is scheduled for issue August 29, 1980.

  Copies?

  Not necessary for construction; critical T/R may note this practice but details are a QA & production concern. N.F.

- MCAR 37: Broken Reactor Vessel Anchor Studs

  A third stud failure was reported on February 5, 1980. Preliminary analysis of the test data indicates the studs were rendered susceptible to failure by excessive hardness. All anchor studs for the Unit 1 reactor vessel will be detensioned to prevent further breakage of studs. Unresolved questions from a review of records pertinent to purchase of the reactor vessel anchor studs by CPCo and Bechtel were discussed in a meeting in Shreveport, Louisiana on February 14, 1980, between CPCo, Bechtel, Mississippi Valley Structural Steel, Southern Bolt and Fastener, and the NRC. The second interim report was issued April 23, 1980. The next status report has been rescheduled for issue July 15, 1980.

- MCAR 38: Component Identification

  Interim Report 2 was issued on May 16, 1980. B&W stated it could not support Bechtel's initial conclusion that the deficiency was not reportable. Engineering has therefore determined that the issue addressed by this MCAR is probably reportable under 10 CFR 50.55(e). The next interim report is scheduled for issue August 1, 1980.

- MCAR 39 : Incorrect drawing for emergency core cooling actuation system

  The final report is scheduled for issue on July 8, 1980.

- Significant QA Open Items requiring Action are:

  - Action Item 2313B, MCAR 24, Interim Report 9 needs to be rescheduled, as discussed in the section on MCAR activity.

  - Action Item 0564A. SDDRs 288 and 395 were approved but required W.J. Woolley to update these drawings. These SDDRs were approved in mid 1977 and to date the vendor drawings have not been revised.

8500094

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

November 12, 1979

BLC- 8450

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

Attention: Mr. R.C. Bauman

Subject: Consumers Power Company
Midland Plant - Job 7220
Cooling Pond Material
File [redacted], C-5412
Reference: CPCo letter Serial 110,
2/11/74

Gentlemen:

This is a complete response to the referenced letter. This letter requested that Bechtel consider having tests done to determine the dispersive characteristics of the clay soils used in the construction of the cooling pond dike.

On October 6, 1979, approximately 10 pounds of dike material was sealed in a plastic bag and submitted for testing. Enclosed are the results of these tests conducted by D.H. Gray, Professor of Civil Engineering at the University of Michigan. These tests clearly show that the material is nondispersive in nature, and therefore the cooling pond dike cannot be considered susceptible to failure due to the hydraulic fracture of dispersive clays.

Very truly yours,

for M.O. Rothwell
L.H. Curtis
Project Engineer

CAD/ht
11/5/20

Enclosure: Letter from H. Gray of the University of Michigan
to D. Schulze of Goldberg Zoino-Cunnicliff & Associates
dated 10/15/79

cc: S. Blue
L. Curtis
D.B. Miller
T.J. Sullivan
J. Wanzeck
Com Log

SB500123

0112

bcw/Att:
P. A. Becnel
J. F. Newgen
[redacted]
K. Wiedner
S. S.Afifi
P. A. Martinez

000256

JOB 7220
PROJ. ENGR. Z
ASST. P. E. P 1
MECH.
ELECT.
CS
FILE NO. 0505

September 17, 1979

BLC-8167

Consumers Power Company
Mr. G. S. Keeley
Project Manager
1945 West Parnall Road
Jackson, Michigan 49201

RECEIVED
SEP 20 1979
BECHTEL
A.A. 7220

9/25/79

Midland Units 1 and 2
Consumers Power Company
Bechtel Job 7220
REMOVAL OF LOOSE SANDS
Files 0618B/2801

Reference (1) Serial 3478, Oct. 6, 1978, Newgen to Cooke.
(2) BCCC 3587, Oct. 23, 1978, Cooke to Newgen.
(3) NRC Summary of Apr. 10-11, 1979, Meetings on Operations.
Attachment (A) Response to FSAR Question 362.2.

Dear Mr. Keeley:

Reference (1) raised questions about the applicability of the provisions of Article 9 of the Bechtel Consumers Power Company Contract with respect to confirmation of the removal of loose natural sands. Reference (2) advised of the establishment of a separate account for costs associated with additional borings and any future corrective measures.

Attachment (A) is the response to FSAR Question 362.2 which was submitted in February 1979 with FSAR Revision 18, which provided information and concluded that the surficial sands existing in the plant area have relative densities greater than 75 percent. This subject was discussed with the NRC Geotechnical Engineering Section on April 10, 1979, and is noted in Reference (3) as being resolved.

bcw/Att:
P. A. Becnel
J. F. Newgen
[redacted]
K. Wiedner
S. S.Afifi
P. A. Martinez

000256

JOB 7220
PROJ. ENGR. Z
ASST. P. E. T
ASST. P. E. T
ASST. P. E. P 7
ASST. P. E.
MECH.
ELECT.
CS
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C.S.
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C.
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P.
ADM.
FILE NO. [redacted] 0505 A

9/25/79 4 att

September 17, 1979

BLC-8167

Consumers Power Company
Mr. G. S. Keeley
Project Manager
1945 West Parnall Road
Jackson, Michigan 49201

RECEIVED
SEP 20 1979
BECHTEL
AA 7220

Midland Units 1 and 2
Consumers Power Company
Bechtel Job 7220
REMOVAL OF LOOSE SANDS
Files 0618B/2801

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Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

bcc: S. Blue
G. Lefevre
Com Log

February 9, 1979

BLC- 7152

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

Attention: Mr. R.C. Bauman

Subject: Consumers Power Company
Midland Plant - Job 7220
Subsidence Surveillance
File: [redacted], C-1700, C-75

Gentlemen:

We have reviewed Dow's subsidence survey information given to us by D. Sibbald of CPCo. We notice that Dow installed a number of benchmarks around their salt wells during 1977. It appears that these benchmarks replace the majority of survey monuments that were installed since 1958. In order to have a continuity for a long-term subsidence monitoring program, we feel that a correlation between 1958-76 and 1977 surveys should be established. We also have difficulty establishing relationships between various datums that are used by Dow.

We would like to obtain the survey information recorded by Dow for the period between 1969 and 1976.

It should be noted that there are three subsidence benchmarks installed on Dow property (reference benchmarks 10, 11, and 12, Drawing C-997). We understand that our field personnel were not able to record the elevations of these benchmarks during their surveying cycle. We would like to get these readings as soon as possible.

We believe a meeting between CPCo, Dow, and Bechtel would be helpful to resolve the points discussed above. Please advise us of a convenient time during the latter part of February 1979.

Very truly yours,

for R.L. Castleberry
Project Engineer

RAO/bob
1/19/14

cc: T.C. Cooke

SBS00132

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

bcc: S.S. Afifi
J.F. Newgen
K. Wiedner
L.D. Sokol
Com Log

BLC- 7014

January 15, 1979

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

Attention: Mr. R.C. Bauman

Subject: Consumers Power Company
Midland Plant - Job 7220
Additional Site Testing for the
Diesel Generator Building Area
File: [redacted], C-79(Q)

Gentlemen:

We have enlisted the services of Dr. R.D. Woods, from the University of Michigan, to perform dutch cone tests in and around the diesel generator building. The dutch cone test results are an indication of the bearing pressure of the tested soil.

We request your approval to expand Dr. Woods' scope of work to include evaluating and reporting the dutch cone test data. Dr. Woods is very experienced with the practical and theoretical aspects of this type of test. In the interest of scheduling, we have initiated the necessary paperwork to proceed in this direction.

May we have your approval on the additional work to be performed by Dr. Woods on or before January 19, 1979.

Very truly yours,

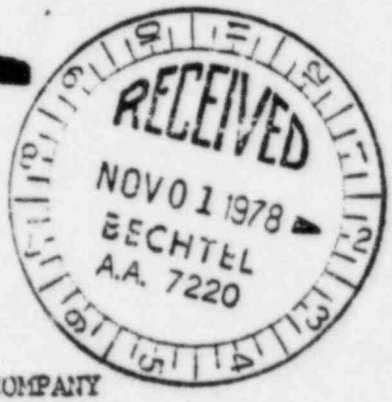
for R.L. Castleberry
Project Engineer

JGH:la
1/8/2

SB500134

bc:

H. W. Wahl	J. F. Newgen
J. P. LeBlanc	J. Milandin
W. G. Jones	L. A. Dreisbach
R. Hermeston	W. G. Moring
K. Wiedner	S. L. Blue
P. A. Becnel	S. E. Afifi
P. K. Hansen	
E. A. Rumbaugh	
[redacted]	



JOB 7220

	ACT.	INFO.	COPY	INIT.
PROJ. ENGR.		X		
ASST. P. E. T		1		
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ELECT.				
CS				
CIVIL			X	
ARCH.				
O.E.				
CONSTR. CONTROL				
PROJ. MGT.				
PROC. MGT.				
FIELD				
CONST. COORD.				
FSAR				
ADMIN.				
FILE NO.				

FILE NO. 0270, 0670 Z

November 1, 1978

BLC-6747

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

Midland Units 1 and 2
Consumers Power Company
Bechtel Job 7220
CONTINUATION OF DIESEL GENERATOR BUILDING WORK
Files 0614/2801

Dear Mr. Keeley:

This letter is to formalize the items discussed during our meeting of October 25, 1978, at the Midland jobsite. We advised that the consultants' recommendation on the course of action for the diesel generator foundation question is expected by November 7, 1978. Preliminary discussions with the consultants, however, have indicated two possible courses of action appear likely -- either accepting the building anticipated settlements throughout its life and modifying the design, or preloading the soil to incur most of the settlement prior to plant operation. In either case it would be desirable that the subsurface soils be monitored for movement. Recognizing that there will be some interval between obtaining the consultants' recommendation and embarking on whatever plan is ultimately approved, at this meeting we outlined our plan of activities for continuation of diesel generator building construction and preparation for the possible surcharging of the building area.

Specifically, we propose to:

(1) Proceed with modification work on the building. This includes releasing any settlement restraints imposed by the electrical duct banks and then grouting any gaps which exist beneath the building foundations to insure adequate contact with the underlying soil.

(2) Concurrent with this activity we plan to proceed with installation of soil settlement monitors in and around the building.

(3) In preparation for the possibility that surcharging may be undertaken, we will proceed with the design and installation of measures to protect the turbine building and adjacent transformer areas from any effects of the surcharge.

(4) We will also proceed with the installation of any frost protection measures which may be needed. We currently envision using a layer of sand for this protection.

(5) Prior to and after releasing the electrical duct banks, we will perform survey measurements on the ends of the casing for the condensate pipes. We will also perform visual inspection and gap measurement for the following pipes: condensate at casing entry and exit, service water at building entry, and diesel oil at building entry. Visual inspection shall be for physical damage or the potential of damage due to settlement. Gaps will be measured at the top, bottom, and sides of pipes.

Since our meeting we have developed order-of-magnitude cost estimates which show that the release of the duct banks and grouting will cost approximately $125,000, and soil monitors will cost $135,000, and the preparations for surcharging will cost $240,000.

The advance measures for protection of the turbine building and transformer area and frost protection, which are required only if preloading is used, would provide a schedule advantage if started at this time should preloading be decided upon.

So that the underlying soil may be subject to conditions anticipated for plant operation, we request that you proceed to fill the cooling pond to its design level of elevation 627.

As we currently envision having the diesel generators for Unit 2 available for hot functional testing on the first of March, 1980, it is imperative that the construction schedule be maintained. Our current schedule requires that construction be resumed by March 1, 1979, at the very latest. It is highly desirable to have the weight of the building in place as soon as possible in the event preloading is undertaken. We therefore request your concurrence to resume building construction.

8500139

Bechtel Power Corporation

As the builders risk insurance for the Midland Project is furnished by Consumers Power Company, we ask that you notify your insurers of the large settlements being encountered and take whatever steps are necessary to preserve rights under the insurance applicable to these circumstances.

As there is considerable urgency to these items, it is our hope to be able to start work immediately. We will discuss any questions or comments you may have at the meeting tomorrow, November 2, 1978.

Very truly yours,

P. A. Martinez
Project Manager

PAM/pp

cc: T. C. Cooke
D. B. Miller

SD500140

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

cc: P. Martinez
L. Sokol
Com Log

BLC- 6619

September 27, 1973

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

Attention: Mr. R. C. Bauman

Subject: Consumers Power Company
Midland Plant - Job 7220
Diesel Generator Building
Foundation Investigation
File: 0270, C-2640

Gentlemen:

This letter is to confirm a commitment made with CPCo's approval on September 14, 1973 during a meeting at the site that Bechtel would retain an independent consultant to review the settlement problems associated with the Diesel Generator Building. Dr. R. B. Peck and Dr. W. J. Hendron, Jr. have been contacted and will be independent consultants used in evaluating the subject foundation problems. Dr. Peck will be at the site on 9/28/73 to review the boring program and preliminary results with our Geotech group and project engineering.

Both Dr. Peck and Dr. Hendron have a Hydro and Community Facilities Division Consulting Services Agreement with the Geotech Department and will be reimbursed according to the terms of the agreement, copies of which can be obtained on request.

Mr. Cooke, at the site, has been advised of the site visit by Dr. Peck. Should you desire additional information, please contact this office.

Very truly yours,

R. L. Castleberry
Project Engineer

GAT/db

8810010141

2664

bcc: Com Log
L. Sokol
P. Martinez

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

BLC- 6533

September 12, 1978

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

Attention: Mr. R. C. Bauman

Subject: Consumers Power Company
Midland Plant - Job 7220
Soils Laboratory Testing
File: [redacted] C-79(Q)

Gentlemen:

This letter is to confirm the telephone conversation on September 8, 1978, between R.L. Castleberry and R.C. Bauman in which Consumers gave their concurrence for going sole source on Technical Service Agreement 7220-C-79(Q).

Attached for your information is Specification 7220-C-79(Q), Rev 0 which will be used as part of the technical service agreement for the soil testing program in the diesel generator building area.

We anticipate the technical service agreement will go to Goldberg-Zoino-Dunnicliff Associates, Inc. of Newton Upper Falls, Massachusetts. Our justification for going sole source is as follows:

a) It is not within the scope of the present onsite laboratory testing firm.

b) It is desired that an independent testing laboratory be used because of the significance of the test results.

c) Goldberg-Zoino-Dunnicliff Associates have recently been awarded a similar type contract on another Bechtel project.

d) Goldberg-Zoino-Dunnicliff Associates have a Bechtel-approved QA program.

e) The expediency in obtaining the desired testing information.

The total cost for this TSA is estimated to be less than $10,000. Should you desire additional information, please contact this office.

Very truly yours,

R. L. Castleberry
Project Engineer

SB 500142

JGH/cap
9/8/6

Attachment: Specification 7220-C-79(Q), Rev 0

2777

MIDLAND PLANT UNITS 1&2

CATEGORY I STRUCTURES LIKELY TO SUFFER GROSS DAMAGE AND THEIR IMPACT CAPACITIES

ITEM NO.	STRUCTURE	MAXIMUM VALUE OF FACTOR WV THE STRUCTURE CAN WITHSTAND WITHOUT DAMAGE (kip-ft/sec)	REMARKS (Reference to item numbers on Attachment 3, Ref. 1)
1.	Auxiliary Building - roof at El. 704-0 between column lines H & K.C in North-South direction and between column lines 5.3 and 7.8 in the East-West direction, 1'-9" thick	5614	Item No. 8
2.	Auxiliary Building - (i) roof at El. 695-6, between Unit 1 Containment and column line K and West of column line 5.0, 1'-9" thick; (ii) roof at El. 695-6, between Unit 2 Containment and column line K, East of column line 8.2, 1'-9" thick; (iii) roof at El. 687-0 West of column line 5.6, between column lines AA and D in North-South direction, 1'-9" thick; (iv) roof at El. 687-0, East of column line 7.4, between column lines A and D in North-South direction, 1'-9" thick	4253	Item Nos. 14, 12, 18
3.	Diesel generator building - roof	1492	Item No. 2
4.	Diesel generator building - walls	3848	Item No. 2
5.	Service Water Pump Structure - roof	1231	Item No. 5
6.	Service Water Pump Structure - walls	2799	Item No. 5

NOTES: Factor WV is the product of weight and velocity of the aircraft. Weight is expressed in kips and the velocity is expressed in ft/sec.

SB500143

20000

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

bcc: J.F. Newgen
R.A. Grote
S. Rao
J. Donnelly

BLC-4157

May 23, 1977

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

Attention: Mr. T.C. Cooke

Subject: Consumers Power Company
Midland Plant - Job 7220
Foundation Settlement
File: 0270, C-76, C-1700

Reference: 1)CPCo letter, Serial 2078,
dated 3/10/77

Gentlemen:

This is a complete response to Reference 1.

Specification 7220-C-76, "Installing Benchmarks, and obtaining and recording foundation settlement data surveys ", has been revised to incorporate your comments. Benchmarks and settlement markers will be installed by Bechtel and a record of settlement surveillance maintained by Bechtel until normal operation of the plant is assumed by Consumers Power Co. No subcontract will be involved with this program.

Very truly yours,

for R.L. Castleberry
Project Engineer

JJD/jc

Enclosure: Spec. 7220-C-76, Rev.1

cc: R.C. Bauman

SR500144

001197

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

March 25, 1977

BLC-3809

bcc: J. Hurley
G. LeFevre
P. Smith
S. Blue
R. Rixford

Consumers Power Company
1945 W. Parnall Road
Jackson, Michigan

Attention: Mr. R. C. Bauman

Subject: Consumers Power Company
Midland Plant - Job 7220
FSAR Preparation
Geotechnical Information
File: .0270, FSAR 2.5, C-1650

Gentlemen:

Section 2.5 of the FSAR addresses the geologic characteristics of the site. One part of this section describes the effects of man's activities on the site stability. Dow's past, and continuing, salt mining activities adjacent to the plant are addressed in the FSAR.

In order to provide up-to-date information in the FSAR, basic data relative to these mining operations for the period from 1970 to the present is needed.

We are therefore requesting that Dow provide the following data, for a radius of 2 miles from the present plant boundary:

1. Logs of any new wells employed in the production of salt or subsurface recharge.

2. The location of such new wells.

3. Production figures on the amount of salt removed.

4. Any subsidence monitoring data for the period.

8500145

We are proceeding to prepare the sections related to the requested information and are confident that any statements made in the text will not be contradicted by the unreviewed material. However, the data should be obtained and examined before the FSAR is submitted to the NRC.

In addition, to adequately prepare FSAR Section 2.5.1.2, it is necessary that the area within a 5 mile radius of the site be geologically mapped.

The field mapping should be initiated soon after all snow has melted and before foliation has come out. Late April or early May would be the prime time. It is estimated it will take two geologists from 2 to 3

001710

weeks to map the study region. A similar 2 to 3 weeks time will be needed for the related office work. Additional transportation and living expenses will also be incurred. Total effort is expected to be 600 manhours with $1500 for expenses.

We would appreciate your authorization for this work by April 1, 1977 so arrangements can be made to start the work when weather permits. The information relating to Dow is requested by April 15, 1977.

Very truly yours,

R. L. Castleberry
Project Engineer

RLR/caf

SD500146

001711

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

TELECOPY

November 12, 1976

BLC-3289

Consumers Power Company
P.O. Box 1963
Midland, Michigan 48640

Attention: J. L. Corley

Subject: Consumers Power Company
Midland Plant - Job 7220
Nonconformance Reports
File: 0465, C-0465, C-1140, 0535.2

References: A) Nonconformance Report No. QF 133
B) Bechtel letter to Consumers BLC-3067 dated 9-17-76

Gentlemen:

This is a complete response to the NRC QF-133.

Our office has reviewed the drawings in question. Drawings C-109 and C-111 were reissued in 1973 as part of the design package to Subcontract 7220-C-210. Because the design had not progressed to a point where the total extent of all Q-listed structures, pipes, ducts, etc., in the yard area could be totally identified, it was decided to include all of this area as Q-listed work. This approach has been continued in defining the limits of Canonie's QA Program, except as modified by the questioned note on drawings C-109 and C-111. However, as design work became more complete, it was agreed that certain areas (i.e., primarily to the east of the power block) would not be used for Q-listed structures or systems; also, using only drawings C-109 and C-111 would require all future backfill activities for non Q-listed pipes, ducts, etc., to be treated as Q-list work. Therefore, drawing C-45 was issued to more accurately define the Q-listed areas, and thus avoid un economical application of the QA program. Drawing C-45 was not issued to Canonie, and thus does not modify the limits of work covered by his QA program.

Therefore, the following drawings and notes define the limits of the Quality Assurance Program.

1. Dwg. no. C-109, Rev. 9, note no. 6.
2. Dwg. no. C-111, Rev. 9, note no. 7.
3. Dwg. no. C-45, Rev. 0, note no. 2.

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A note on Drawings C-109, Rev. 9 and C-111, Rev. 9 defines an area that does not require the implementation of a QA program. This area is located south of coordinate S 5050 and west of coordinate E 100. There are no structures, systems, or components requiring the implementation of a QA Program located in this area. The remaining plant area earthwork will be completed in accordance with drawing number C-109, Rev. 9 (note no. 6). Therefore, Q-listed backfill requirements for areas around the Diesel Generator Building and the Service Water Pump Structure remain unchanged.

Drawing number C-45, Rev. 0 is included in the Project Q-List, Rev. 7. Project Q-List, Rev. 7 was transmitted to CPCo for their approval via BLC-3067 dated September 17, 1976 (Reference B). In addition, drawing C-45, Rev. 0 has been reviewed and approved by the Chief Engineer's Office as indicated by the Design Review Notice (DRN) dated 11-15-74. Drawing C-45, Rev. 0 is also listed on Revision 3 of the Design Control Check List (DCCL) dated 6-16-76.

Based on the facts outlined above, we believe that no revisions to the drawings in question are required.

Please advise if you have further questions on this item.

Very truly yours,

R. L. Castleberry
Project Engineer

SR/sg

SB500147A 002590

Bechtel Associates Professional Corporation

Post Office Box 1000
3621 South State Road
Ann Arbor, Michigan 48106

bcc: W. Holub
G. Richardson
K. Wiedner
J. Newgen
J. Connolly
G. Tuveson
R. Baker
S. Mills

October 30, 1975

BLC-2054

Consumers Power Company
P. O. Box 1963
Midland, Michigan 48640

Attention: Mr. J. Corley

Subject: Consumers Power Company
Midland Plant - Job 7220
CPCo Nonconformance Report
No. QF-66
File: 0462.0270 0535.2

Gentlemen:

It appears that the originators of NCR QF-66 may have misinterpreted those sections of the PSAR which deal with the type soils used as support for Class I structures. The questions raised in the NCR have been derived from one PSAR sentence, rather than by consideration of the totality of PSAR material on the subject. The PSAR does not state that all the backfill material above 605 will be cohesive, as implied by the NCR. However, it is true that over 85% of the backfill material used is cohesive.

The DRL question 5.1.11 in the PSAR addressed the method of support for Class I components or critical appurtenances, such as Class I piping. Basically, the DRL requested the PSAR to address a solution to the potential for liquefaction of any in situ sandy soils that may be supporting Class I structures.

Fine sands and silty sands with a low relative density (loosely deposited or compacted) are susceptible to liquefaction; but, sand or cohesionless soils with a properly selected grain size distribution deposited or compacted to a sufficient relative density are not sensitive to liquefaction. Also, most cohesive (clay type) soils are not normally susceptible to liquefaction because of their inner molecular structure. The cohesive and cohesionless soils listed in Specification C-211 as structural backfill have been selected and the compaction specified so that proper support will be provided for all structures and the potential for liquefaction is eliminated.

Many areas of the PSAR, such as DRL questions 2.14 and 5.1.11 and PSAR sections 2.8.4.3 and 2.8.4.6, indicate that controlled compacted fill which by definition is either cohesive or cohesionless (granular) will be used to support Class I structures. However, due to economics more than 85% of the controlled compacted backfill on the project is cohesive material and only where it is considered an engineering requirement is granular material used.

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FORM G - 6 200M

COPY

BECHTEL CORPORATION

December 18, 1968

Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Attention: Mr. W. E. Kessler

Subject: Consumers Power Company
Midland Plant Units 1 & 2
Job No. 7220
Report on Cooling Pond
Soils Survey
File: 0270, C-1900 C-5425

Gentlemen:

Attached are six (6) copies of the supplement to the Dames and Moore report on soil drilling, sampling and testing for the cooling pond, which we transmitted to you on November 13, 1968.

The report with supplement includes complete logs of boreholes and results of soil classification and compaction tests as well as partial results of triaxial shear tests and permeability tests which we expect to be completed in the current week.

We found the report satisfactory both with regard to technical content and the manner of presentation.

The results of this soils investigation, together with data from earlier investigations, enabled us to conclude that the soils conditions in most of the cooling pond area generally are satisfactory. The foundation soils over most of the proposed dike and baffle alignment have adequate bearing capacity and, except for sandy pockets in the top 5 to 18 feet, have very low permeability. A seepage cutoff through the sandy pockets where these occur will be necessary, but, at this stage, we are hoping that the cutoff can be achieved, in most, if not all areas, by means of a core trench backfilled with impervious fill.

A number of additional boreholes would be desirable, especially along the west wing where only two boreholes were put down because of the changed dike location.

Because the quantity of cleansand in the pond area may be inadequate for the drainage zones in the dike, outside sources of sand should be investigated and samples tested. Also, potential sources of rip rap for slope and channel protection will have to be established

in the event these will be required.

We expect to be able to advise you of our recommendations for further soils and other investigations and testing, for both the cooling pond and the plant, by the 15th of January, 1969, with the intent that field investigations and drilling can commence on about February 3, 1969.

Very truly yours,

Original signed by
J. H. BLASINGAME

J. H. Blasingame
Project Engineer
Bechtel Company

PAM:ea
(In dup.)
Encl.

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001354

(0271)

General Offices: 212 West Michigan Avenue, Jackson, Michigan 49201 • Area Code 517 788-0550

JUN 25 1968

June 18, 1968

Bechtel Corporation
P. O. Box 3965
San Francisco, California

Subject: Midland Plant
Soil Investigation
Spec C-1

Attention: J. H. Blasingame

Gentlemen:

We have reviewed your specification C-1 and believe that samples should be taken at every change in strata regardless of the frequency. Also, since this region has been deposited by glaciers, it would be prudent to be sure that the material found under the interior of the plant areas extends to the outer periphery of the structures. If previous borings do not demonstrate this to be a fact, more borings should be taken.

Yours very truly,

WCC/ce

W. C. Cooper
Coordinator of Consulting
Engineering Services

SC500170

JOB 7220

	Info	Action	Initial
J. H. B.	C		
K. O. S.	(3)		
J. D. S.			L
R. L. C.			
E. L. C.			
F. C. D.			
P. A. M.		L	

6/24 Rec'd

Consumers Power Company

JAN 1 0 1979

JOB 7220			
	ACT.	INFO.	COPY	INIT.
PROJ. MGR.		2		
ASST. P. E. T		1		
ASST. P. E. T		3		
ASST. P. E. P				
ASST. P. E. E				
MECH. ELEC.				
CC				
CIVIL			XC	1-10-79
P.O.				
ARCH.				
QA				
CATHODIC PROT.				
PROD. MGT.				
PROD. MGT.				
FIELD				
CONST. MGMT.				
FSAR				
ADMIN.				
K Wichner			XC	1/17/79
FILE NO. [redacted]			0670.2	
			XC 1/17/79	

General Offices: 212 West Michigan Avenue, Jackson, Michigan 49201 • Area Code 517 788-0550

January 9, 1979

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

MIDLAND PROJECT
SURCHARGING OF THE DIESEL GENERATOR BUILDING AREAS
FILE: C-81 SERIAL: 6329

We have reviewed the Specification C-81, Rev 0, which was forwarded for our comments by BLC-6908 dated December 14, 1978.

We have no comments and find the specification and settlement monitoring program for the diesel generator building area acceptable.

This will confirm the verbal transmittal of the above message to Mr M Velastegui by telephone on January 2, 1979.

R L Teuteberg

for: R C Bauman
Project Engineer

RCB/RLT/jbg

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2903

Consumers Power Company

General Offices: 212 West Michigan Avenue, Jackson, Michigan 49201 • Area Code 517

JOB 7220				
	ACT.	INFO	COPY	INIT.
PROJ. ENGR.		2		
		1		
ASST. P. E. T				
ASST. P. E. T				
ASST. P. E. P				
ASST. P. E. F				
MECH.				
ELECT.				
CS				
CIVIL		3		
P.D.				
ARCH.				
Q.E.				
C.TR./ENGR. PL.				
PROJ. MGR.				
PROC. MGR.				
FIELD				
CONST. COORD.				
PSAR				
ADMIN.				
R. Wredner			✓	11/2/79
FILE NO.	0271			

XC-C0505

RECEIVED
OCT 30 1979
BECHTEL
AA 7220

October 22, 1979

Mr J A Rutgers
Project Manager
Bechtel Power Corporation
PO Box 1000
Ann Arbor, MI 48106

MIDLAND PROJECT -
REMOVAL OF LOOSE SAND -
FILE 0130 UFI 08*06 SERIAL 7802

Reference: 1) Consumers Power Company Letter, Serial 3478, Dated October 6, 19
2) Bechtel Letter, BCCC-3587, Dated October [illegible]
3) Bechtel Letter, BLC-8167, Dated September [illegible], 1979

We have reviewed Bechtel letter, BLC-8167, (Reference 3) and disagree with the conclusion that Bechtel is not responsible for the additional costs associated with efforts to resolve NRC Question 362.2. We disagree for the following reasons:

1. The NRC raised the loose sand question in early 1970. On Page 3.00-1 of the PSAR, Bechtel provided the NRC with a discussion of how the sands would be treated. The Bechtel intentions as stated in the PSAR were as follows: "For example, in those areas of the turbine building adjacent to the emergency diesel generator building, existing sand will be removed if further tests show relative density of this sand is less than 75%." It is obvious that in place density testing was intended to be performed in order to verify the natural sand densities.

2. Bechtel Engineering communicated this commitment to construction in 1975 by placing a note on Drawing C-44 indicating that sands with less than 75% relative densities must be removed.

3. The loose sand commitment was also delineated in PSAR Section 2.5.4.5.1. This was a statement that the design drawing (C-44) was issued to require removal of loose sands with relative densities less than 75%.

001971

4. In mid-1978, Bechtel Engineering asked both the Bechtel Construction and Consumers Power Company Field Engineers if they had any knowledge of density tests taken for the purpose of clearing areas where natural sands had existed. Consumers Power Company civil field personnel spent several days looking at records in Jackson to identify any field tests performed to document the densities of the sand. All efforts by Bechtel and Consumers Power Company were unable to identify any documented field density tests which would resolve this question. In mid-1976 when the investigation occurred, all of the areas in question had been covered by approximately 30' of backfill.

It seems obvious to us that although field density tests were to be performed to approve areas where natural sands existed, they were not performed or if performed, they were not documented. Based on the inability to show by documentation that the commitment had been adequately addressed, borings were ordered by Bechtel Engineering to resolve the NRC question. If density test had been performed and documented initially, the recent borings and engineering analysis would not have been required. Failure to properly meet PSAR and FSAR commitment and the requirements of Drawing C-44, has resulted in significant costs to Consumers Power Company.

Therefore, we do not accept the argument that because the recent borings showed natural sands which had relative densities greater than 75%, Bechtel has no liability for additional costs. It is our contention that no borings or analysis would have been necessary if Bechtel had properly executed drawing, FSAR and PSAR requirements.

G S Keeley
Project Manager

GSK/cg

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8500215

TELECOPY

Bechtel Power Corporation

Inter-office Memorandum

To L. H. Curtis

Date August 5, 1980

Subject Job 7220 Midland Project
Summary of Onsite Geotech
Soils Engineer Duties and
Responsibilities

From L. E. Davis

Of Construction

At Midland, MI

Copies to BCBE-3125R
J. Wanzeck
S. Rao
B. Sevo
J. Betts
K. Kleinhardt
P. Corcoran

This memo is written to transmit to Project Engineering the Field's comments (attached) on the Summary of Onsite Geotech Soils Engineer Duties and Responsibilities prepared by the Project Soils Engineer, J. Wanzeck.

It is requested that Project Engineering respond by August 8, 1980 with a memo addressing their review and concurrence with this job description. Your expeditious action on this will be appreciated.

L. E. Davis

LED/PAJ/jrh

Attachment

S:500225

AUG 0 6 1980

JOB 7220

ACT | INFO | COPY | INIT

PROJ ENGR
ASST PE DES PROG
ASST PE
ASST PE
ASST PE
ASST PE PIPG
ASST PE PES
LIC & SAFETY
MECH
NUC SYSTEM
PLANT DES
ELECT
CNTL SYS
CIVIL/STRUCT
ARCH
QE
CTR/EAGR PL
ENGRG MGR
PROJ MGR
PROC MGR
FIELD
CONST COORD
ADMIN
FILE NO.

MARKED UP COPY BY FIELD ENGR. AND QA 8/4/80

1

SUMMARY OF ON-SITE GEOTECH SOILS ENGINEER DUTIES AND RESPONSIBILITIES

POSITION: On-site Geotech Soils Engineer

PROJECT: Midland Units 1 & 2 — THIS NEEDS DEFINITION

REPORTS TO: Field Lead Civil Engineer (FOR ADMINISTRATIVE DIRECTION)

GENERAL JOB REQUIREMENTS:

1. Notify Project Soils Engineer, WHO IS THIS? AND QUALITY CONTROL ENGINEER, of any on-site soil related activity not in accordance with the specifications, drawings, or engineering practice.

2. Prepare a daily report in accordance with the attached outline on THE FIELD ENGR. ~~the form provided (Figure 1).~~ (FORM ATTACHED) These daily reports shall be prepared at the completion of each day's work and shall be submitted to the Project Soils Engineer at the end of each work week.

3. Notify ~~Assistant Field Superintendent~~ PROJECT SUPERINTENDENT OF CONSTRUCTION and/or Field Project Engineer or other appropriate construction personnal of any construction activity detrimentally affecting the quality of soil related work.

4. Provide pertinent information to Project Engineering personnel as required.

DAILY RESPONSIBILITIES

1. Excavation: Monitor foundation excavations suitability to insure foundations and other facilities are constructed in accordance with applicable specifications and drawings. — NEEDS DEFINITION.

2. Backfill: Monitor backfill operations to insure conformance to applicable specifications.

3. Compaction Testing: Monitor all on-site testing operations to insure the intent of Specifications C-211 and C-208 are meet. Observe selected laboratory tests daily to insure compliance with specifications. Review testing reports and NOTIFY the Project Soils Engineer of any problems.

E. DAILY REPORTS OUTLINE

1. Backfill

Observations of backfill operations should be reported daily, with the following items reported, when observed:

a. Backfill area
b. Compaction equipment types used
c. Loose lift thickness
d. Number of passes
e. Discussion of any problems
f. Discussions with construction, engineering, or contractor personnel.
g. Weather conditions affecting backfill operations.
h. Any fill being placed without adequate compaction.

2. Excavations

Record any observations made including:

a. Area observed
b. Approximate excavation dimensions
c. Condition of the excavation.

3. Compaction Testing

Record any deviance from specified testing procedures and attach the affected test results. DEVIANCES WHICH CANNOT BE RESOLVED BY THE ON-SITE GEOTECH SOILS ENGINEER WILL BE IDENTIFIED AS AN ACTION ITEM PER ~~ITEM~~ 4.

4. Action Item List

A list of action items shall be attached to each submittal, defining action items resulting from the on-site soils engineer's observations and those personnel responsible for these items. TRACKING AND CLOSURE OF ALL IDENTIFIED ITEMS IS THE RESPONSIBILITY OF THE ON-SITE GEOTECH SOILS ENGINEER.

Daily Report Submittal

1. Field engineer daily report ~~sheet~~

2. Other pertinent documents, such as any correspondence from or to construction, received directly in the field.

3. Action Item List

4. THE DAILY FIELD ENGINEER REPORT AND ATTACHMENTS SHALL BE ROUTED TO QUALITY CONTROL.

REVISED

2

The following are to be documented by the on-site geotechnical engineer as needed on the daily field engineering report.

1. ? Perform as the "contractor"?

2. Assure that construction requirments, and testing are in accordance with ASTM-D-1557-D; ASTM D 422-63; ASTM-D-2049-69; and ASTM-D-2216-71.

3. Determine if materials below and beyond the required excavation limits were disturbed because of excavation methods employed. How?

4. Approve foundation (SUBGRADE) and review (FOR ACCEPTABLE) ~~applicable~~ tests prior to fill placement.

5. Prior to (RESUMPTION OF BACKFILL OPERATIONS EACH SPRING) ~~each year~~ approve all areas in which backfill material is to be placed.

   Determine type and number of tests to be taken in the layer upon which the fill is to be placed.

6. Determine suitability of the structural backfill material in accordance with Section 8.8 of this spec.

7. Spec. 7220-C-211, Rev. 10, paragraph 8.1, "The suitability of backfill material is to be determined by the on-site geotechnical soils engineer in accordance with Section 8.8 of this specification."

8. Assure that except for sand from off-site sources, materials used for plant area backfill are in accordance with the material portion of Section 13.3 of C-210.

9. Where applicable, a pprove use of zone 4A material for the top 6 inches of area fill.

10. Approve sand from off-site sources.

11. Approve locations of lean concretes in lieu of backfill.

12. Determine exceptions to the requirements of ~~this~~ section (8.3.2 of spec. C-211) (i.e. free from lenses, pockets, streaks, or other imperfections).

13. ? Direct all soils work. ? HIT SUPT

14. Approve exceptions to requirements of ~~this~~ section (8.3.6 of spec. C-211) (i.e. suspension which ambient temperature 32°F and falling). Document if heating, cover inside building or other means of projection are used.

15. Determine compatibility of rapid moisture determination methods with results obtained using ASTM D 2216. If required.

16. Select and approve compaction equipment based on demonstrated ability.

17. Provide information to project engineering regarding proposed compaction equipment and locations if other than hand held equipment is used within 3 feet of structure walls. Use TWX ~~of~~ FAX, but

4

18. Verify that equipment is capable of obtaining the same acceptable compaction effort achieved in the test pad area.

Verification to include:

- number of passes
- speed
- RPM
- overlap/pass
- lift thickness

TRAVEL

MEASURED VISUAL?

Document if applicable to equipment used.

19. Visually inspect and approve material to be used from stockpile. ~~Direct~~ any exceptions to the specified daily inspection and testing requirement.

PROVIDE DIRECTION AND DOCUMENT

20. Determine all density test locations.

21. Review and approve each test report. Review and initial all acceptable test report sheets from U. S. Testing and document on field engineering reports the ~~samples~~ reviewed.

TEST REPORTS

22. DETERMINE THE NECESSITY FOR BENCHING INTO PREVIOUSLY COMPACTED AREAS PER SECTION 8.3.4 OF SPEC. C-211.

IF HE DOES WHAT THIS PROCEDURE SAYS THE MAN WILL SPEND 70% TO 80% OF HIS TIME DEVELOPING THE REPORTS, NOT WATCHING THE WORK.

S 50329

Bechtel Power Corporation

Inter-office Memorandum

To L.H. Curtis

Date June 16, 1980

Subject Jcb 7220 Midland Project
Utility Monitoring After Diesel
Generator Surcharge Removal
BCBE-3032

From L.E. Davis

Of Construction

At Midland, Mi.

Copies to

C. McConnell
R. Rixford

Reference: I.O.M. from Rixford to Boos dated April 22, 1980

Attached for your information are the results of the utility monitoring after surcharge removal. These measurements were taken in accordance with the requirements of Drawing 7220-C-1040. All utilities, except the condensate lines, were monitored for movement after surcharge removal.

The condensate lines were not measured after surcharge removal because they were cut, prior to surcharging, and allowed to settle with the Diesel Generator Building. After the surcharge was removed, new pieces of pipe were fabricated and installed to compensate for the movements.

These submittals complete the action items required of the field based on Drawing 7220-C-1040.

for L.E. Davis

LED/JWW/jrm

Attachment

S:500236

JUN 18 1980

7/2/80

6/30

JOB 7220

	ACT	INFO	COPY	INT
PROJ ENGR				
ASST PE 1				
ASST PE 2				
ASST PE LAB				
ASST PE PMC				
ASST PE REG				
LIC & SAFETY				
MECH				
NUC SYSTEMS				
PLANT DES			✓	
ELECT			✓	
CIVIL SYS				
CABL/STRUCT			✓	
ARCH				
QE				
CTR/SHOP PL				
ENGNG MGR				
PROJ MGR				
PROC MGR				
FIELD				
CONST COORD				
ADMIN				✓

BECHTEL

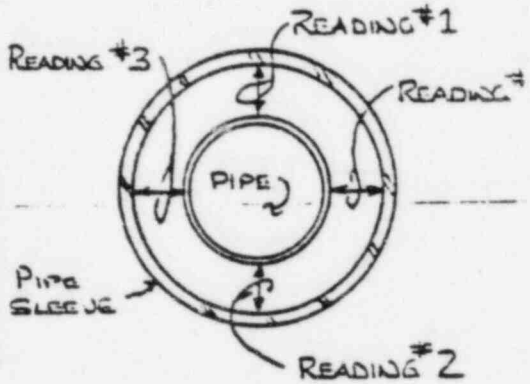
DESIGN BY Gina Wasylewski DATE 5-2-80 CHECKED BY _____ DATE _____ SHEET NO. _____

PROJECT DIESEL GENERATOR SURCHARGE MEASUREMENTS JOB NO. _____

SUBJECT PIPE PENETRATIONS AFTE SURCHARGE CALCULATION NO. _____ FILE NO. _____

WALL PENETRATIONS

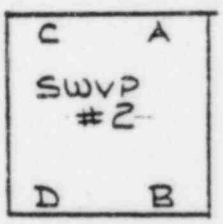
DATE	PEN. NUMBERS - SEE DWG M-162 SH. 1 FOR LOCATIONS			
PEN#	READING #1	READING #2	READING #3	READING #4
1	1¼"	1½"	1¾"	1¼" E
2	1¼"	1½"	1¾"	1¼" E
5	2¾"	¼"	1¾"	1¼" S
6	2⅛"	⅞"	1⅜"	1⅝" S
8	2⅜"	⅝"	1½"	1½" W
9	2¼"	¾"	1¾"	1¼" W
11	2¼"	¾"	1⅝"	1⅜" W
12	2"	1"	1⅝"	1⅜" W
13	PENETRATION ABANDONED			
14	PENETRATION ABANDONED			
29	—	—	—	—
32	2¼"	3¼"	3¼"	1½" E
33	—	—	—	—
34	—	—	—	—
38	—	—	—	—
41	—	—	—	—
31	—	—	—	—
	SERVICE WATER VALVE PIT #2			
A	PIPE BLOCKED IN SLEEVE			
B	1¾"	2¼"	1"	3" W
C	1"	3"	⅞"	3⅛" E
D	1¾"	2¼"	1⅞"	2⅛" W
	SERVICE WATER VALVE PIT #1			
A	2¾"	1¼"	2"	2" E
B	3"	1"	2⅛"	1⅞" W
C	2¼"	1¾"	2¾"	1¼ E
D	2⅝"	1⅜"	1⅞"	2⅛" W



PLAN

3"Ø THRU 4"Ø

TEMPORARY PIPE
3"Ø THRU 4"Ø
3"Ø THRU 4"Ø
TEMPORARY PIPE
3"Ø THRU 4"Ø



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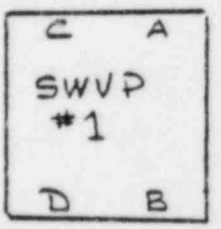

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FIELD ENGINEER'S REPORT FORM

MIDLAND UNITS 1 & 2

JOB 7220 DATE 5-5-80 PAGE 1 OF 1

ITEM NO.	INSPECTION DESCRIPTION	ACTION REQUIRED/TAKEN
	DIESEL GENERATOR BLDG. ACTIVITIES AFTER SURCHARGE REMOVAL	
	IN ACCORDANCE WITH THE GENERAL NOTES ON DRAWING C-1040 A VISUAL EXAMINATION FOR RELATIVE MOVEMENTS OF THE DUCTBANKS, WAS PERFORMED. THE CONDUITS WERE INSPECTED FROM INSIDE THE TURBINE BLDG. AND SERVICE WATER VALVE PITS. THERE WERE NO SIGNS OF CRACKING OR SHEARING, OF THE CONDUITS, AT THE DUCTBANK-EXTERIOR WALL INTERFACE.	NO SIGNS OF SHEARING OR CRACKING WERE FOUND. THEREFORE, NO FURTHER ACTION IS REQUIRED AT THIS TIME.
	THE FOLLOWING DUCTBANKS WERE INSPECTED:	
	1) DUCTBANK UNDER EAST FOOTING OF D/G BLDG FROM TURBINE BLDG. TO METER PIT #2.	
	2) DUCTBANK AT SERVICE WATER VALVE PIT #2.	
	3) DUCTBANK AT SERVICE WATER VALVE PIT #1.	
	4) DUCT BANK FROM TURBINE BLDG. INTO WESTERNMOST BAY OF D/G BLDG.	

REMARKS: REF DWG. E-502 & E-531 FOR LOCATIONS

S:500238

Jim Waskowski
SIGNATURE

ROUTE
JIM BETTS
AL BOOS

FILE Jim Waskowski

FIEL ` ENGINEER'S REPOF ` FORM

MIDLAND UNITS 1 & 2

JOB 7220 DATE 5-5-80 PAGE 1 OF 1

ITEM NO.	INSPECTION DESCRIPTION	ACTION REQUIRED/TAKEN
	DIESEL GENERATOR BLDG ACTIVITIES AFTER SURCHARGE REMOVAL.	
	THE CONDENSATE WATER LINES, THAT PENETRATE Q LINE WALL OF THE TURBINE BLDG, WERE CUT LOOSE PRIOR TO SURCHARGE LOADING AND WERE RECENTERED IN THE PENETRATIONS AFTER REMOVAL OF SURCHARGE. THEREFORE, NO MEASUREMENTS ON THE LINES WILL BE TAKEN.	

REMARKS:

S:500239

ROUTE

JIM BETTS
AL BOOS

SIGNATURE

FILE WASYLEWSKI

FIELD ENGINEER'S REPORT FORM

MIDLAND UNITS 1 & 2

JOB 7220 DATE 10 JUN 80 PAGE 1 OF 1

ITEM NO.	INSPECTION DESCRIPTION	ACTION REQUIRED/TAKEN
(1)	THE FOLLOWING CONDUITS WERE INSPECTED IN ACCORDANCE WITH DWG C-1040(Q) REV 4 "ELECTRICAL DUCT-BANK REQUIREMENTS" (ITEM C.)	

1AA047	1NA298	1NA038	2NA003
2AA051	1AA045	1NA039	2NA004
1BA070	1NA299	1NA040	2NA006
1BA072	1NA300	1NA041	2NA007
2NA260	2BA069	1NA042	2NA008
2NA261	2NA512	1NA043	2NA009
2NA262	2NA402	1NA044	2NA252
2NA263	2NA293	1NA109	2NA253
1NA295	1NA035	1NA111	2NA254
1NA296	1NA036	2NA001	2NA255
1NA297	1NA037	2NA002	

EACH CONDUIT WAS INSPECTED BY PULLING A SEGMENTED HARD FIBER COMPOSITION RABBIT. NO SIGNIFICANT OBSTRUCTIONS OR DISCONTINUITIES WERE ENCOUNTERED IN THESE CONDUITS. THIS REPORT, IN CONJUNCTION WITH PREVIOUS FER DATED 14MAY80, COMPLETES THE REQUIRES AS OUTLINED BY DWG C1040.

REMARKS:

S:500240

SIGNATURE

ROUTE

BJ COLLIN
B MATTHEWS
W NIELSON
J BETTS

FILE DIESEL GENERATOR

FIELD ENGINEER'S REPORT FORM

MIDLAND UNITS 1 & 2

JOB 7220 DATE 14MAY80 PAGE 1 OF 2

ITEM NO.	INSPECTION DESCRIPTION	ACTION REQUIRED/TAKEN
1	PURSUANT TO NRC QUESTIONS NRC-10CFR50.54(f) QUESTION #7 - REGARDING ELECTRICAL DUCT BANKS PASSING THROUGH FOOTINGS OF THE DIESEL GENERATOR BUILDING, THE FOLLOWING CONDUITS WERE INSPECTED:	

1BA034	1AA006	2AA016	2BA005
35	33	09	04
31	07	17	14
32	10	39	08
33	14	38	34
36	34	08	33
26	15	07	15
27	35	06	07
25	08	15	16
28	09	10	36
29	16	41	35
30	36	40	06

REMARKS:

S:500241

SIGNATURE

ROUTE

B KOLLN
B MATTHEWS
W NIELSON
J BETTS

FILE DIESEL GENER

FIELD ENGINEER'S REPORT FORM

MIDLAND UNITS 1 & 2

JOB 7220 DATE 14MAY80 PAGE 2 OF 2

ITEM NO.	INSPECTION DESCRIPTION	ACTION REQUIRED/TAKEN
	EACH CONDUIT WAS INSPECTED BY PULLING A SEGMENTED, HARD FIBER COMPOSITION BABBIT. NO SIGNIFICANT OBSTRUCTIONS OR DISCONTINUITIES WERE ENCOUNTERED.	

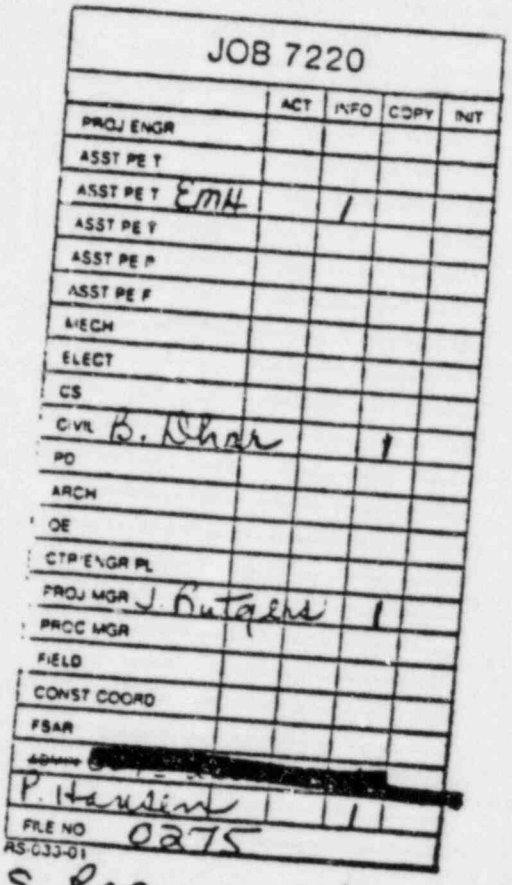
REMARKS:

S:500242

SIGNATURE

ROUTE

FILE



MESSAGE #1087
RX TWX:*
BECHTEL ARB

6095 MIDLAND, MI MAY 20, 1980 TIME: 9:15A.M.
TWX: 810-223-6032
ATTENTION: L.H. CURTIS

SUBJECT: JOB 7220 MIDLAND PROJECT
Q-LISTED BACKFILL
BCBE-2982R(Q) ✓

REFERENCES: 1) C/PCO NCR M-01-9-0-038 DATED 5-15-80.

THE PLACEMENT AND COMPACTION OF Q-LISTED BACKFILL IS CURRENTLY ON HOLD IN SEVERAL AREAS DUE TO THE REFERENCED NCR ON THE QUALIFICATION OF COMPACTION EQUIPMENT. IN PARTICULAR THE USE OF THE POGO STICK IS MANDATORY IN TIGHT AREAS AND THE NCR IS PREVENTING ITS USE.

PLEASE EXPEDITE THE DISPOSITION OF THE REFERENCED NCR SO AS NOT TO FURTHER HOLD UP CONSTRUCTION.

L.E. DAVIS
BECHTEL MIDL
LED/JPB/SLM

CC: J. RUTGERS ✓
P. HANSEN ✓
B. DHAR ✓
S. RAO ✓
P. CORCORAN

8500243

BECHTEL ARB
Time 200915 Disconnect
Connect 116 Secs Listed 09:45 ??? 05/20/80

RECEIVED
JAN 16 1980
BECHTEL
A.A. 7220

Bechtel Power Corporation

Interoffice Memorandum

JOB 7220				
	ACT	INFO	COPY	INIT
PROJ ENGR				
ASST PE G				
ASST PE T				
ASST PE T				
ASST PE P				
ASST PE E				
MECH				
ELECT				
CS				
CIVIL	✓	✓	✓	
PD				
ARCH				
QE				
CONSTR MGR PL				
PROJ MGR				
PROC MGR Ext				
FIELD				
CONST COORD				
FSAR				
ADMIN				
FILE NO	0275			
ASSIGN				

To L. H. Curtis

File No

Subject Job 7220 Midland Project
Subcontract 7220-FSC-318
Geotech Work for Subcontractor
BCBE-2711

Date January 14, 1980

From L. E. Davis

Of Construction

Copies to J. Wanzeck
A. Boos
J. Betts
M. Peterson

At Midland, MI

It has come to our attention that the Geotechnical Services Group may require the installation of nine more Borros Anchors in the tank farm; two or three additional soil sample borings; and deeper borings at PD-14 and PD-24. We wish to inform you that approximately one and one-half (1 1/2) weeks of work will complete all presently authorized boring work performed by our Subcontractor, Raymond International.

It is our intention, once all authorized work is complete, to demobilize the Subcontractor's drill rigs and close out his subcontract. It can cost up to $2,000 per drill rig to remobilize. Please insure that all additional Geotechnical work, which is to be authorized by your office, is transmitted to the field by January 23, 1980 in order to avoid remobilization charges.

L. E. Davis

LED/JWL/MR/rmb

S 500258

Bechtel Power Corporation

Interoffice Memorandum

To L. H. Curtis

File No

Subject Job 7220 Midland Project
Subcontract 7220-C-208
Soils Testing
Specification 7220-C-208
BCBE-2660-R

Date December 11, 1979

From L. E. Davis

Of Construction

At Midland, MI Ext

Copies to J. Wanzeck
J. Hook
W. Barclay
H. Adler

Reference: IOM No. BCBE-2591, L. E. Davis to L. H. Curtis, dated October 30, 1979

We have not received a response to our above referenced IOM concerning zero-air-voids testing and related data incorporation into Specification 7220-C-208.

For your information, we enclosed a copy of the referenced IOM No. BCBE-2591 and attachments.

Please furnish a prompt response in order that we may close this open item.

for L. E. Davis

LED/JWL/HA/rmb

Attachment

8500260

RECEIVED
DEC 13 1979
BECHTEL
AA 7220

JOB 7220

	ACT	INFO	COPY	INIT
PROJ ENGR				
ASST PE T		1		
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ELEC'				
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CIVIL		2		
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CTR/ENGR PL				
PROJ MGR				
PROC MGR				
FIELD				
CONST COORD				
FSAR				
ADMIN				

Bechtel Power Corporation

Interoffice Memorandum

To L. H. Curtis

File No

Subject Job 7220 Midland Project
Soils Testing
BCBE-2591

Date October 30, 1979

From L. E. Davis

Of Construction

Copies to J. Wanzeck
J. Hook
B. Barclay
H. Adler

At Midland, MI Ext

Reference: Letter from J. F. Newgen to M. Anselno of U. S. Testing, dated June 26, 1979.

At the request of Project Engineering, the above referenced letter was written to U. S. Testing instructing them to check all field density tests for cohesive material against a zero-air-voids curve.

The attached letter from U. S. Testing requests that this check be incorporated in Specification C-208 along with the frequency required.

Please make the necessary changes to Specification C-208 as soon as possible.

L. E. Davis

LED/JPB/mkm

Attachments

8500261

OCT 2 9 1979

Bechtel Power Corporation

Post Office Box 2167
Midland, Michigan 48640

October 29, 1979

U. S. Testing Co., Inc.
1415 Park Avenue
Hoboken, NJ 07030

Attention: Mike Anselmo

Job 7220 Midland Project
Subcontract 7220-C-208
Zero-Air-Voids Testing
C-208-B-431

Dear Mr. Anselmo:

Reference: U. S. Testing letter, File No. UST-C-208-206, dated July 3, 1979

This letter is in response to your above referenced letter. Your question concerning whether we require zero-air-voids comparison for granular as well as cohesive soils in order to determine your mode of data presentation has been referred to Engineering for decision. We will advise you upon our receipt of the Engineering response.

Also, your request that the method used in generating data be identified in Specification 7220-C-208, Section 4.0, and that the frequency of the zero-air-voids comparison should be identified in Specification 7220-C-208, Section 9.1, has been transmitted to Engineering for action.

Very truly yours,

for L. E. Davis
Site Manager

LED/JWL/HA/rmb

cc: John Speltz

S:500262

cc: J. Speltz

Post Office Box 7
Midland, Michigan 48640
June 26, 1979

U.S. Testing
1415 Park Ave.
Hoboken, New Jersey 07030

Attention: Mike Anselno

Job 7220 Midland Project
Subcontract No. 7220-C-208
Soils Testing
C-208-2-(0)

Dear Mr. Anselno;

To confirm earlier conversations with your on-site laboratory chief, you are hereby directed to check all field density tests against a zero-air-voids curve, using an assumed specific gravity of 2.65. A suggested method is:

Plot a zero-air-voids curve on the same graph as used for ASTM D1557 reporting.
Plot the field density test result on the graph.
Any field test result which plots on, or to the right of the zero-air-voids curve shall be regarded as suspect and cause for retest. Report all such field tests immediately to Quality Control.

Please implement the above immediately.

If there are any questions concerning this direction contact W. L. Barclay at the Midland jobsite.

Very truly yours,

J. F. Newgen
Project Superintendent
Bechtel Power Corporation
Agents for Consumers Power Co.

JFN/WLB/vmm

S 500263

States Testing Company, Inc.
ver Generation Services Division
ARK AVENUE
KEN, NEW JERSEY 07030 (201) 792-2400 (212) 943-0488

concrete testing
on-site inspection
nondestructive testing
environmental evaluatic
training programs

File No: UST C-208-205
July 3, 1979

RECEIVED
JUL 6 1979
BECHTEL POWER CORP.
JOB 7220
FILE C-208

Bechtel Power Corporation
Post Office Box 2167
Midland, Michigan 48640

Attention: Mr. J.F. Newgen

Re: Midland Project Soils Testing
Bechtel Letter C-208-2-(0)

Dear Mr. Newgen:

Your referenced correspondence of June 26, 1979 is acknowledged and will be implemented.

2 Please clarify if you require zero-air-voids comparisons for granular as well as cohesive soils as this will have to be considered in determining the mode of data presentation.

3 Our approved Quality Assurance Manual requires that the methods used in generating data be identified in section 4.0 of Project Specification 7220-C-208. Please add the following to that section:

USBR DES. E-11 Paragraph 7, Zero-Air-Voids Curve

4 The frequency of the zero-air-voids comparisons should be identified in section 9.1 of specification 7220-C-208.

5 Your response will facilitate the required implementation.

Very truly yours,

UNITED STATES TESTING CO., INC.

John Speltz
Project Supervisor

JS/bv

S-500264

32

RECEIVED
DEC 14 1979
BECHTEL
AA 7220

Bechtel Power Corporation

Interoffice Memorandum

To L. H. Curtis

File No

Subject Job 7220 Midland Project
Subcontract 7220-C-208
Specification 7220-C-211 (Q),
Revision 7, Section 8.0,
Paragraph 8.1.1
BCBE-2659-R

Date

From L. E. Davis

Of Construction

At Midland, MI Ext

Copies to

On November 9, 1979, on IOM BCBE-2621-R, we transmitted a request for criteria information concerning the above subject specification. Copies of pertinent documents were attached to the IOM.

To date, we have not received a response from your office.

For your information, we forward a copy of IOM BCBE-2621-R with its attachments.

We request a prompt response to this matter.

L. E. Davis

LED/JWL/HA/rmb

Attachment

JOB 7220

	ACT	INFO	COPY	INIT
PROJ ENGR				
ASST PE T		/		
ASST PE T				
ASST PE T				
ASST PE P				
ASST PE F				
MECH				
ELECT				
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CIVIL	✓		✓	
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CTR ENGR PL				
PROJ MGR				
PROC MGR				
FIELD				
CONST COORD				
FSAR				
ADMIN				
FILE NO				

AB-033-81

S;500265

NOV 9 1979

Bechtel Power Corporation

Interoffice Memorandum

To L. H. Curtis

File No.

Subject Job 7220 Midland Project
Subcontract 7220-C-211 (Q), Rev. 7
Section 8.0, Paragraph 8.1.1
BCSE-2621-R

Date November 9, 1979

From L. E. Davis

Of Construction

Copies to

At Midland, MI. Ext.

On July 17, 1979, on U. S. Testing Company letter, UST Co. C-208-209/1015.130, the Subcontractor raised a question in reference to the gradation of materials.

Our letter, C-208-B-411, dated September 28, 1979, advised that Bechtel Geotech would provide the required criteria.

Subsequently, the attached U. S. Testing letter of October 25, 1979 advised that Bechtel Geotech has not provided the required information.

Please provide the required criteria so that we may transmit to U. S. Testing.

Copies of the three discussed letters are attached.

L. E. Davis

LED/JWL/HA/rmb

Attachments

8500266

United States Testing Company, Inc.

1415 PARK AVENUE
HOBOKEN, NEW JERSEY 07030 (201) 792-2400 (212) 943-0188

program audits
vendor surveillance
concrete testing
on-site inspection
construction
environmental evaluation
training programs

File: UST Co. C-208-229/1015.300
October 25, 1979

Bechtel Power Corporation
Post Office Box 2167
Midland, Michigan 48640

Attention: Mr. L. Davis

Subject: Midland Project Job 7220
Subcontract 7220-C-208
Clarifications to Specification
7220-C-211 (Q) Revision 7

Dear Mr. Davis:

Reference: Letter Bechtel Power Corporation
C-208-B-411 - September 28, 1979

Letter U. S. Testing Company
C-208-229/1015.130 - July 17, 1979

Please be advised that item No. 1 of the above referenced Bechtel letter is not being practiced on the job site. U. S. Testing field personnel attempts at acquiring the proper criteria to be used for determining skip grading requirements have failed. Your action, requiring the Geotech Engineer to provide U. S. Testing with this information, would be appreciated.

Very truly yours,

UNITED STATES TESTING COMPANY, INC.

M. Anselmo
Project Engineer

MA:hg

cc: Mr. J. Lillywhite
Mr. J. Speltz

8500267

OUR LETTERS AND REPORTS ARE FOR THE EXCLUSIVE USE OF THE CLIENT TO WHOM THEY ARE ADDRESSED AND THEY AND THE NAME OF THE UNITED STATES TESTING COMPANY, INC. OR ITS SEALS OR INSIGNIA ARE NOT TO BE USED UNDER ANY CIRCUMSTANCES IN ADVERTISING TO THE GENERAL PUBLIC AND MAY NOT BE USED IN ANY OTHER MANNER WITHOUT OUR PRIOR WRITTEN APPROVAL. SAMPLES NOT DESTROYED IN TESTING ARE RETAINED A MAXIMUM OF THIRTY DAYS

Bechtel Power Corporation

Post Office Box 2167
Midland, Michigan 48640

September 28, 1979

U. S. Testing Co., Inc.
1415 Park Avenue
Hoboken, NJ 07030

Attention: M. Anselmo

Job 7220 Midland Project
Subcontract 7220-C-208
Clarifications to Specification
7220-C-211 (Q) Revision 7
C-208-B-411

Dear Mr. Anselmo:

Reference: Letter U. S. Testing Company C-208-209/1015.130 July 17, 1979

This letter is written to provide clarification to your questions raised in your letter C-208-209/1015.130 of July 17, 1979.

1) Section 8.0, Paragraph 8.1, Article 8.1.1 - Geotech Engineer will provide criteria to be used for determining skip grading requirements for structural backfill and receiving gradations.

2) Section 8.0, Paragraph 8.7, Article 8.7.1 - Geotech Engineer will provide a technician who will supply the acceptable technical compaction criteria applicable at the time of testing.

3) Section 8.0, Paragraph 8.8, Article 8.8.2 - A REM has been written to clarify that the visual inspection will be of a representative sample having physical characteristics of the load being examined.

Please confirm that these interpretations are in practice with your personnel.

Very truly yours,

for J. F. Newgen
Site Manager

JFN/JWL/DLP/br

cc: J. Speltz

S:500268

United States Testing Company, Inc.
Power Generation Division
1415 PARK AVENUE
HOBOKEN, NEW JERSEY 07030 (201) 792-2400 (212) 943-0488

File: UST Co. C-208-209/1015.130
July 17, 1979

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

Attention: Mr. Joel F. Newgen

Re: Midland Project Job 7220
Subcontract 7220-C-208
Subcontract Change Notice 104F

550(I) C-208

Dear Mr. Newgen:

In reference to the subject Change Notice, U. S. Testing will take exception to Specification 7220-C-211 (Q), Revision 7, until clarification is given to the following:

Section 8.0, Paragraph 8.1, Article 8.1.1 states that gradations of materials used for structural backfill within 3 feet of exterior walls shall not be skip graded. U. S. T. was not issued the criteria to be used for determining skip grading, therefore, we assume that Bechtel Project Engineering is responsible for reviewing gradations for skip grading.

Section 8.0, Paragraph 8.7, Article 8.7.1 requires 85% R.D. for Cohesionless materials used under structures and 80% R.D. in other areas. U. S. T. is not responsible for knowing the exact location of all the structures on site, therefore, we assume that Bechtel Engineering will continue to be responsible for providing U. S. Testing with the applicable acceptance criteria at the time of testing.

Section 8.0, Paragraph 8.8, Article 8.8.2 states that "material delivered to the jobsite...from offsite sources shall be visually inspected..." Since the receipt of this specification by our onsite laboratory, the inspections have been made in the form of general observations of the physical characteristics of the soil at the time of sampling. However, if a more in-depth inspection is required, please define the specific criteria we are to employ as this was always a Bechtel Q. C. function and not U. S. Testing's.

S 500269

Route Copy

OUR LETTERS AND REPORTS ARE FOR THE EXCLUSIVE USE OF THE CLIENT TO WHOM THEY ARE ADDRESSED AND THEY AND THE NAME OF THE UNITED STATES TESTING COMPANY, INC. OR ITS SEALS OR INSIGNIA ARE NOT TO BE USED UNDER ANY CIRCUMSTANCES IN ADVERTISING TO THE GENERAL PUBLIC AND MAY NOT BE USED IN ANY OTHER MANNER WITHOUT OUR PRIOR WRITTEN APPROVAL. SAMPLES NOT DESTROYED IN TESTING ARE RETAINED A MAXIMUM OF THIRTY DAYS

Bechtel Power Corporation
Attention: Mr. Joel F. Newgen
Page 2 of 2

July 17, 1979

If you have any questions, please contact me at your earliest convenience.

Very truly yours,

UNITED STATES TESTING COMPANY, INC.

M. Anselmo
Project Engineer

MA:hg
enc.

cc: Mr. J. Lillywhite
Mr. J. Speltz

S 500270

BECHTEL

'04 F

OWNER Consumers Power Company — BECHTEL POWER CORPORATION

SUBCONTRACT NO. 7220-C-208 — JOB NO 7220

TO: U. S. Testing Co. Inc.
1415 Park Avenue
Hoboken NJ 07030

BECHTEL LETTER SERIAL = 7220-C-208-B-388

DATE July 6, 1979

PAGE 1 OF 1

THIS CHANGE NOTICE IS FORWARDED FOR YOUR SIGNATURE. PLEASE COMPLETE THIS FORM AS REQUIRED AND RETURN THE ORIGINAL TO THIS OFFICE. A COPY HAS BEEN INCLUDED FOR YOUR FILES.

DESCRIPTION OF CHANGE:

ansmitted herewith for your files and to be incorporated in Exhibit "E", Drawing
st of your Subcontract, are copies of the following documents as listed below or on
e attached sheet(s).

ditional copies, if noted, have been hand-carried to your Jobsite Superintendent.

u are responsible for updating your files and construction sticks. Please sign
d return this Change Notice within ten (10) days.

Technical Specification 7220-C-211(Q) Revision 7

U. S. TESTING CO.
JUL 11 1979
NUC. CONSTR. INSP.

- ☒ PROCEED WITH WORK
- ☒ NO CHANGE IN PRICE AUTHORIZED
- ☒ PROPOSAL NOT REQUIRED
- ☒ DRAWINGS/DATA ATTACHED
- ☐ NOTICE TO PROCEED REQUIRED
- ☒ NO EXTENSION OF TIME AUTHORIZED
- ☐ SUBMIT PROPOSAL WITHIN _____ DAYS
- ☐ _____

W. Ross Fowler, Lilly White 7/6/79
FIELD CONTRACTS ADMINISTRATOR — DATE

For FIELD CONSTRUCTION MANAGER — 6 July 79 DATE

TO: BECHTEL POWER CORPORATION — SUBCONTRACTOR LETTER SERIAL # _____

- ☐ ACKNOWLEDGE AND ACCEPT THIS CHANGE NOTICE AS SPECIFIED.
- ☒ ACKNOWLEDGE AND ACCEPT WITH THE EXCEPTION OF THE FOLLOWING.

S 500271

SEE ATTACHED LETTER

- ☒ ARE
- ☐ ARE NOT

PROCEEDING WITH THIS CHANGE NOTICE.

A PROPOSAL

- ☐ HAS BEEN
- ☐ WILL BE
- ☒ WILL NOT BE

SUBMITTED.

Robert S. Rashid — SIGNATURE
7/16/79 — DATE
United States Testing Co. — COMPANY

10 (Rev. 7-77)

RECEIVED
NOV 13 1979
BECHTEL
A.A. 7220

Bechtel Power Corporation

Interoffice Memorandum

To L. H. Curtis

File No.

Subject Job 7220 Midland Project
Subcontract 7220-C-211 (Q), Rev. 7
Section 8.0, Paragraph 8.1.1
BCBE-2621-R

Date November 9, 1979

From L. E. Davis

Of Construction

Copies to

At Midland, MI. Ext.

On July 17, 1979, on U. S. Testing Company letter, UST Co. C-208-209/1015.130, the Subcontractor raised a question in reference to the gradation of materials.

Our letter, C-208-B-411, dated September 28, 1979, advised that Bechtel Geotech would provide the required criteria.

Subsequently, the attached U. S. Testing letter of October 25, 1979 advised that Bechtel Geotech has not provided the required information.

Please provide the required criteria so that we may transmit to U. S. Testing.

Copies of the three discussed letters are attached.

L. E. Davis

LED/JWL/HA/rmb

Attachments

S:500272

JOB 7220

	ACT.	INFO.	COPY	INIT.
PROJ. ENGR.				
ASST. P. E. T		/		MOB
ASST. P. E. T				
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ASST. P. E. P				
MECH.				
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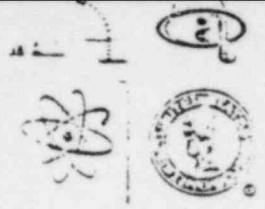
CIVIL	✓		✓	
P.D.		✓		11/16
ARCH.				
Q.E.				
C.TRENCH PL.				
PROJ. MGR.				
PROC. MGR.				
FIELD				
CONST. COORD.				
FSAR				
ADMIN.				
Geotech		JXC		11/16
FILE NO.				

United States Testing Company, Inc.

1415 PARK AVENUE
HOBOKEN, NEW JERSEY 07030 (201) 792-2400 (212) 943-0185



program audits
vendor surveillance
concrete testing
on-site inspection
nondestructive testing
environmental [illegible]
training programs

File: UST Co. C-208-229/1015.300
October 25, 1979

Bechtel Power Corporation
Post Office Box 2167
Midland, Michigan 48640

Attention: Mr. L. Davis

Subject: Midland Project Job 7220
Subcontract 7220-C-208
Clarifications to Specification
7220-C-211 (Q) Revision 7

Dear Mr. Davis:

Reference: Letter Bechtel Power Corporation
C-208-8-411 - September 28, 1979

Letter U. S. Testing Company
C-208-209/1015.130 - July 17, 1979

Please be advised that item No. 1 of the above referenced Bechtel letter is not being practiced on the job site. U. S. Testing field personnel attempts at acquiring the proper criteria to be used for determining skip grading requirements have failed. Your action, requiring the Geotech Engineer to provide U. S. Testing with this information, would be appreciated.

Very truly yours,

UNITED STATES TESTING COMPANY, INC.

M. Anselmo
Project Engineer

MA:hg

cc: Mr. J. Lillywhite
Mr. J. Speltz

S 8500273

OUR LETTERS AND REPORTS ARE FOR THE EXCLUSIVE USE OF THE CLIENT TO WHOM THEY ARE ADDRESSED AND THEY AND THE NAME OF THE UNITED STATES TESTING COMPANY, INC. OR ITS SEALS OR INSIGNIA ARE NOT TO BE USED UNDER ANY CIRCUMSTANCES IN ADVERTISING TO THE GENERAL PUBLIC AND MAY NOT BE USED IN ANY OTHER MANNER WITHOUT OUR PRIOR WRITTEN APPROVAL. SAMPLES NOT DESTROYED IN TESTING ARE RETAINED A MAXIMUM OF THIRTY DAYS.

Post Office Box 2167
Midland, Michigan 48640

September 28, 1979

U. S. Testing Co., Inc.
1415 Park Avenue
Hoboken, NJ 07030

Attention: M. Anselmo

Job 7220 Midland Project
Subcontract 7220-C-208
Clarifications to Specification
7220-C-211 (Q) Revision 7
C-208-B-411

Dear Mr. Anselmo:

Reference: Letter U. S. Testing Company C-208-209/1015.130 July 17, 1979

This letter is written to provide clarification to your questions raised in your letter C-208-209/1015.130 of July 17, 1979.

1) Section 8.0, Paragraph 8.1, Article 8.1.1 - Geotech Engineer will provide criteria to be used for determining skip grading requirements for structural backfill and receiving gradations.

2) Section 8.0, Paragraph 8.7, Article 8.7.1 - Geotech Engineer will provide a technician who will supply the acceptable technical compaction criteria applicable at the time of testing.

3) Section 8.0, Paragraph 8.8, Article 8.8.2 - A REM has been written to clarify that the visual inspection will be of a representative sample having physical characteristics of the load being examined.

Please confirm that these interpretations are in practice with your personnel.

Very truly yours,

for J. F. Newgen
Site Manager

JFN/JWL/DLP/br

cc: J. Speltz

S:500274

United States Testing Company, Inc.
Power Gen[illegible]
1415 PARK AVENUE
HOBOKEN, NEW JERSEY 07030 (201) 792-2400 (212) 943-0498

File: UST Co. C-208-209/1015.130
July 17, 1979

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

Attention: Mr. Joel F. Newgen

Re: Midland Project Job 7220
Subcontract 7220-C-208
Subcontract Change Notice 104F

550(I) C-208

Dear Mr. Newgen:

In reference to the subject Change Notice, U. S. Testing will take exception to Specification 7220-C-211 (Q), Revision 7, until clarification is given to the following:

Section 8.0, Paragraph 8.1, Article 8.1.1 states that gradations of materials used for structural backfill within 3 feet of exterior walls shall not be skip graded. U. S. T. was not issued the criteria to be used for determining skip grading, therefore, we assume that Bechtel Project Engineering is responsible for reviewing gradations for skip grading.

Section 8.0, Paragraph 8.7, Article 8.7.1 requires 85% R.D. for Cohesionless materials used under structures and 80% R.D. in other areas. U. S. T. is not responsible for knowing the exact location of all the structures on site, therefore, we assume that Bechtel Engineering will continue to be responsible for providing U. S. Testing with the applicable acceptance criteria at the time of testing.

Section 8.0, Paragraph 8.8, Article 8.8.2 states that "material delivered to the jobsite...from offsite sources shall be visually inspected..." Since the receipt of this specification by our onsite laboratory, the inspections have been made in the form of general observations of the physical characteristics of the soil at the time of sampling. However, if a more in-depth inspection is required, please define the specific criteria we are to employ as this was always a Bechtel Q. C. function and not U. S. Testing's.

8500275

Route Copy

OUR LETTERS AND REPORTS ARE FOR THE EXCLUSIVE USE OF THE CLIENT TO WHOM THEY ARE ADDRESSED AND THEY AND THE NAME OF THE UNITED STATES TESTING COMPANY, INC. OR ITS SEALS OR INSIGNIA ARE NOT TO BE USED UNDER ANY CIRCUMSTANCES IN ADVERTISING TO THE GENERAL PUBLIC AND MAY NOT BE USED IN ANY OTHER MANNER WITHOUT OUR PRIOR WRITTEN APPROVAL. SAMPLES NOT DESTROYED IN TESTING ARE RETAINED A MAXIMUM OF THIRTY DAYS

July 17, 1979

If you have any questions, please contact me at your earliest convenience.

Very truly yours,

UNITED STATES TESTING COMPANY, INC.

M. Anselmo
Project Engineer

MA:hg
enc.

cc: Mr. J. Lillywhite
Mr. J. Speltz

S 500276

RECEIVED
FEB 02 '79
BECHTEL
A.A. 7220

Bechtel Power Corporation
Interoffice Memorandum

	ACT.	INFO.	COPY	INIT.
PROJ. ENGR.		2		
ASST. P. E.		3		
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ELECT.				
CIVIL				
P.D.				
PROC. MGR.				
FIELD CONST. COORD.				
FSAR				
ADMIN.				
FILE NO. 0670.2				

TELECOPY

To R. L. Castleberry

Date January 29, 1979

Subject Job 7220 Midland Project
Swiss Hammer Test Results
Required for Disposition of
NCR 1745
BCBE-2157

From J. F. Newgen

Of Construction

At Midland, MI

Copies to

J. Hook
R. Schulman
W. Barclay

Please find below the Swiss Hammer test results for Diesel Generator Slab #2 at elevation 664' (Pour No. DG 664 D), required for disposition of NCR 1745, as verbally requested per Project Engineering via R. Schulman. The following are test rebound values obtained from Soiltest Swiss Hammer #5940 on January 29, 1979 at various test locations as designated on the attached sheet for C-1c concrete (4000 psi @ 28 days) placed at pour DG 664 D on December 28, 1978.

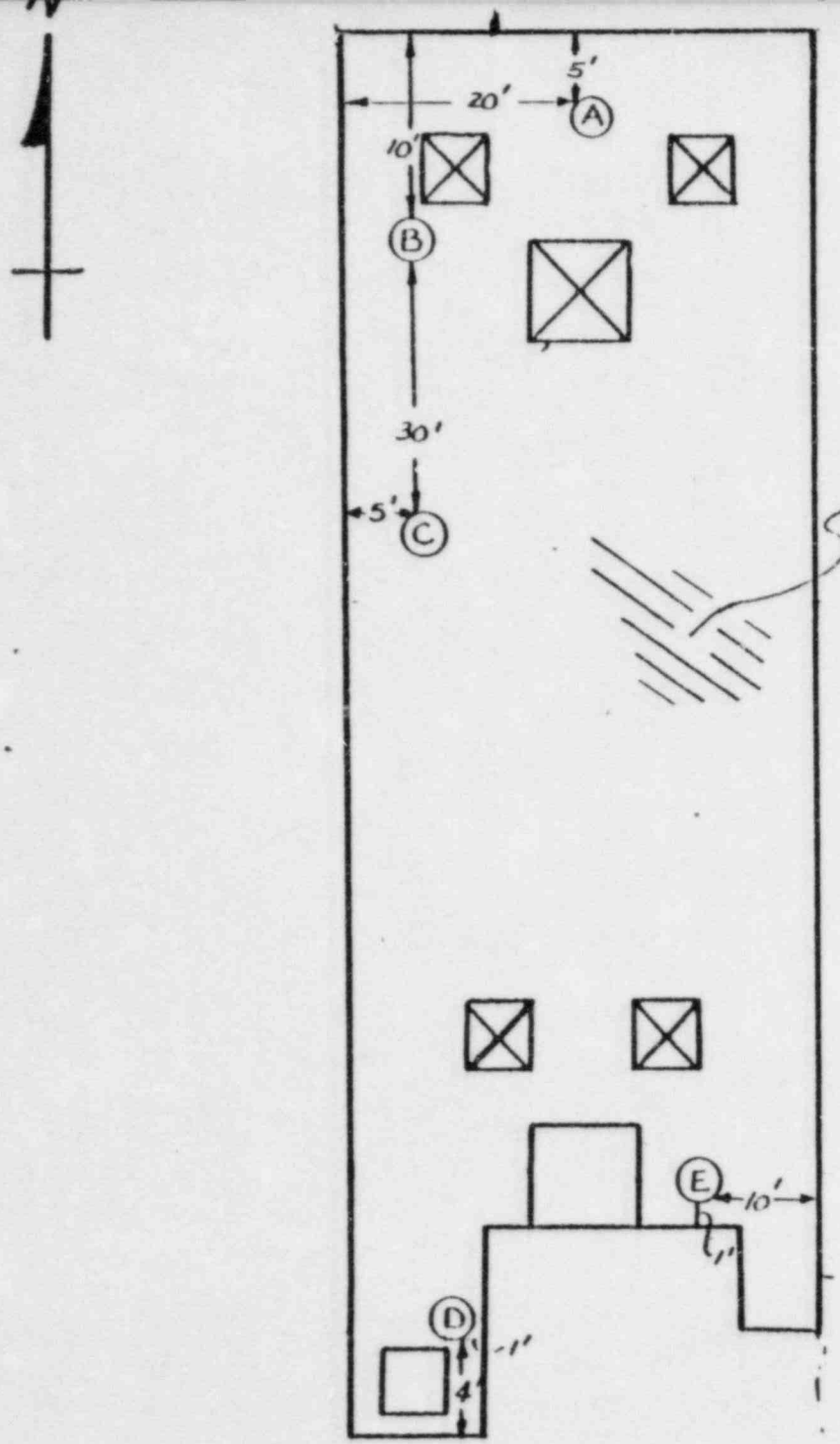
Test Area	Rebound Values	Average Rebound
A	21, 23, 26, 21, 21, 22, 27, 23, 22, 25	23.1
B	19, 20, 26, 21, 21, 28, 25, 34, 28, 25	24.7
C	23, 26, 28, 30, 30, 22, 25, 23, 23, 26	25.6
D	32, 34, 20, 22, 23, 22, 25, 20, 19, 24	23.1
E	25, 25, 23, 25, 25, 30, 28, 25, 27, 28	26.1

J. F. Newgen

JFN/RDK/vmm

Attachment

8505080 [illegible]



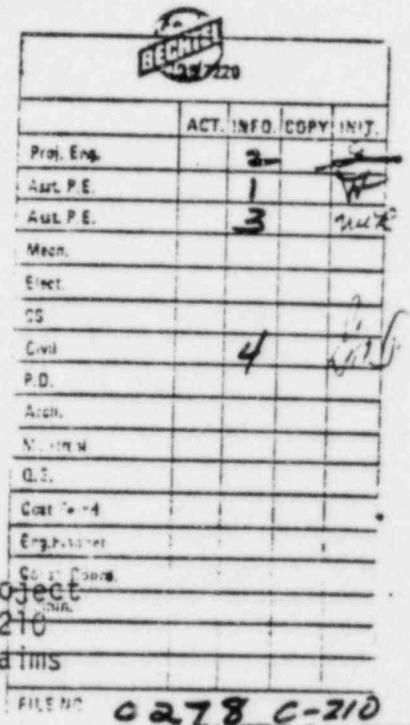
DIESEL GENERATOR
SLAB #2 AT ELEV. 664'

Bechtel Power Corporation

Post Office Box 2167
Midland, Michigan 48640

1C

November 17, 1975



Consumers Power Company
P. O. Box 1963
Midland, Michigan 48640

Attention: T. C. Cooke

Dear Mr. Cooke:

Job 7220 Midland Project
Subcontract 7220-C-210
Proposed Canonie Claims
BCCC 1372

XC 12-5-7

In accordance with the agreements reached at our November 14, 1975 meeting on resolving claims submitted by Canonie Construction Company, we submit the following items for response by Consumers Power Company.

1. Does CPCo wish to take part in a review of Canonie Construction Company bid documents and job pictures at Canonie Construction Company's office in South Haven, Michigan?

2. Does CPCo desire and audit by an outside accounting firm of Canonie Construction Company records in order to confirm the claim of loss by Canonie Construction Company?

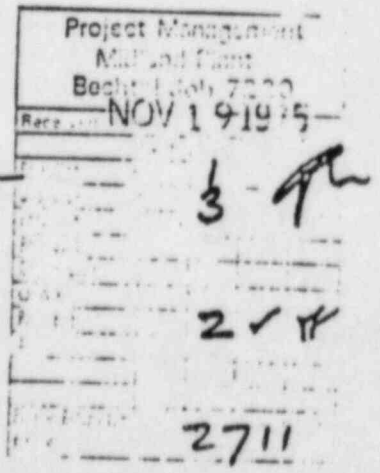
3. For negotiating purposes with Canonie Construction Company, we wish CPCo set a maximum dollar figure as a guideline based upon the parameters as discussed with CPCo to settle subject claims.

We propose to have a response to Canonie Construction Company by November 26, 1975 regarding their claims and the immediate action we intend to take. With this in mind we would appreciate your answer to the above items by November 20, 1975.

Very truly yours,

SB500368

J. F. Newgen



JFN/JCC/kt/af

GENERAL ANALYTICS, INC. GAI Project No. 70-123

March 12, 1970

Notes from Meeting with AEC
Consumers Power Company
Midland Plant, Units 1 and 2
Subsidence Potential
Bechtel Job No. 7220

Representing AEC:

Tom Cardone

Hank Waldron

Dan Muller

Dr. Wilson (University of Michigan)

Representing Consumers Power Company:

Bob Allen, Vice President

Bill Kessler, Project Engineer

Representing Dow Chemical Company:

J. F. Maddock, Project Manager

Ralph Hultin, Section Manager, Wells and Gas Fields

The statements of various individuals are summarized in the following notes:

Waldron - There is not enough data presented on the solution mining to be sure that subsidence will not occur. Among the unknowns are the cavern geometry and the state of stress in the rock above the cavity. With this lack of knowledge, any analyses of subsidence should assume the worst conditions.

Kessler - Are calculations available showing subsidence is a problem?

Waldron - Not convinced that assumptions are correct or that Woodward-Clyde has considered the worst conditions.

Muller - Suggested that the discussion concentrate on a review of the Woodward-Clyde Report.

SC500628

Waldron - The brine wells are not a problem as long as recharge maintains a static head. As for solution mining, he would like different cavity shapes considered. Will a different geometry produce a worse stress condition? Also, consider effect of future salt solution mining in the vicinity of the plant. Would like to see present data for each well.

Hultin - Woodward-Clyde study was based on Young's Modulus and Poissons ratio data obtained in a well two miles from the site. The stratigraphy of the area is very uniform, therefore, the data can be projected. Don Deere, University of Illinois, has discussed both the logging technique and the finite element approach with Dow, and feels it is the best way of evaluating the problem.

Cardone - Are there fracture concentrations in the area?

Hultin - No.

Kessler - Is there any reason to believe there are nonuniform conditions?

Waldron - With solution mining of seven thin beds there is some uncertainty as to the extent of the cavities.

Hultin - Experience with many wells in the area indicates that a cavity is likely to develop as a cylinder more in interbedded salt seams, such as at the site, than in a thick salt bed. The collapse of rock beds between the dissolved salt seams results in blocks dropping to the bottom of the cavity. The Solution Mining Institute has done considerable research but is unable, as yet, to measure the size of cavities.

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Waldron - Concerned with creep in salt below a depth of 3000 feet. What will happen to the solution cavities in the future?

Hultin - Flow in the salt occurs at depths greater than 7500 feet, however, his observations indicate that no flow occurs above this depth. As an example, he indicated Dow knows that in wells extracting salt from small cavities (10,000 tons of salt, 16 cubic feet = 1 ton of salt) at a depth of 4200 feet no flow occurs.

Cardone - Perhaps analyses should be based on multiple cavities due to the possible flow of the salt.

Hultin - Fingering out of dissolved salt beds results in pillars between wells. The 25 foot height of the cavity is conservative. They do not remove more than 10 per cent of the salt in the solution well field. They can also tell if interconnection between wells occurs.

Wilson - The greater the diameter of the opening the more likely there is to be surface movement. Also the greater height of the opening, the more likely the possibility of a break occurring at the ground surface. The Woodward-Clyde report considered two diameters, 630 feet and 1260 feet, both with a seam thickness of 25 feet. Suggested looking at interconnection and realizing it is channeled rather than cylindrical in shape. Would feel more comfortable with a family of cavity shapes being analyzed.

Hultin - Any small amount of extraction, that is, a change of stress at depth, will have some effect on the ground surface.

Cardone - Would like to know how much subsidence could be expected and the type of subsidence. Again asked that the interrelationship of the cavities be looked at.

Wilson - 1200 foot diameter cavity, considered by Woodward-Clyde, probably gives the worst case. Wilson also asked if hydraulic fracturing had been used in developing the solution wells.

Hultin - Some fracturing has been tried in wells in the Midland area but not at the plant. (Check on this) For the finite element analysis the shape of cavity considered has to be symmetrical. Both Dr. Nair (Woodward-Clyde) and Dr. Deere concur on this. (I agree)

Wilson - The Woodward-Clyde report is short of detail. He would like to see more information on the wells and the condition of the rock around the cavity.

Cardone - Did boundary conditions change for the 1200 foot cavity?

Hultin - Has work by Woodward-Clyde summarizing a study being done for the Solution Mining Institute.

Cardone - Would like to see family of cavity shapes analyzed plus consideration of interplay between cavities, especially known interconnections.

Hultin - Raised the question of bulking effect of any caving, and indicated that it is a very significant factor. Wilson agreed. The overburden pressure assuming 1 psi per foot of depth is approximately 4000 psi. The hydrostatic pressure is about 2000 psi, leaving a pressure differential of 2000 psi. Temperature of the salt is about 105° F.

Wilson - Looking at various shapes of cavities should result in taking salt creep into effect. He suggested looking at the creep of salt in salt domes developed for the AEC.

Cardone - The analyses presented are elastic, is the deformation plastic?

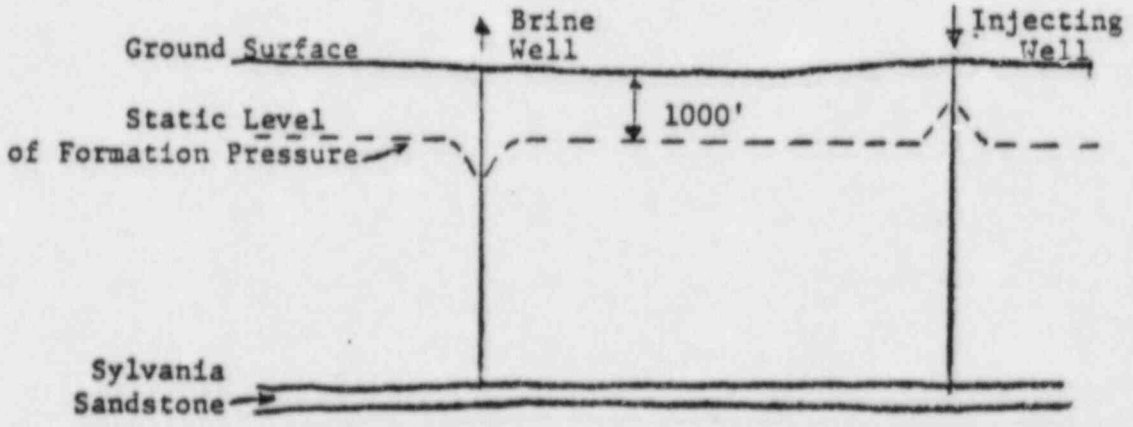
Wilson - The E values from sonic logs are good, however, he would like to

look at the stress about the cavity and the strength of the rock.

Hultin - Although about 60 feet of salt is present, experience indicates only about 25 feet of this thickness is removed.

Cardone - Is there a connection between the brine in the Sylvania Sandstone and the salt?

Hultin - It requires 2000 psi to move the brine in the Sylvania Sandstone. (Clarify this answer) Initially, the formation pressure in the Sylvania Sandstone was at the ground surface, however, pumping has reduced the presure to a level 1000 feet below the ground surface. This level is now held constant by recharging through injection wells.



Cardone - Concerned on the possible effects of the brine wells on subsidence.

Lunch Break

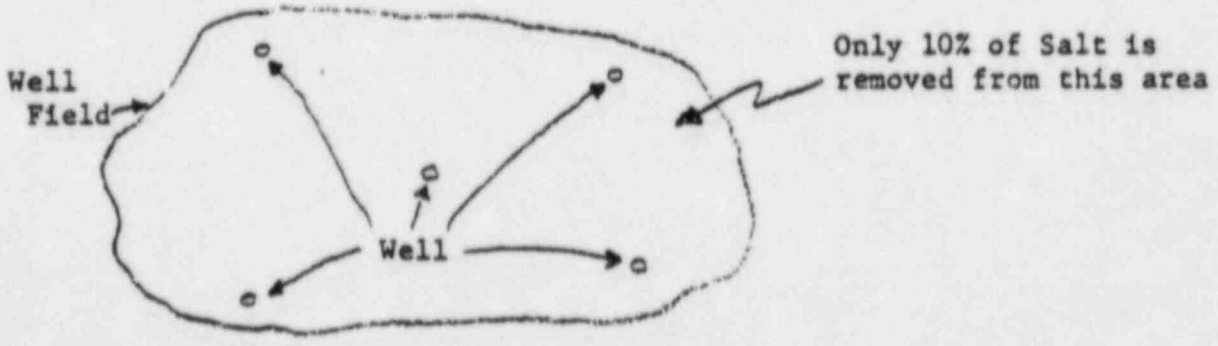
McClure - Regional subsidence is not a problem. Only offset, that is a vertical break at the surface, could be a problem. However, the calculations by Woodward-Clyde indicate very small movements at the ground surface. Although the movements are small the area of surface influence is large as indicated by Woodward-Clyde's Figure 6 and there could be some overlapping of these movements at the surface. However, adding

these movements, is an extremely conservative approach and would still result in very small movements.

Wilson - In evaluating subsidence, three approaches are possible.

1. Intuition - he would expect no offset at the ground surface.
2. Emperical, again he would expect no offset.
3. Analysis, this also shows there should be no offset.

Hultin - Wells 10 and 17 are not connected. No. 17 is estimated to be about 600 feet in diameter. It is not operating and is only on a standby basis. The flow noted by AEC and Bechtel personnel when visiting the site is only a small flow required to keep the water at the top of the well from freezing. The monuments used to check for movements of the ground surface are normally offset 10 to 15 feet from the wells. He again emphasized that only 10 per cent of the volume by salt is removed from the area of the well field.



Wilson - Agrees that Dow uses a low density well spacing.

McClure - Several inches of settlement is not a problem at the plant.

Cardone - Asked that data be submitted on tolerance of plant to settlement. He then listed various things he would like to see covered in the final report.

1. Survey data on the bench marks, 1958 to 1968.

2. Search of literature presented as a bibliography.
3. Properties of overlying strata. Are the rock moduli time dependent?
4. Spacing of joints and fractures - core description of rocks in the roof of the salt cavity. A log of each well.
5. Assurance on cavity size.
6. Microseismic and slope indicator data. (This was strenuously objected to by Allen, McClure and Gray - Cardone received no backing by Wilson or Waldron and the item was deleted)
7. Analysis of drawdown in brine wells and how it affects salt cavities.
8. Dow's intentions regarding mining of the Salina Salt.
9. Cavities of 5 closest wells - is interconnection possible?
10. Maximum tolerable strain on structure.
11. Methods of stabilizing site. (Allen objected - this will not be discussed if study shows subsidence is not a problem.)
12. Dynamic considerations - will earthquake cause collapse?

Draft of report to be reviewed March 25.

Richard E. Gray

SD500634

FORM G-2 2QOM 5-68 M

BECHTEL CORPORATION
INTER-OFFICE MEMORANDUM

Date December 16, 1968

To J. H. Blasingame

From H. H. Burke

Dept. H & T - Soils

Copies to J. G. Thon
P. A. Martinez

At 50 Beale Street

Subject: Midland Power Site - Job No. 7220 - Soil Investigation at Cooling Pond Site

RECEIVED
BECHTEL CORP.
DEC 18 1968
POWER DIVN.
S. F.

At the request of Mr. P. Martinez, we have reviewed the soils report by Dames and Moore dated November 6, 1968, as well as supplementary data received to date. The report includes complete logs of boreholes and results of soil classification and compaction tests performed in Chicago, as well as partial results of triaxial shear tests and permeability tests carried out in the Dames and Moore laboratory in San Francisco. We found the report satisfactory both with regard to technical content and the manner of presentation.

The triaxial shear and permeability testing program was being continued after the submission of the above report, and we expect it to be completed towards the end of the current week.

We have been reviewing the results of these tests with Dames and Moore personnel as they became available. We understand that the Chicago branch of Dames and Moore will shortly re-issue the soils report, incorporating the complete testing data.

The results of this soil investigation, together with data from earlier investigations, enabled us to conclude that the soil conditions in the cooling pond area generally are satisfactory. The foundation soils over most of the proposed dike and baffle alignment have adequate bearing capacity and, except for sandy pockets in the top 5 to 18 feet, have very low permeability. A seepage cutoff through the sandy pockets where these occur will be necessary, but, at this stage, we are hoping that the cutoff can be achieved, in most if not all areas, by means of a core trench backfilled with impervious fill

However, because of the considerable distance between the boreholes, we do not expect that the soil investigation has disclosed all the potential trouble spots along the dike alignment. One particular area of uncertainty is at borehole 104 opposite the Tittabowasse River where pervious sand was reported to a depth of 17.5 feet. Neighboring boreholes did not indicate similarly unfavorable conditions.

SB500748

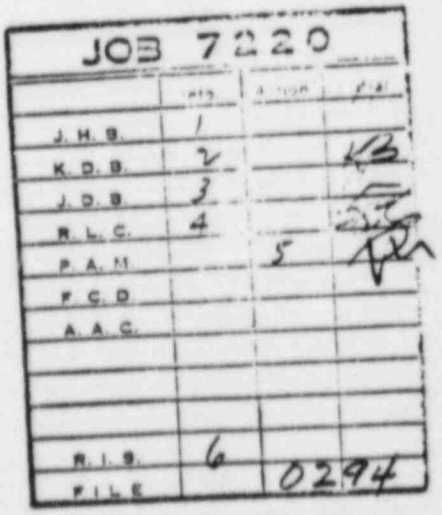
PROJECT FILE 7220

A number of additional boreholes would be desirable to delineate more clearly the extent of poor foundation conditions in a few such doubtful areas, as well as to verify the location of sand deposits in the pond area suitable as fill for drainage zones in the dikes. Also, because of change in dike location, only two boreholes were put down along the entire west wing of the dike and additional boreholes would be desirable in that area.

Because the quantity of clean sand in the pond area may be inadequate for the drainage zones in the dikes, outside sources of sand should be investigated. Laboratory tests on potential drain sand samples will be required. Also, potential sources of riprap for slope and channel protection will have to be established.

HHB:RLK:es

Harris H. Burke



SB500749

Copies To:

JWC
GSK
TCC
DMB
TRT
JEB
TRT
JARutgers, Bechtel
MMiller, IL&B
File 0485.16
Serial
UFI

TELECON RECORD

Date July 14, 1980 2:00 PM

010154

Participants	Company
GSKeeley)	
TJSullivan)	Consumers Power Company
TRThiruvengadam)	
JEBrunner)	

Subject Request by Corps of Engineers for Additional Information Regarding Plant Fill

Reference: Letter from A Schwencer of USNRC to JWCook of CPCo dated June 30, 1980

Discussion

D Hood was called in connection with the request by NRC for additional information on behalf of their consultants, chiefly, the U S Corps of Engineers. This additional information required by the Corps consisted, among other items, of several new soil borings in Category I area and also in Cooling Pond Dike and detailed laboratory tests on samples taken. Hood was informed of an earlier telephone call by G S Keeley to Joe Kane of NRC on the same subject.

G S Keeley questioned the logic and the necessity of additional soil borings and laboratory tests. Quite a few of these borings are requested to be located in Category I area where several borings have already been taken. The borings adjacent to the service water pump structure and Aux building electrical penetration areas that were required by Corps to verify the design adequacy of piles and caissons are not needed since these structures are designed to penetrate into the till. CPCo's reasons for not taking any new borings in the Diesel Generator Building area to prove the adequacy of the preload program have already been documented in previous responses to NRC questions and NRC meetings with consultants, Drs Peck and Hendrow. Again, the need for soil borings in Cooling Pond Dike is not clearly established since the dike is a nonseismic Category I structure. Furthermore, Bechtel and their consultants strongly advise against any borings in the dike as they create a potential for undermining the integrity of the dike. Since the cooling pond dike is not a safety issue, especially in the hearings, the need for exploration is questioned. In light of all the objections raised above, G S Keeley requested D Hood to set up a meeting with the NRC, their consultants, Bechtel and CPCo at the earliest possible time to resolve the questions.

8501110

D Hood stated that CPCo should wait until another letter from the NRC is received, wherein, additional details of the new soil borings and laboratory tests, along with the reasons for requesting them will be provided. This letter will be sent to CPCo within two to three weeks. Hood explained that is the staff's policy to review the request by their consultants in detail and since this issue involves several disciplines, there will be delays due to coordination.

G S Keeley expressed considerable skepticism on the promised time span of two to three weeks of receipt of the letter.

In conclusion, D Hood stated that CPCo should wait until the receipt of the letter before setting up the meeting. G S Keeley said that he would include this and another item for discussion in the agenda for the meeting with H Denton scheduled for August 5, 1980 to express CPCo's frustrations in facing continuing series of delays in getting this issue resolved.

T J Sullivan asked when we would receive the NRC meeting minutes on Fire Protection and Reactor Vessel Anchor Bolts. Hood stated that he has issued the meeting notes before he went on vacation and CPCo would receive it very soon. G S Keeley informed Hood that J W Cook had talked with A Schwencer to have the Case Load Forecast Panel meet before the Board meeting, since the fuel load dates have been revised for Unit 1 to be December 1983 and for Unit 2 to be July 1983.

G S Keeley

8501111

Bechtel Associates Professional Corporation

Inter-office Memorandum

To K. Wiedner

Subject Midland Units 1 & 2-Job 7220
Rammer Compactor RV4B

Copies to S. L. Blue
A. Boos
[redacted]
W. R. Ferris
J. Delarm
A. S. Marshall
M. Peterson
S. Rao
J. O. Wanzeck
1320, 3410

Date 30 June 1980

From S. S. Afifi

Of Geotechnical Services

At Ann Arbor 10D5

This is to summarize my visit to the Midland Jobsite on June 26, 1980. At your request, I made the trip to look into uses of the rammer type compactor Model RV4B, generally known as the pogo stick. Accompanying me on the site tour were A. S. Marshall and J. O. Wanzeck from Geotech and S. Rao from Project Engineering. I spoke to Milt Peterson and Jack Delarm from Bechtel constructio and Bob Wheeler from Consumers Power Company.

Background Information

The following background information was provided to me.

1. Uses of the rammer compactor are very limited. It has been estimated that future application of the compactor would involve at the most 100 to 200 cubic yards of fill. This compactor was used in the past on a very limited basis.

2. The rammer compactor is only used in tight areas where it is not possible to use another piece of equipment. Concrete fill is not always permissible or desirable in such areas.

3. Application of the compactor can be limited to sands only (no clay).

4. Construction would like to continue using the compactor where applicable.

5. Consumers Power Company is committed to qualify the rammer type compactor.

Recommendations

By a copy of this memo, the following recommendations are made to project engineering.

1. Make a test fill using the rammer type compactor on structural and pit run sands. The equipment can be released after results are evaluated.

8501268

2. Regarding previous sand fill placed with this compactor, obtain all pertinent data including location, inspection reports and field density tests. This information should be evaluated by Engineering and Geotech. It is understood that this compactor was not used in the past for clay.

I was advised by Bechtel construction that the remaining fill in Q-areas is very limited in magnitude. It is perhaps on the order of 2000 cubic yards. I recommend that the fill in the Q-areas be limited to structural sand in the future. This should simplify the operations without significantly impacting lost. It is understood that there are no remaining specific applications for clay fill in Q-areas.

S. S. Afifi

SSA/lak

8501269

Bechtel Associates Professional Corporation

Inter-office Memorandum

To L. M. Curtis

Date 22 April 1980

Subject Midland Units 1 & 2-Job 7220
Consultant Services
on Plant Fill (S-173)

From S. S. Afifi

Of Geotechnical Services

Copies to S.L. Blue
P. K. Chen
B. Dhar
J.O. Wanzeck
K. Wiedner
1320, 2140

At Ann Arbor 10D5
7220-80-122

RECEIVED
APR 23 1980
BECHTEL
A.A. 7220

REFERENCES: 1. Letter from L. S. Rubenstein (NRC) to S.Howell (CPCo) dated April 1, 1980

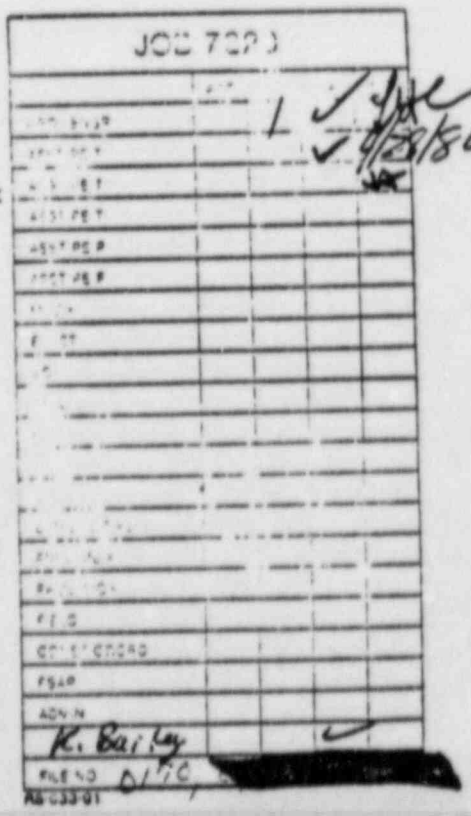
2. IOM from B. Dhar to J. O. Wanzeck dated April 10, 1980

Attached you will find a description of services to be performed by consultants R. B. Peck, A. J. Hendron, Jr., C. H. Gould, M. T. Davisson and R. Loughney on plant fill as requested in Reference 2 and outlined in Reference 1.

A copy of this information was hand carried to S. Lo of project on April 21, 1980.

JOW/lap
Attachment

Jowanzeck /For SSA
S. S. Afifi



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R. B. Peck and A. J. endron, Jr.

1. Continue to review results of field settlement measurements.

2. Review approaches to settlement evaluations.

3. Review FSAR subsection pertinent to the fixes such as surcharging, underpinning and permanent dewatering.

4. Participate in evaluating results of field measurements to be taken during and after installation of the permanent dewatering system and results of load tests on caissons to be conducted during underpinning.

5. Make periodic visits to the site to observe construction operations.

M. T. Davisson

1. Reviews the technical specifications for furnishing, installing and testing closed end pipe piles for the service water pump structure.

2. Observes pile load testing and reviews the pile load test data.

3. Makes periodic visits to the site to observe pile installation procedures, review pile driving records, and inspection reports.

R. W. Loughney

1. Reviews the design of the permanent dewatering system being performed by Bechtel.

2. Reviews the technical specifications for installation of the system.

3. Makes periodic visits to the site to observe the permanent dewatering system installation.

4. Reviews construction inspection reports.

5. Reviews results of performance tests made on the permanent dewatering system after installation.

C. Gould

1. Reviews the technical specifications for underpinning of the auxiliary building.

2. Reviews the design details to be submitted by the subcontractor.

3. Instruct the inspectors on what to look for in inspecting construction activities and in understanding the specifications.

4. Makes periodic visits to the site to review construction activity and field inspection records.

5. Reviews results of field installation load tests to be performed on the caissons.

8501319

TRIP REPORT

PROJECT	JOB NUMBER	DATE(S) OF TRIP
Midland Units 1 & 2	7220-101	April 10, 1980

TRAVELER(S) NAME AND POSITION

Kirk Bailey - Geologist

TRIP TO/PURPOSE

To monitor observation wells and check construction dewatering system operations.

PERSONS CONTACTED

C. Willson/Surveying, C. D. Sack/Loughney Dewatering, J. Speltz/U. S. Testing
M. Rung/Subcontracts

RESULTS (USE ADDITIONAL PAGE IF NECESSARY)

Arrived site at 1000 hours. Proceeded to take full set of observation well readings as well as reading Loughney observation wells inside the Turbine Building and two piezometers inside the Diesel Generator Building. Observation wells AX-2 and AX-10 inside train bay of the Auxiliary Building still needs protection.

Contacts

C. Willson of survey and got elevations for observation wells PD-39 and PD-42 as requested last week.

J. Speltz of U. S. Testing and received originals of this weeks monthly eductor well tests as well as summary sheets for month of March. Also received our copy of weekly fines test results. Had them pick up soil samples to run sand gradations for last observation wells drilled. Will have to pick up all test samples from U. S. Testing next week.

C. D. Sack of Loughney Dewatering for weeks observation well data. He did not have the information ready for me. He also did not have results from week of 3/21/80 as requested last week. He said he would mail them to me. He also said they had taken a water sample and sent it to Agua Assoc. in New Jersey for analysis. I told C. D. Sack that tank purging preparations are on hold at this time.

M. Rung of subcontracts and gave him a list of Loughney materials used for the installation of observation wells as had been arranged between M. Rung, W. Kinzer and C. D. Sack. He will transmit this list to Loughney. Left site at 1530 hours for Ann Arbor.

FOLLOWUP ACTION NEEDED (IDENTIFY ANY SPECIFIC COMMITMENTS)

1. Protection for AX-2 and AX-10 inside train bay of Auxiliary Building.
2. Weekly observation well readings for weeks ending 3/21 and 4/11 from Loughney Dewatering.
3. Pick-up test samples and results from last sand gradation done by U. S. Testing.

PREPARED BY (NAME)	SIGNATURE	LOCATION	DATE
K. R. Bailey	K. R. Bailey	AAO 10D5	4/14/80

DISTRIBUTION

S. L. Blue
W. C. Paris, Jr.
J. O. Wanzeck
File: 3120

8 5 0 5 0 3 2 1

VIBRATORY SETTLEMENT OF DIESEL PEDESTALS

for

Bechtel Corporation

Richard D. Woods

February 29, 1980

8503330

VIBRATORY SETTLEMENT OF DIESEL PEDESTALS

Diesel-Generator Vibrations and Soil Conditions

Computations by Bechtel personnel (Bandyopadhyaya, 1977) estimated the maximum vibration motion of the Diesel-Generator-Foundation system to be 0.00008 inch at an operating speed of 450 rpm. Increasing this displacement slightly to 0.0001 inch (peak), the maximum acceleration would be about 0.0006 g. The soil supporting the diesel-generator pedestal is assumed to consist of 30 feet of clean sand at a relative density (D_r) of 45%.

Settlement Analysis

Most efforts to estimate settlement of sand due to vibratory loads have dealt either with accelerations greater than 1 g as for vibratory compaction or with ground motions of large shearing strain amplitude as for earthquakes. Neither of these conditions prevail in the case of the diesel-generator pedestals.

Experience of the writer is that vibrations less than those which are perceptible by people* do not cause measureable settlement. At 450 rpm the level of vibration acceleration which is perceptible by people is about 0.001g. Therefore, it is noted that the estimated diesel-generator acceleration is less than this threashold and vibration induced settlement would be imperceptible.

However, in an attempt to quantify the magnitude of imperceptible settlement, the results of laboratory experiments by Seed & Silver (1972) were employed. The clean quartz sand in the Seed & Silver tests were subject to multiple repititions of shearing strains at an acceleration of 0.3 g. The sand was compacted to relative densities of 45% and 60% before starting the tests, and the vertical vibration compaction strain was measured for three magnitudes of cyclic shearing strain amplitude.

To apply the Seed & Silver results to the diesel pedestal settlement analysis, the cyclic shearing strain

*See Richart, Hall and Woods (1970)

in the sand supporting the pedestal was estimated as follows:

$$\gamma = \text{cyclic shearing strain amplitude} = \frac{A_{pp}}{V_s x T_s}$$

in which

A_{pp} = peak to peak vibration amplitude (in)
V_s = shear wave velocity in soil (ft/sec)
T_s = period of pedestal vibration (sec)

therefore

$$\gamma = \frac{0.0002}{800 \times 12 \times 0.13} = 1.6 \times 10^{-7} \text{ or } 1.6 \times 10^{-5} \%$$

The Seed & Silver test results for relative density 45% and 60% were extrapolated to a shearing strain amplitude of 1.6×10^{-5}%, see Figs. 1 and 2. From these figures the vertical strains due to vibratory compaction were found for 2, 10 and 300 cycles of a shearing strain amplitude of 1.6×10^{-5}%. These vertical strains were then plotted on Fig. 3 and extrapolated to a number of cycles of shearing strain amplitude equivalent to one year of continuous operation of the diesel generators (450 rpm x 60 min/hr x 24 hr/da x 365 da) i.e. 230×10^6 cycles.

Using this approach, it was found that the vertical strain for a sand D_r of 60% was greater than that for D_r of 45% which does not agree with basic principles of soil mechanics. However, because considerable extrapolation was required to arrive at these vertical strains and because the magnitude of the vertical strain from this analysis was not greatly different for D_r=45% and D_r=60%, a single value of vertical strain equal to 10^{-4} % was selected as appropriate, see Fig. 3.

For the 30 feet thick sand stratum undergoing a vertical strain of 10^{-4}%, the settlement amounts to:

30 ft x 12 in/ft x 0.000001 = 0.0004 inch.

This is clearly in the imperceptible range and confirms the writers previous experience.

S6501332

Conclusions

Based on the preceding analysis, it is anticipated that the settlment of the diesel-generator pedestals due to self-excitation will be imperceptible. However, because of the approximate nature of this analysis, the simplifying assumptions that were used, and the variability of the soil supporting the diesel pedestals, a settlement of 1/4 inch should be expected.

References

Bechtel calculation No. 38,
Civil Structure, Midland Units 1 & 2, 7220
File no. 50850-50999, dated 5-13-77

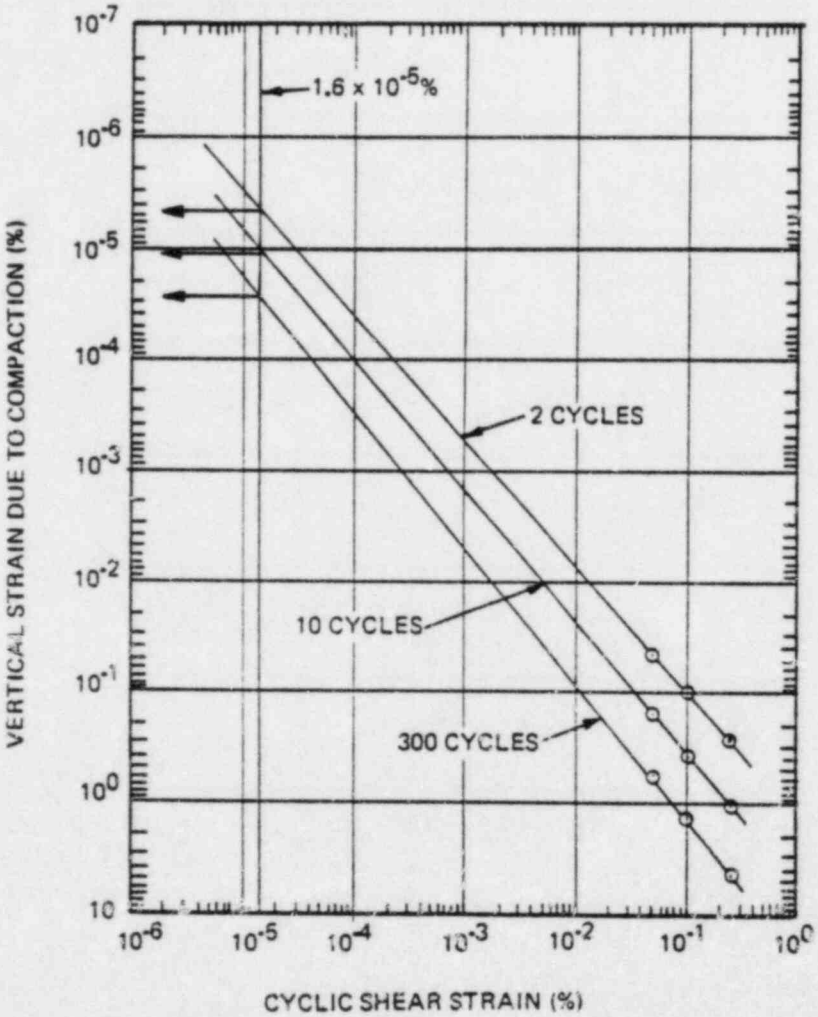
Seed, H.B. and Silver, M.L. (1972), "Settlement of Dry Sands During Earthquakes," Journ. of Soil Mech and Found. Div., ASCE, Vol. 98, No. SM 4, April, pp. 381-397.

Richart, F.E., Jr., Hall, J.R., Jr., and Woods, R.D. (1970), Vibrations of Soils and Foundations, Prentice-Hall, Engelwood-Cliffs, N.J.

Analysis and Computations Checked by:

Larry P. Jedele 2/29/80

Larry P. Jedele, P.E. Date



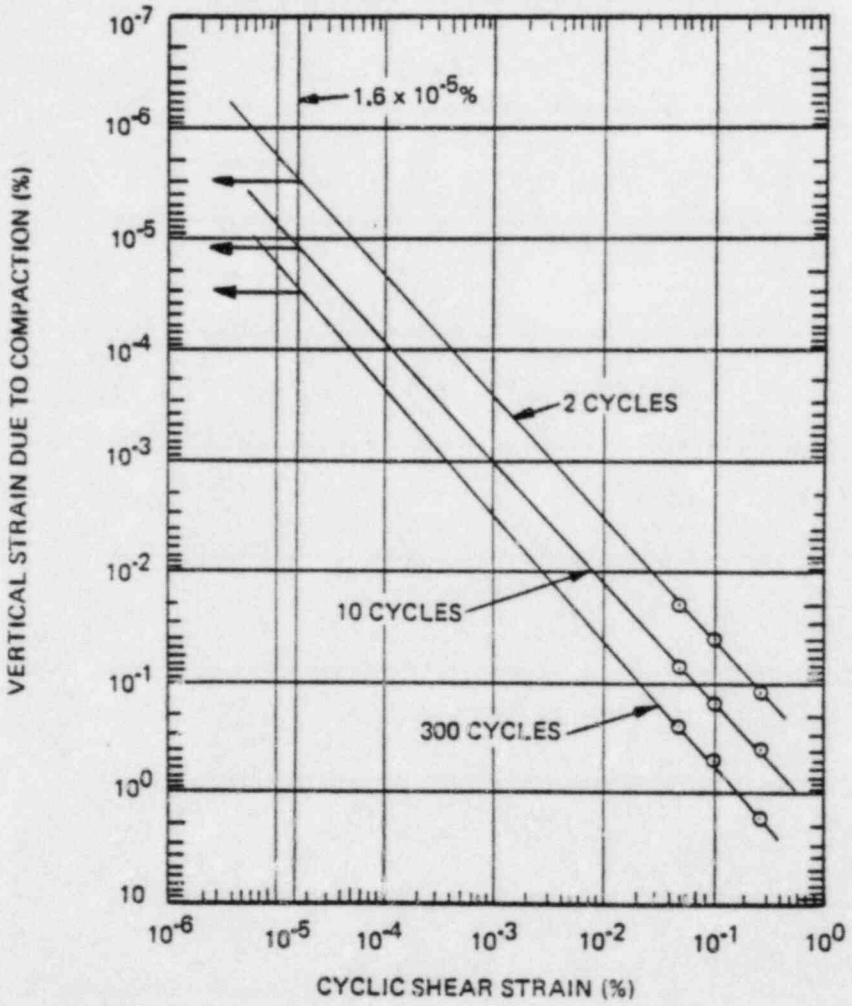
σ_v = 350 lb/ft^2

D_r = 45%

FIG. 1

VERTICAL STRAIN VS CYCLIC SHEAR STRAIN
(FROM SEED & SILVER, 1972)

S8501334



σ_v = 350 lb/ft^2

D_r = 60%

FIG. 2

VERTICAL STRAIN VS CYCLIC SHEAR STRAIN
(FROM SEED & SILVER, 1972)

S 50 335

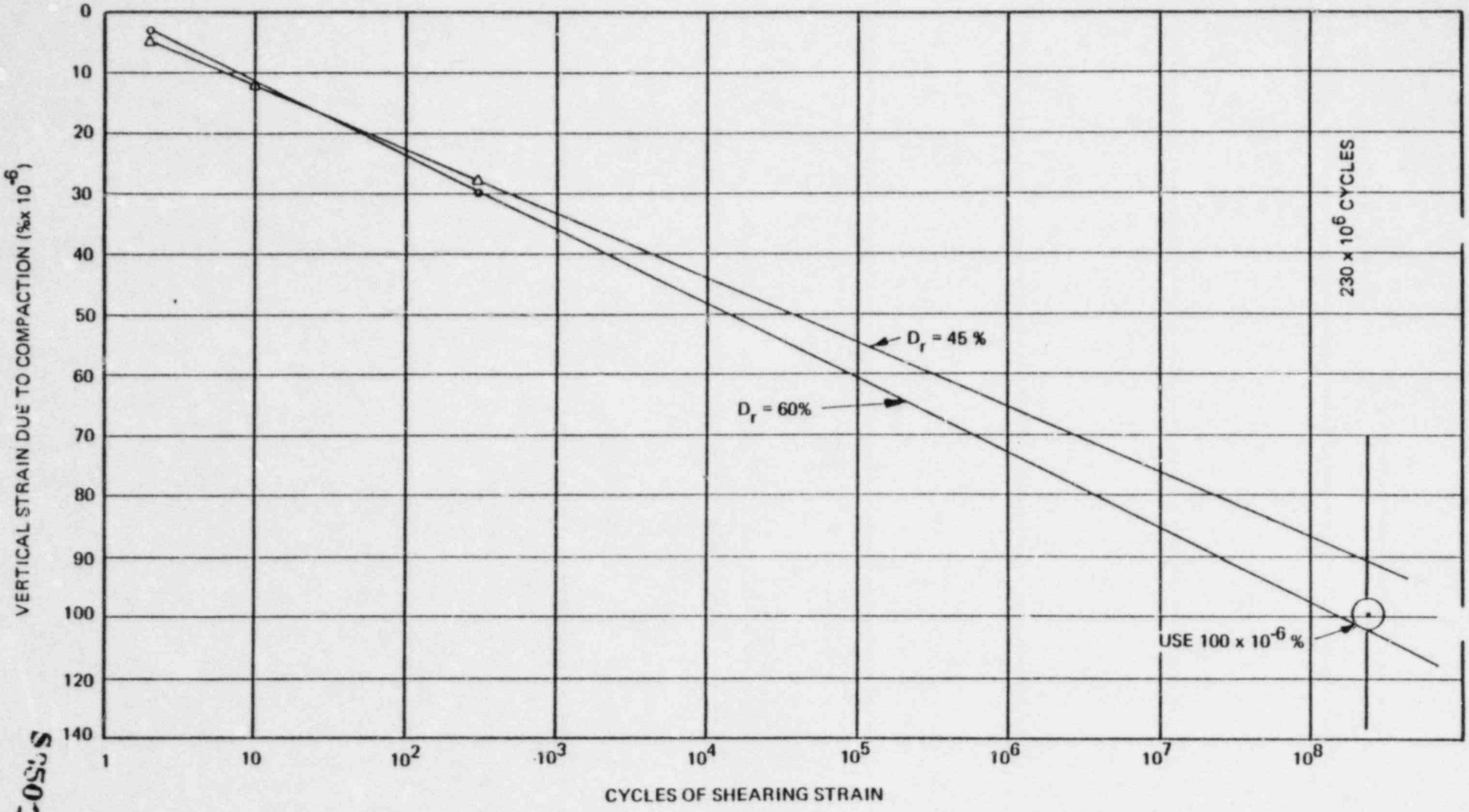


FIG. 3

VERTICAL STRAIN VS CYCLES OF SHEARING STRAIN

CONSULTING MEETING - BECHTEL

ANN ARBOR, MICHIGAN

JANUARY 7 & 8, 1980

January 7 & 8, 1980 - Reviewed the Permanent Dewatering System - Midland Plant:

It was agreed:

1. That the backfill around the Category I pipe lines and ducts need not be dewatered as it is not subject to liquidation.

2. That any loose sand backfill layers beneath the Category I ducts and pipes subject to liquidation need to be dewatered.

3. To move the proposed 20 operating and 20 standby dewatering wells in front of the Service Water Structure and Intake Structure closer to the said structures so that the dewatering wells will intercept the sand backfill beneath the service water pipes that is subject to liquidation, instead of dewatering the original sand further away from the structures and depending on the original sand gradient dewatering the sand backfill under the service water pipes along the buildings. The test pumping of the temporary dewatering wells for the punctured electrical ducts near the Service Water Structures indicates that the original sand alone will not drain the overlying sand backfill.

4. That 100 percent redundant system will be provided at the Service Water Intake Structu to compensate for the allowable down time, ½ to 1 day.

5. To locate the deepwells South of the Diesel Generator Building as close as possible tc the boring locations that show deeper depths of original sand. Install and pump six wells and determine from observation wells in the original sand and the backfill sand at the Diesel Generator Building if the water levels in the various pervious strata are responding as a unit or if the water levels in the original sand and the sand backfill indicate that the water in the sand backfill does not drain into the underlying original sand at sufficient rate to meet the requirements of no water remaining perched in the sand backfill during the operations of the plant because the initial water, or any future water from other sources; if so additional deepwells would be installed around the perimeter of the Diesel Generator Building as required to drain off the perched water.

Two deepwells without pumps would be installed near the end of the discharge pipes at the pond, and if the gradient developed on the pumping of the wells at the Diesel Generatc Building is not sufficient for the desired down time, these wells would be operated as required to obtain the gradient needed to obtain the desired down time.

In the Trainbay Area, 4 deepwells would be installed within area initially and supplemented as required to meet the requirements. The same observation well procedure used for the Diesel Generator Building would be followed at the Trainbay Area.

Approximately 6 deepwells would be installed in the area East of the Power Block to dewater this area.

Some of the existing contruction deepwells at the Reactor 1 would be used to offset the leakage through the dyke on the West side and some of the existing temporary construct deepwells at the Unit 2 reactor would be used to supplement the deepwells installed on the East side.

SB501402

Observation Wells:

a. 3 sets of 2 continuous graph recording observation wells with alarms that alert the operating personnel when the water level has risen to a level that requires action.

   A set at the Diesel Generator Building

   A set at the Service Water Structures

   A set at the Trainbay

b. The other observation wells would be recorded initially and every week or so to verify the automatic observation wells.

c. For each new well installed an observation well, 1" diameter maximum would be installed within the well gravel packs. The observation well would have a 5' length of screen on the bottom and extend above the ground surface.

d. Observation wells in the standby wells would be checked periodically, 6 at the Service Water Structure, 3 in the Diesel Generator Building, and 2 in the Trainbay Area.

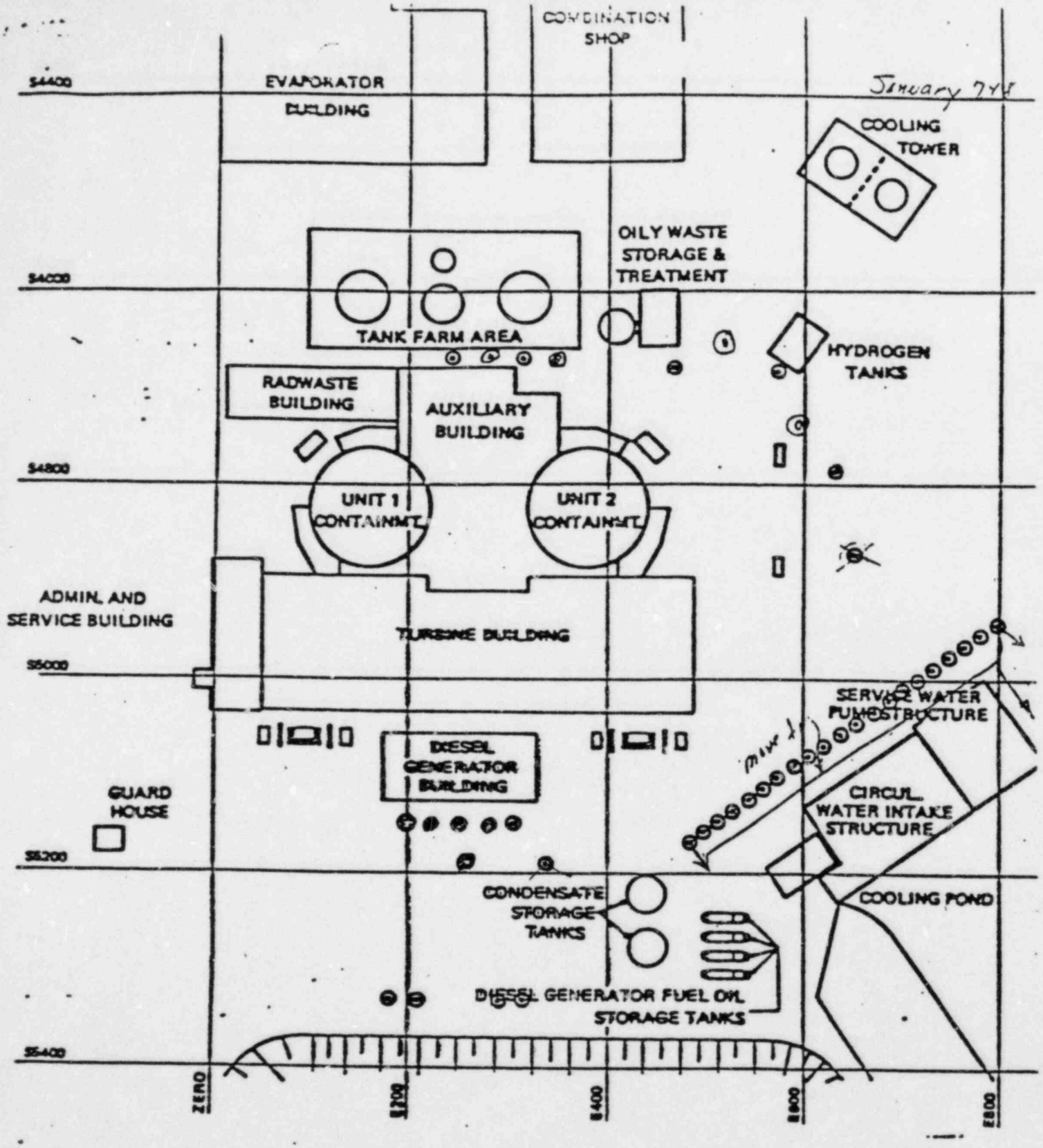
e. Existing observation wells, AX-1, AX-2, and AX-10 at the Trainbay Area and a selection of other existing observation wells would be used.

The discharge from the wells would be monitored with meters (sparling type), from five ± separate discharge headers. All wells and discharge headers would have provisions for taking water samples.

Each well would be checked initially for allowable fines, and the total allowable for each discharge pipe determined and checked therefore until a higher percentage of fines shows up at a discharge pipe at which time the individual wells would be tested to locate the well or wells showing the increase and the situation corrected.

Periodically the wells would be treated to maintain their capacity.

The wellscreens would be plastic, 6.625 O.D., 0.450" wall with continuous screen below elevation 624, gravel packed in a 12'-3/4" I.D. hole, galvanized steel riser would be used for the discharge riser. The collector headers would be plastic. Manholes or pitles adapters would be used for access to the wells.



BECHTEL
ANN ARBOR

MIDLAND POWER PLANT

0 50 100 150 200
SCALE IN FEET

SB501404

Bechtel Associates Professional Corporation

Inter-office Memorandum

To L. H. Curtis

Subject Midland Units 1/2-Job 7220-001
Plant Fill Settlement (S-108)

Copies to S. L. Blue
B. Dhar
M. Rothwell
J. A. Rutgers
J. O. Wanzeck
1320, 3410

Date 18 December 1979

From S. S. Afifi

Of Geotechnical Services

At Ann Arbor 10 D 5
7220-79-277

REFERENCE: IOM P. A. Becnel to J. A. Rutgers, dated November 26, 1979.

IOM from J. A. Rutgers to L. H. Curtis, dated November 26, 1979

Geotech review of borings and Canonie's fill placement record have shown no significant contributing factors to the fill placement at the above site.

RECEIVED
DEC 20 1979
BECHTEL
A.A. 7220

S. S. Afifi

JOW/nm

JOB 7220

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ADMIN				
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RS-033-01

S0501444

0046

FIEL ENGINEER'S REPOR. FORM

MIDLAND UNITS 1 & 2

JOB 7220 DATE 12-4-79 PAGE 1 OF 1

ITEM NO.	INSPECTION DESCRIPTION	ACTION REQUIRED/TAKEN
(1)	BACKFILL IN PROGRESS (DAY) (BACKFILL WORK DONE PER C-211 A AND ESTABLISHED PROCEDURES FOR EQUIPMENT AND MATERIALS USED) (a) SAND FILL AT DUCT BANK NORTH OF PAINT SHOP, FROM ABOUT E280 TO E940 (FINE YELLOW SAND USED) (b) STRUCTURAL SAND FILL AT PIPE REPAIR EXCAVATION IN TRUCK BAY 4 SOUTH OF EAST TANK (BORATED H_2O - UNIT 2) (c) FINE YELLOW SAND FILL PLACED OVER CONCRETE BACKFILL AT EXCAVATION NE OF CAMBINATION SHOP, APPROX LOCATION S4240, E500. INSUFFICIENT DEPTH (ABOUT 14") OF SAND FILL PLACED TO PERMIT TESTING.	
(2)	EXCAVATIONS (a) AT AREA 1(a) ABOVE. BOTTOM OF CONCRETE MUMAT, CLEANED OF ANY SIGNIFICANT UNSUITABLE MATERIALS. (b) AT AREA 1(b) ABOVE, BOTTOM OF FIRM WET SAND (BELOW GW WATER TABLE) AT EL. ABOUT 625.5. CLEANED OF ANY SIGNIFICANT UNSUITABLE MATERIALS. (c) AT AREA 1(c). FROZEN & UNSUITABLE MATERIALS REMOVED, 1 LIFT OF FINE YELLOW SAND LEFT ON CONCRETE BACKFILL, COMPACTED; ~~FURTHER~~ FURTHER MATERIAL TO BE PLACED AFTER APPROVAL.	(a,b,c) EXCAVATIONS APPROVED TO PLACE SAND BACKFILL AT (a) & (b) REQUIRED TEST FREQ. IS 1 PER 100 cyd. FILL AT (c) INSUFFICIENT MATERIAL FOR RELIABLE TESTS.

REMARKS:

Q.C. Items: 1(b), 2(b)

SS501456

SIGNATURE

ROUTE

J. Betts
M. Peterson
A. Boos
C. Paulados (Q.C.)
J. Toal

FILE YARD 0063

FIELD ENGINEER'S REPORT FORM

MIDLAND UNITS 1 & 2

JOB 7220 DATE 11/30/79 PAGE 1 OF 2

ITEM NO.	INSPECTION DESCRIPTION	ACTION REQUIRED/TAKEN
(1)	FROST PENETRATION OF 2 TO 4 INCHES WAS NOTED IN EXCAVATIONS PROPOSED FOR WORK THIS DATE. SUCH EXCAVATIONS INCLUDE AREA ADJACENT (WEST) TO CONTAINMENT UNIT 1, E.M.H. NORTHEAST OF THE NORTH CONDENSATE TANK, STAINLESS STEEL PIPE REPAIR PIT SOUTH OF UNIT 2 BORATED H_2O TANK, AND PORTIONS OF DUCT BANK EXCAVATIONS EAST OF E.M.H. #8. SOME MATERIALS PILED NEAR THESE AREAS, PROPOSED FOR USE AS BACKFILL, WERE ALSO FROZEN	IN ACCORDANCE WITH SPEC. # C-211 Q (E), FROZ FILL MATERIALS WERE REJECTED AND FROZEN MATERIAL IN EXCAVATIONS REMOVED
(2)	STORM DRAIN LINE EXCAVATION EXTENDING FROM ~~THE~~ EAST WALL OF AUX BLDG, EAST ABOUT 30', AT ABOUT S4735, WAS BACKFILLED W/ STRUCTURAL SAND WITHOUT GEOTECH OR Q.C. PERSONNEL BEING INFORMED OF THE WORK. SUCH WORK WAS DONE SOMETIME DURING THE PERIOD 11-26 TO 28-79.	THIS BACKFILL WAS ABOUT 4' DEEP, AND IS TO BE REMOVED AND REPLACED. NEW FILL TO BE PLACED ACCORDING TO C-211(Q) (E)
(3)	EXCAVATION ADJACENT TO (WEST OF) UNIT 1 CONTAINMENT WAS CLEANED OF FROZEN MATERIAL, INCLUDING PREVIOUSLY PLACED FILL AND BANKS OF EXCAVATIONS. SURFACE WAS RECOMPACTED BEFORE MORE FILL WAS PLACED.	EXCAVATION APPROVED TO RESUME BACKFILL. ~~SOME~~ SUPERVISION WAS WARNED TO PREVENT PLACEMENT OF ANY FROZEN MATERIAL, OR OF FILL ON ANY FROZEN MATERIAL

REMARKS:

Q.C. Items 1, 2, 3, 5(a)

S.501461

SIGNATURE

ROUTE

J. Betts
M. Peterson
A. Boos
C. Pavledes (Q.C.
J. Tao

FILE 1/2ED 0063

FIELD ENGINEER'S REPORT FORM

MIDLAND UNITS 1 & 2

JOB 7220 DATE 11/30/79 PAGE 2 OF 2

ITEM NO.	INSPECTION DESCRIPTION	ACTION REQUIRED/TAKEN
(4)	EXCAVATION AT ABOUT S4240, E500 WAS CLEANED OF ANY SIGNIFICANT UNSUITABLE MATERIAL TO BOTTOM EL. OF 624'. SIZE ABOUT 10'X20' AVE. DIMENSION.	EXCAVATION APPROVED FOR CONCRETE BACKFILL TO ABOUT ELEVATION 630.5.
(5)	BACKFILL IN PROGRESS (DAY) (ALL BACKFILL WORK DONE ACCORDING TO C-211 A AND ESTABLISHED PROCEDURES AND EQUIPMENT AND MATERIALS USED) (a) SAND FILL PLACED AT EXCAVATION ADJACENT TO W. SIDE OF UNIT 1 CONTAINMENT. (b) 4A STONE COMPLETED AT EXCAVATIONS ADJACENT TO & EAST OF E.M.H. "B"	
(6)	BACKFILL WORK WAS STOPPED AT 12:30 pm IN AREA 5(a) ABOVE BECAUSE FROST PENETRATION DUE TO THE 25°F OR LOWER TEMPERATURES WAS OCCURRING FASTER THAN PLACEMENT OF FILL WAS BEING DONE. AT THAT TIME, NO OTHER BACKFILL WORK WAS IN PROGRESS.	

REMARKS:

SB501462

SIGNATURE

ROUTE

FILE 0069

FIELD ENGINEER'S REPORT FORM

MIDLAND UNITS 1 & 2

JOB 7220 DATE 11/29/79 PAGE 1 OF 2

ITEM NO.	INSPECTION DESCRIPTION	ACTION REQUIRED/TAKEN
(1)	BACKFILL IN PROGRESS (DAY)	
	(ALL FILL PLACED PER C-211(Q) & AND ESTABLISHED PROCEDURES FOR EQUIPMENT AND MATERIALS USED)	
	(a) CLAY AND 4A STONE PLACED ALONG DUCT BANK R/E OF GUARDHOUSE FROM ABOUT SS185:W95 TO SS165:W50.	
	(b) SAND FILL PLACED AT AREA OF DAM "8" AND ADJACENT DUCT BANKS EAST OF THE COOLING TOWERS	
	(c) SAND FILL AT SMALL PORTIONS OF DUCT BANK ADJACENT TO AND EAST OF THE HOTWELL CONDENSATE TANK.	
(2)	FROST	
	WE FOUND 2 TO 4 INCHES OF FROZEN MATERIAL AT THE SURFACE OF RECENTLY PLACED FILLS IN AREAS WHERE FURTHER BACKFILLING IS NEEDED.	FROZEN FILL WAS REMOVED.
	AT AREA 1(a) 6 INCHES CLAY WAS PLACED OVER FROZEN SAND FILL.	CLAY WAS REMOVED TO PERMIT REMOVAL OF 2½" TO 3" OF FROZEN SAND
	WE ALSO FOUND UP TO 2" FROST PENETRATION IN BANKS OF EXCAVATIONS.	FROZEN MATERIAL TO BE REMOVED OR THAWED BEFORE PLACING SAND AGAINST BANKS OF EXCAVATIONS.
(3)	MOISTURES OF CLAY SAMPLES TAKEN 11-28-79 WERE: ① 10.6 ② 13.9 ③ 10.9 THE WEATHER MATERIALS HAD ALREADY BEEN REMOVED PRIOR TO ANY REPORTS. THE RESULT ③ WAS APPARENTLY	

REMARKS: THE HIGHEST MOISTURE CONTENT OF ANY CLAY PLACED FROM THIS STOCKPILE THIS WEEK

NO SOILS WORK IN Q-LISTED AREAS THIS DATE.

SIGNATURE

ROUTE

J. BETTS.
M. PETERSON
A. BOOS

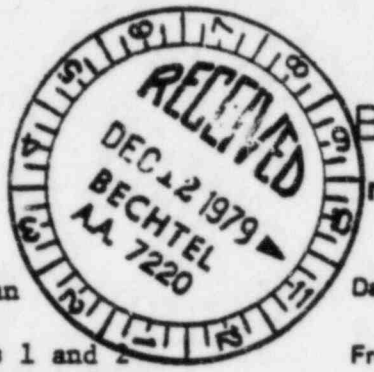
J. TOAL

FILE YARD

SC501464

0071

TELECOPY TO D. W. HALLIGAN (MET) 36



Bechtel Power Corporation

Inter-office Memorandum

0035 69

JOB 7220

	ACT	INFO	COPY	INIT
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CTRVENGR PL				
PROJ MGR				
PROC MGR				
FIELD				
CONST COORD				
FSAR				
ADMIN				
J. Wunsch			C	
FILE NO				

AE-033-01

To D. W. Halligan

Date December 7, 1979

Subject Midland Units 1 and 2
Consumers Power Company
Bechtel Job 7220
PLANT FILL SETTLEMENT

From J. A. Ruggeri

Of Project Management

At Ann Arbor Office

File 0614

Copies to

R. D. Allen
P. A. Becnel
[redacted]
H. B. Friend
P. K. Hansen
F. A. Hollenbach
M. G. Johnson
L. C. McKillip
H. O. Reinsch
E. A. Rumbaugh
H. W. Wahl
K. Wiedner
R. K. Vassar

Following is an update on the activities related to the plant area fill settlement.

(1) A bid clarification meeting was held with Mergentine Corporation. The bid expiration date was requested to be extended to mid-January 1980, which allows the information resulting from the meeting to be sent to both bidders and to provide the client more time for their approvals.

(2) Final coordination required to start lowering the cooling pond was held at the jobsite. Spilling of water is scheduled to begin on Monday, December 10, 1979. * R/F ON HOLD. SEE ITEM 4 (DW)

(3) The initial group of three pump tests required to determine ground water parameters for designing the dewatering system have been completed and results are being evaluated by GeoTechnical Services. The third pump test was restarted in the deep sand to provide additional data to help in designing the system for the possibility of a higher seismic acceleration. If the draw down established to date continues the concept of deep sand dewatering will be confirmed.

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(4) The NRC has issued an order to Consumers Power Company suspending remedial work on substandard soil and fill beneath safety related structures. A coordination meeting will be held today, December 7, 1979, to prepare for a meeting with Consumers Power Company on Tuesday, December 11, 1979.

The order states that the licensee or any person whose interest is affected by this order may within 20 days (by 12/26/79) request a hearing with respect to all or parts of the order. Consumers is reviewing their strategy as to whether or not to request a hearing in that they are disappointed that the NRC has, apparently, ignored responses to their 50.54(f) Questions. We expect their decision by December 12, 1979.

John A. Rutgers

JAR/BCM/kb

Bcc

8502488

BECHTEL
ANN ARBOR

cc. B. Dhar
S. Co.

MEMORANDUM

TO S. Emerson LOCATION 6 C 6

FROM D. Reeves / B.C. McConnel / B. Dhar DATE 10-15-79 19

SUBJECT Diesel Generator Bldg JOB NO. 7220

Broken and Bent Anchor [redacted] C-0294
Bolts on the Pedestals

Attached are plan views of the diesel generator pedestals showing the extent of the damage to the anchor bolts. Please advise us of any additional inspection and testing that will be required.

Please determine the corrective action required as soon as possible to minimize the construction schedule impact.

D. Reeves / BC McConnel

S-702167

AAO-521

CALCULATION SHEET

BECHTEL

CALC. NO. _____ REV. NO. _____

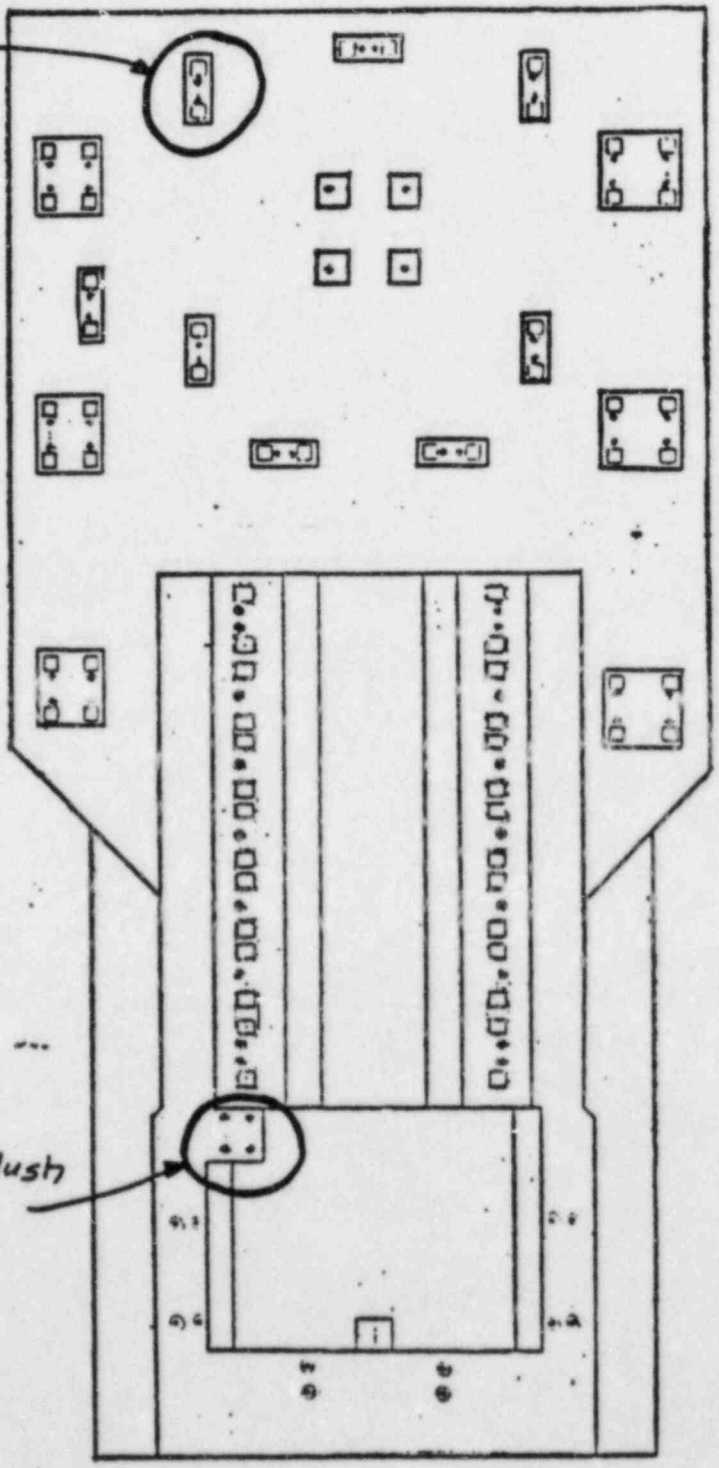
ORIGINATOR M.D. Reeves DATE 10-15-79 CHECKED _____ DATE _____

PROJECT Midland JOB NO. 7220

SUBJECT D.G. Pedestal Anchor Bolts SHEET NO. _____

Bay # 1 (complete)

Both bolts bent south 20°-30°



All 4 bolts sheared off flush w/ concrete

8702768

CALCULATION SHEET

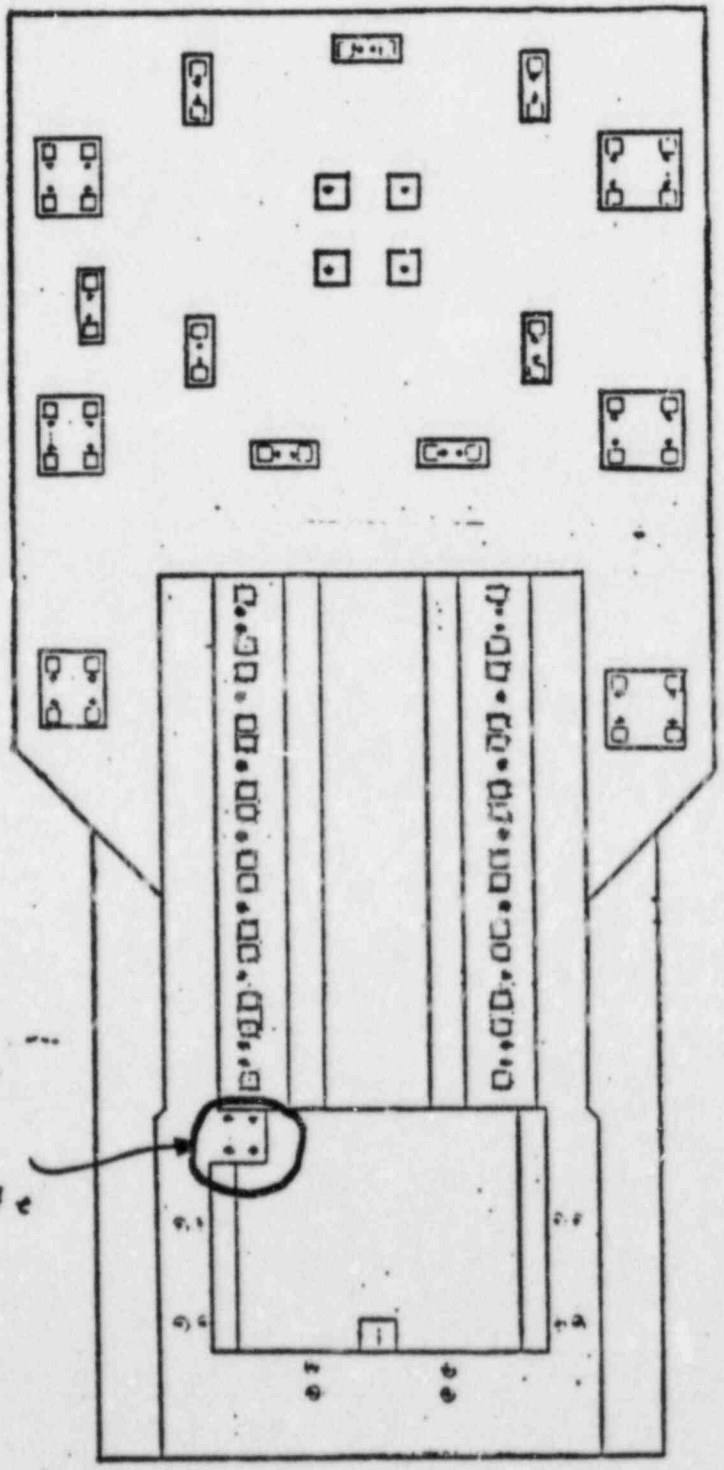
CALC. NO. _____ REV. NO. _____

ORIGINATOR M.D. Reeves DATE 10-15-79 CHECKED _____ DATE _____

PROJECT Midland JOB NO. 7220

SUBJECT D.G. Pedestal Anchor Bolts SHEET NO. _____

Bay # 2 (complete)



All A bolts sheared off flush w/ concrete

S3702769

CALCULATION SHEET

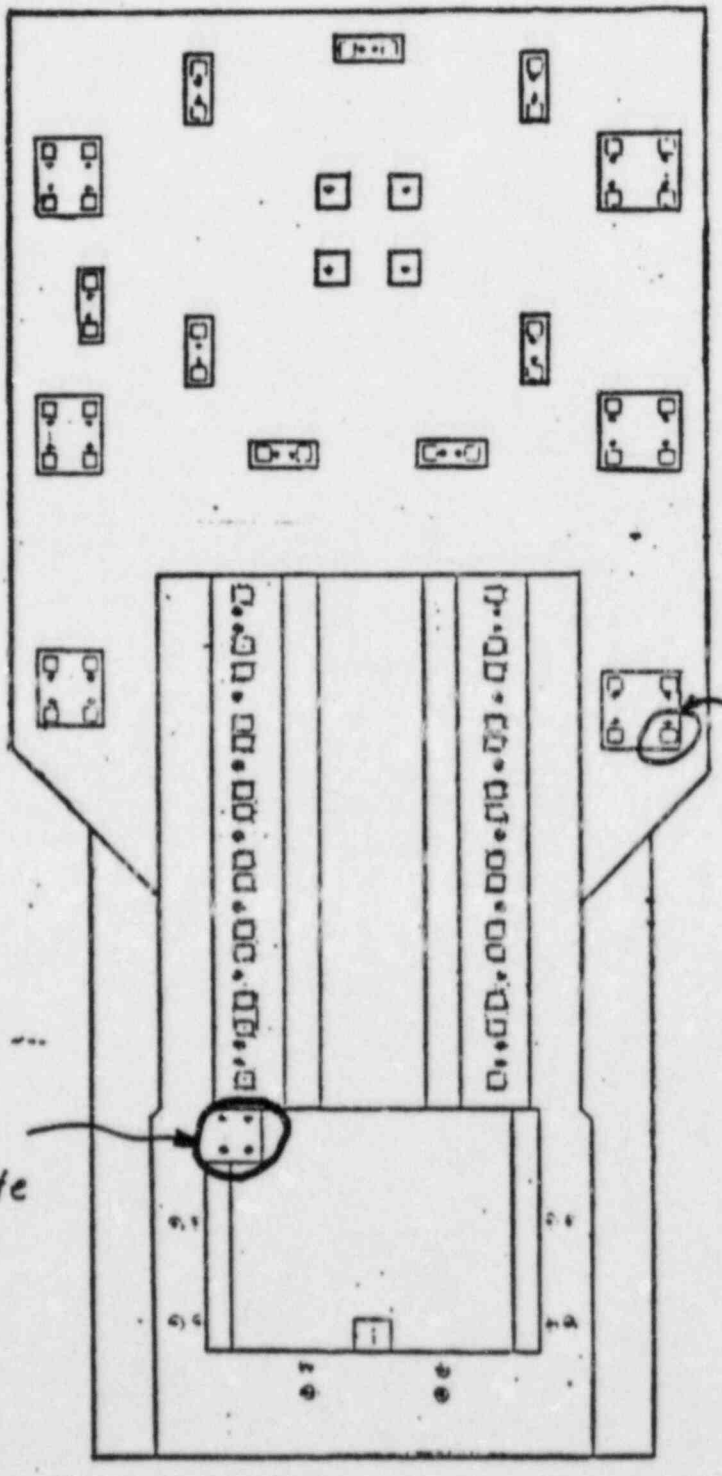
CALC. NO. _____ REV. NO. _____

ORIGINATOR M. D. Reeves DATE 10-15-79 CHECKED _____ DATE _____

PROJECT Midland JOB NO. 7220

SUBJECT D. G. Pedestal Anchor Bolts SHEET NO. _____

Bay # 3 (Complete)



SB702770

CALCULATION SHEET

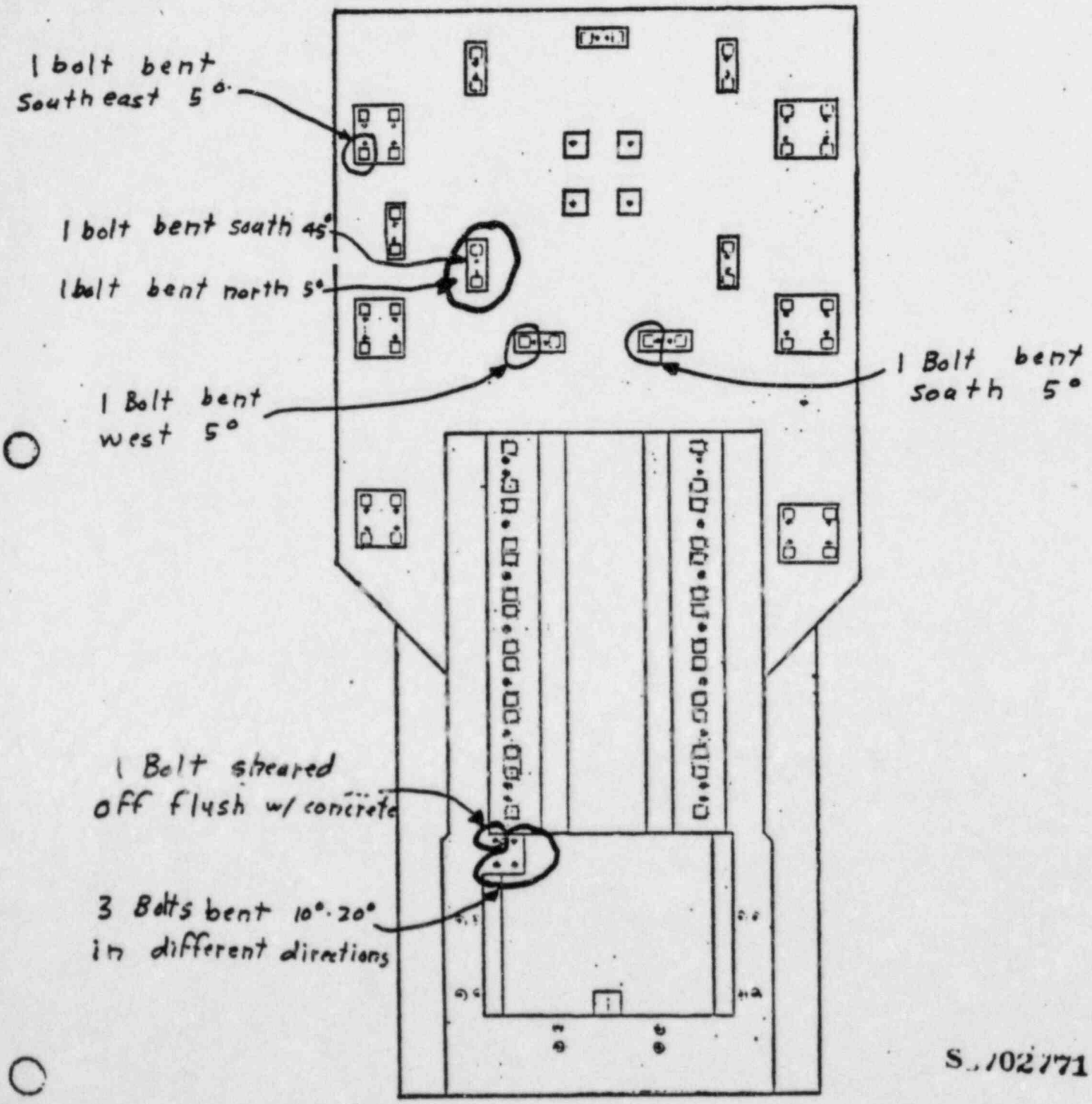
CALC. _____ REV. NO. _____

ORIGINATOR M. D. Reeves DATE 10-15-79 CHECKED _____ DATE _____

PROJECT Midland JOB NO. 7220

SUBJECT D.G. Pedestal Anchor Bolts SHEET NO. _____

Bay # 4 (complete)



S-102771

2XC's 10-29 79 File C-075C
x/c C-76
x/c

Telephone call

ROUTE C. McCONNEL
S. RAO
B. DHARA

BY CARL DIRNBAUER OF ANN ARBOR
TO CHUCK WILSON OF MIDLAND
DATE 10/12 '79 TIME 9:50 AM
SUBJECT SETTLEMENT MARKER SW-4

FILE: C-76, C-075
JOB NO 7220

I CALLED CHUCK TO FIND OUT WHY SETTLEMENT MARKER SW-4 ON THE SOUTHWEST CORNER OF THE SERVICE WATER PUMP STRUCTURE HAS NOT BEEN SURVEYED SINCE 7/22/78. HE INFORMED ME THAT CONSTRUCTION PERSONNEL HAVE INSTALLED A TELEPHONE CONDUIT OVER THE MARKER AND IGNORED HIS REPEATED SUGGESTIONS THAT IT BE MOVED. HE AGREED WITH ME THAT A LETTER FROM ENGINEERING TO FIELD WOULD BE AN EFFECTIVE METHOD OF INITIATING ACTION TO RESOLVE THIS PROBLEM.

Called J.P. Betts to find out what the problem was & he returned my call @ 10/11 He indicated that the interference has been removed & the survey will resume

Rao

Note: No letter to field is required

Rao

S5702784

[redacted]

Bechtel Associates Professional Corporation

Inter-office Memorandum

BEBC- 3329

To L.E. Davis

Date [redacted]

Subject Midland Plant Units 1 & 2
Job 7220
Emergency Diesel Fuel Oil
Buried Piping

From L.H. Curtis

Of Engineering

At Ann Arbor

Copies to File: 0274, 4210

L. Basinski
J. Clements
L. Curtis
[redacted]
Com Log

Reference: IOM BEBC-2613, 1/2/78

Our records show that we have not yet received a response to the referenced memorandum, which requested final routing information for the subject piping.

Please note that routing criteria for this piping remain as stated in the referenced memorandum and the enclosed telex.

In addition to the above, DCN 6 to P&ID 7220-M-452 revises the depth and sloping criteria for the subject piping, due to the building and yard settlement in the area of the diesel generator building.

L.H. Curtis

SWE/ht
10/8/1

Enclosures: Telex, Castleberry to Sidhu, 7/23/79

8702785

Conformation Copy

WU INFOMASTER

BECHTEL ARB

002981C082 0846EST
ZCZC 01 ANN ARBOR MI MMARCH 23
ZIP 48640
ATTN: AMAR SIDHU
BECHTEL POWER CORP
3500 E. MILLER ROAD
MIDLAND, MI 48640
BT

JOB 7220
MECHANICAL

	A	I	C	INIT
G. SUPV.				
D. SUPV.				
R.P. LDR.				
T.G. LDR.				
P.F. LDR.				
PIP. LDR.		1		
G.T.C.				
MSS COOR.				
DISP. OE				
FSAR COOR.				
T/G COOR.				

FILE M-421

SUBJECT: CPCO/MIDLAND PLANT - JOB 7220
EMERGENCY DIESEL F.O. UNDERGROUND PIPING
FILE M-4218

THE UNDERGROUND PORTIONS OF THE SUBJECT PIPING SHOULD BE PROVIDED WITH ADEQUATE SEPARATION FOR MISSILE PROTECTION IN ACCORDANCE WITH THE FOLLOWING GUIDANCE.

1. FOR THOSE PORTIONS OF THE SUBJECT PIPING BURIED LESS THAN 4 FEET FROM THE SURFACE, A MINIMUM OF 15 FEET SHOULD BE MAINTAINED BETWEEN A AND B TRAINS OF THE SAME UNIT. UNIT 1 AND 2 PIPING MAY BE BURIED IN THE SAME TRENCH.
2. FOR THOSE PORTIONS OF THE SUBJECT PIPING BURIED MORE THAN 4 FEET FROM THE SURFACE, A 15-FOOT SEPARATION BETWEEN A AND B TRAINS OF THE SAME UNIT IS PREFERRED, BUT IS NOT A STRICT REQUIREMENT. EACH CASE CAN BE REVIEWED INDIVIDUALLY.

J. HINK FOR R. L. CASTLEBERRY
ANN ARBOR / 7PE-2118 / 7223 / SLK

NNNN

S8702786

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

IN-HOUSE MEETING NOTES NO. 5

MIDLAND PLANT UNITS 1 AND 2

CONSUMERS POWER COMPANY

BECHTEL JOB 7220

DATE: October 12, 1979

PLACE: Ann Arbor

SUBJECT: Buried Yard Pipe Settlement Analysis

FILE: 0279.1, [redacted]

ATTENDEES:

Engineering	Geotechnical Services
B. Dhar	P.K. Chen
B.C. McConnel	G. Givens
D. Riat	
M. Rothwell	
R. Tulloch	

PURPOSE: To review the present status of analysis; prediction of future settlement; and to develop a plan of action.

ITEMS DISCUSSED:

1) Profiles by Goldberg-Zoino-Dunnicliff & Associated (GZD) have been completed in the diesel generator building area. This completes all planned profiles.

2) Preliminary future settlement valves have been developed. They will be finalized by October 17, 1979.

3) Action plan.

   a) Finalize the stress analysis technique.

   b) Perform the stress reanalysis, if required.

   c) Alternative 1: Stresses due to present settlement are acceptable

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1. Combine with future predicted settlement and stresses are acceptable (stop)

2. Combine with future predicted settlement and stresses are not acceptable (go to Item a or b).

   a. Refine future settlement predictions by use of additional monitoring devices (Return to Item 2).

   b. If stresses are still unacceptable, go to alternative (Item 3d).

d) Alternative 2: Stresses due to present settlement are not acceptable.

1. Evaluate present stress methods.

2. Verify that the profiles are correct by optical survey.

3. Verify the locked-in stresses by cutting pipe at local points.

ACTION ITEMS:

B.C. McConnel/D. Riat/ R. Tulloch	1.	Discuss the Nold aquaducer and how the profile data was developed on October 12, 1979.
D. Riat/R. Tulloch	2.	Review analytical techniques used to date and results obtained on October 15, 1979.
D. Riat/R. Tulloch	3.	Inform M. Rothwell of results of Item 2 to set up next meeting date.
All	4.	Develop date of completion for the alternative identified in Action Item 2.
B.C. McConnel	5.	Provide comments on preliminary future settlement of P.K. Chen by October 15, 1979.
P.K. Chen/G. Givens	6.	Finalize future settlement values by October 19, 1979.

Prepared by B. Chad M. Connel
B.C. McConnel

Reviewed by B Dhar
B. Dhar
Civil/Structural
Group Supervisor

BCM/jo
10/16/5

S 7702750

C-2645

GEOTECH
ANN ARBOR

BECHTEL

Telephone call

ROUTE SCB
L.H CURTIS
SSAFIFI
[redacted]
K. WIEDNER
1400, 3410

BY JIM WANZECK OF GEOTECH

TO T. DAVISSON CONSULTANT OF U of ILL.

DATE 10-10-79 TIME 11^00

SUBJECT JOB NO

TASK FORCE QUESTION ON ITEM 26
MEETING OF OCT 8, 9, 1979

REFERENCE MEETING NOTES 1018 PAGE 11
ITEM ACTION 26.

I ASKED TOM IF THE DIESEL GENERATORS HAVE TO BE RAN TWO MONTHS TO CHECK SETTLMENT FROM VIBRATION ?

HE STATED THAT THEY SHOULD BE RUN UNTIL THEY STABLIZE (NO SETTLEMENT) THIS MAY TAKE HOURS OR DAYS BUT SPEC'S SHOULD ALLOW 2 MONTHS

JW Wanzeck
J.W WANZECK

SS702862

0046 (12 67)

BECHTEL
ANN ARBOR

[redacted]
C-98P12
XC-10-19-79

MEMORANDUM

TO S. DHAR LOCATION

FROM D. ANDERSON DATE 10/8 19

SUBJECT ACTION ITEMS 16 & 26 JOB NO

MEETING NOTES NO 1018 FILE M6320

DG BUILDING GROUP TASK ACTION ITEMS

WITH REGARD TO ACTION ITEM 26 WE HAVE REVIEWED THE TECHNICAL SPECIFICATION AND FIND THAT WHILE THE THE TECH SPECS DO NOT ALLOW FOR RUNNING OF THE D/G FOR A TWO MONTH PERIOD FOR PEDISTAL VIBRATION, THEY DO NOT PRECLUDE SUCH OPERATION. THEREFORE WE SEE NO REASON WHY A RUN IN PERIOD CANNOT BE INCLUDED AS PART OF THE SETTELMENT PROGRAM.

REGARDING ACTION ITEM 16 WHICH REQUESTS DETERMINATION OF ANY REQUIRED Q ITEMS FOR THE PERMANENT DEWATERING SYSTEM; PLEASE BE ADVISED THAT IT WAS CONCLUDED IN TWO (2) RECENT DEWATERING MEETINGS THAT NO MECHANICAL EQUIPMENT (PUMPS PIPING & VALVES) WOULD BE REQUIRED TO BE "Q" LISTED

SWE.

S5702868

AAO-521

bcc: D. Anderson
L. Curtis
B. Dhar
S. Emerson
B.C. McConnel
K. Wiedner
Com Log

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

Transamerica Delaval Inc.
550 85th Avenue
Oakland, California 94621

October 5, 1979

Attention: C. Renfro

Subject: Consumers Power Company
Midland Plant - Job 7220
Emergency Diesel Generators
File: M18PR, [redacted]

References: 1) Telecon, S. Emerson (Bechtel) to C. Renfro (DeLaval), 4/16/79
2) Telecon, S. Emerson (Bechtel) to C. Renfro (DeLaval), 9/7/79

Gentlemen:

Delaval was informed in the referenced telephone conversations that the emergency diesel generators foundations have experienced settlements. The settlements have been both general and differential in nature. Commitments have been made to the NRC that the diesel generators will be installed in a level plane.

A grout leveling scheme has been developed to allow installation of the diesel generators. The diesel engine crank-shaft elevation shown in Table I of the attached sketch was established on the basis of the as-built concrete elevation in the engine area. The average grout thickness provided under the engine is shown at location K in the sketch and averages from 1-3/8 inch to 1-5/8 inch. The variations in leveling grout thickness at other locations for the engine, generator, and auxiliary equipment skid are shown at locations A through J, along with the original Delaval design grout thickness.

Your concurrence or recommendations on the following conditions are requested.

1. **Locations A and B indicate that either little or no grouting allowance exists. In these cases, the concrete will be chipped as required to provide a minimum of 1/2 inch of leveling grout.**

2. **At location G of bays 1 and 2 and location I of bay 2, the leveling grout thickness exceeds the Delaval grout requirement by approximately 7/16 inch and 7/8 inch, respectively. This increase in**

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grout thickness could require additional bolt length to allow nut engagement. Verify whether the existing bolts have sufficient length, or indicate how the extra length could be accommodated (special nuts, lengthening etc). If replacement bolts are required, may these bolts be fabricated onsite in accordance with Delaval's revised shop detail drawings?

3. In conjuction with Item 2, the only nonremovable bolts on the generator end of the foundation are for the pneumatic barring device. Provide your recommendations for fit-up modifications or adaptors if the existing anchor bolts are not long enough.

Our immediate need is to establish the crank shaft elevations for the Unit 2 diesel generators which are located in bays 3 and 4 on the sketch. Therefore, your concurrence with the schame is requested by October 12, 1979. Please provide your recommendation on bolt length adjustments (Item 2) and fit-up requirements (Item 3) by October 2[illegible], 1979. Your immediate attention to this matter will be greatly appreciated.

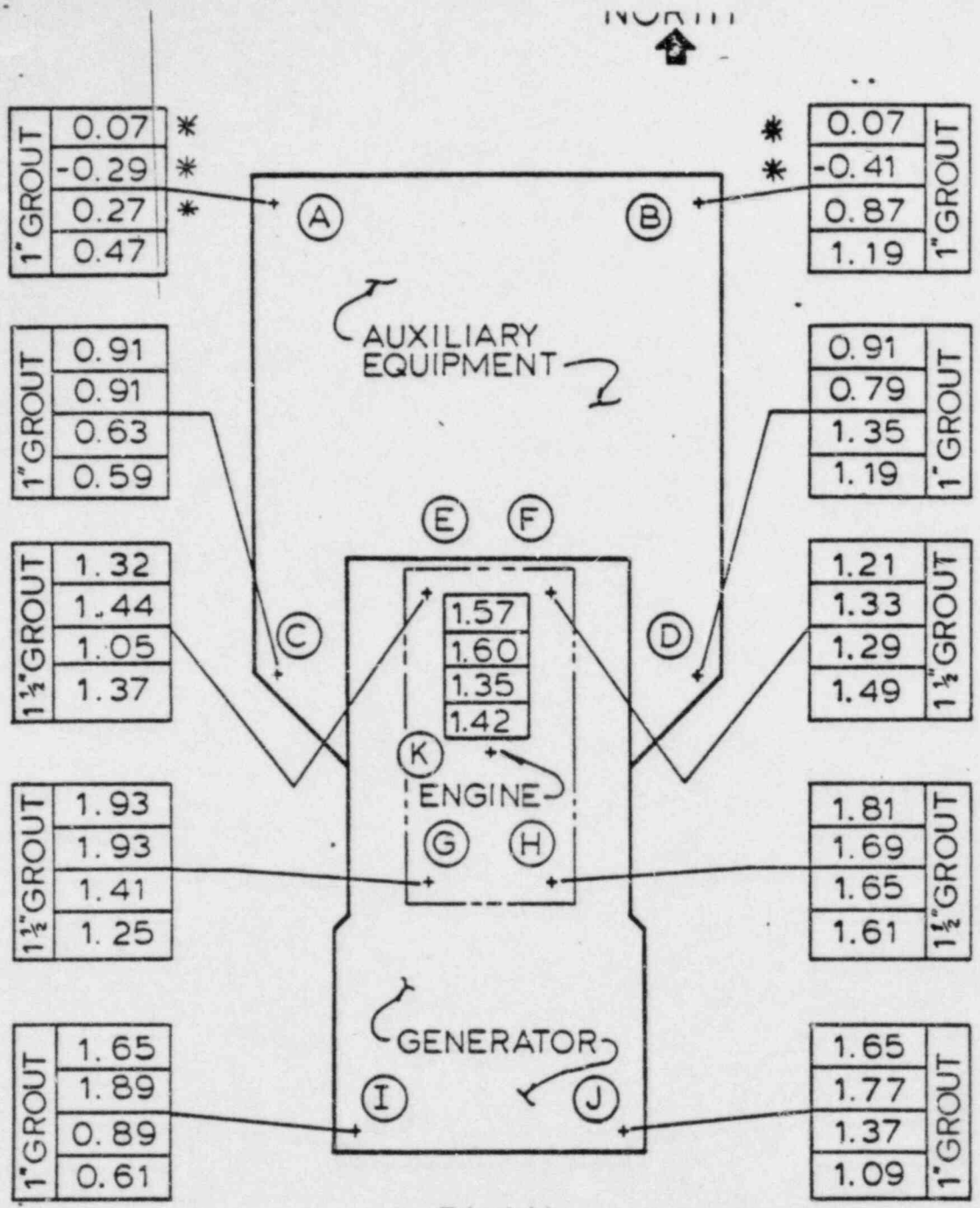
Very truly yours,

M. Salastegui
for L.H. Curtis
Project Engineer

BCM/sg
9/27/2

Enclosure: Sketch Plan of Diesel Generator Foundation

SB702811



PLAN

DIESEL GENERATOR FOUNDATION

LEGEND

DESIGN GROUT THK	
	BAY 1 * *
	BAY 2 * *
	BAY 3 * *
	BAY 4 * *

TABLE I

BAY	EQUIP. NO.	CRANK SHAFT ℄ ELEV.
1	1G11	640'-0¾"
2	1G12	640'-0¾"
3	2G11	639'-11¾"
4	2G12	639'-10¾"

** EXIST. AVAILABLE GROUT THK.

* CONC. WILL BE CHIPPED (APPROX. ¾") IF REQUIRED TO ALLOW LEVELING GROUT THK OF ½" MINIMUM.

S/702812

ATTACHMENT TO LETTER DATED 10-4-1979

XC: R.C. HSU

BECHTEL
ANN ARBOR

MEMORANDUM

TO R. RIXFORD LOCATION QA

FROM B. DHAR DATE 10-5 19 79

SUBJECT SEISMIC ANALYSIS FOR DUCT BANKS JOB NO. 7220

FILE C[redacted]

THE SEISMIC EVALUATION OF OVERSIZED DUCT BANKS ~~[redacted]~~ IS SCHEDULE TO BE COMPLETED BY END OF DECEMBER, 79.

S3702813

AAO-521

BECHTEL
ANN ARBOR

c.c. | S.C. Lo w/o
P.K. Chan w/o

MEMORANDUM

TO S. Afifi w/o LOCATION 10 D

FROM B. Dhar / B.C. McConnel / D. Reeves DATE Oct. 4 19 79

SUBJECT Diesel Generator Bldg JOB NO. 7220 - 101
Circ. Water Discharge Lines FILE [redacted]

Attached is the survey data for the interior dimensions of the circulating water discharge lines dated:

Initial readings
March 27, 1979
April 17, 1979
September 13, 1979

The data generally shows very little change in the pipe dimensions

D. Reeves, BCM

S3702814

AAO-521

From 1 in Line	Vertical	Horizontal
1	7'-11½"	7'-11 3/8"
2	7'-11 3/8"	7'-11 3/8"
3	7'-11 7/8"	7'-11¼"
4	8'-0⅛"	7'-10 13/16"
5	8'-0"	7'-11 1/16"
6	8'-0 3/16"	7'-11⅛"
7	8'-0⅛"	7'-11⅛"
8	8'-0 1/16"	7'-10 5/8"
9	~~8'-0¼"~~ 7'-11 7/16"	7'-11¼"
10	7'-11¾"	7'-11 3/8"

S.5702815

Measurement #1 was taken 10' South of the Centerline of the 12" Drain Line. The Spacing Between All the Measurements is 10'. Each Station is marked with Flourescent Orange Paint and the 2 pts where we took our Horizontal Measurement is marked the same Way

3/27/79

om Line	Vertical	Horizontal
1	7'-11 3/8"	7'-11 1/4"
2	7'-11 3/16"	7'-11 1/2"
3	7'-11 1/16"	7'-11 5/16"
4	8'-0 1/8"	7'-11"
5	8'-0"	7'-11 1/2"
6	8'-0 1/4"	7'-11 1/8"
7	8'-0"	7'-11 1/8"
8	8'-0"	7'-10 9/16"
9	8'-0 1/4"	7'-11 1/8"
10	7'-11 5/8"	7'-11 1/2"
11	7'-11 1/2"	8'-0 1/8"
12	7'-11 3/4"	7'-11 3/4"
		SD70816
13	8'-0 1/8"	7'-11 1/4"
14	7'-11 7/8"	7'-11 1/4"
15	8'-0 1/4"	7'-11"

4/17/79

rom Line	Vertical	Horizontal
1	7'-11 3/8"	7'-11 1/4"
2	7'-11 1/8"	7'-11 1/2"
3	7'-11 7/8"	7'-11 1/2"
4	8'-0"	7'-11 1/8"
5	8'-0"	7'-11 5/8"
6	8'-0 3/16"	7'-11 1/4"
7	8'-0"	7'-11 5/16"
8	8'-0"	7'-10 3/4"
9	8'-0 1/4"	7'-11 3/16"
10	7'-11 1/2"	7'-11 9/16"
11	7'-11 1/2"	8'-0"
12	7'-11 5/8"	7'-11 3/4"
13	8'-0 1/8"	7'-11 1/8"
		SB702817
14	* 8'-0 3/16"	7'-11 1/4"
	8'-0 3/8"	7'-11"

	Vertical	Horizontal
1	7'-11 3/8"	7'-11 1/16"
2	7'-11 3/16"	7'-11 1/2"
3	7'-11 7/8"	7'-11 5/8"
4	8'-0"	7'-11 1/8"
5	8'-0"	7'-11 9/16"
6	8'-0 1/4"	7'-11 1/4"
7	8'-0"	7'-11 1/8"
8	8'-0"	7'-10 3/4"
9	8'-0 1/4"	7'-11 1/8"
10	7'-11 5/8"	7'-11 3/8"
11	7'-11 3/8"	8'-0"
12	7'-11 5/8"	7'-11 3/4"
13	8'-0 1/8"	7'-11"
14	8'-0 1/4"	7'-11 1/4"
15	8'-0 1/4"	7'-10 5/8"

S5702818

BECHTEL
ANN ARBOR

C 2645

x S. L. Blue
x J. O. Ulmgard
[redacted]
x C. McConnel
13 20, 3410

MEMORANDUM

TO Doug Reese (Civil/structural) LOCATION SC

FROM P. K. CHEN (Geotech) DATE 10/4/79 19 79

SUBJECT Settlement Monitoring of Borated Water Tanks (Midland Unit 1 & 2) JOB NO 7220-101

FILE

Listed below is the (settlement) monitoring procedures of borated water tanks:

1. Prior to the tank filling, settlement readings should be taken to provide the zero datum.
2. Loading-time diagram should be recorded.
3. During and after the tank filling, settlement readings should be taken as follows:
   - 3a. once per week for the first three months
   - 3b. once per two weeks for the next three months.
   - 3c. Geotech will evaluate the settlement data to determine the monitoring frequency thereafter.

At the present moment, we felt that the existing settlement markers (T1 thru T6) are adequate enough to provide the required information. Should adverse condition (excessive settlement) occur, additional monitoring instruments may required.

Please advise if there are any questions.

S 5702819

AAO-521

To	JBFalahee, M-1168B SHHowell, P-20 6 LBLindemer, M-1066A	JWCook, M-1155A RFGreen, P-14-303 GSKeeley, P-14-408B	MCKoschik, M-870A (G)

C-2645

FROM JLBacon, M-1085A

DATE September 7, 1979

000025

Consumers Power Company

INTERNAL CORRESPONDENCE

SUBJECT ATOMIC ENERGY - MIDLAND PLANT
- Reactor Construction Permit & Operating License
- Operating License: Hearing
(Correspondence)

CC PABecnel, San Francisco, CA
PAMartinez, Ann Arbor, MI
CEMahaney, Lynchburg, VA

Attached is a copy of the NRC Staff's response to the ASLB's August 2, 1979 order which directed the Staff to report its estimate for DES issuance and to comment on the feasibility and desirability of hearing the diesel generator building issue ahead of other safety issues. In its response, the Staff adheres to its July 10, 1979 response, urging denial of the Company's motion insofar as the diesel generator building issue is concerned and requesting that the Board hold in abeyance a ruling on that portion of the motion concerning the environmental phase of the proceeding.

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OCT 03 1979
BECHTEL
AA 7220

JOB 7220

	ACT.	INFO.	COPY	INIT
PROJ. ENGR.		2		
ASST. P. E. T		3		
ASST. P. E. T				
ASST. P. E. P		1		WOR
ASST. P. E. P				
MECH.				
ELECT.				
CS				
CIVIL				
P.D.				
ARCH.				
G.E.				
C.TR./ENGR. PL.				
PROJ. MGR.				
PROC. MGR.				
FIELD				
CONST. COORD.				
FSAR			FXC	
ADMIN.				
K. Wieland			✓	
FILE NO. C-271 Lets, 0490.3				

10/4/79
10/11/79

8702820

9/4/79

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD 000025

In the Matter of

CONSUMERS POWER COMPANY

(Midland Plant, Units 1 and 2)

Docket Nos. 50-329
50-330
(Operating Licenses Proceeding)

NRC STAFF RESPONSE TO
BOARD'S AUGUST 2 ORDER

On August 2, 1979, this Board issued a Memorandum and Order directing the NRC Staff to report its current estimate for the issuance of its Draft Environmental Impact Statement and to comment on the feasibility and desirability of hearing the diesel generator building issue in advance of other safety issues.

The Board correctly notes in its Order that the date for DES issuance in the Staff's July 10 response to Consumers' Motion is different from the date appearing in the July 6, 1979 Status Summary Report. The date in the Staff's response was the current projection. The date was revised following a public meeting at which Consumers urged the Staff to issue the DES earlier, even though the Staff informed Consumers that such action would result in a long comment period since the Staff did not plan to revise the FES issuance date of November, 1980. These environmental schedule problems, of course, result in part because of slippages in the safety review. In addition, the Staff has been considering what revisions in the DES review will be necessary as a result of the Three Mile Island accident. The Staff's conclusions may cause further revisions to the estimate for DES issuance. It would not be wise to issue a FES based on

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C. P. Co. Legal

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safety assumptions which ultimately proved to be inaccurate because of signi-
ficant changes in construction, costs or requirements. As the Staff noted
in its July 10 response, however, it may be possible to have separate hearings
on environmental issues before this Board. Some of those issues are presently
framed are unaffected by the ongoing safety review and could be resolved in
hearing.

The NRC Staff does not believe that separating the diesel generator building issue from other safety issues is appropriate. As the Board and parties are aware, the Staff sent a 50.54(f) letter to Consumers on March 21, 1979 requesting information to enable the Staff to determine whether enforcement action such as license modification, suspension or revocation should be taken. Consumers' reply was filed on April 24, 1979[1/] and has been supplemented several times, most recently on August 10, 1979. Another report is promised on or before September 7, 1979.[2/] At present, the Staff cannot state with any certainty what its position will be with regard to Consumers' proposed course of action, nor can it state what further proceedings will be necessary. For purposes of the OL review, however, the diesel generator building issue involves the Applicant's quality assurance program and implementation and, therefore, necessarily impacts other significant aspects of the Staff review effort. Consequently, the Staff does not believe that much constructive progress could be made in evidentiary hearings which attempted to separate the settlement issue from the other issues in the proceeding. Furthermore, the Staff would not be able to issue a partial SER on the issue without having substantially completed other major portions of the safety review. In such circumstances, the Staff

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1/ Served on the parties by letter dated April 30, 1979.

2/ Letter from S. Howell to J. Keppler dated August 10, 1979.

8007020822

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does not believe it desirable to hear the diesel generator building issue in advance of other safety issues.

For the foregoing reasons, the Staff adheres to its July 10, 1979 response and urges that the Board deny Consumers' Motion to the extent it is directed to the safety phase of this proceeding and that the Board hold the portion of the motion concerning the environmental phase of the proceeding in abeyance.

Respectfully submitted,

William J. Olmstead

William J. Olmstead
Counsel for NRC Staff

Dated at Bethesda, Maryland
this 4th day of September, 1979.

8507020823

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

000025

In the Matter of	)	
CONSUMERS POWER COMPANY	)	Docket Nos. 50-329 50-330
(Midland Plant, Units 1 and 2)	)	(Operating Licenses Proceeding)

CERTIFICATE OF SERVICE

I hereby certify that copies of "NRC STAFF RESPONSE TO BOARD'S AUGUST 2 ORDER", dated September 4, 1979, in the above-captioned proceeding, have been served on the following by deposit in the United States mail, first class, this 4th day of September, 1979.

* Ivan W. Smith, Esq.
Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

* Mr. Gustave A. Linenberger
Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dr. Frederick P. Cowan
6152 N. Verde Trail
Apt. B-125
Boca Raton, Florida 33433

Frank J. Kelley
Attorney General of the State of Michigan
Stewart H. Freeman
Assistant Attorney General
Gregory T. Taylor
Assistant Attorney General
Environmental Protection Division
720 Law Building
Lansing, Michigan 48913

Myron M. Cherry, Esq.
1 IBM Plaza
Chicago, Illinois 60611

Ms. Mary Sinclair
5711 Summerset Street
Midland, Michigan 48640

Michael I. Miller, Esq.
Ronald G. Zamarin, Esq.
Martha E. Gibbs, Esq.
Caryl A. Bartelman, Esq.
Isham, Lincoln & Beale
One First National Plaza
42nd Floor
Chicago, Illinois 60603

*Atomic Safety & Licensing Board Panel
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

*Atomic Safety & Licensing Appeal Panel
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

*Docketing and Service Section
Office of the Secretary
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

8307020824

000025

Judd L. Bacon, Esq.
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

R. L. Davis, Esq.
J. E. Dicks, Esq.
L. F. Nute, Esq.
The Dow Chemical Company
Legal Dept., 47 Bldg.
Midland, Michigan 48640

Mr. Steve Gadler
2120 Carter Avenue
St. Paul, Minnesota 55108

Wendell H. Marshall, Vice President
Midwest Environmental Protection Associates
RFD 10
Midland, Michigan 48640

William J. Olmstead
Counsel for NRC Staff

8702825

	INFO	ACTION	INITIAL
B. STAFFORD			
D. REEVES			
D. YUAN			
LAKSHMI			
J. NOOK			
S. RAO			
S. LO		L	
P. SHEN			
C. McCONNEL		2	BCM

Comments:

Looks like [illegible]

Forward to [illegible]

C-2675

Bechtel Associates Professional Corporation

Inter-office Memorandum

To	L. H. Curtis	Date	3 October 1979
Subject	Midland Units 1 & 2-Job 7220 50.54(f) Response and Diesel Generator Building Task Group	From	S. S. Afifi
		Of	Geotechnical Services
Copies to	S. L. Blue [redacted] P. K. Chen R. Rixford J. O. Wanzeck K. Wiedner 1320, 3410	At	Ann Arbor 10(D) 7220-79-210

REFERENCE: IOM from R. L. Rixford to S. S. Afifi, dated October 1, 1979 (Action Item S-79)

To respond to Question 4 by providing the criteria and the extent to which residual settlements will be permitted, it is understood and agreed that Geotech will provide an estimate of ultimate and differential residual settlements of the Diesel Generator Building by December 1979. Engineering will investigate whether the Diesel Generator Building can withstand the estimated ultimate and differential residual settlement.

With respect to the four items listed in the referenced memorandum, presented herewith are the corresponding responses.

Item 1 and 2: All the inputs (Soils and building movements vs. time, surcharge loading history) are obtained through the project.

Item 3: Geotech is currently evaluating the ultimate residual and differential settlements based on the available up-to-date data.

Item 4: The estimated residual settlements will be provided to the project by December 1979.

If there are any questions, please advise.

P. K. Chen for
S. S. Afifi

PKC/lap

8702828

TELECOPY

BEBC- 3311

Bechtel Associates Professional Corporation

Inter-office Memorandum

To J.F. Newgen

Date October 3, 1979

Subject Midland Plant Units 1 & 2
Job 7220
Plant Area Dewatering
File: 0274 [redacted]

From L.H. Curtis

Of Engineering

At Ann Arbor

Copies to

L. Basinski
J. Betts
A. Boos
L. Curtis
J. Darby
B. Dhar
T. Johnson
B.C. McConnel
W. Paris, Jr.
J. Wanzeck
K. Wiedner
Com Log

References: 1) BEBC-3294, 9/24/79
2) Drawing 7220-C-1145(Q), Rev 4

To expedite the field investigations program for the plant area dewatering system, the instructions in Reference 1 have been modified. Four boring locations have been eliminated, five boring locations have been shifted to more accessible areas, locations of three pump test wells have been predetermined, use of Revert as a hole-stabilizing agent will be permitted, and the installation requirements for the pump test wells have been established.

The revised schedule of borings described in Reference 1 is as follows:

Boring*	Location	Approximate Depth**	Well
PD-1	S5335/E50	75	No
PD-2	S5335/E110	55	No
PD-3	S5335/E185	55	Yes**
PD-4	S5335/E250	75	No
PD-5	S5335/E315	55	No
PD-6	S5325/E390	55	Yes**
PD-7	S5335/E450	75	No
PD-8	S5325/E515	55	No
PD-9	S5260/E600	75	No
PD-10	S5275/E485	55	Yes**
PD-11***	S5065/W30	60	Yes**
PD-13	S5095/E540	55	Yes**
PD-14***	S4980/E980	50	Yes**
PD-15***	S4870/E695	55	Yes
PD-19	S5192/E160	60	Yes
PD-20	S5192/E348	60	Yes

*Borings PD-12, 16, 17, and 18 have been eliminated.
**To be determined by onsite geotechnical engineer
***New location

8702829

Bechtel Associates Professional Corporation

TELECOPY

Revised Reference 1, Note 1 to read:

1) The holes for the borings shall be advanced with casings, hollow-stemmed augers and clean water, or with the use of Revert. Bentonite or other hole-stablizing chemical agents shall not be used.

Revised Reference 1, Note 4 to read:

4) Borings PD 1, 2, 4, 5, 7, 8, and 9 shall be plugged in accordance with Note 11 on Drawing 7220-C-1145(Q). The remaining borings shall be either plugged in accordance with Note 11 on Drawing 7220-C-1145(Q) or converted to a pump test well or to an observation well as directed by the onsite geotechnical engineer. Wells shall be provided with permanent barrier protection.

All other requirements specified in Reference 1 remain the same.

The pump test wells shall be a minimum of 8 inches in diameter and shall be provided with a minimum of two observations wells and two borros anchors at each location. The installation details of the test wells, observation wells, and borros anchors, and the procedure for performing the pump test will be at the direction of the onsite geotechnical engineer.

for Mothwell
L.H. Curtis

BCM/js
10/1/5

FIELD ENGINEER'S REPORT FORM

MIDLAND UNITS 1 & 2

JOB 7220 DATE 29 MAY 79 PAGE 1 OF 3

~~ITEM NO~~	~~INSPECTION DESCRIPTION~~	~~ACTION REQUIRED/TAKEN~~
	PURSUANT TO RESOLUTION OF NCR # 2072, REGARDING EMBEDDED CONDUIT 2BA074, THE FOLLOWING INSPECTION WAS PERFORMED:	
	ALL UNUSED CONDUITS IN THE ASSOCIATED DUCTBANK WERE INSPECTED AS DESCRIBED ON ATTACHED FSK-EY-136 REV 0. RESULTS ARE NOTED BELOW	
CONDUIT	REMARKS	
1BA037	CABLE IN CONDUIT	
1BA001	PRESSURE DROP 100→40 PSIG IN 15 MINUTES	
1BA003	NO SIGNIFICANT PRESSURE DROP	
1BA038	" " " "	
1BA002	" " " "	
1BA004	CABLE IN CONDUIT	
1AA017	NO SIGNIFICANT PRESSURE DROP	
2BA042	CABLE IN CONDUIT	
2BA044	NO SIGNIFICANT PRESSURE DROP	
2BA043	" " " "	
1AA060	CABLE IN CONDUIT	
1AA061	PRESSURE DROP 100→40 PSIG IN 15 MINUTES	
2AA062	NO SIGNIFICANT PRESSURE DROP	
2AA063	" " " "	
2EA029	CABLE IN CONDUIT	

REMARKS:

ATTACHMENT: FSK-EY-136-20 S5702335

SIGNATURE JR KNOKE

ROUTE

DRM MATTHEWS
HARPER
NIELSON
THOMPSON

FILE

FIELD ENGINEER'S REPORT FORM

MIDLAND UNITS 1 & 2

JOB 7220 DATE 29MAY79 PAGE 2 OF 3

~~ITEM NO~~	~~INSPECTION DESCRIPTION~~	~~ACTION REQUIRED/TAKEN~~
CONDUIT	REMARKS	
2BA073	NO SIGNIFICANT PRESSURE DROP	
2BA074	NO RESISTANCE TO PRESSURE. SUBSEQUENTLY, THIS CONDUIT WAS PRESSURIZED WITH WATER WHICH BUBBLED TO THE SURFACE AT APPROX COORDINATES S4980 / E725. THIS POINT IS COINCIDENT WITH A SITE BORING LOCATION NOTED ON DRAWING C-1145(G) REV 2, WHICH IS ASSUMED TO BE THE CAUSE OF THE LEAK NOTED ON REFERENCED NON-CONFORM REPORT	
2AA001	CABLE IN CONDUIT	
2AA004	NO SIGNIFICANT PRESSURE DROP	
2AA005	" " " "	
2AA002	CABLE IN CONDUIT	
1AA004	" " "	
1AA005	" " "	
1AA002	NO SIGNIFICANT PRESSURE DROP	

WITH THE EXCEPTION OF 2BA074, A FISH MANDREL* WAS PULLED BY HAND THROUGH EACH INSPECTED CONDUIT, WITH NO CONSEQUENTIAL OBSTACLES.

*ENSLEY PART # E-882

REMARKS:

S3702636

SIGNATURE JR KNOKE

ROUTE

FILE

FIELD ENGINEER'S REPORT FORM

MIDLAND UNITS 1 & 2

JOB 7220 DATE 28MAY79 PAGE 3 OF 3

~~ITEM NO.~~	~~INSPECTION DESCRIPTION~~	~~ACTION REQUIRED/TAKEN~~
	CONCLUSIONS —	
	WITH THE EXCEPTION OF DAMAGED CONDUIT ZB40 THERE IS NO INDICATION OF ABNORMALITIES WHICH WOULD IMPEDE CABLE PULLING.	
	RECOMMENDATION —	
	PENDING ECONOMIC ANALYSIS OF ALTERNATIVE CABLE ROUTING(S), CONDUIT ZBA074 SHOULD BE EXCAVATED, INSPECTED, AND REPAIRED IF POSSIBLE	

REMARKS:

S3702837

SIGNATURE

ROUTE

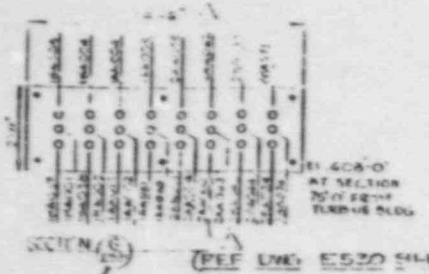
FILE

CALCULATION SHEET

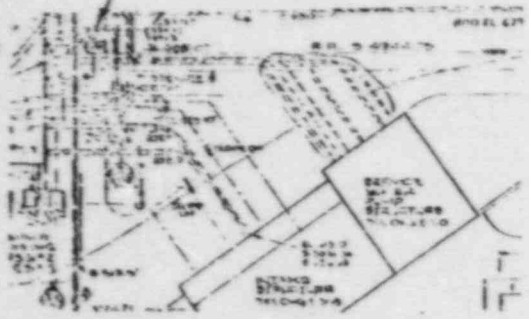
DESIGN BY: JR KNOKE DATE: 3MAY'19

PROJECT: MIDLAND UNITS 1&2

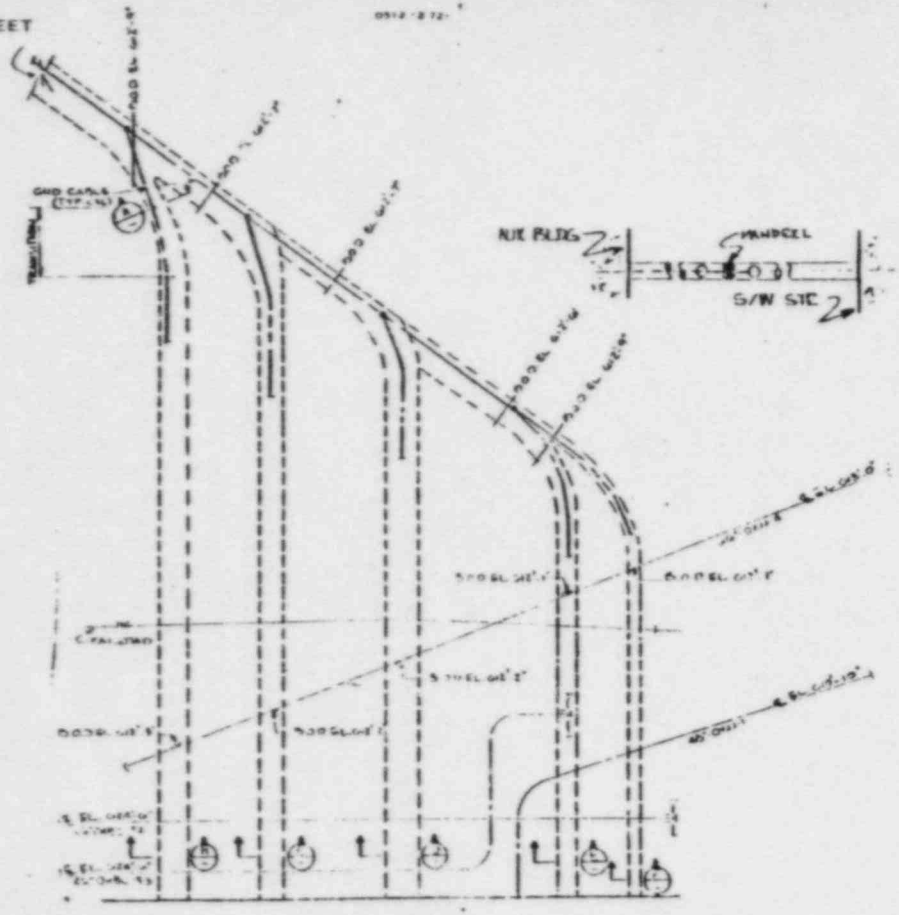
SUBJECT:



SECTION (5) (REF DWG E520 SH1)



LOCATION PLAN
(REF DWG E521)



SERVICE WATER PUMP STRUCTURE DUCT BANK
SECTION A
(REF DWG E510)

INSPECTION PROCEDURE

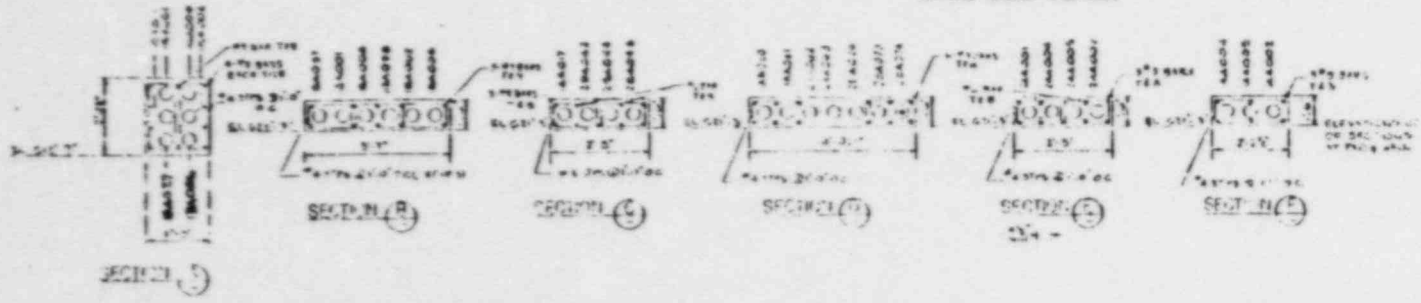
(1) ATTACH PULL ROPE TO EACH END OF MANDREL

(2) PULL MANDREL THROUGH CONDUIT IN EACH DIRECTION

(3) IF OBSTRUCTIONS ARE ENCOUNTERED, MARK LOCATION(S) ON ROPE

(4) MEASURE & RECORD DISTANCES FROM MANDREL TO ROPE MARK AND REMOVE MARKING PRIOR TO INSPECTION OF NEXT CONDUIT.

(5) PRESSURIZE EACH CONDUIT TO 100# PSIG AND HOLD FOR 15 MINUTES. REPORT SIGNIFICANT PRESSURE LOSSES



REV	DATE	ITEM	DRN	CHK	APP
0	3MAY'19	ISS FOR INSP	JRK		

SERVICE WATER PUMP STR DUCT BANK INSPECTION

S-702338

FSK-EY-136 REV 0

C-2645

Bechtel Associates Professional Corporation

Inter-office Memorandum

To S. S. Afifi

Date October 1, 1979

Subject Midland Units 1 & 2
50.54(f) Response and Diesel
Generator Building Task Group

From R. L. Rixford

Of Quality Assurance

Copies to S. L. Blue
L. H. Curtis
[redacted]
J. A. Ritgers
K. Wiedner

At Ann Arbor

REFERENCE: 1) IOM, S. S. Afifi to R. L. Rixford dated 9/25/79
2) IOM, R. L. Rixford to S. S. Afifi dated 9/6/79

This is to acknowledge receipt of Reference 1, submitting your comments on Revision 3 of the responses to the NRC 50.54(f) Questions. As stated in Reference 2, your comments were needed by 9/10/79 to support a 9/14/79 submittal to the client. The revision was submitted, on schedule, 9/14/79 without the benefit of your input on this very crucial matter.

In the attachment to Reference 2 you were requested to provide information that would support an effort to meet a December, 1979 date for providing a final response to the NRC Question 4. Reference 1 concurred with the December, 1979 date, but did not provide the requested information.

The objective is to respond to Question 4 by providing the criteria and the extent to which residual settlements will be permitted. To enable us to provide you with any information you need and to provide us with a way to monitor your progress, Reference 2 asked you to provide a list of:

1. What inputs you need to get started.

2. Who is to provide these inputs.

3. What steps you will have to go through.

4. How long each of these steps will take.

To allow us to get our input to you as soon as possible, please provide the above information by October 8, 1979.

R. L. Rixford

RLR/cf

8702840

(-26-5

x S.L. Blue
x L.M. Cath
x [redacted]
x J. Wanek
x S.S. Stiffi
3410, 1320

BECHTEL
ANN ARBOR

MEMORANDUM

TO C. McConnel LOCATION SC

FROM P. K. Chen of Geotech DATE Sept. 25, 79 19 79

SUBJECT Instrument Monitoring Frequency D/G Bldg. JOB NO 7320-001 (Midland unit 1&2)

FILE

Tabulated below is the required monitoring frequency of D/G instruments

Instrument Type	Monitoring frequency		
D/G markers, platforms, berm anchors.	SEPT 25 – Oct. 31, 79 Nov. 1 – Dec. 31, 79 JAN 1, 80 thereafter	weekly monthly bi-monthly	
piezometers.	SEPT. 25 – Oct 31, 79 Oct. 31 thereafter	bi-weekly monthly	(performed by Geotech)
Sonder & deep form anchors.	SEPT 25 → SEPT 29, 79 SEPT 30 → Oct 30, 79 Oct. 30, 79 thereafter	daily bi-weekly monthly	(performed by G&D)

The above monitoring frequency for various instruments will be changed during and after the installation of permanent dewatering system at the power block area. We will advise you at that time. If you have any questions, please advise us.

S3702841

AO-521

C-764

Bechtel Associates Professional Corporation

Inter-office Memorandum

To R. L. Rixford

Date 25 September 1979

Subject Midland Units 1 & 2-Job 7220-001
50.54 (f) Response Rev.3

From S. S. Afifi

Of Geotechnical Services

Copies to S. L. Blue
[redacted]
K. Wiedner w/o
1320, 3410

At Ann Arbor 10 D 5
7220-79-200

REFERENCE: IOM from R. L. Rixford to S. S. Afifi, dated September 6, 1979
Subject: 50.54 (f) Response, Rev. 3 (S-60)

We have reviewed the additional information attached with the reference memo. Return herewith are the pages which contain comments.

P. K. Lee for
S. S. Afifi

PKC/nm
Attachment

8702242

Question 4

Specify and justify the acceptance criteria which you will use to judge the acceptability of the fill, structures, and utilities upon conclusion of the preload program. Compare these criteria with that to which the material was to have been compacted by the original requirements set forth in the PSAR. The response should consider all areas where preloading is either planned or in progress (i.e., diesel generator building, borated water storage tanks, diesel fuel oil storage tanks, Unit 1 transformer, condensate storage tanks, and others still under evaluation). Describe how conformance to these criteria will result in assurance that unacceptable residual settlements cannot reasonably be expected to occur over the life of the plant. For each such area, state the extent of residual settlement which will be permitted and the basis for each limit.

Response

The criteria and the extent to which residual settlements will be permitted will be provided by December 1979. The manner in which acceptability criteria for the fill will be developed is discussed in the following paragraphs. Acceptability of the structures and utilities will be determined based on their ability to accommodate the predicted fill settlements.

The compaction requirements set forth in the PSAR were based on the premise that significant engineering properties, strength, and compressibility are related to degree of compaction. Where the engineering properties can be established by other, more direct means, the degree of compaction becomes irrelevant.

The surcharge and the completed portion of the diesel generator building will produce stresses in the fill that, at all depths, will exceed those that will prevail when the structure is operational. The surcharge will remain until excess pore pressures are essentially dissipated and the rate of residual settlement becomes small and can be predicted conservatively by extrapolation. It can then be concluded with assurance that, after removal of the earthen surcharge, the rate of settlement will be considerably less than the aforementioned prediction. Because of the initial variability of the degree of compaction of the fill, it is unlikely that the compaction requirements of the PSAR will be satisfied at all points, but because of the ensured favorable settlement characteristics due to the surcharge, the design intent of the PSAR will be met.

9/20/79
We concur with this date we need to assure that this date will be met.
please provide a list of:
1. what inputs are needed
2. who is to provide these inputs
3. what steps you will have to go thru.
4. how long these steps will take

S5702843

Question 6

You propose to fill the borated water storage tanks and measure the resulting structure settlements.

(a) On what basis do you conclude a surcharge no greater than the tank loading will achieve compaction to the extent intended by the criteria stated in the PSAR? What assurance is provided by the technique that residual settlement for the life of the plant will not be excessive?

(b) A similar procedure is proposed for other tanks, including the diesel fuel oil storage tanks, and should also be addressed.

(c) The borated water storage tanks have not yet been constructed and are to be located upon questionable plant fill of varying quality. Provide justification why these safety-related tanks should be constructed prior to assuring the foundation material is suitable for supporting these tanks for the life of the plant. For example, can the tanks be removed with reasonable effort without significant impact?

Response (to Question 6, Part a)

The field exploration program in the area of borated water storage tanks shows that the material below the top 4 feet is satisfactory. All unsuitable material will be removed and replaced by suitable compacted fill. This condition is suitable for the support of these tanks. To confirm this and demonstrate that the fill is satisfactory, the tanks will be constructed and filled with water in order to make a full-scale test of the foundation soils. The tank filling will provide reliable information for predicting long-term settlement, which will allow a conservative design [illegible] the degree of compaction set forth in the PSAR may not be satisfied at all points, the PSAR design intent will be met because the fill will have been subjected to a full-scale load test, which will allow a reliable prediction of long-term settlement.

The full-scale load test provides direct and reliable assurance that unpredicted long-term settlements will not occur. Because the piping connections will be made to allow startup flushing, filling, and testing of the tank, selected points on the piping between the borated water tank and the auxiliary building will be monitored for differential settlement and

[redacted]

Bechtel Associates Professional Corporation

Inter-office Memorandum

To L. H. Curtis

Date [redacted]

Subject Midland Units 1 & 2-Job 7220-101
Review of Diesel Generator
Settlement Evaluation with
Consultant

From S. S. Afifi

Of Geotechnical Services

At Ann Arbor 10 D 5
7220-79-199

Copies to

S. L. Blue
[redacted]
K. Wiedner
1320, 3410, 2140
J. O. Wanzeck

Attached please find the meeting notice regarding Diesel Generator Building Settlement Evaluation. Please notify the Consumer's Power Company so they can send a representative for the meeting. Should you have questions, please let us know.

P. K. Chen for
S. S. Afifi

PKC/nm
Attachment

S3702845

MEETING NOTICE

BECHTEL JOB NO. 7220-101
PROJECT Midland Units 1 & 2

SUBJECT OF THE MEETING

Diesel Generator Building Settlement Evaluation

DAY Thursday, October 25, 1979

TIME 8:30 a.m. TO 2:30 p.m.

LOCATION 10 D 5 Bechtel Power Corp., Ann Arbor, Michigan

ATTENDEES

Prof. A. J. Hendron, Jr.
W. R. Ferris
B. Dhar
S. S. Afifi
P. K. Chen
CPCo Representative

The addressee, checked above, if unable to attend, is requested to:
☐ NOTIFY CHAIRPERSON ☒ SEND REPRESENTATION

PURPOSE OF THE MEETING

To review up-to-date diesel generator building settlement data.

☐ AGENDA ATTACHED ☒ MEETING NOTES WILL BE DISTRIBUTED

CHAIRPERSON	PHONE	DATE
P. K. Chen	7185	9/19/79

KW 9-21-79

SD702346

AAO-818

Bechtel Associates Professional Corporation

Inter-office Memorandum

TELECOPY
BEBC- 3294

To J.F. Newgen

Date September 24, 1979

Subject Midland Plant Units 1 & 2
Job 7220
Plant Area Dewatering
File: 0274, [redacted]

From L.H. Curtis

Of Engineering

At Ann Arbor

Copies to
K. Wiedner
L. Basinski
J. Darby
B. Dhar
B.C. McConnel
T. Johnson
W. Paris, Jr.
J. Wanzeck
A. Boos
J. Betts
Com Log

Reference: Drawing C-1145(Q) Revision 4

To define the recharge rate parameters for the plant area dewatering system design, additional borings are required. Several of these borings may be developed into wells for pump tests after evaluation of the boring data.

Boring Ident.	Location	Approx. Depth*	Well
PD-1	S5335/E50	75	No
PD-2	S5335/E110	55	No
PD-3	S5335/E185	55	Yes
PD-4	S5335/E250	75	No
PD-5	S5335/E315	55	No
PD-6	S5325/E390	55	Yes
PD-7	S5335/E450	75	No
PD-8	S5325/E515	55	No
PD-9	S5260/E600	75	No
PD-10	S5275/E485	55	Yes
PD-11	S5065/E165	60	Yes
PD-12	S5132/E295	60	Yes
PD-13	S5095/E540	55	Yes
PD-14	S4995/E800	50	Yes
PD-15	S4940/E585	55	Yes
PD-16	S4820/E72	55	Yes
PD-17	S4745/E420	60	Yes
PD-18	S4678/E250	75	Yes
PD-19	S5210/E160	60	Yes
PD-20	S5210/E348	60	Yes

8702847

*The actual depth shall be determined by the onsite geotechnical engineer.

The borings shall be made in accordance with Drawing C-1145(Q) notes 1, 2, 3, 4, 5, 6 and the following additional criteria.

1) The holes for the borings shall be advanced with casings or hollow stemmed augers and clean water. Revert, Bentonite or other hole stabilizing chemical agents shall not be used.

2) Grain size analysis in accordance with ASTM D422-63 shall be preformed on each layer of natural and backfill sand greater than 2 feet in thickness.

3) Falling head permeability test shall be made in accordance with U.S. Department of Interior Bureau of Reclamation designation E-18 in all natural and back fill sand greater than 5 feet in thickness by either driving a 3 inch O.D. split spoon sampler or by drilling below the casing to a depth specified by the onsite geotechnical engineer.

4) Borings PD 1, 2, 4, 5, 7, 8 and 9 shall be plugged in accordance with note 11 on Drawing C-1145(Q). The remaining borings shall be either plugged with cement grout, or backfilled with sand to allow conversion to permanent observation wells as directed by the onsite geotechnical engineer. These wells shall be provided with permanent barrier protection.

The above locations and criteria will be added to Drawing C-1145.

This boring program requires your immediate attention and should be scheduled for completion by October 5, 1979.

for W.O. Rothwell
L.H. Curtis

BCM/jet
9/20/4

S5702848

C-2645

TELECOPY D. W. HALLIGAN
MET 36
1 page

Bechtel Power Corporation

000447

Inter-office Memorandum

To D. W. Halligan

Subject Midland Units 1 and 2
Consumers Power Company
Bechtel Job 7220
PLANT FILL SETTLEMENT

Date September 21, 1979

From John A. Rutgers

Of Project Management

At Ann Arbor Office

File 0614

Copies to

R. D. Allen
P. A. Becnel
[redacted] Curtis
H. B. Friend
P. K. Hansen
F. A. Hollenbach
M. G. Johnson
L. C. McKillip
H. O. Reinsch
E. A. Rumbaugh
H. W. Wahl
K. Wiedner
R. K. Vassar

JOB 7220

	ACT.	INFO. COPY	INIT.
PROJ. ENGR.		2	
ASST. P. E. T			
ASST. P. E. T			
ASST. P. E. P		1	
ASST. P. E. F			
MECH.			
ELECT.			
CS			
[redacted]		✓	9/25
P.D.			
ARCH.			
Q.E.			
C.TR./ENGR. FL.			
PROJ. M.E.D.			
PROC. [illegible]			
FIELD			
CONST. [illegible] D.			
FSAR			
ADMIN.			
plan fill			
FILE NO. 0670.2			

Following is an update on activities relating to the settlement.

(1) The specification and design drawing for the installation of the service water structure piles were issued.

(2) Construction has been released to place the floor topping, equipment anchor bolts, stairs and walkways for the mezzanine floor in the diesel generator building.

(3) Bid proposals for the auxiliary building underpinning have been received and are being reviewed by Project and Geotechnical Services.

(4) Installation of dewatering wells inside of the turbine building has begun.

R.H. Curtis / for J.A.R.
John A. Rutgers

Bcm
JAR/BCM/br

S5702849

XC: L.H. CURTIS

BECHTEL
ANN ARBOR

MEMORANDUM

TO T. JOHNSON LOCATION ANN ARBOR

FROM B. DHAR DATE 20 SEPTEMBER 1979

SUBJECT AUTHORIZATION FOR PRODUCTION USE OF A USER WRITTEN SUBROUTINE FOR BSAP-POST JOB NO 7220 FILE [redacted]

THE COMBINE MODULE OF BSAP-POST (CE201) PROVIDES A SUBROUTINE TO PERFORM SCALER COMBINATIONS OF THE RESPONSE FROM A BSAP ANALYSIS. THE MODULE ALSO ALLOWS THE USER, AS AN OPTION, TO WRITE A SUBROUTINE TO PERFORM THE COMBINATION OF RESPONSE DATA BY WHATEVER METHOD THE USER SPECIFIES. THE LATTER, IT IS UNDERSTOOD, REQUIRES APPROPRIATE AUTHORIZATION FROM THE CHIEF ENGINEER BEFORE THE OPTION MAY BE UTILIZED FOR PRODUCTION PURPOSES. SUCH A SUBROUTINE HAS BEEN WRITTEN AND TESTED WITH THE PURPOSE TO FACILITATE THE COMBINATION OF CO-DIRECTIONAL RESPONSES TO THE THREE COMPONENTS OF AN EARTHQUAKE BY THE SRSS METHOD. THE FINITE ELEMENT MODEL ANALYSIS OF THE DIESEL GENERATOR BUILDING, CURRENTLY IN PROGRESS, WOULD BENEFIT FROM THIS USER WRITTEN SUBROUTINE BY ALLOWING THE COMPUTER TO PERFORM THE LARGE AMOUNT OF REPETITIVE CALCULATIONS. THEREFORE IT IS REQUESTED THAT THE NECESSARY AUTHORIZATION BE GIVEN TO ALLOW THE USE OF THIS USER WRITTEN SUBROUTINE.

IT IS NECESSARY THAT SEISMIC RESPONSES FOR THE DIESEL GENERATOR BUILDING BE CALCULATED BY THE SRSS METHOD TO REMAIN CONSISTANT WITH OUR COMMITMENT IN APPENDIX 3A-126 OF THE MIDLAND FSAR WHICH STATES, IN PART, THAT THE DESIGN INITIATED AFTER REV. 1 (2/76) OF NRC REG. GUIDE 1.92 CONFORM TO THE REQUIREMENTS OF THIS SECTION OF THE REGULATORY GUIDE.

B Dhar

8702350

AAO-521

bcc: S. Afifi
J. Clements
K. Wiedner
J.A. Rutgers
Com Log

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

BLC- 8184

September 18, 1979

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

Attention: Mr. R.C. Bauman

Subject: Consumers Power Company
Midland Plant - Job 7220
Tolerable Settlement of
Seismic Category I Structures
File: 0270, [redacted]

Gentlemen:

This is to acknowledge the request made by Consumers Power Company on August 15, 1979. For each Seismic Category I structure, Bechtel will specify a maximum allowable settlement and time rate. The values for the diesel generator building will be available by the end of 1979 and the values for the remaining buildings in June 1980. They will be incorporated into an FSAR revision or an appropriate specification.

Very truly yours,

for M O Rothwell
L.H. Curtis
Project Engineer

SL/js
9/10/6

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

S3702851

[redacted]

Bechtel Associates Professional Corporation

Inter-office Memorandum

To L. H. Curtis

Date [redacted]

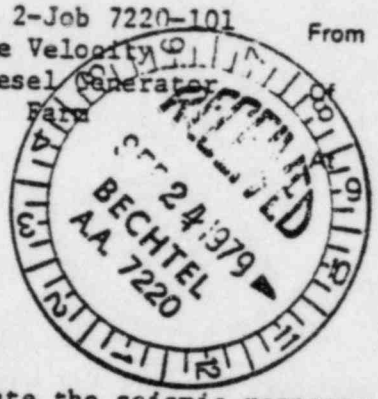
Subject Midland Units 1 & 2-Job 7220-101
In-Situ Shear Wave Velocity
Measurements - Diesel Generator
Building and Tank Farm

From S. S. Afifi

Geotechnical Services

Ann Arbor 10 D
7220-79-193

Copies to
S. L. Blue
B. Dhar
C. McConnel
J. O. Wanzeck
1320, 3410
R. Woods



In order to evaluate the seismic response of the structures supported by fill to determine that they satisfy the committment made in the PSAR, it was decided and agreed between Engineering and Geotech that in-situ shear wave velocity measurements would be made as follows:

a) Diesel Generator Building: Three or four sets of in-situ shear wave velocity measurements will be conducted. For each set of measurements, three boring holes (approximately 45 feet depth) will be required. Also, one additional set will be made outside the surcharge area to evaluate the dynamic modulus difference between no surcharge versus surcharge.
b) Tank Farm Area: Two sets of in-situ shear wave velocity measurements will be conducted.

The boring locations are listed in the attached sheet.

All the in-situ shear wave measurements will be made by Dr. R. D. Woods (Consultant). J. O. Wanzeck and P. K. Chen (Geotech) will coordinate with Engineering and Field to accomplish the task.

P. K. Chen for
S. S. Afifi

PKC/nm

JOB 7220

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FIELD		
CONST.		
PSAR		
ADMIN.		
FILE NO.	0670.2	

SB702852

TANK FARM

	SET ONE	SET TWO
(1)	350 E 4,625 S	200 E 4,600 S
(2)	350 E 4,619 S	200 E 4,594 S
(3)	350 E 4,610 S	200 E 4,585 S

NON SURCHARGE AREA

	SET ONE	ALTERNATE SET (condensate storage tank)
(1)	125 E 5,272 S	400 E 5,225 S
(2)	131 E 5,272 S	400 E 5,231 S
(3)	140 E 5,272 S	400 E 5,240 S

SB702853

C-2645

GEOTECH
ANN ARBOR

BECHTEL

Telephone call

ROUTE × S.L. Blue
× S.S. Biffi
× L.H. Curtis
× C. McConnel
× [redacted] 1400, 3410

BY P. K. CHEN OF Geotech - A²

TO Prof. A.J. Hendron, Jr (Consultant) OF Univ. of Ill, Civil Eng.

DATE Sept. 17 19 79 TIME 1:00 pm

SUBJECT Discontinue settlement monitoring of the modified berm anchors within the D/G Bldg

JOB NO. 7220-101

I briefly informed Prof. Hendron the recent construction activities on the D/G bldg. Also, I told him that John Dunnicliff (instrument consultant) was in Ann Arbor last wk to discuss the necessary instruments to be monitored after surcharge removal. It was agreed that settlement monitoring on the modified berm anchors within the D/G could be discontinued. Prof Hendron concurred with the decision.

SB702888

0048 (12-67)

BECHTEL
ANN ARBOR

MEMORANDUM

TO S. BLUE (GEOTECH) LOCATION AAO

FROM B. DHAR (CIVIL) DATE SEPT 8 19 79

SUBJECT DIESEL GENERATOR BUILDING JOB NO 7220

SETTLEMENT INSTRUMENTATION FILE C-0894, [redacted]

COPIES TO: 1.) S. LO 2) C. DIRNBAUER 3) C. McCONNELL

AS YOU KNOW THE SURCHARGE IN AND AROUND THE DIESEL GENERATOR BUILDING HAS BEEN REMOVED. DURING THE PROCESS OF REMOVAL, A NUMBER OF PLATES AND PERMANENT SETTLEMENT MARKERS WERE DESTROYED. THE MARKERS, DG's 5, 8, 9, 12, & 13, WERE DESTROYED ON 8-25-79 AND REPLACED ON 8-28-79. THE PLATES WHICH WERE RENDERED USELESS ARE AS FOLLOWS:

PL-5	PL-9	PL-27	PL-35	PL-39
PL-6	PL-24	PL-31	PL-36	PL-40
PL-4	PL-25	PL-33	PL-37	PL-41
PL-8	PL-26	PL-30	PL-38	PL-34

IF YOU DESIRE TO HAVE THESE REPLACED OR IF YOU HAVE ANY OTHER COMMENTS ON THE DAMAGE TO THIS INSTRUMENTATION, PLEASE RESPOND BY SEPT 13, 1979

B. DHAR

SB702899

Rec
SAO/

BECHTEL

ANN ARBOR

MEMORANDUM

TO D. ANDERSON LOCATION AAO

FROM B. DHAR / S. RAO DATE 9-6-79 19

SUBJECT EMERGELXY DIESEL FUEL OIL LINES JOB NO. 7220

FILE C-0294, C-2000, C-2640 [redacted]

COPIES TO: 1.) C. DIRNBAUER

REFERENCES: 1.) TOM DATED 6-14-79, ANDERSON TO THUESON
2.) BEBC 2613 DATED JAN 2, 1979

THIS IS A COMPLETE RESPONSE TO REFERENCE 1. THE EMERGENCY DIESEL FUEL OIL LINES CAN BE LOWERED TO THE REQUIRED ELEVATIONS AND ROUTED IN ACCORDANCE WITH THE SEPARATION GUIDELINES SPELLED OUT IN REFERENCE 1.

DIESEL FUEL OIL LINES 2"-1HBC-498 AND 1-½" 1HBC-4 WERE ORIGINALLY ROUTED IN AN AREA WITH NON-Q FILL. THEY SHOULD BE RE-ROUTED IN ACCORDANCE WITH BEBC 2613 (REF 2) AND MEET THE ELEVATION AND SEPARATION CRITERIA ESTABLISHED IN REF. 1.

B. DHAR

CAD

S:702902

AAO-521

C-2645

Telephone call

BY Cooke/Horn/Marguglio/Bird/Thiruvengadam OF CPCo Site/Jackson

TO Martinez/Dhar/Rixford/Ganguly/Chen OF Bechtel AAO

DATE August 15, 19 79 TIME

SUBJECT REMOVAL OF PRELOAD

JOB NO 7220, MIDLAND 1 & 2

Copy R.L.Castleberry
T.E.Johnson
[redacted]
W.G.Moring
A.Ganguly
R.L.Rixford
L.A.Dreisbach
S.E.Afifi
P.K.Chen
K.Wiedner

A draft of the letter BLC-8021 concerning removal of preload, dated August 15, 1979, was reviewed and agreed to.

Consumers Power requested that Bechtel specify the tolerable rate and tolerable maximum settlement for all Class I structures by the end of 1979. These values should be compared in the specification with those predicted. The vehicle for specifying the settlement characteristics could be the FSAR, a design specification, a drawing, or other, but not a letter.

Action RLC/Dhar

Bechtel agreed to provide a letter committing to this requirement.

P. A. Martinez

PAM/pp

SB702905

AAO-522

FILE: 2645

Bechtel Associates Professional Corporation

Inter-office Memorandum

To W. R. Ferris

Date 2 August 1979

Subject Midland Units 1&2-Job 7220-101
Diesel Generator Settlement
Evaluation Due to Surcharge
Program

From S. S. Afifi

Of Geotechnical Services

At Ann Arbor 10 D 5

Copies to

S. L. Blue w/o
R. L. Castleberry w/o
K. Wiedner w/o
[redacted]
P. K. Chen w/o
1310, 3410

Attached please find the preliminary settlement evaluation for the Diesel Generator Building of Midland Units 1 and 2 for your review and comments. Copies have also been sent to Drs. Peck and Hendron respectively.

P. K. Chen for
S. S. Afifi

JOW/nm
Attachments

S3702934

CALCULATION COVER SHEET

PROJECT MIDLAND JOB NO. 7220-101 DISCIPLINE

SUBJECT DIESEL GENERATOR BUILDING. FILE NO.
SETTLEMENT DATA AND PREDICTED SETTLEMENT CALC. NO.

ORIGINATOR ADITYA MOHAN. DATE 8/1/79

CHECKER P. K Chen DATE 8/1/79 NO. OF SHEETS 26

RECORD OF ISSUES

NO.	DESCRIPTION	BY	DATE	CHKD	DATE	APPRD	DATE	DATE FILMED
0	—	AM	8/1/79	PKC	8/1/79			

PRELIMINARY CALC. ☒ COMMITTED PRELIMINARY DESIGN CALC. ☒

SUPERSEDED CALC. ☐ FINAL CALC. ☐

STATEMENT OF PROBLEMS:

Present Diesel Generator Building settlement data and estimate long term settlement

FOR INFORMATION ONLY

SOURCES OF DESIGN CRITERIA:

1. Design loads
2. Precise measured settlement data
3. Surcharge load history
4. Design live loads
5. Optically measured settlement data.

SOURCES OF FORMULA & REFERENCES:

—

PRELIMINARY

S3702935

CALCULATION SHEET

CALC. NO. _____ REV. NO. 0

ORIGINATOR ADITYA MOHAN DATE 7/30/79 CHECKED [illegible] DATE 8/2/79

PROJECT MIDLAND UNIT 1 & 2 JOB NO. 7220-101

SUBJECT DIESEL GENERATOR BUILDING SHEET NO. 1

SETTLEMENT DATA AND PREDICTED SETTLEMENT

PURPOSE:

The purpose of this study is to present the measured settlement data and to estimate longterm (40 years) settlement of Diesel Generator Building.

STUDY CRITERIA:

1. Temperature corrected and uncorrected settlement measurements of four deep (El. 535.0) Borros Anchors.

2. Optically measured settlement data of all the Borros Anchors and building settlement markers.

3. Time versus average settlement, surcharge load and piezometer data.

PRELIMINARY

SOURCES OF DESIGN PARAMETERS:

1. Avg. design dead load 2.5 KSF from FSAR, (actual dead wt. placed ≈ 2.0 KSF)

2. Precise measured settlement data of four deep and Otherin Borros Anchors provided by G2D, Assoc.

3. Surcharge load about 2 KSF from field measurements.

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CALCULATION SHEET

CALC. NO. _____ REV. NO. _____

ORIGINATOR _____ DATE 8/1/79 CHECKED _____ DATE 8/2/79

PROJECT MIDLAND JOB NO. 7220-101

SUBJECT D.G. Building Settlement data & Settlement Prediction. SHEET NO. 2/

4. Design live load 500 PSF, FSAR

5. Optically measured settlement data obtained from field.

6. The 20' surcharge load to accelerate the rate of settlement started on November 22, 1978 and completed on April 7, 1979.

ASSUMPTIONS:

1. Four deep borros Anchors (El. 535'0) are installed deep enough to provide and represent as local absolute movement of the bldg. bench marks.

2. The average temperature correction factors have been evaluated using several days two set readings taken at various time and temperature of single day.

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3. All settlement readings taken at different time of days have been normalized at a base temperature of 70°F.

4. Primary consolidation settlement was relatively rapid and completed nearly during the application of surcharge.

5. Relatively slow rate of settlement at the present time represent the portion of secondary compression.

PRELIMINARY

CALCULATION SHEET

CALC. NO. _____ REV. NO. _____

ORIGINATOR P. K. CHEN DATE 7/31/79 CHECKED Ouc DATE _____

PROJECT Midland units 1 & 2 JOB NO. 7220-101

SUBJECT D/G building settlement data and predicted settlement SHEET NO. 31

Method of Analysis:

1. Based on the readings recorded for D/G markers, boron anchors, settlement plates (8 piezometers) since the beginning of surcharge program (10 ft, then 20 ft), it is concluded that primarily consolidation has completed. Plots of total settlement vs. time have been made as shown in the Appendix. It is worthy to note that all plots started from the beginning of surcharge.

2. It is well known that the vertical settlement ρ of a foundation due to loads transmitted to the underlying soils, may be described as the sum of three components:

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$$\rho = \rho_d + \rho_c + \rho_s$$

in which ρ_d is the immediate or distortion settlement, ρ_c is the consolidation settlement, and the ρ_s is the secondary compression settlement. Judging all the settlement vs. time plots as shown in the Appendix, it is evident that both the distortion & consolidation settlement were occurred relatively rapid and nearly completed during the application of surcharge (thus, the settlement remained to be measured will be the secondary settlement.

PRELIMINARY

Secondary compression is considered to be that portion of the time-dependent settlement which occurs at essentially constant effective stress. Thus, during secondary compression, the rate of volume strain is not controlled by the rate

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CALCULATION SHEET

CALC. NO. _____ REV. NO. _____

ORIGINATOR P. K. Chen DATE _____ CHECKED Chu DATE _____

PROJECT MIDLAND JOB NO. 7220-101

SUBJECT D.G. BUILDING SETTLEMENT DATA & SETTLEMENT REDUCTION SHEET NO. 41

at which pore water can flow from the soil, and therefore, should not depend upon the thickness of the layer considered.

It has been observed in many laboratory and field measurements that the relationship between the magnitude of secondary compression and time is approximately a straight line on a semilog plot after the primary consolidation has been completed. Thus, the void ratio (or settlement) change may be expressed approximately as

$$\Delta H \sim (\Delta e) = -C_\alpha \log \frac{t_2}{t_1} \quad (1)$$

where ΔH = settlement (estimated) after primary consolidation

t_2 = the time at which the magnitude of secondary compression is desired. (In this project, t_2 = 40)

t_1 = the time on the extrapolated secondary compression curve corresponding to the 100% primary consolidation

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C_α = slope of straight line on semilog plot of settlement vs. time.

PRELIMINARY

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CALCULATION SHEET

ORIGINATOR Cur DATE 3/1/79 CALC. NO. _____ REV. NO. _____

CHECKED pkc DATE 3/7/79

PROJECT MIDLAND JOB NO. 7220-101

SUBJECT DG BUILDING SETTLEMENT DATA & SETTLEMENT PREDICTION SHEET NO. 5/

3. Brief History of Surcharge

On November 22, 1968, a surcharge program, to accelerate the settlement, on Diesel Generator building was started. Within two weeks after starting, the surcharge reached to an approximate uniform height of 6 feet. This height remained unchanged for three weeks and then within the following week it was raised to 7 feet. The 7 feet surcharge remained till middle of Jan. 197. From second week of Feb. '79 the surcharge height was raised to about 10 feet. This 10 feet surcharge remained constant till third week of March '79. Additional intended 10 feet surcharge was completed on April 7, 1979. Since ~~April 7, 1979~~ to present day the building is under a total 20 feet uniform surcharge. Prior to placing the surcharge, extensir

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CALCULATION SHEET

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ORIGINATOR GS DATE 8/1/79 CHECKED pkc DATE 8/2/79

PROJECT MIDLAND JOB NO. 7220-101

SUBJECT DG BUILDING SETTLEMENT DATA AND SETTLEMENT PREDICTION SHEET NO. 61

instrumentation was intalled in the area to be surcharged; some instruments were installed outside the surcharge area to provide a comparison. The surcharge was extended 20 feet away from the three building walls (South, East and West). The details of surcharge time history are presented in Appendix.

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CALC. NO. _____ REV. NO. _____

ORIGINATOR _____ DATE 9/1/79 CHECKED _____ DATE 8/2/79

PROJECT MIDLAND JOB NO. 7220-101

SUBJECT DG BUILDING SETTLEMENT DATA & SETTLEMENT PREDICTION. SHEET NO. 7/

4. Brief History of Instrumention Program for Settlement Measurements:

Twenty nine (29) settlement markers (DG-Markers) were installed on the building foundations and walls, and on the generator pedestals to monitor movements of the building and pedestals during and after construction. In addition, the following instruments were installed in and adjacent to the Diesel Generator Building for monitoring progress of consolidation of the foundation material under the influence of a surcharge load.

BA-1 thru BA-60 — Borros Anchors, for monitoring surface and subsoil movement. (Installed befor the placement of surcharge)

BA-61 thru ~~BA-64~~ — Deep Borros Anchors (El. 535), for monitoring absolute movement of building. (For Precise measurements, installed from June 6 to June 13, 1979)

PL-1 thru PL-52 — Settlement Platforms, for monitoring settlement of the pre-surcharge ground surface. (Installed before the placement of surcharge)

P2-1 thru P2-48 — Open Standpipe piezometers, for monitoring foundation pore water pressure. (Installed before the placement of surcharge)

S-1 thru S-4 — Soundex, for monitoring rebound measurement during and after

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CALCULATION SHEET

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PROJECT SUNLAND JOB NO. 7220-101

SUBJECT DC BUILDING SETTLEMENT DATA & SETTLEMENT PREDICTION. SHEET NO. 8/

Initially all the settlement measurements of Borros Anchors (BA-1 thru BA-60) were obtained by optical survey technique. The accuracy of this technique is only limited to ± 0.01 foot. As depicted from total settlement versus time plots, presented in Appendix, the optical survey technique was adequate enough to evaluate the primary consolidation portion of building settlement. However, for an evaluation of secondary compression portion of building settlement this technique was considered inadequate. Because of this reason it was decided to instal four deep Borros Anchors, at an elevation of 530.0, (BA-61 thru BA-64), to represent PRELIMINARY bench marks and to measure absolute movement of the building. In addition, some of the Borros Anchors adjacent to the building

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PROJECT MIDLAND JOB NO. 7220-101

SUBJECT DR. BOILDIN: SETTLEMENT DATA & SETTLEMENT PREDICTION. SHEET NO. 9/

Walls and adjacent to the pedestal were modified to measure building movement relative to the tip elevations of Borros Anchors. In brief, the modification was made such that future readings can be made with a mechanical dial indicator height gauge. The anticipated accuracy because of this modification was better than 0.01 inches.

Two of the four deep Borros Anchors are located outside the building, alongside the south wall [illegible] the east (BA-63) and west (BA-61) corners. A reference bracket is attached to the building wall at each location, through which the [illegible] rod is passing. The remaining two deep Borros Anchors are located within the building, one (BA-62) in the east bay, and other (BA-64) in the

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CALCULATION SHEET

CALC. NO. _____ REV. NO. _____

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PROJECT MIDLAND JOB NO. T229-101

SUBJECT DC BUILDING SETTLEMENT DATA & SETTLEMENT PREDICTION. SHEET NO. 10/

West bay, with reference surfaces. The measurement on all four deep Borros Anchors and other modified Borros Anchors started between June 6 and June 13, 1979, approximately 60 - 67 days after the completion of 20 feet surcharge. As fas as possible settlement measurements were taken two times a week on all deep and modified Borros Anchors. Together with these readings optical measurements were also continued

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During the reading of the digital indicator height gauge a continous record of temperature and time of the day was maintained.

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Particularly, the deep Borros Anchors and some selected Borros Anchors were read two times of a day to evaluate any temperature effect on the settlement readings.

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PROJECT MIDLAND JOB NO. 7220-101

SUBJECT DG BUILDING SETTLEMENT DATA & SETTLEMENT PREDICTION. SHEET NO. 11

From the settlement readings and the corresponding temperatures, at a single day, plots of settlement reading and temperature were generated to evaluate an average temperature correction factor for each deep Borros Anchor. These plots indicated that average temperature correction factor for two Borros Anchors (outside the building) BA-61 and BA-63 was 0.00087"/°F and 0.00065"/°F, respectively. The readings of remaining two Borros Anchors (inside the building) BA-62 and BA-64 indicated negligible temperature correction factors. All the readings for the two Borros Anchors were adjusted to a base temperature of 70°F and re-plotted on the settlement Vs time curves. The plots of settlement Vs time for four deep Borros Anchors are presented in Figures 1 to 4.

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CALCULATION SHEET

CALC. NO. _____ REV. NO. _____

ORIGINATOR Cm DATE 8/1/79 CHECKED pkc DATE 8/2/79

PROJECT MIDLAND JOB NO. 7220-101

SUBJECT DG BUILDING SETTLEMENT DATA & SETTLEMENT PREDICTION SHEET NO. 12/

5. Evaluation of Secondary Compression or Residual Settlement

From the time versus settlement plots for all building and pedestal markers and the Borros Anchors it is clear that consolidation due to surcharge was relatively rapid and it took place during the placement and within few weeks (1-3 weeks) after completion of surcharge on April 7, 1979. Furthermore, it was observed that the pore water pressure response in most of piezometers was relatively rapid. The developed pore water pressure also dissipated during the placement of surcharge and within few weeks after completion of surcharge. Based on these observation following conclusions can be drawn:

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SUBJECT DG BUILDING SETTLEMENT DATA & SETTLEMENT PREDICTION. SHEET NO. 13

1. It can definitly be concluded that the primary consolidation portion of time dependent settlement was complete during the placement of surcharge and 1-3 weeks after completion of surcharge on April 7, 1979.

2. The portion of time dependent settlement which is occuring now and occured 1-3 weeks after completion of surcharge, under a constant surcharge of 20 feet, is mainly secondary consolidation.

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As described above, in the Method of Analysis section, that the secondary compression and time relationship is approximately a straight line on a semi-log graph paper and the slope, C_α, of this straight line can be

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ORIGINATOR _____ DATE 8/1/79 CHECKED PKC DATE 8/2/79

PROJECT MIDLAND JOB NO. 7225-101

SUBJECT OG BUILDING SETTLEMENT DATA & SETTLEMENT PREDICTION SHEET NO. 14

used to estimate total secondary compression at a desired time. The accuracy of the estimated settlement is directly proportional to the value of C_α.

In order to determine the accurate value of C_α, coefficient of secondary compression, the absolute total precise settlement data of the four Borros Anchors was plotted on semi-log paper on a much larger scale, i.e, 0.020" inch of total settlement equal to 1 inch. These plots presented in figures 1 to 4. The settlement plots, on semi-log paper, presented in the Appendix correspond to a scale of 1 inch of total settlement equal to 1 inch. The settlement plots for the four deep Borros Anchors were started at the date of their installation. The position

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of the starting date, on time log scale in one log cycle, was carefully selected from the adjacent settlement markers curves presented in the Appendix. The selected settlement markers, which were close to the deep Borros Anchors, were given below.

Deep Borros Anchors	Adjacent Markers
BA-61	DG-3
BA-62	DG-16
BA-63	DG-1
BA-64	DG-4

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From each of Borros Anchor's the settlement curves the, C_2 value was measured. The value of C_2 for BA-61 and BA-62 was 0.24" per time log cycle. The values of C_2 for BA-63 and BA-64 were 0.15", and

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CALC. NO. _____ REV. NO. _____

ORIGINATOR _____ DATE 8/1/79 CHECKED pke DATE 8/2/79

PROJECT MIDLAND JOB NO. 7220-101

SUBJECT DG BUILDING SETTLEMENT DATA & SETTLEMENT PREDICTION. SHEET NO. 16

0.127" per time log cycle, respectively.

The time, t_2, at which total secondary compression is desired is 40 years or 14600 days.

Several times, t_1, at which 100 percent primary consolidation completed were selected for the purpose of computation. It is obvious from the Equation (1) that greater is the time, t_1, smaller will be settlement. The total secondary settlement for various t_1 for the four deep Borros Anchors are tabulated

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TOTAL SECONDARY COMPRESSION IN INCHES IN 40 YEARS

time, t_1 (DAYS)	BA-61 $C_\alpha = 0.24$*	BA-62 $C_\alpha = 0.24$*	BA-63 $C_\alpha = 0.15$*	BA-64 $C_\alpha = 0.127$*	* Unit inches/time log cycle
1	0.1"	0.1	0.625	0.528	
10	0.75	0.75	0.47	0.401	
100	0.52	0.52	0.32	0.275	
200	0.44	0.44	0.28	0.24	

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ORIGINATOR Cuy DATE 8/1/79 CHECKED pke DATE 8/2/79

PROJECT MIDLAND JOB NO. 7220-101

SUBJECT DG BUILDING SETTLEMENT PATH & SETTLEMENT PREDICTION. SHEET NO. 17

DISCUSSION OF RESULTS

Based on the settlement observations and the calculations presented in this study following important points were derived.

1. All settlement measurements made during during the placement of the surcharge and following the completion of 20 feet surcharge on April 7, 1979, indicated that the primary consolidation ~~was relatively rapid~~.

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2. The major portion of primary consolidation completed during the time surcharge was placed.

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3. The remaining portion of primary consolidation completed within 1 to 3 weeks after completion of 20 feet surcharge on April 7, 1979

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PROJECT MIDLAND JOB NO. 7220-101

SUBJECT DG BUILDING SETTLEMENT DATA & SETTLEMENT PREDICTION. SHEET NO. 18/

4. The maximum building settlements which occurred after completion of surcharge on 4/7/79 to 7/27/79 was 0.048 feet (Marker DG-3 on Southeast corner of the D.G. Building). The maximum settlement between the dates 6/7/79 and 7/26/79 for the same marker was 0.015 feet or 0.18 inches. All other markers showed much smaller settlement between the above dates.

5. Almost all ~~Piezometer readings~~ indicated that the pore water pressure was dissipated during the placement of surcharge and within 1 to 3 weeks after completion of the surcharge.

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ORIGINATOR Cm DATE 8/1/79 CHECKED PKC DATE 8/2/79

PROJECT MIDLAND JOB NO. 7220-101

SUBJECT DG BUILDING SETTLEMENT DATA & EXTRAPOLATION. SHEET NO. 19

6. The slow time dependent settlement which is occuring now and took place after completion of primary consolidation appears to be time dependent secondary compression.

7. Since, time dependent secondary compression occurs at essentially constant effective stress and not controlled by the rate of pore water pressure dissipation, therefore it is expected to continue for extremely long time.

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8. The present precise settlement data, (up to 7/26/79) of the Dead Borros Anchors, when plotted on semi-log graph paper appreximatly falls on a straight line. These observations are consistant with the observations made by others in the past.

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CALC. NO. _____ REV. NO. _____

ORIGINATOR Ajw DATE 8/1/79 CHECKED pke DATE 8/2/79

PROJECT MIDLAND JOB NO. 7220-101

SUBJECT DG BUILDING SETTLEMENT DATA & SETTLEMENT PREDICTION SHEET NO. 20/

9. The slope, C_α, of the precise settlement data when plotted on semi-log graph paper can be used to predict total secondary compression during the 40 years, useful life of the plant.

10. The slope, C_α, has a maximum value of 0.24" per time log cycle for the two deep Borros Anchors (BA-61 and BA-62) on the eastern end of the building. For the western end of the building the value of C_α, measured from the data of Borros Anchors, BA-63 and BA-64, ~~ranged~~ from 0.150 to 0.127 inch per time log cycle.

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11. Based on the above values of C_α, the estimated settlement for 40 years will range from 0.52 to 0.32 inches. The corresponding differential settlement will be 0.20 inch

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CALCULATION SHEET

ORIGINATOR Cru DATE 8/1/79 CALC. NO. _____ REV. NO. _____

PROJECT MIDLAND CHECKED pkc DATE 8/2/79

SUBJECT DG BUILDING SETTLEMENT DATA & SETTLEMENT PREDICTION JOB NO. 7220-101

SHEET NO. 21

12. The above estimated settlement is conservative because the value of C_c will be somewhat smaller after removal of surcharge. No estimate of this reduction in C_c value is known at present time.

13. Since, small amount of secondary compression will take place during the 40 years, therefore it will not cause any excessive stress in any part of the structure and its components.

14. Since, the building [illegible] approximately 1½ times the design loads, therefore the operation load will not cause any more settlement.

FOR INFORMATION ONLY

PRELIMINARY

SJ702956

AO-520 6/76

CALCULATION SHEET

ORIGINATOR [illegible] DATE 8/1/79 CHECKED [illegible] DATE 8/2/79

CALC. NO. _____ REV. NO. _____

PROJECT MIDLAND JOB NO. 7220-101

SUBJECT OC BUILDING SETTLEMENT DATA & SETTLEMENT PREDICTION. SHEET NO. 22/

RECOMMENDATIONS AND CONCLUSIONS

Finally, based on the above discussions it is suggested that the surcharge load can safely be removed during the month of August, 1979. Further it is suggested that rebound measurements during and after the surcharge removal be continued for an extended period of time.

FOR INFORMATION ONLY

PRELIMINARY

S3702957

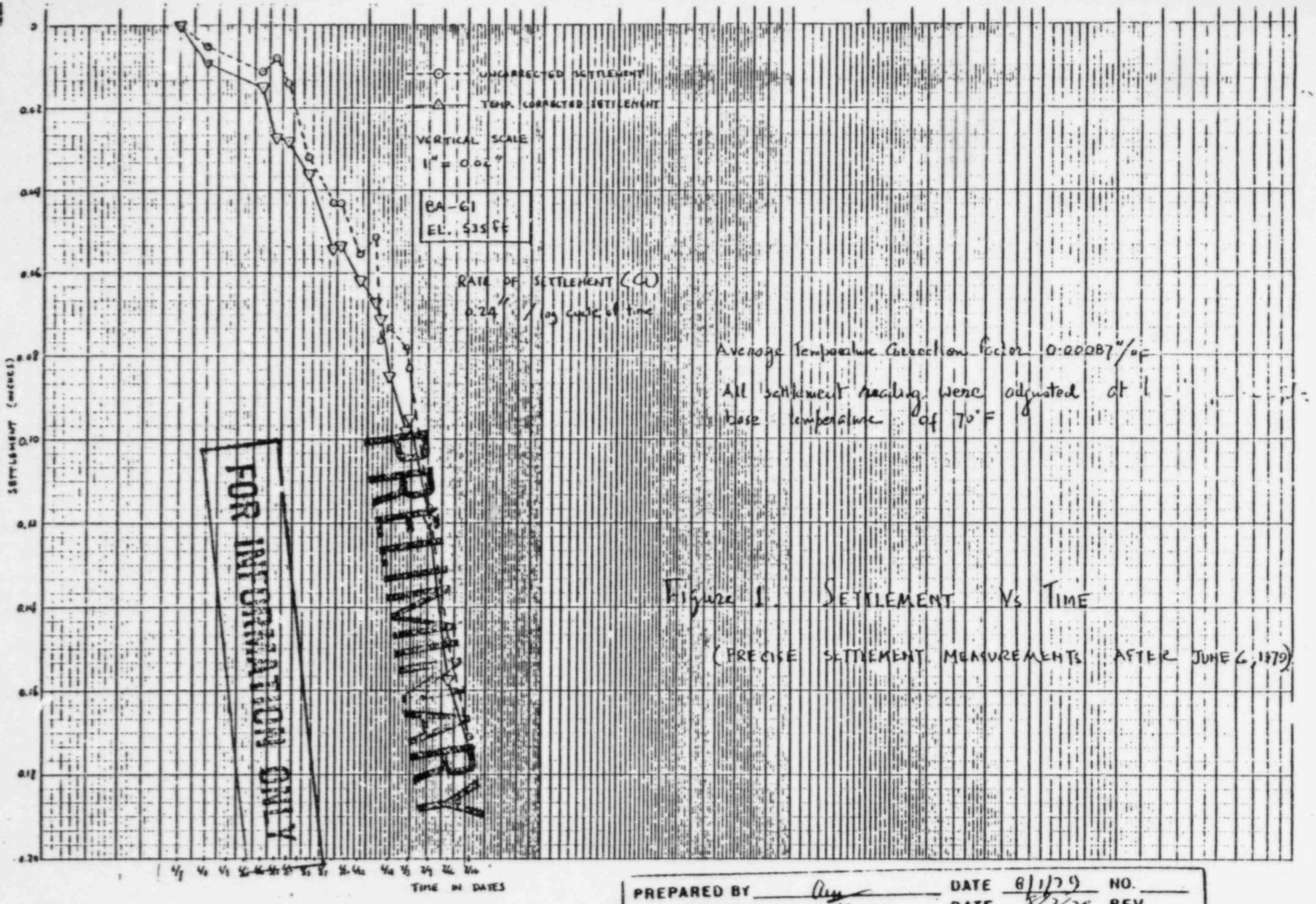


Figure 1. SETTLEMENT Vs TIME

(PRECISE SETTLEMENT MEASUREMENTS AFTER JUNE 6, 1979)

PREPARED BY Ayn	DATE 8/1/79	NO.	
CHECKED BY PKS	DATE 8/2/79	REV.	
PROJECT MIDLAND	JOB NO.: 7220-A1	FILE	
SUBJECT DL BUILDING SETTLEMENT DATA & SETTLEMENT PREDICTION.		SHEET NO. 23	

S.S.7029S8

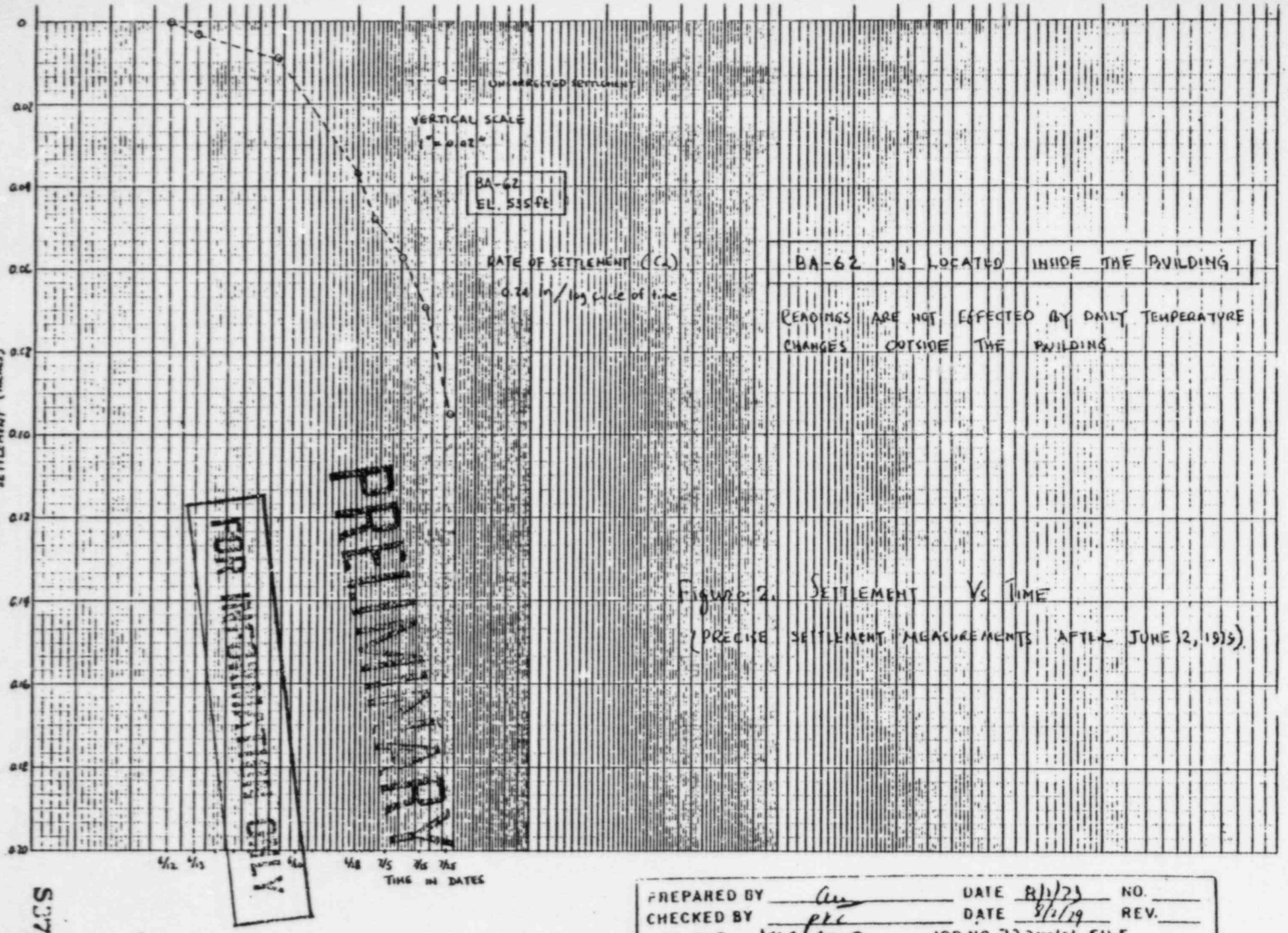
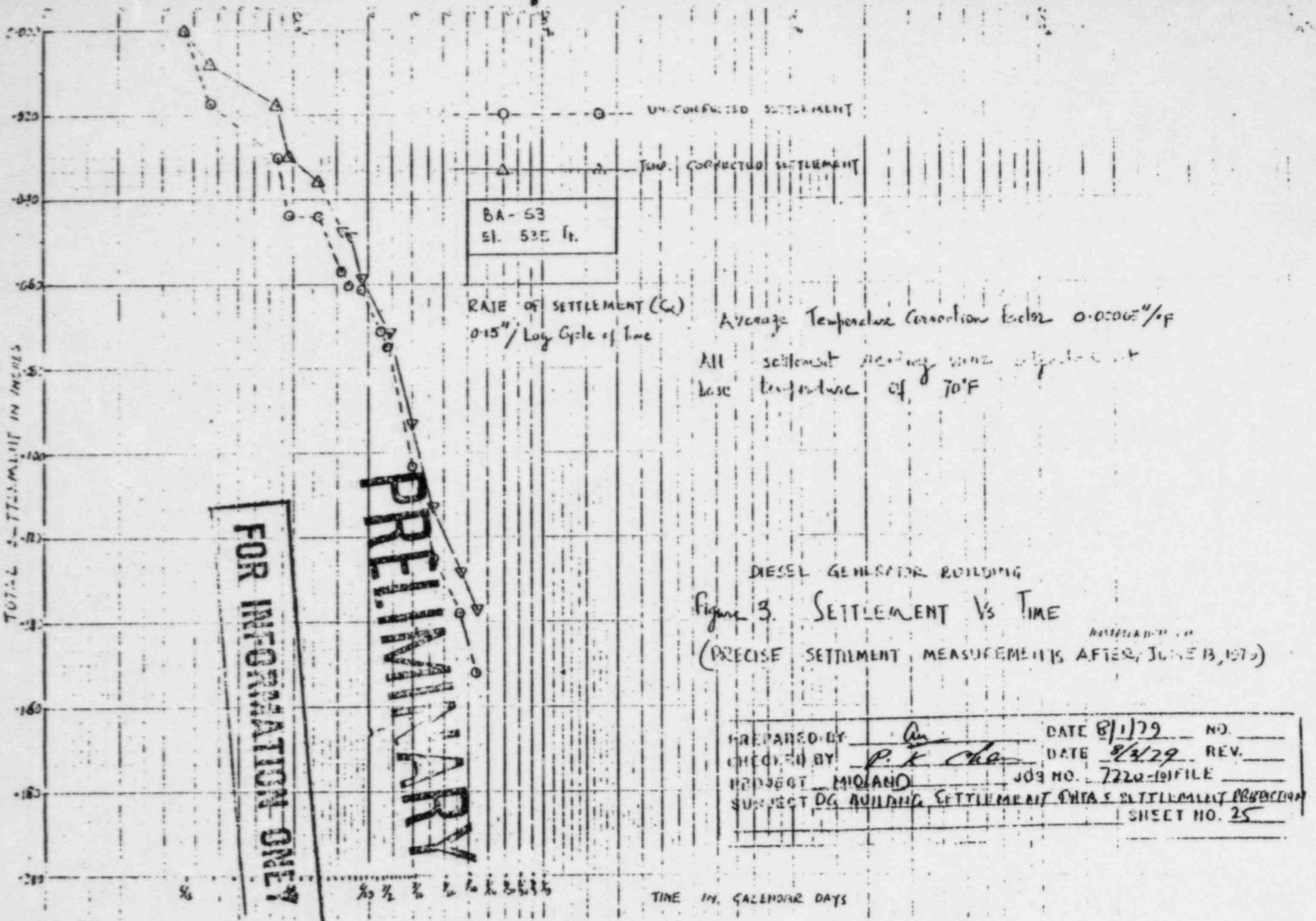


Figure 2. SETTLEMENT Vs TIME
(PRECISE SETTLEMENT MEASUREMENTS AFTER JUNE 12, 1975)

PREPARED BY		DATE 8/1/79	NO.
CHECKED BY		DATE 8/1/79	REV.
PROJECT MIDLAND	JOB NO. 7220-101	FILE	
SUBJECT DC BUILDING SETTLEMENT DATA & SETTLEMENT PREDICTION.		SHEET NO. 24	

S3202359



DIESEL GENERATOR BUILDING

Figure 3. SETTLEMENT Vs TIME

(PRECISE SETTLEMENT MEASUREMENTS AFTER JUNE 13, 1979)

PREPARED BY _____ DATE 8/1/79 NO. _____
CHECKED BY _____ DATE 8/2/79 REV. _____
PROJECT MIDLAND JOB NO. 7220-191 FILE _____
SUBJECT DG BUILDING SETTLEMENT DATA & SETTLEMENT PREDICTION
SHEET NO. 25

S0702360

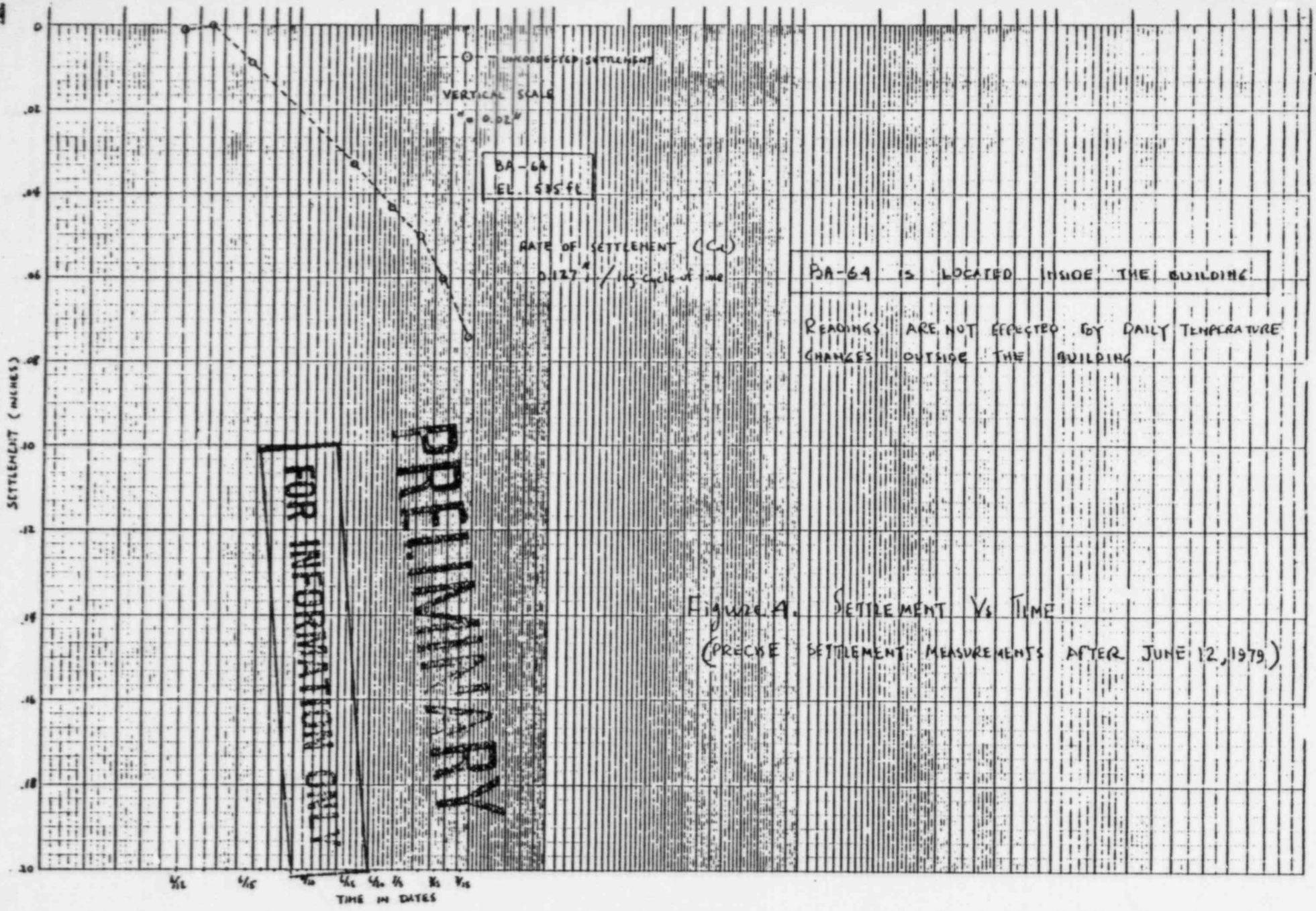


Figure A. SETTLEMENT Vs TIME
(PRECISE SETTLEMENT MEASUREMENTS AFTER JUNE 12, 1979)

PREPARED BY Cox	DATE 8/1/79	NO.	
CHECKED BY pkc	DATE 8/2/79	REV.	
PROJECT MIDLAND	JOB NO. 7220-101	FILE	
SUBJECT DC BUILDING SETTLEMENT DATA & SETTLEMENT PREDICTION		SHEET NO. 26	

S270296

Bechtel Associates Professional Corporation

Inter-office Memorandum

To R. L. Castleberry

Subject Midland Units 1 and 2
Job 7220-001
Time Settlement Plots

Copies to S. L. Blue w/o
B. Dhar w/o
J. O. Wanzeck w/a
K. Wiedner w/o
1320, 3410, 3900

Date 3 August 1979

From S. S. Afifi

Of Geotechnical Services

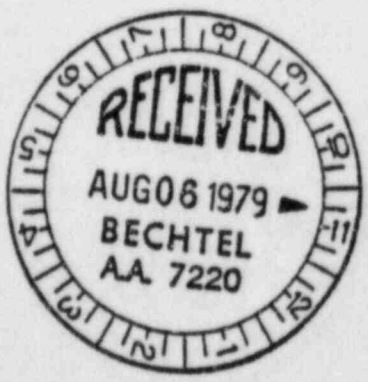
At Ann Arbor 10 D 5
7220-79-141

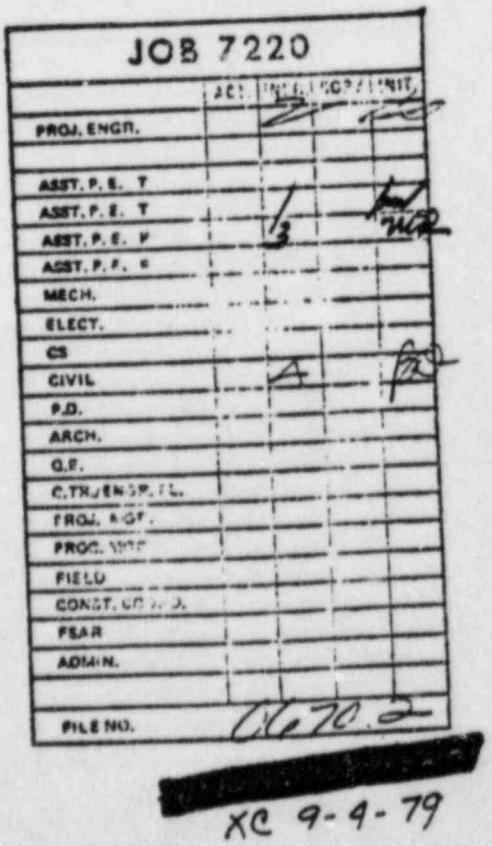
Attached you will find the updated time settlement plots through July 16, 1979 as received from Goldberg-Zoino.

These were requested by Chuck McConnel.

JOWanget for/SSA
S. S. Afifi

JOW/nm
Attachments





XC 9-4-79

SB702907

GOLDBERG, ZOINO, DU .CLIFF
and ASSOCIATES INC.
Geotechnical Consultants
30 Tower Road
NEWTON UPPER FALLS, MA 02164

LETTER OF TRANSMITTAL

DATE July 24, 79 | JOB NO. 7220

ATTENTION

RE: Midland Nuclear Plant
Diesel Generator Bldg.
Results of Settlement Monitoring
Program

TO Dr. Sherif Afifi
Bechtel Power Corp
Ann Arbor, Michigan

GENTLEMEN:

WE ARE SENDING YOU ☑ Attached ☐ Under separate cover via _____ the following items.

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO.	DESCRIPTION

GEOTECH
ANN ARBOR
DISTRIBUTION

DISC	ACT	INFO	W/A	INIT
MGR		1		
ADMIN				
DRFT				
SOILS		2		
[illegible]		3		
PKC		4		
PMT		5		
Proj.				
Proj. Engr				1240

JOB 7220 FILE 3900
REC'D JUL 27 1979

THESE ARE TRANSMITTED as checked below:

☐ For approval ☐ Approved as submitted ☐ Resubmit_____copies for approval
☑ For your use ☐ Approved as noted ☐ Submit_____copies for distribution
☐ As requested ☐ Returned for corrections ☐ Return_____corrected prints
☐ For review and comment ☐ _____
☐ FOR BIDS DUE _____ 19_____ ☐ PRINTS RETURNED AFTER LOAN TO US

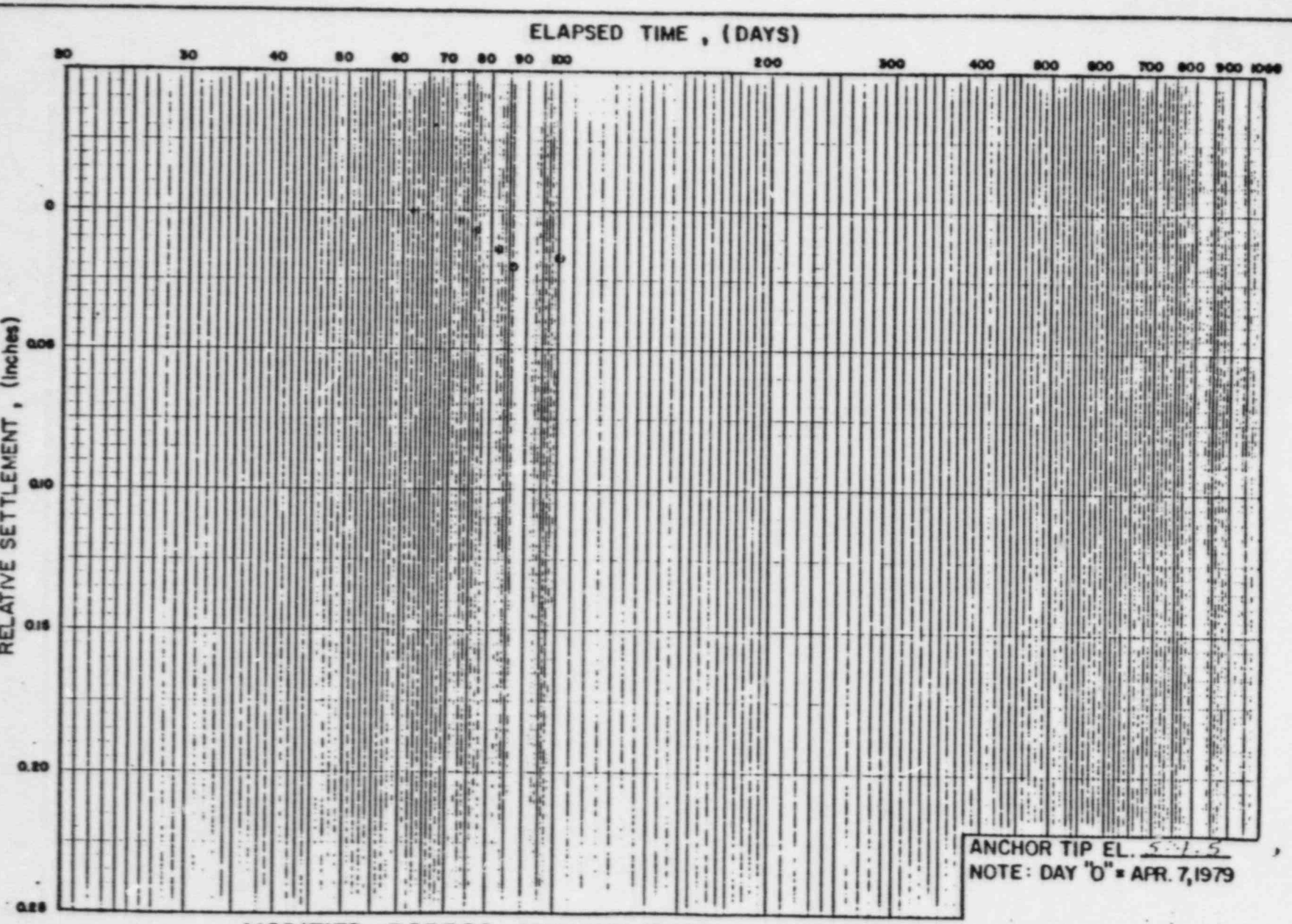
REMARKS Updated time-settlement plots to include Field readings of July 16, 1979

SB7C2908

COPY TO _____

SIGNED [signature]

FILE No. 2220-R



MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

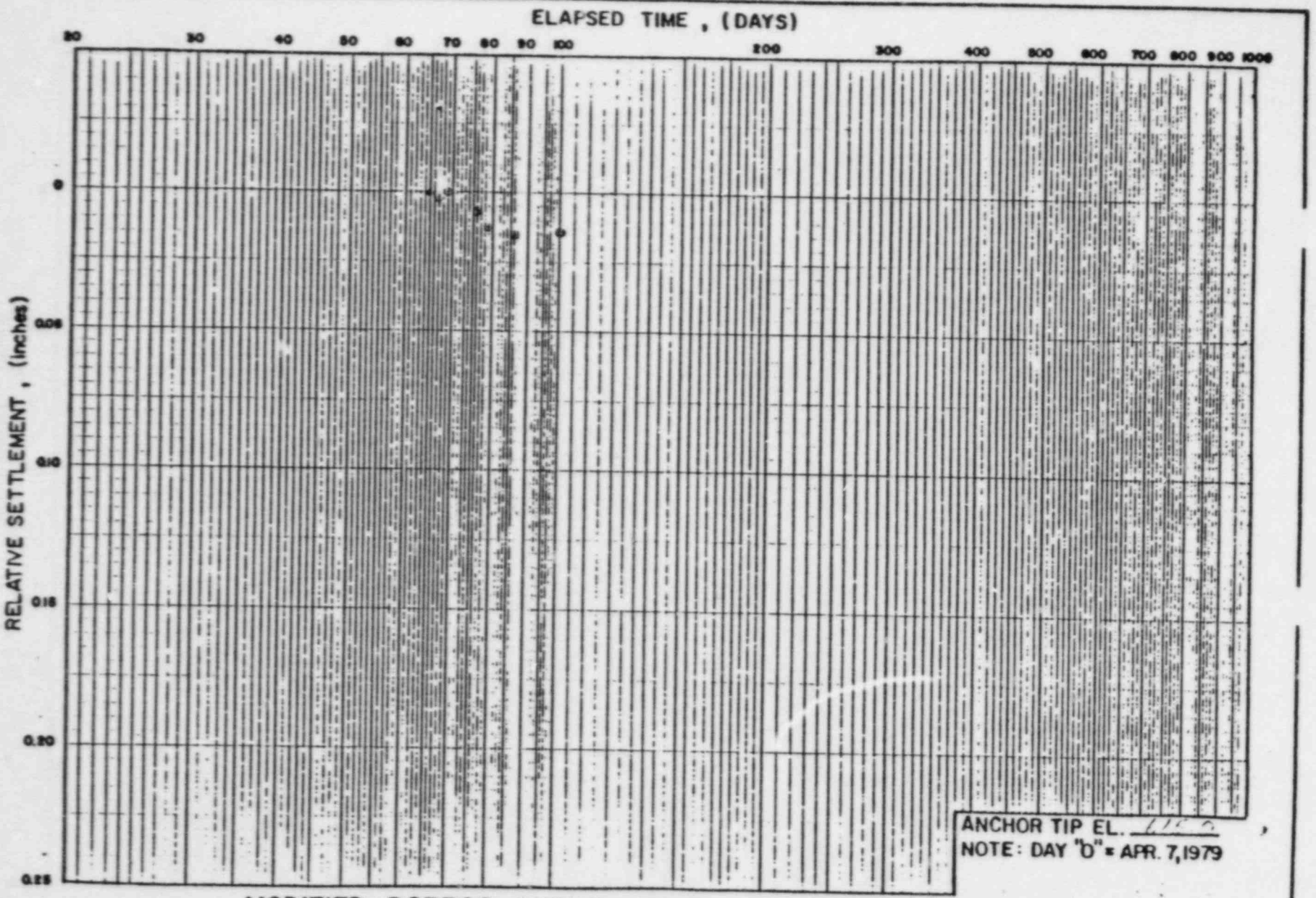
BORROS ANCHOR No. M9-11

MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

S3702309

FILE No. 2220-R



MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. E1-31

MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

S370229-10

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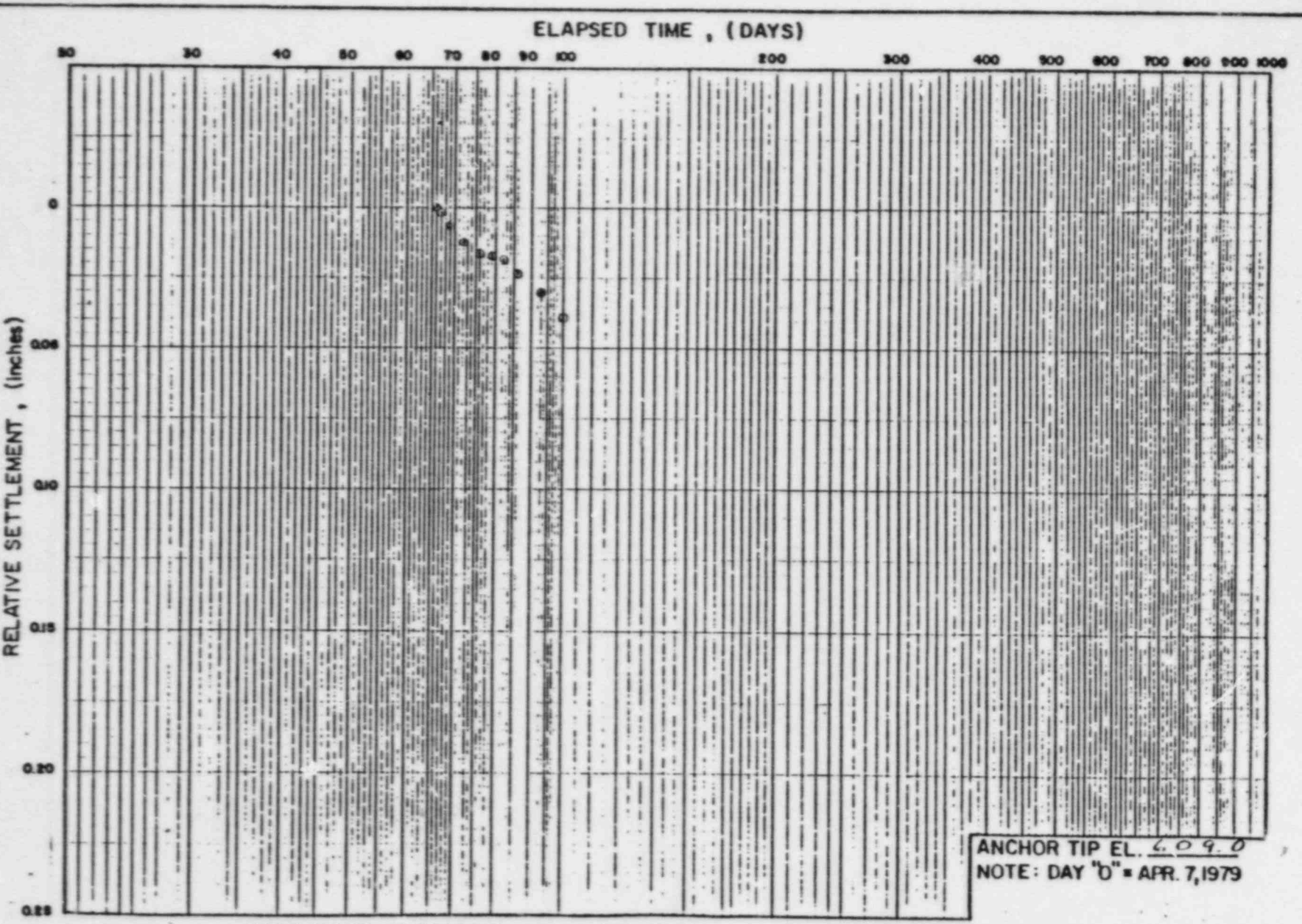


MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

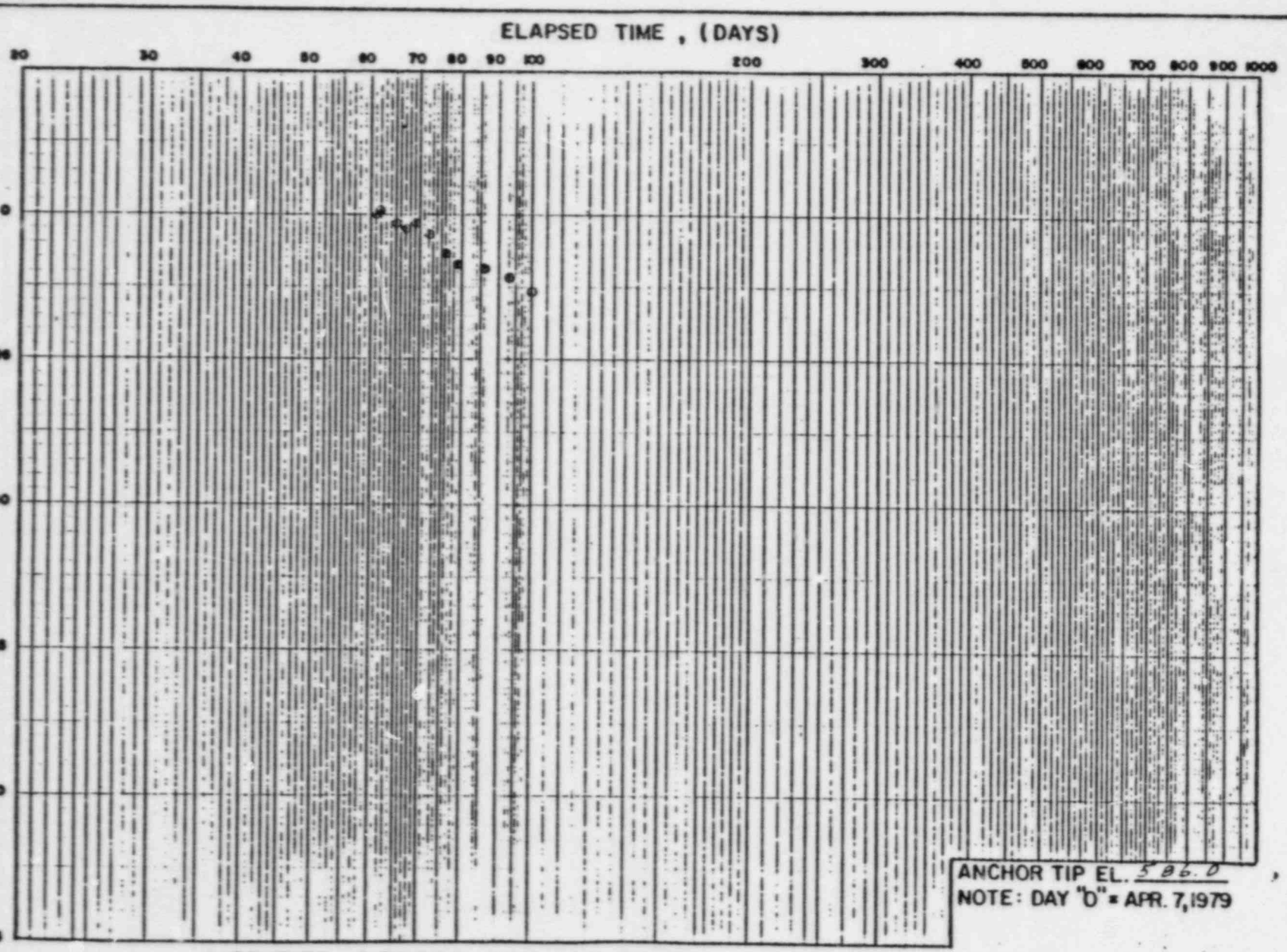
BORROS ANCHOR No. B1-33

MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

S-17-0944

FILE No. 2220-R



MIDLAND PLANT-DIESEL GENERATOR BUILDING

MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. BA-52

GEOTECHNICAL INSTRUMENTATION ENGINEERS

S9702942

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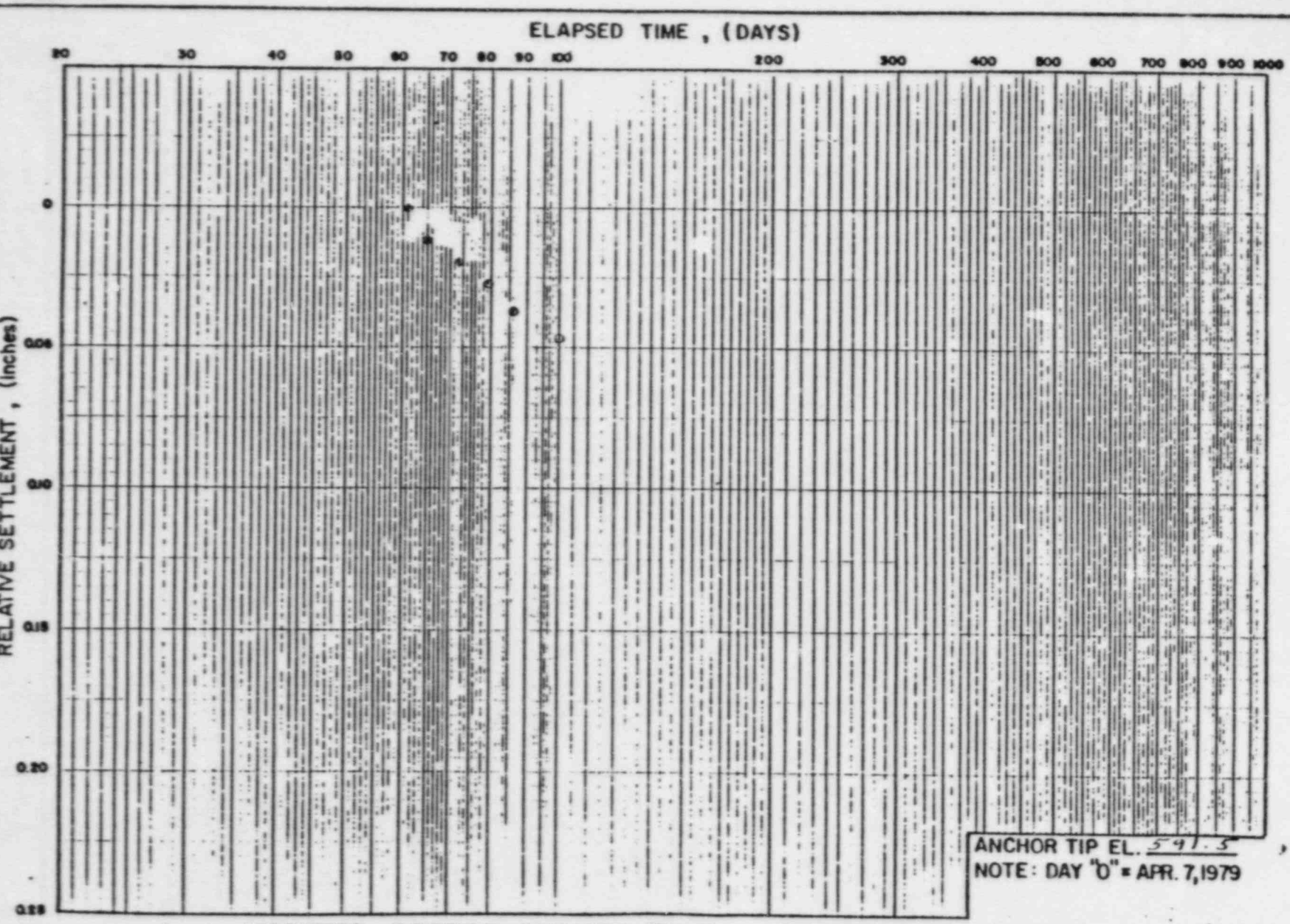

MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. BA-12

MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

S-7702913

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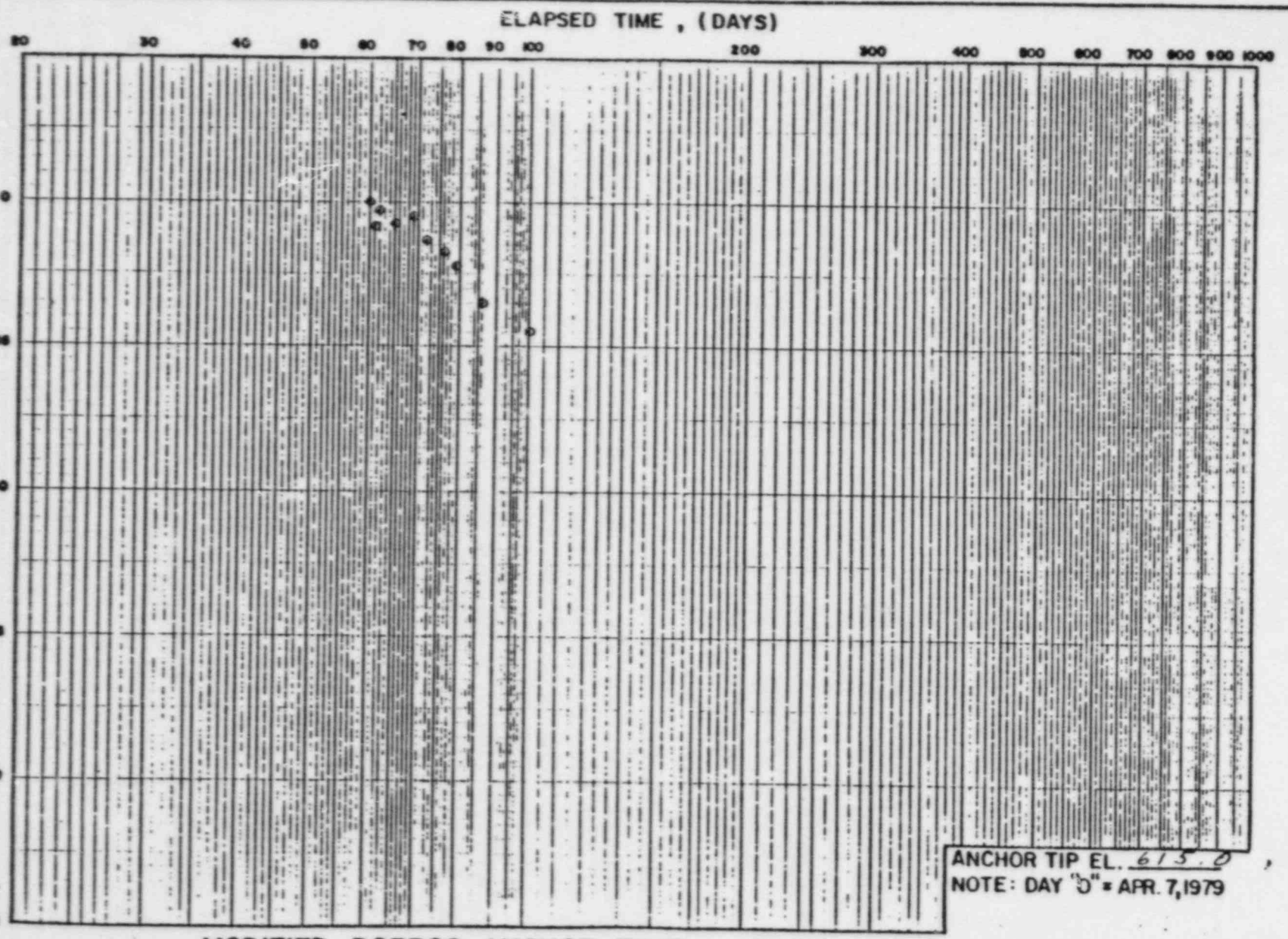

ANCHOR TIP EL. 615.0

NOTE: DAY "0" = APR. 7, 1979

MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. BA-10

MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

SB702914

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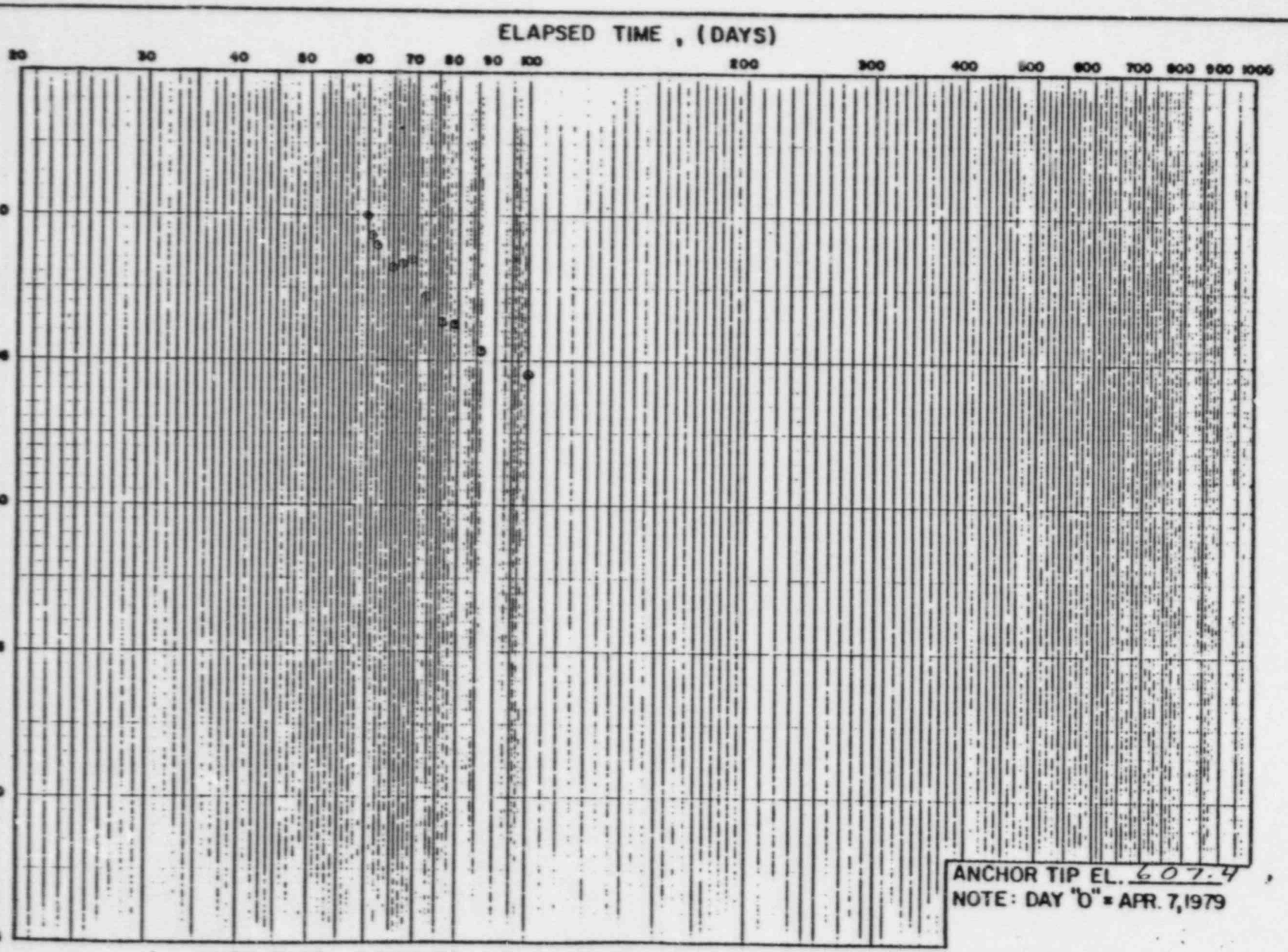

ANCHOR TIP EL. 607.4

NOTE: DAY "0" = APR. 7, 1979

MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. BA-9

MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

S8702915

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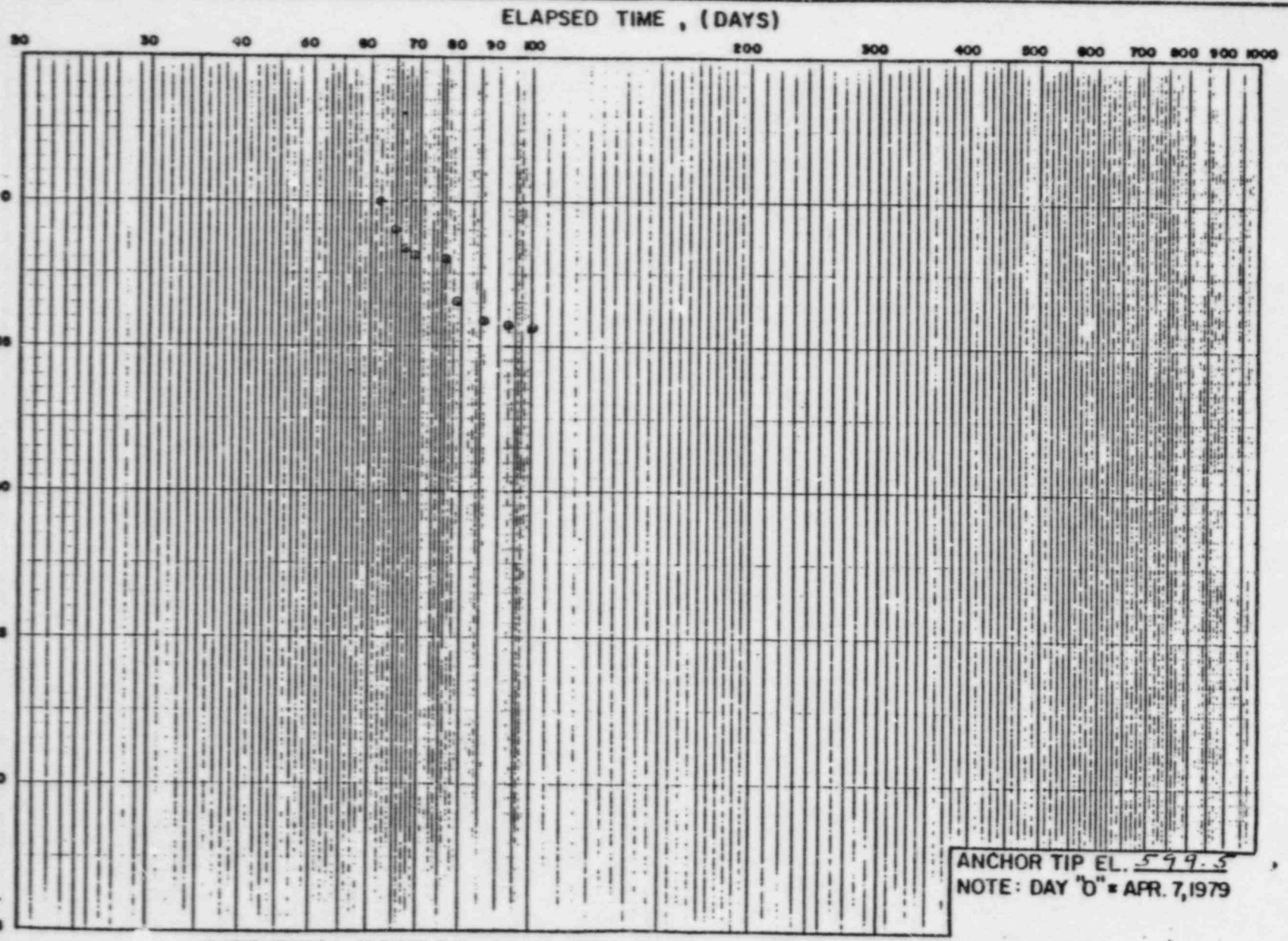

MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. BA-49

MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

SI 702916

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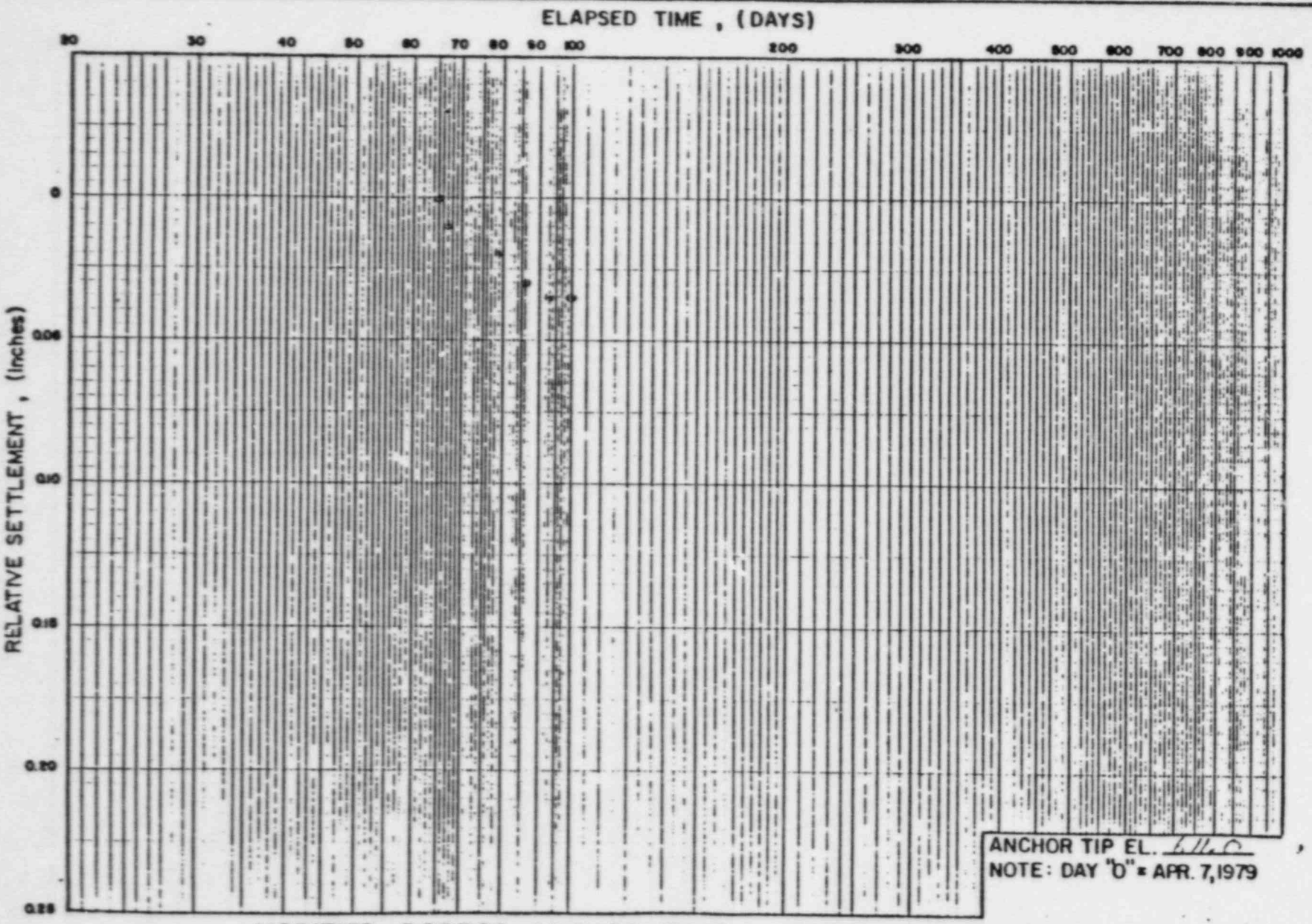

MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. BA-2C

MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

S37029117

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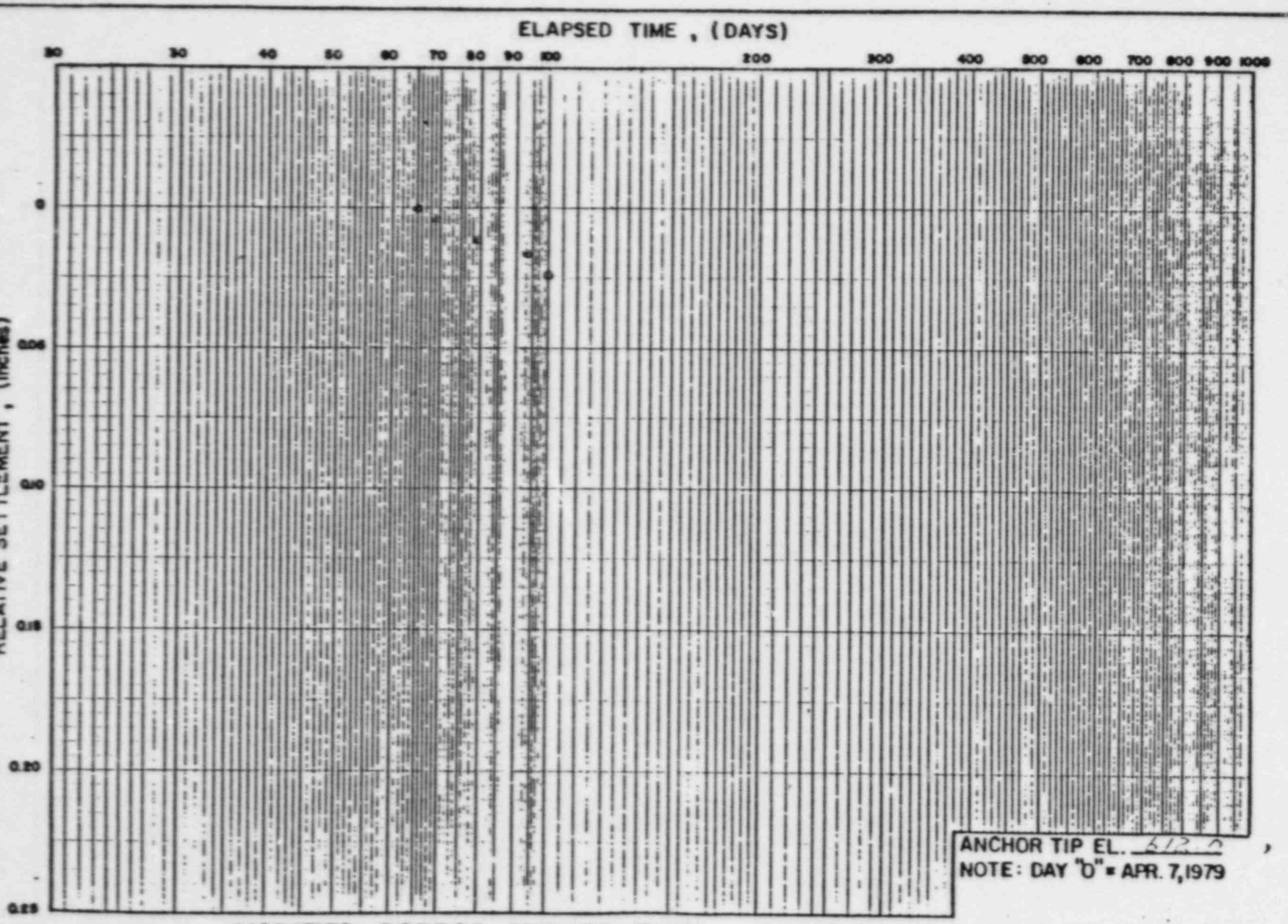

MIDLAND PLANT-DIESEL GENERATOR BUILDING

MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. BA-20

GEOTECHNICAL INSTRUMENTATION ENGINEERS

SI 7029 18

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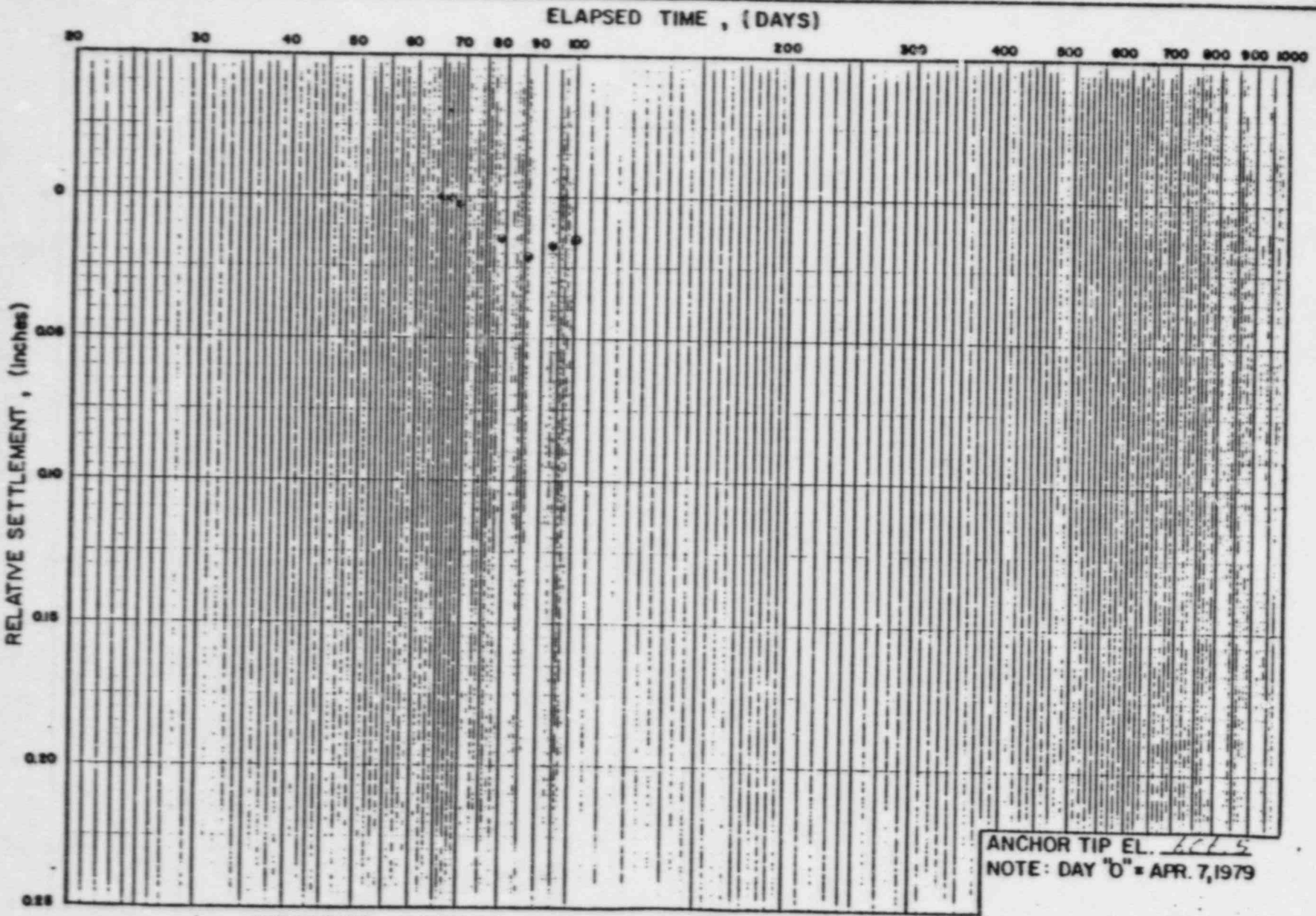


ANCHOR TIP EL. 227.5

NOTE: DAY "0" = APR. 7, 1979

MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

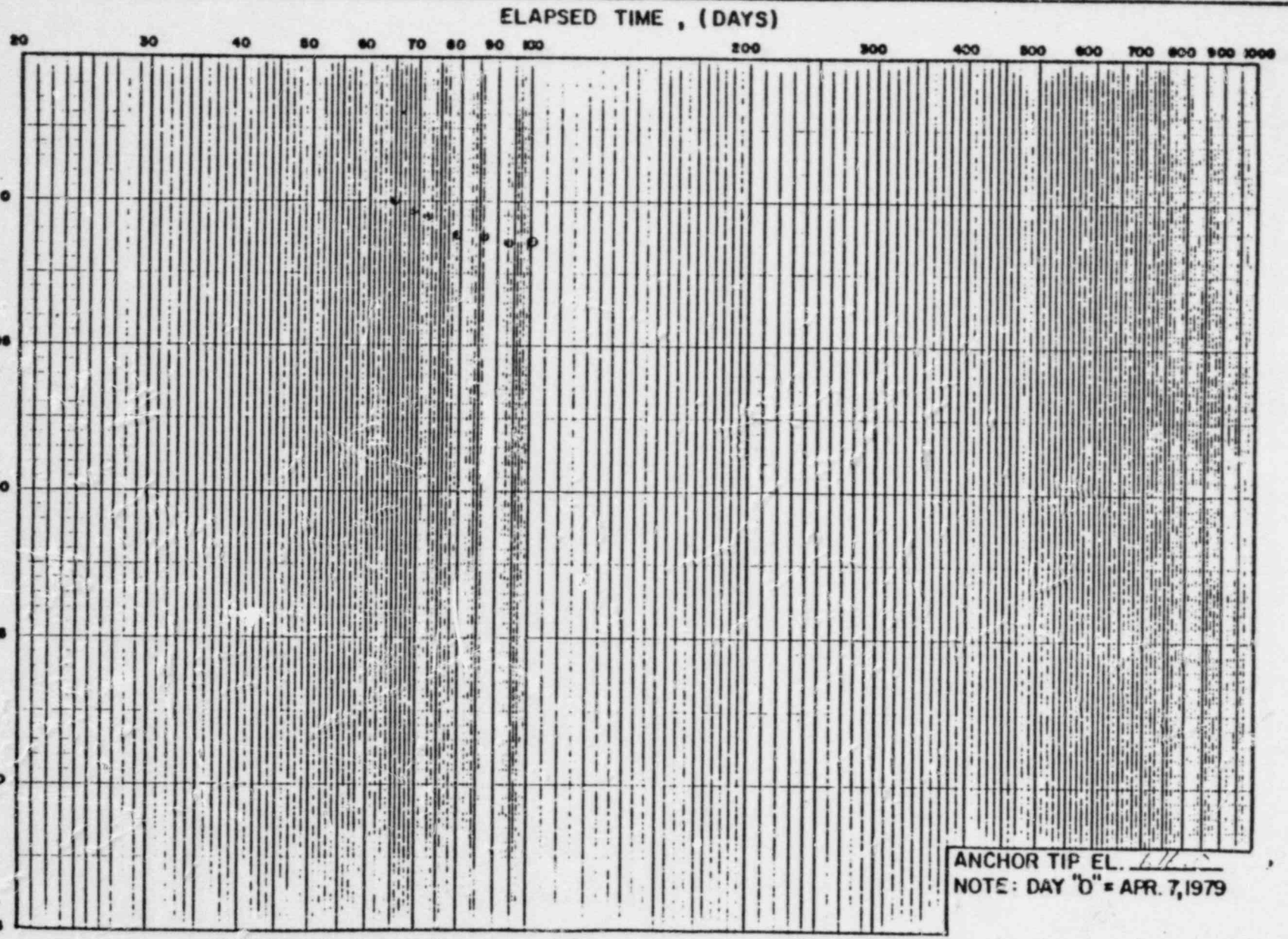
BORROS ANCHOR No. 1-3

MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

S/7029/9

FILE No. 2220-R



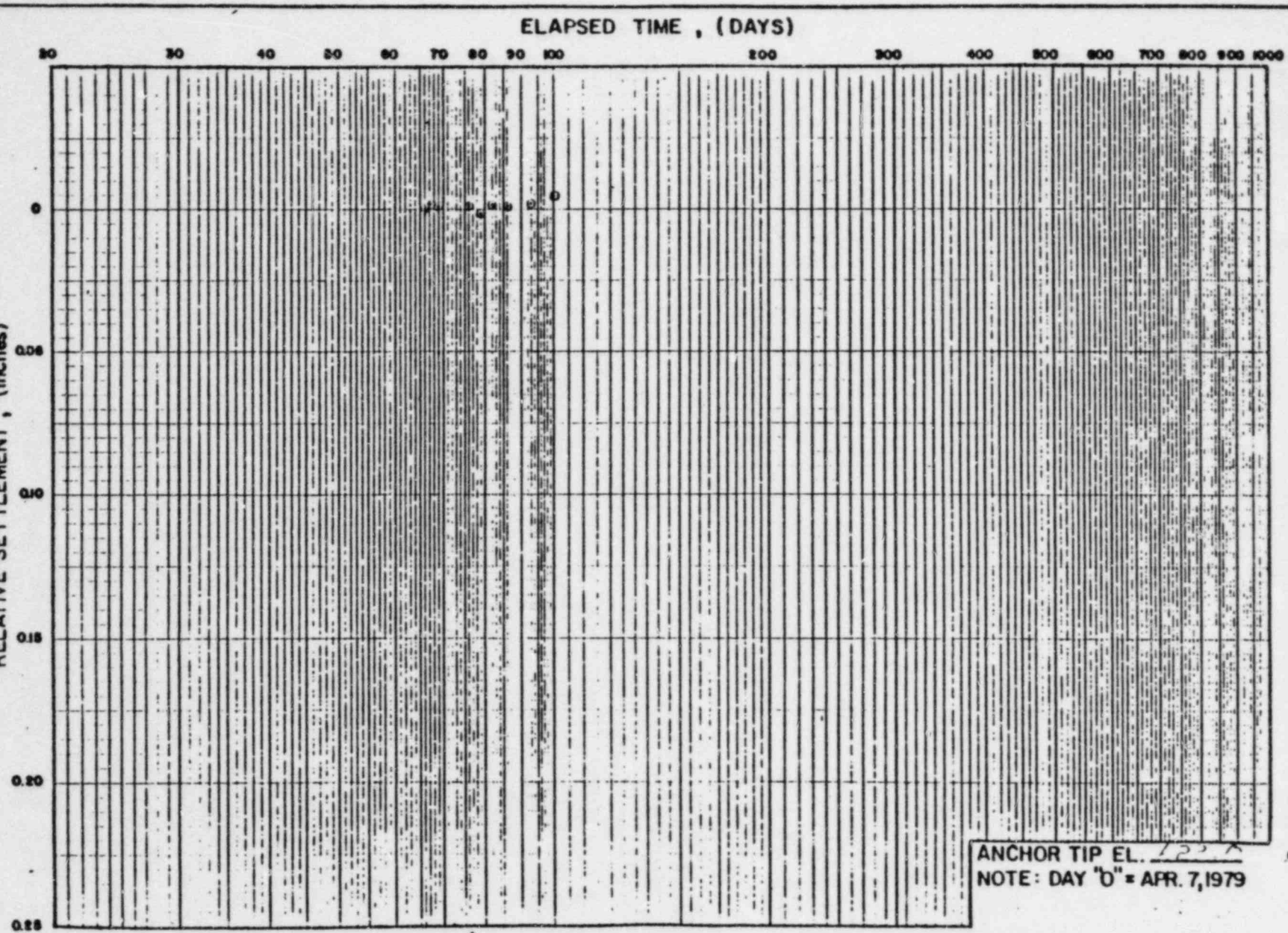
MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. B-1-2

FILE No. 2220-R



MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. B-1-39

MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

SU7029 21

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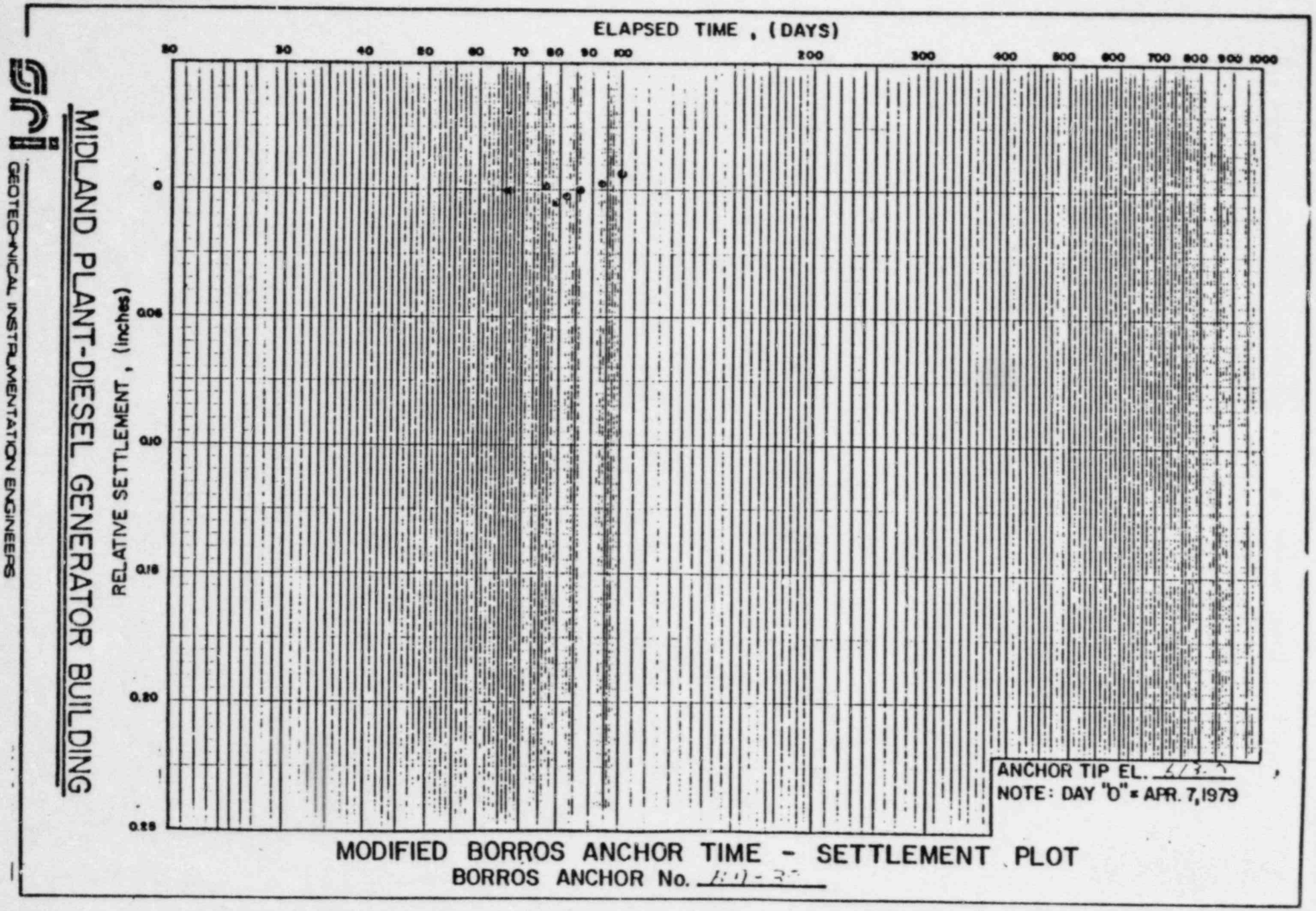

MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. B-1-3

SBZ02922

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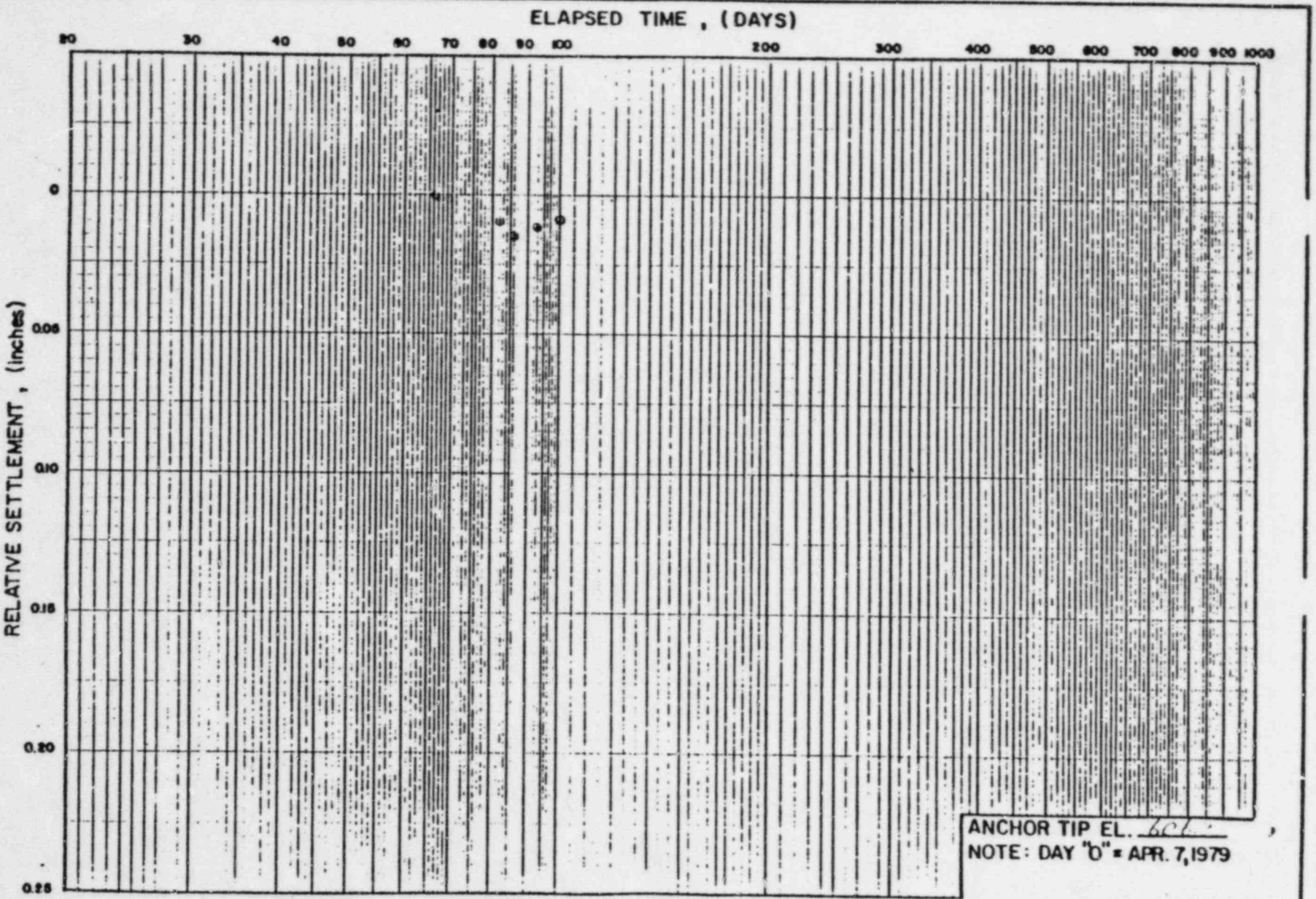

MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No.

S3702923

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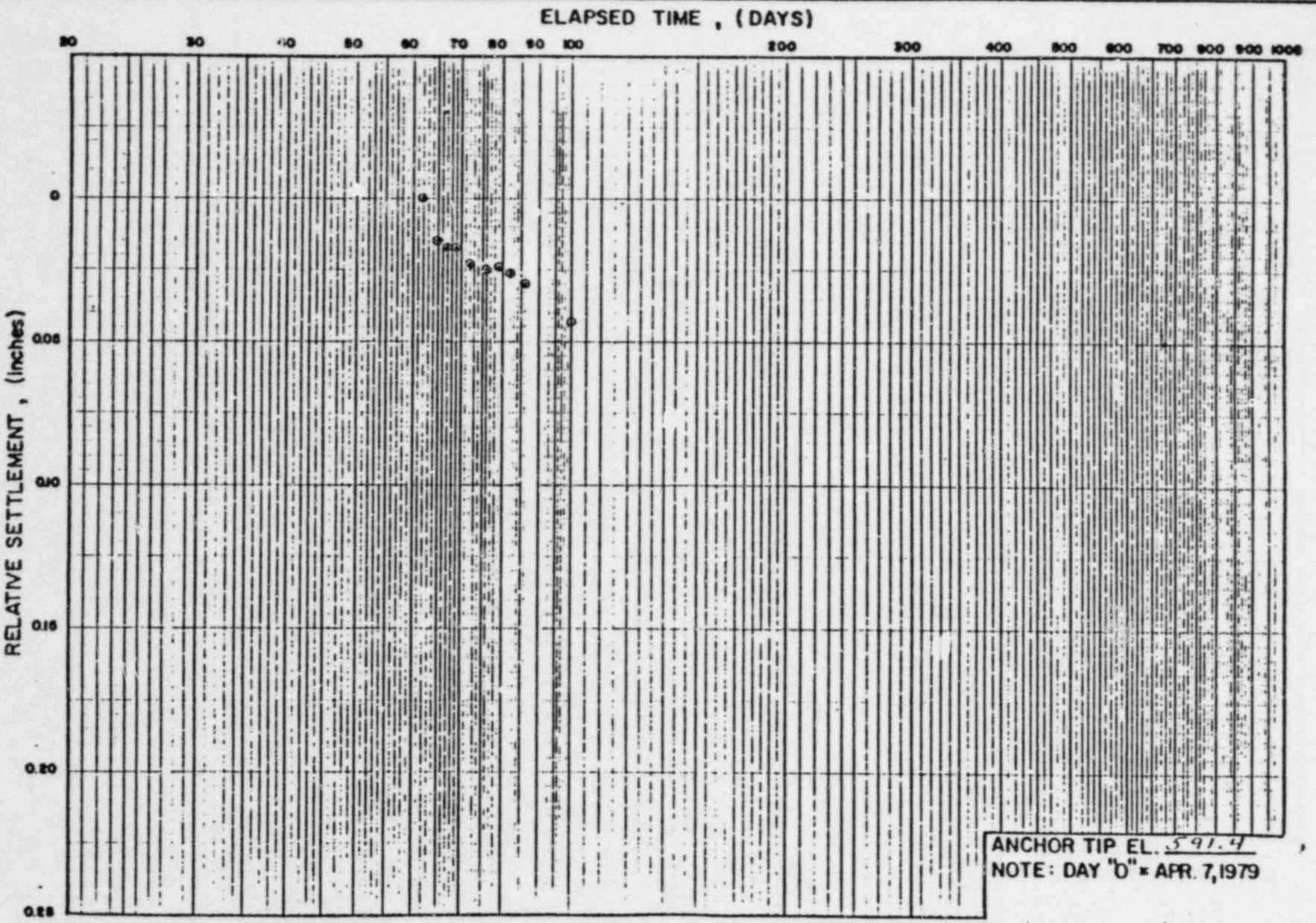

MODIFIED BORROS ANCHOR TIMF - SETTLEMENT PLOT

BORROS ANCHOR No. BA 42

MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

S/702924

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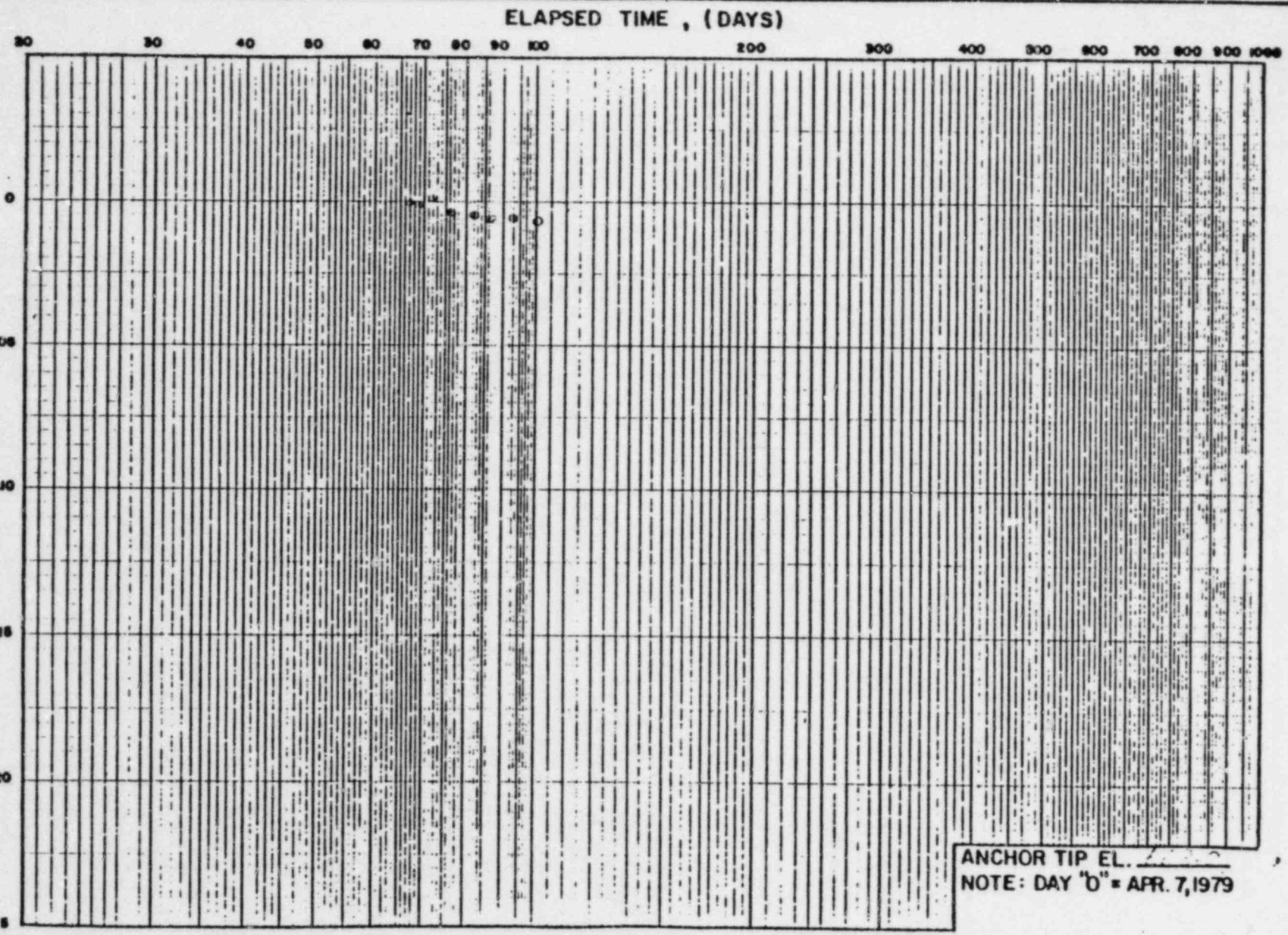

MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. I-1-71

8702925

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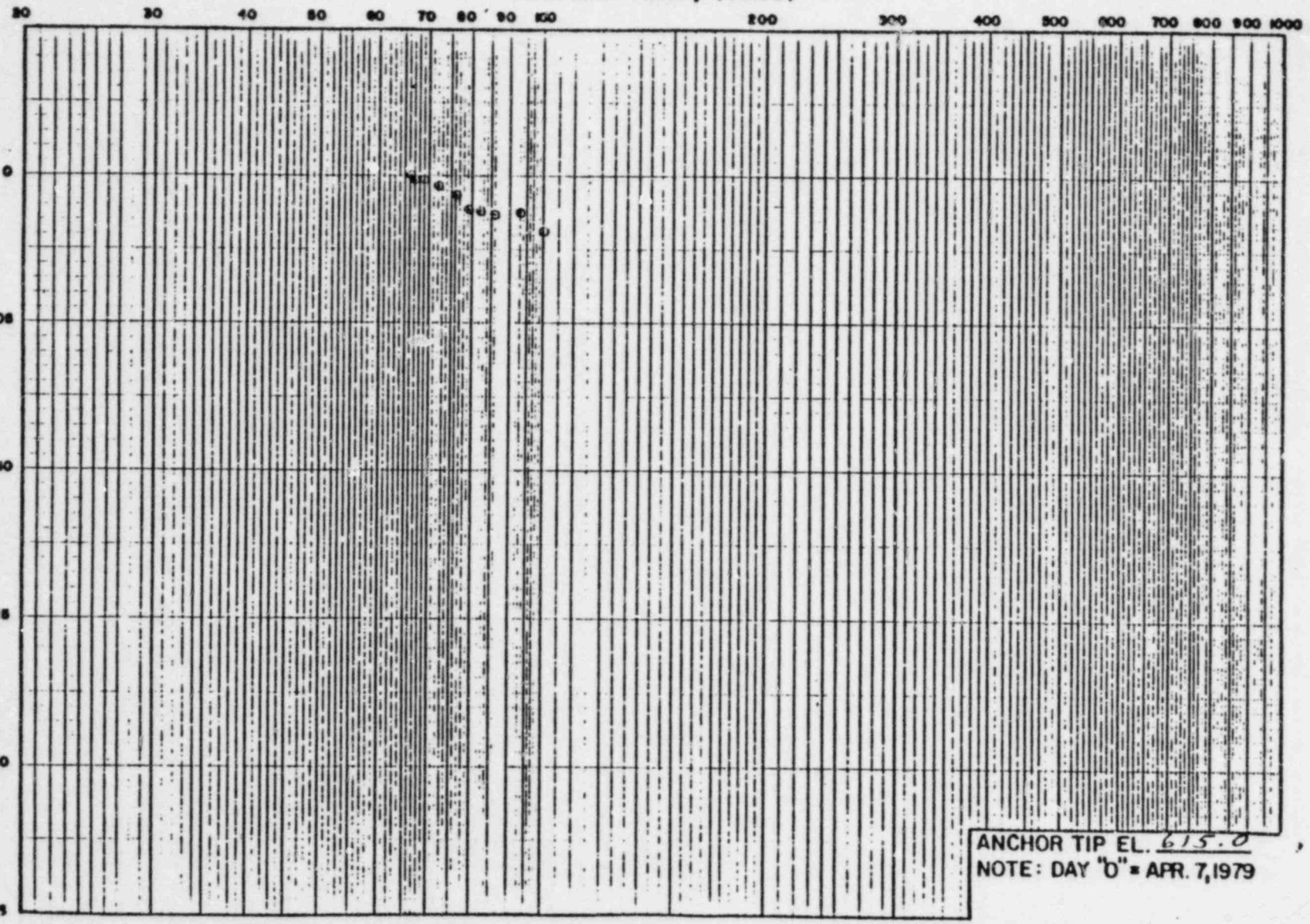

MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. BH-40

MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

8702926

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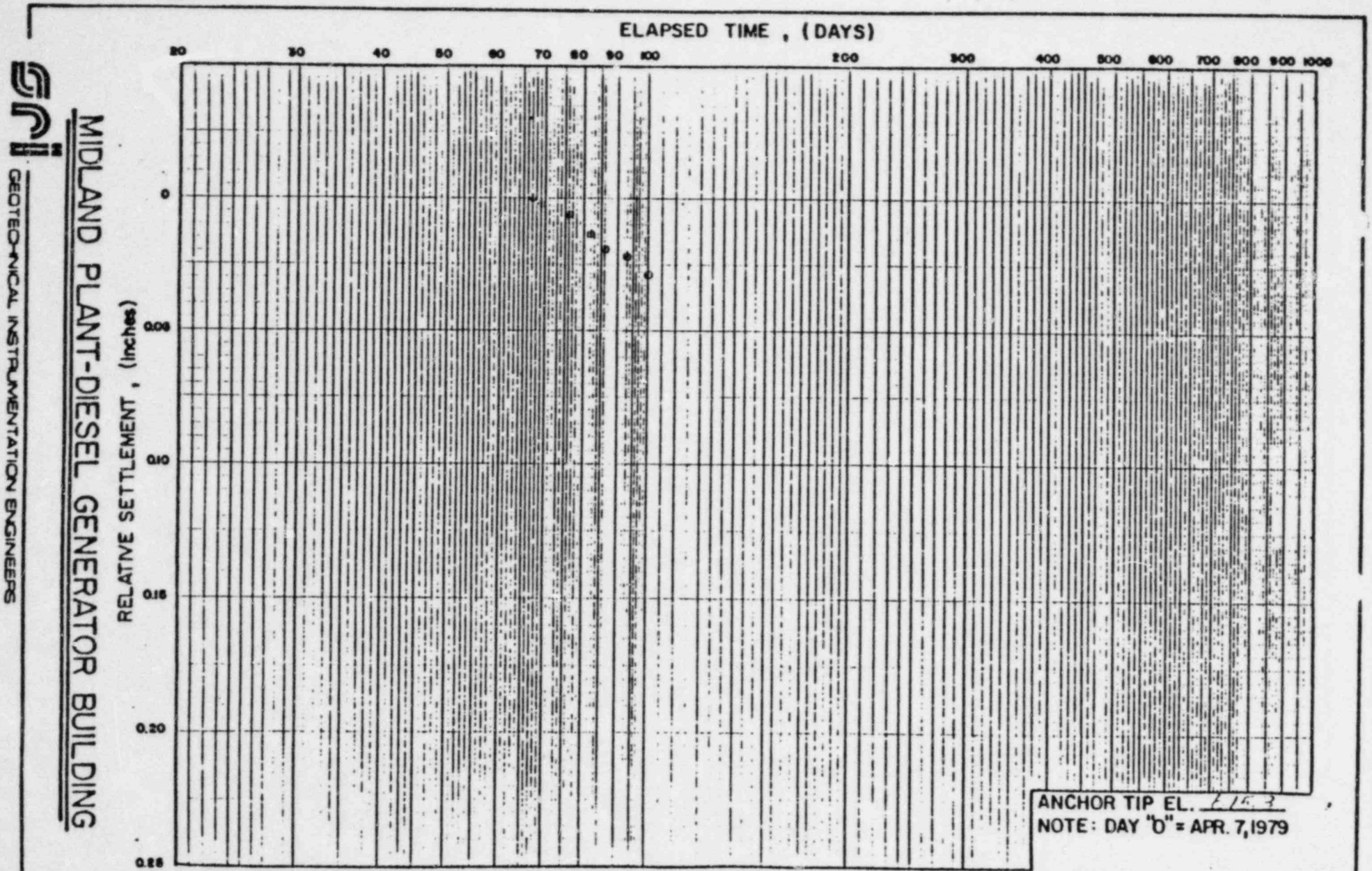

MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. BA-3C

8107029227

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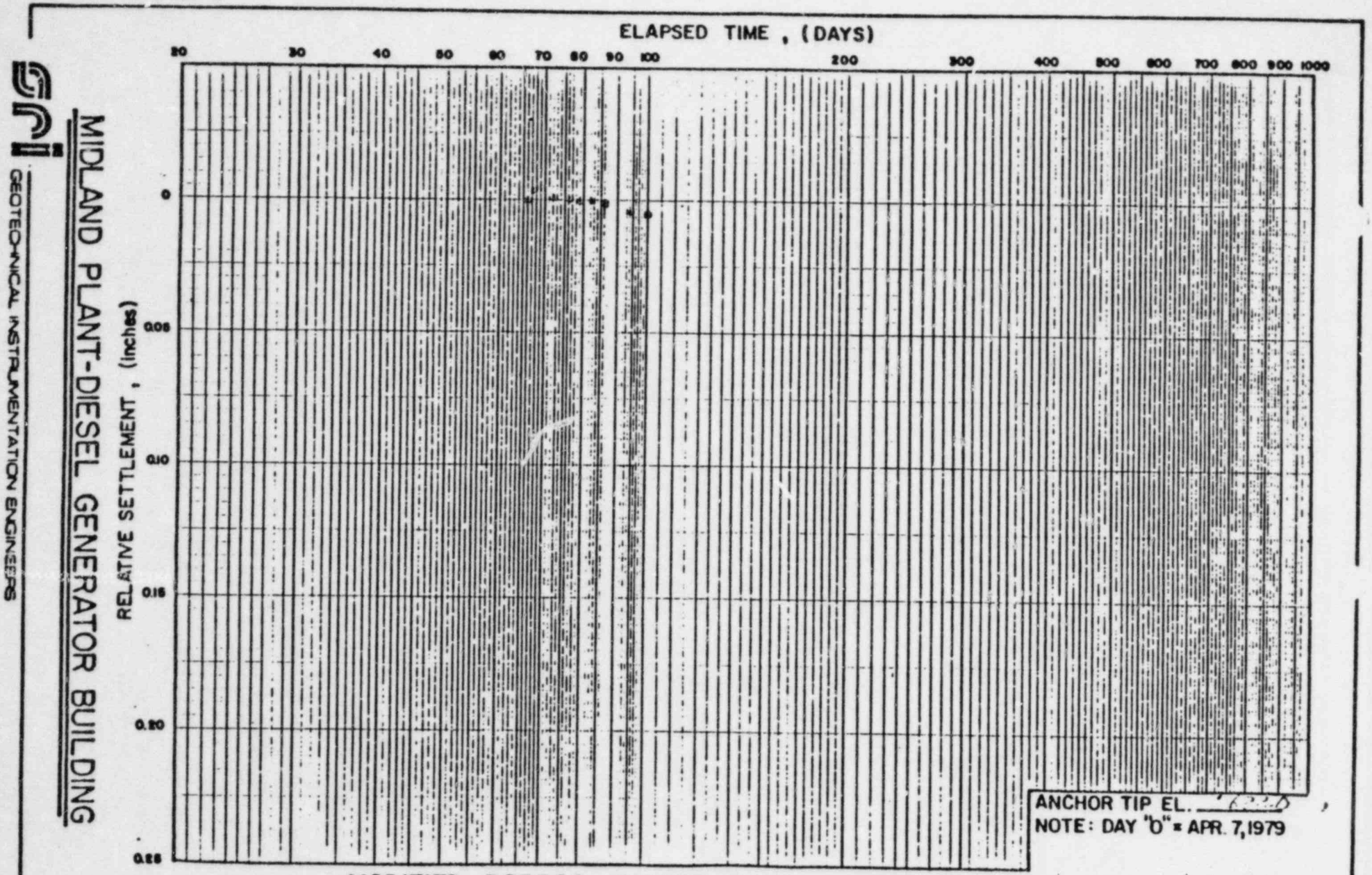


MIDLAND PLANT-DIESEL GENERATOR BUILDING

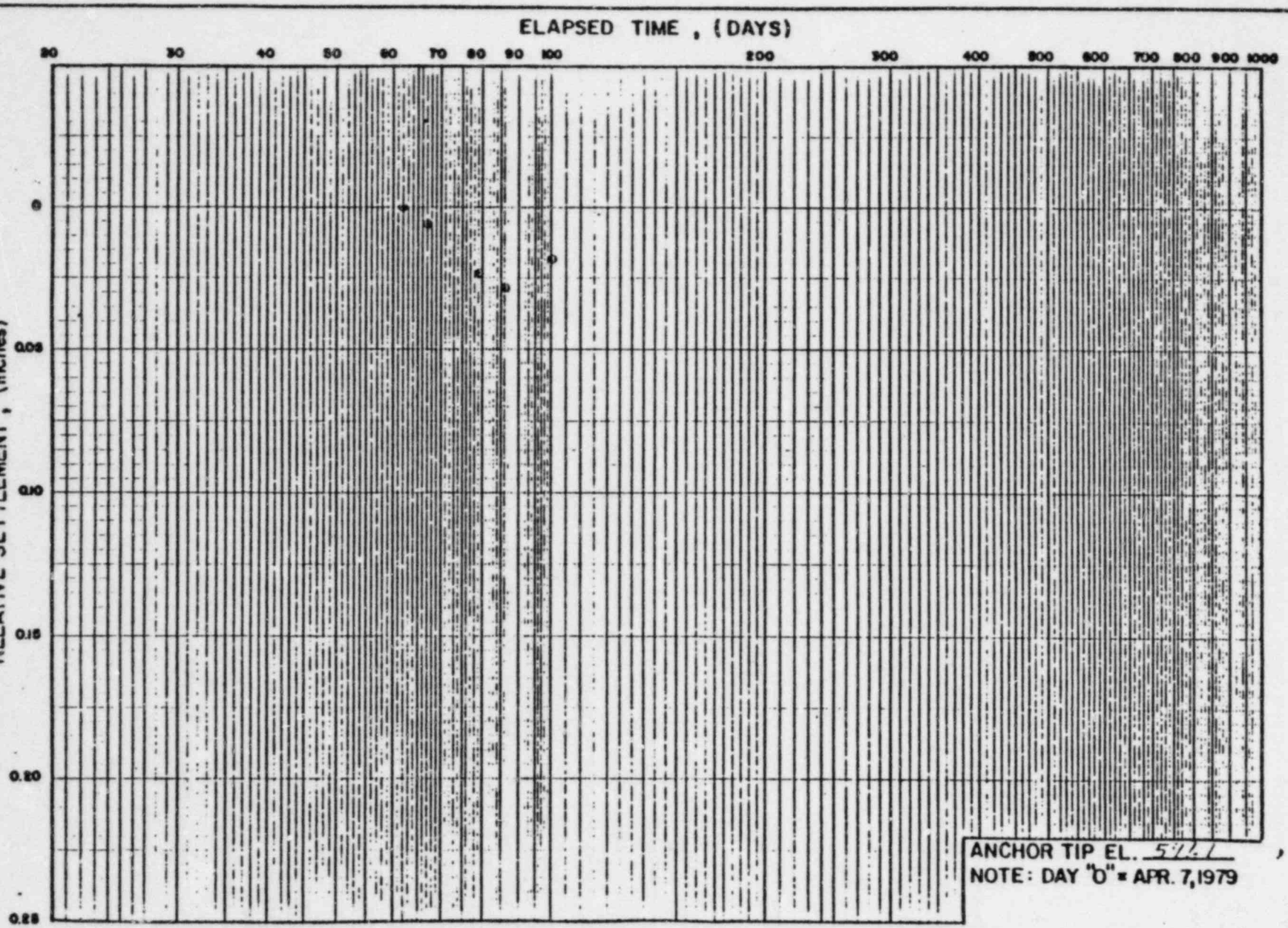
GEOTECHNICAL INSTRUMENTATION ENGINEERS

MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. LA-21

S#702928

FILE No. 2220-R



MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. BA-44

MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

SJ702929

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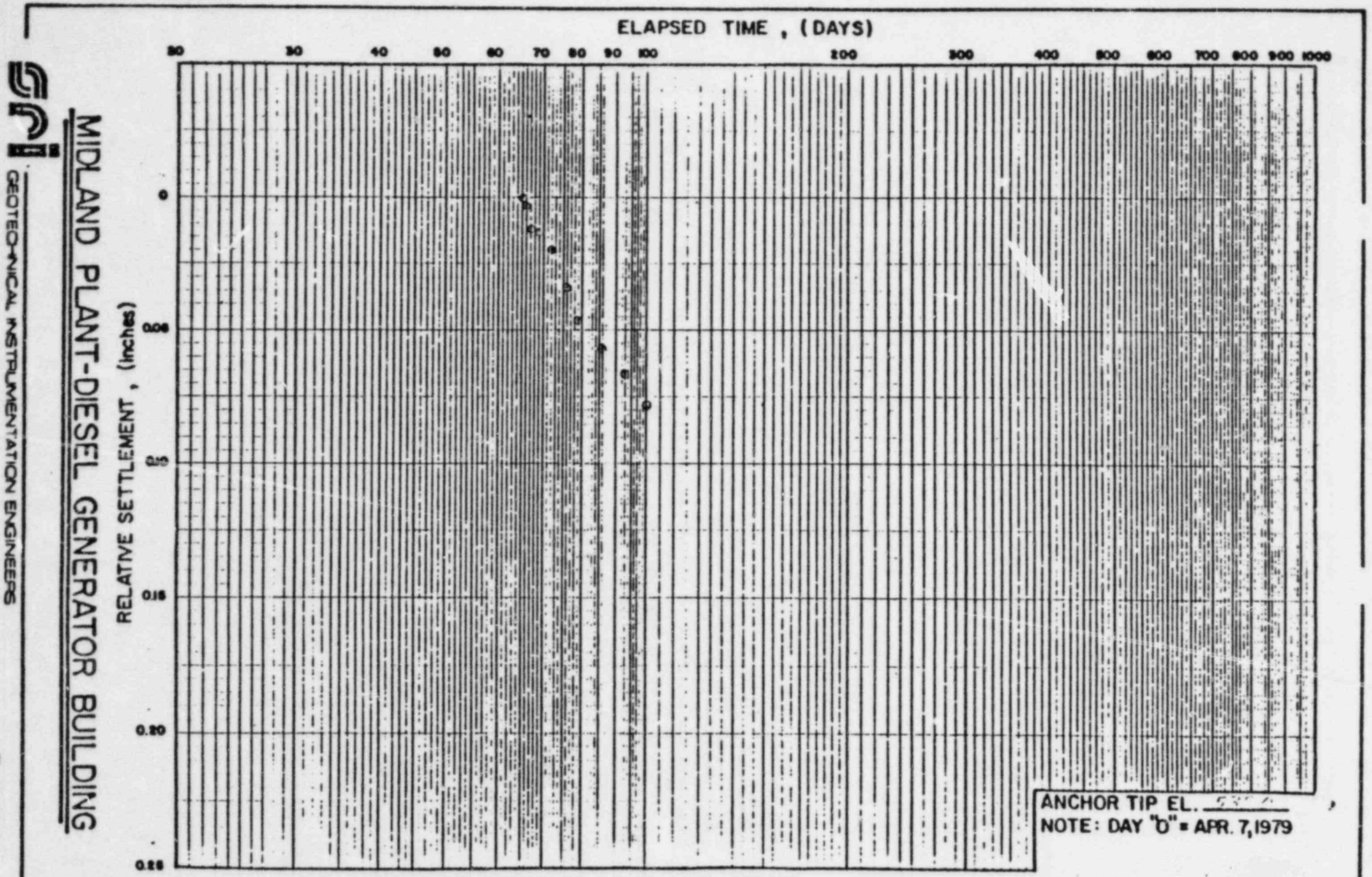


MIDLAND PLANT-DIESEL GENERATOR BUILDING

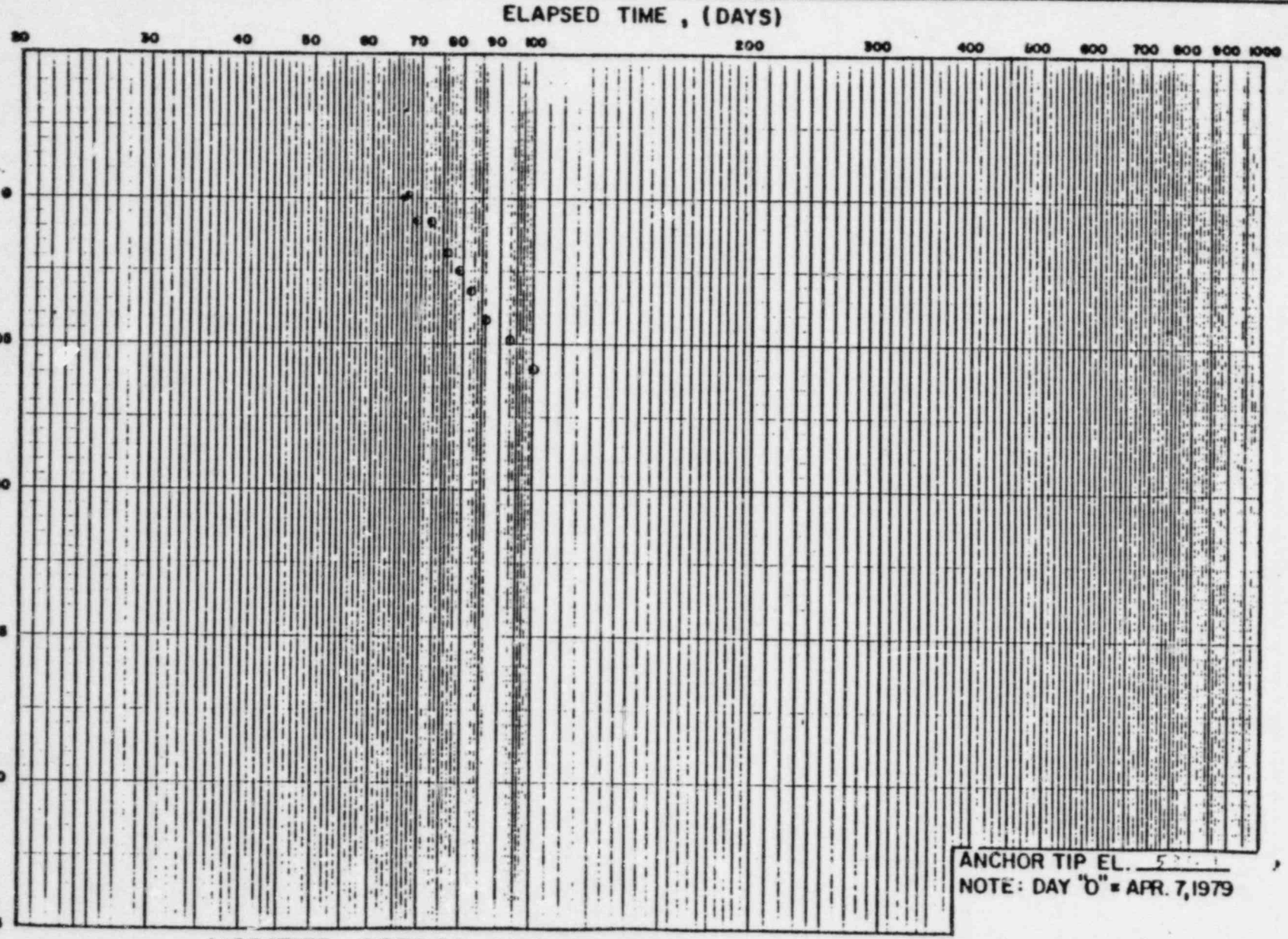
GEOTECHNICAL INSTRUMENTATION ENGINEERS

MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. BA-62

8702230

FILE No. 2220-R



MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. BA-64

MIDLAND PLANT-DIESEL GENERATOR BUILDING

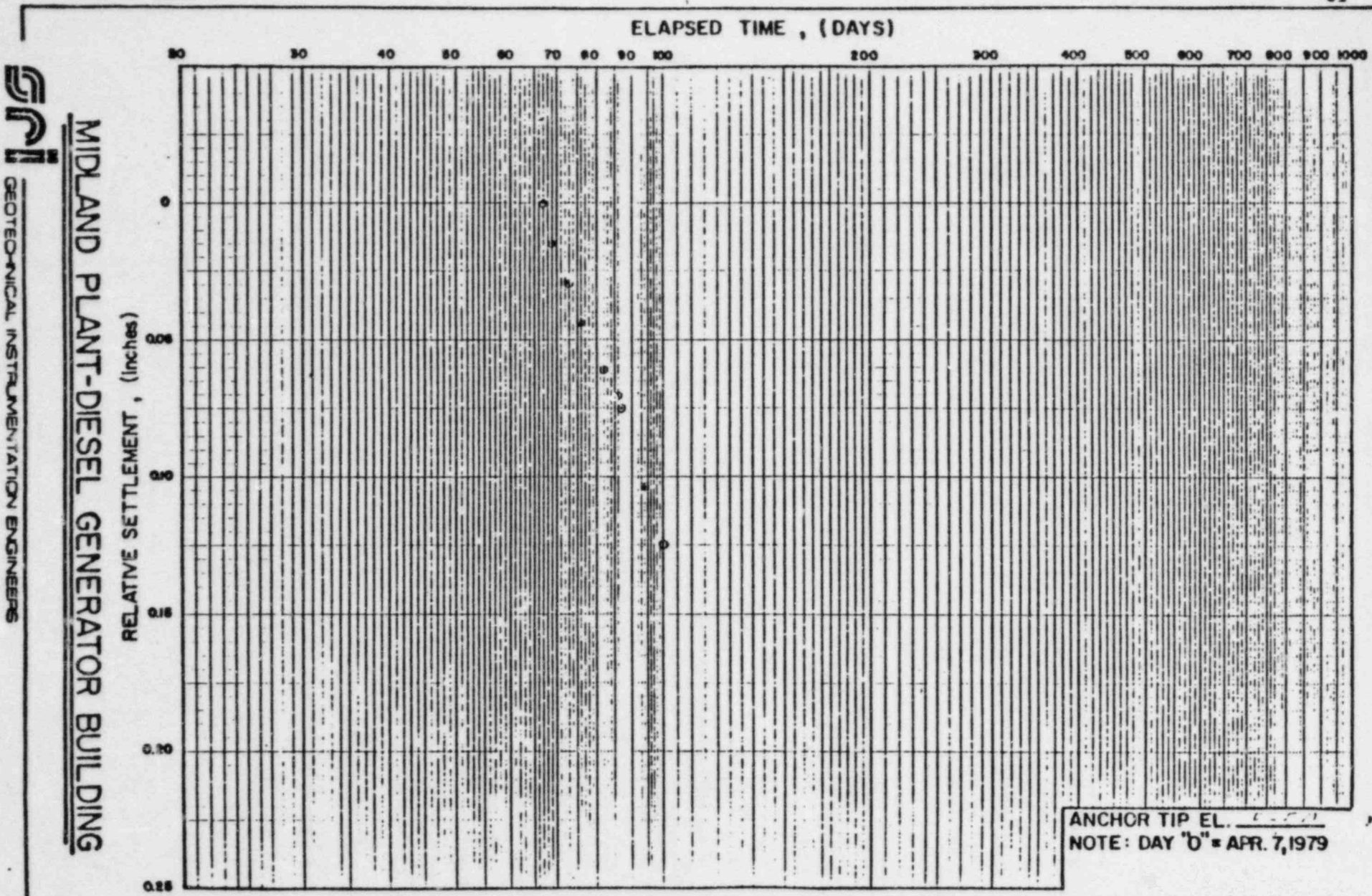
GEOTECHNICAL INSTRUMENTATION ENGINEERS

S7702931

8702932

ELAPSED TIME , (DAYS)
RELATIVE SETTLEMENT , (inches)
ANCHOR TIP EL.
NOTE: DAY "0" = APR. 7, 1979
MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT
BORROS ANCHOR No. B1-L1
FILE No. 2220-R
MIDLAND PLANT-DIESEL GENERATOR BUILDING
GEOTECHNICAL INSTRUMENTATION ENGINEERS

FILE No. 2220-R



MIDLAND PLANT-DIESEL GENERATOR BUILDING

GEOTECHNICAL INSTRUMENTATION ENGINEERS

MODIFIED BORROS ANCHOR TIME - SETTLEMENT PLOT

BORROS ANCHOR No. B-1-63

S370233

Bechtel Associates Professional Corporation

Inter-office Memorandum

To R. L. Castleberry

Date 24 July 1979

Subject Midland Units 1 & 2
Job Number 7220-101
Meeting Notes

From S. S. Afifi

Of Geotechnical Services

Copies to S. L. Blue
P. K. Chen
H. H. Burke/W. R. Ferris
T. Johnson
K. Wiedner
J. O. Wanzeck
P. A. Martinez
1320, 3130

At Ann Arbor 10 D 5
7220-79-128

Attached you will find meeting notes from the Denver Meeting with Consultants, Bechtel and Consumers Power.

Please note they will be resubmitted upon receipt of M. T. Davisson's and A. J. Hendron's signature.

JoWanzek for/SSA
S. S. Afifi

JOW/nm
Attachments

RECEIVED
JUL 27 1979
BECHTEL
AA 7220

JOB 7220

	ADV.	INFO. COPY	INIT.
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9-4-79

GEOTECH
ANN ARBOR
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2 July 1979
J958

Dr. Sherif S. Afifi
Assistant Chief Soils Engineer
Bechtel Associates Professional Corp.
P. O. Box 1000
Ann Arbor MI 48106

Re: Midland Units 1 and 2
Consumers Power Company

Dear Dr. Afifi:

The undersigned consultants met in Denver with representatives of Bechtel and Consumers Power to consider soils remedial actions with respect to this project, with the following agenda:

1. Introduction

2. Liquefaction Potential

3. Removal of Surcharge (Diesel Generation Building)

4. Chemical Grouting

5. Need for Removal of Soft Sands under Diesel Generator Structure?

6. Need for Removal of Soft Sands and/or Clays under Electrical Penetration Areas and FW Value Pits?

The following comments by the consultants are numbered according to the foregoing agenda items:

2. Liquefaction Potential

Liquefaction analyses have been conducted by Bechtel, on the basis of Standard Penetration Tests, in the compacted sands below the Diesel Generator Building and various portions of the

Auxiliary Building. These analyses have shown that the sands are not dense but that they do have a factor of safety against liquefaction of about 1.5 for an SSE with a maximum ground acceleration of 0.12g. Nevertheless, due to the erratic nature of the backfill, there is a possibility that some loose pockets could liquefy under the SSE of 0.12g, and if the SSE were raised to a higher level, then liquefaction of much of the sand backfill might become a problem.

General areal dewatering is recommended to eliminate the liquefaction potential. The goal would be to lower the piezometric levels from the present ones to somewhere near the top of the till. Dewatering is a more positive remedial measure than chemical grouting because the process can be positively monitored by piezometers, whereas it may never be possible to prove positively the beneficial effects of grouting.

Even though liquefaction of loose sands is eliminated by dewatering, a seismic shakedown will result in some residual settlement after an earthquake. The magnitude of this settlement should be estimated by Bechtel, and should account for the effects of capillary stresses above the free water surface. These stresses will result in substantially less settlement than would occur if the sand were dry.

An exterior deep-well dewatering system can be used to dewater the plant site, with a mopup dewatering system to remove the crown of the ground water within the dewatered area. Sufficient redundancy can be provided to assure that the ground water will remain within the desired levels in the event of a disruption or failure of any part of the system.

It is anticipated that after the dewatering system has been operational for over 6 months, the system could be down from one to two weeks without the ground water's rising above a critical level.

The nature of the site, existing soil, and backfilled soil is such that, after the initial dewatering of the site, the quantity of the flow into the dewatered area would be less than about 400 gpm.

As determined during the initial dewatering installation the spacing of the dewatering wells would be adapted to compensate for any unforseen soil conditions encountered and/or any

sources of recharge from the backfill placed around pipelines extending to the pond or any source of recharge water from leaky operational pipes located at critical points.

Any equipment used to mop up the water within the exterior dewatering system would be left in place.

The required observation wells would be installed with the necessary controls at the proper locations to ascertain that the desired dewatered conditions are being achieved. The observational system, consisting of piezometers, should be of Q category, but because there is a high degree of redundancy in the well system as well as a long recovery time for recharge should power fail, it is not necessary that the dewatering system itself be Q. The dewatering system need not be seismically qualified, because it will serve its purpose if the water levels are in the drawn-down position just before the earthquake. Failure of the pumps during the earthquake would not destroy the protection.

Frequent monitoring of the groundwater levels and of the operating deep wells would be scheduled. Repair or replacement of non-functioning pumps would be carried out when a sufficient number of pumps are down to permit an economical repair operation. Scheduled cleaning of the well screens would be performed about every three to six months.

On the assumption that the perimeter is about 3000 ft, rough estimated cost of an exterior deep-well system complete with the necessary discharge system, electrical controls and wiring and standby generators would be about $1,200,000. This corresponds to 250-300 deep wells. To this cost should be added that of the interior mopup system, the observation wells, and their controls (probably $200,000), and the yearly cost of maintenance. The estimated yearly maintenance cost for treating the wells and for repairing or replacing the deep-well pumps is about $35,000. To this annual cost should be added the cost of monitoring.

3. Diesel Generator Building

The longer the full surcharge can remain on the area, the more reliable will be the prediction of the clay-seated portion

of the long-term settlement. For this reason, it would be preferable to maintain constant conditions as long as practicable. We realize, however, that practical considerations do not permit an indefinite delay in surcharge removal. If a suitable means is developed for making reliable temperature corrections to the readings of the precise settlement gages, we believe that removal could, if necessary, begin in August.

To this end, we suggest the fabrication and use of possibly four dummy gages, each consisting of a pair of rods in a casing of the same type as that in the actual gages. One rod of each pair would be of identical size and material to that in the actual gages, and the other of invar of the same dimensions. Each assembly would terminate in a block of concrete placed on top of the fill inside the building, adjacent to an active gage. The locations would be selected to provide a range in length of dummy gages corresponding to the maximum range of the active gages in the building.

In addition, all readings should be interpreted carefully and corrected for thermal effects. To the extent possible, readings should be made under constant conditions, as in the early morning.

Loose sands beneath the building will not compromise the static bearing capacity or lead to settlement under static loads applied after surcharge removal. Some settlement must be expected due to vibration of the diesel engines; this should preferably be induced by operating the machines before general dewatering of the area, whereupon the settlement will be correspondingly reduced during use of the machines in the future. Earthquake-induced settlements are discussed under liquefaction potential.

4. Chemical Grouting

According to the discussion of liquefaction potential, Item 2, the need for chemical grouting will be eliminated by the general dewatering.

I do not agree with Mr. Warzeck RB

Mr. Warzeck did not think it was intended that the the diesels had to be operated before dewatering. BCM 11.1.

S3702366

5. Need for Removal of Soft Sands under Diesel Generator Structure

If general, permanent dewatering is adopted, there is no need to excavate the loose sands beneath the diesel generator building. Their static stiffness and bearing capacity are fully adequate for static and dynamic bearing pressures. The connections of pipes and the building or equipment within the building must be capable of taking the differential settlements arising from the likelihood that the sands on the north side of the diesel generator building will undergo some seismic shakedown settlement, whereas the south side of the structure supported on cohesive backfill is not likely to settle significantly under the seismic loading.

6. Need for Removal of Soft Sands and/or Clays under Electrical Penetration Areas and FW Valve Pits

The consultants have been furnished the approximate information listed below:

1. The containment structures have been analyzed as if free of the other structures.

2. The auxiliary building has been analyzed as if free of the other structures.

3. The turbine building has been analyzed as if free of the other structures.

4. The peak single-amplitude of the auxiliary structure at its center of gravity is 0.38 in. for an acceleration of 0.12g.

5. Under present conditions, the stresses in the auxiliary wings are satisfactory on the assumption of an uncracked section, but the steel stress is about 40 ksi if calculated on the basis of a cracked section.

6. A load of 1500 kips at the outer ends of the wings would relieve the overstress.

7. A load of 3000 kips at the outer ends of the wings would restore the original zero deflection.

8. The horizontal dynamic force in each wing would be 1250 kips.

The consultants have considered the following remedial measures:

A. Remove unsuitable material and replace it with mass concrete under the valve pits and wings, and permanently support the K line of the turbine building on jack piles, provide temporary support of the wings with caissons at the outer ends, with capacities up to 3000 kips for each wing.

B. Provide permanent support by caissons of the outer ends of the wings, with a capacity of 3000 kips for each wing. Remove unsuitable material under the valve pits and replace it with mass concrete. Support the K-line of the turbine building with jack piles as required. Two options exist:

(1) Tie the auxiliary building to the turbine mat to provide lateral seismic resistance,

(2) Tie the auxiliary building to the valve pit and the concrete fill beneath it. An additional option is also to tie the valve pit to the buttress access shafts for additional lateral resistance.

Construction procedures for installing jack caissons have been thoroughly reviewed in prior meetings. Concept B calls for permanent Category I caissons; jack piles are not recommended. The following considerations apply to the jacked caissons:

1. The steel casing is ignored for carrying permanent load.

2. Concrete is now Q.

3. The supporting material will be till.

S:702368

4. The design pressure on till is twice that under the PSAR commitment. This is offset by the following advantages:

   a. The caissons will be proof tested to 1.5 times the working load. This test greatly exceeds the 1.12 (perhaps more) by which the working load would be increased in a seismic event. Analysis shows that the bearing value has an adequate factor of safety, exceeding 2.5.

   b. The procedure calls for rejacking the caissons to assure proper load sharing, as with the temporary caissons.

It is our opinion that solution B(1) above represents a sound engineering solution. However, it requires tying a Category I building to a Category II building. If NRC requirements dictate, solution B(2) can be used. It involves tying Category I structures to Category I structures.

7. Service Water Structure

This item was not discussed extensively during the meeting of 28 June, but was previously discussed and is added to this letter to complete the record.

Underpinning the service water structure with driven piles and a corbel is a positive solution. Even if liquefaction should occur, the piles will maintain their buckling load as a minimum. The analysis of the structure should treat the piles in the normal manner; if the buckling load is a lower-bound, the analysis should treat the piles as applying an upward load equal to the buckling load to the structure. The horizontal forces due to earthquake will be taken on the base of the main portion of the structure.

Yours very sincerely,

A. J. Hendron, Jr.

M. A. Davisson

R. W. Loughney

C. H. Gould

R. B. Peck

S[illegible]702969

C-2645

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

Bcc: S. Afifi
A. Almuti
[redacted]
W. Ferris
R. Hermeston
W. Jones
P. Martinez
C. McConnel
J. Newgen
G. Richardso
J. Wanzeck
K. Wiedner
All w/att

July 3, 1979

BLC- 7830

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

Attention: Mr. R. C. Bauman

Subject: Consumers Power Company
Midland Plant - Job 7220
Meeting Notes No. 979
Settlement Problem of
Seismic Category I Facilities
And Structures
File: 0270, 0279, C-1700, C-2645

Gentlemen:

Attached is a copy of meeting notes 979 for the meeting with Consumers in Ann Arbor regarding the planned remedial action for the settlement problem of Seismic Category I facilities and structures.

Very truly yours,

for R. L. Castleberry
Project Engineer

SL/db

Enclosure: Meeting Notes No. 979

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

S.7025S3

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

MEETING NOTES NO. 979

MIDLAND PLANT UNITS 1 & 2

CONSUMERS POWER COMPANY

BECHTEL JOB 7220

DATE: May 11, 1979

PLACE: Ann Arbor, Michigan

SUBJECT: Soils Resolution Plan

FILE: 0279, C-2645

ATTENDEES:

Bechtel	CPCo
S. Afifi	T.C. Cooke
A. Almuti	D.E. Horn
B. Dhar	C.A. Hunt
W. Ferris	G.S. Keeley
R. Hermeston	D.B. Miller
W.G. Jones	T. Thiruvengadam
P.A. Martinez	
B.C. McConnel	
J. Newgen	
G.L. Richardson	
J.O. Wanzeck	
K. Wiedner	

PURPOSE: To inform CPCo of the planned remedial actions relating to Seismic Category I facilities and structures other than the diesel generator building, as well as a brief status report on the diesel generator surcharge (agenda attached)

ITEMS DISCUSSED:

1) Resumption of backfill operations

The NCRs affecting the backfill operations are being resolved on a priority basis. The items discussed in the minutes of the May 4, 1979 meeting (attached to J. Newgen's memorandum to P. Martinez, dated May 4, 1979, BCBM-460) are being resolved. The first priority area is the tank farm. The remaining priorities are being established by Bechtel construction.

8702260

2) Brief review of the diesel generator building settlement

The maximum settlement is approximately 7 inches with a minimum of 3-1/4 inches. The diesel generator building wall settlement history drawings were visually examined. The north and south walls show uniform settlement since December 15, 1978. There is no indication that the condensate lines are impeding the long-term building settlement.

An estimated date for surcharge removal can be made 4 to 6 weeks after establishing a settlement slope. The settlement rate is so small at the present time that more accurate survey methods are being developed. The new methods are anticipated to have an accuracy of $\pm$0.02 inch.

3) Planned remedial actions for structures

a) Service water structure

The northeast portion of the building will be supported by 100-ton piles driven to till. The piles will be designed to support vertical loads only. Horizontal forces will be resisted by the portion of the structure supported on natural soil.

b) Main feedwater isolation valve pits

The questionable soil will be removed and replaced with concrete. A temporary support will be provided and will span from the tendon access pit to the turbine building wall.

c) Auxiliary building electrical penetration room

The questionable soil will be removed and replaced with concrete for both Unit 1 and 2 penetration rooms. The extent of the excavation will be the only difference in the actions taken for each unit. Temporary support provisions are being designed for the Unit 1 electrical penetration room during dewatering. The actual need for the temporary support is still under investigation.

A perimeter dewatering system will be installed to allow excavation in a dry condition. The system will go from the Unit 1 reactor building south, around the turbine, administration, and diesel generator buildings, and then north to the Unit 1 reactor building.

d) Auxiliary building railroad bay

The loose sands susceptible to liquefaction will be chemically grouted. A grouting test program will be performed to develop required spacing, pressure, gel times, and the most effective type of chemical grout.

5) Tanks

a) Emergency diesel fuel oil tanks

There are no anticipated remedial actions. Two locations on each tank are being monitored for settlement. To date, there has been essentially no settlement observed.

b) Borated water tanks

There is no anticipated remedial action. There will be no surcharge placed. The tanks will be constructed, filled with water, and monitored for settlement. The monitoring will be continued until a long-term settlement trend has been determined. The borated water lines will be evaluated for settlement effects. The system turnover and startup requirements are being studied by the task force.

c) Condensate tanks

There is no anticipated remedial action. Connection details to the tank will permit settlement without impacting piping through the use of a metal bellows which will allow up to 6 inches of vertical movement, 1/2 inch of lateral movement, and 1-1/2 degrees of rotation. Due to the low number of loading cycles, the bellows are expected to last as long as the material. The lead time is expected to be 6 weeks.

6) Other structures

a) Service water valve pits

There is no anticipated remedial action. The valve pits serve no structural purpose other than protection for the service water valves from tornado missles and the surrounding soil and water. At present the valve pits are covered by the diesel generator building surcharge. The valve pits will be monitored as part of the FSAR site monitoring program.

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b) Transformer foundations

1. Unit 1 transformer area

Surcharge will be placed over the transformer area and selected points will be monitored.

2. Unit 2 transformer area

There is no anticipated remedial action.

c) Guardhouse

The sand drain in the area has been investigated. The foundation design will not use piles but has been modified to reduce the soil pressure.

d) Retaining wall

There is no anticipated remedial action. The retaining walls will be monitored as part of the FSAR site monitoring program.

7) Underground utilities

a) Piping

1. Service water pipe

All profiling requested from Goldberg-Zoino-Dunnicliff & Associates (GZD) has been completed. Markers are being installed along the top of the line to allow the profiles to be measured in zones where the GZD device could not be used.

2. Borated water pipe

Markers are being installed along the top of the line to allow the profile to be measured.

3. Emergency diesel fuel oil pipes

The present design requires a sloped return to the oil tanks and engineering is investigating the need for this requirement. The diesel oil lines will be surveyed in the future.

4) Condensate water pipes

All profiling requested from GZD has been completed. Engineering is investigating the area immediately below the diesel generator building. This investigation will account for the data from the profiles, borros anchors, settlement plates, building settlements, and condensate line settlement.

b) Electrical duct banks

A formal plan is being coordinated between engineering and construction to include functional monitoring, continuity checking, and a review of existing pulling history.

8) Cost, schedule and contracts

a) Cost - see Attachment 1

b) Schedule - see Attachment 2

for B.C. McConnel

CBM/js
5/25/1

S3702373

AGENDA

Midland Units 1 and 2
Consumers Power Company
Bechtel Job 7220

DATE: Friday, May 11, 1979

TIME: 9:30 a.m.

PLACE: Bechtel Ann Arbor Offices

SUBJECT: SOILS RESOLUTION PLAN

ATTENDEES:

Consumers Power Company	Bechtel
G. S. Keeley	A. Boos/J. Betts
R. Wheeler	K. Wiedner
D. Sibbald	W. Ferris
D. Horn	S. Afifi/J. Wanzeck
T. C. Cooke	J. Hink
C. Hunt	G. Tuveson
T. Thiruvengadam	A. Almuti
	G. Richardson
	W. Jones
	P. Martinez

DISCUSSION ITEMS:

(1) Introduction.

(2) Review of diesel generator building settlements.
- (A) Records
- (B) Condensate liner (hang up or not)
- (C) Schedule for surcharge removal

(3) Planned fixes for structures and contracts
- (A) Service water pump structure
- (B) Isolation valve pits
- (C) Electrical penetration rooms
- (D) Railroad bay

(4) Tanks
- (A) Diesel fuel
- (B) Borated water
- (C) Condensate
- (D) Other tanks

(5) Other structures
- (A) Service water valve pit
- (B) Transformer foundation
- (C) Guardhouse
- (D) Retaining walls

over . . .

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(6) Underground facilities
    (A) Piping
    (B) Duct banks

(7) Cost & Schedule and Contracts
    (A) Piling
    (B) Underpinning
    (C) Grouting
    (D) Dewatering

M/pp

S370233

JOB 7220
MIDLAND UNITS 1 & 2

ATTACHMENT 1

ORDER-OF-MAGNITUDE
COST ESTIMATE
FOR
CORRECTIVE ACTIONS

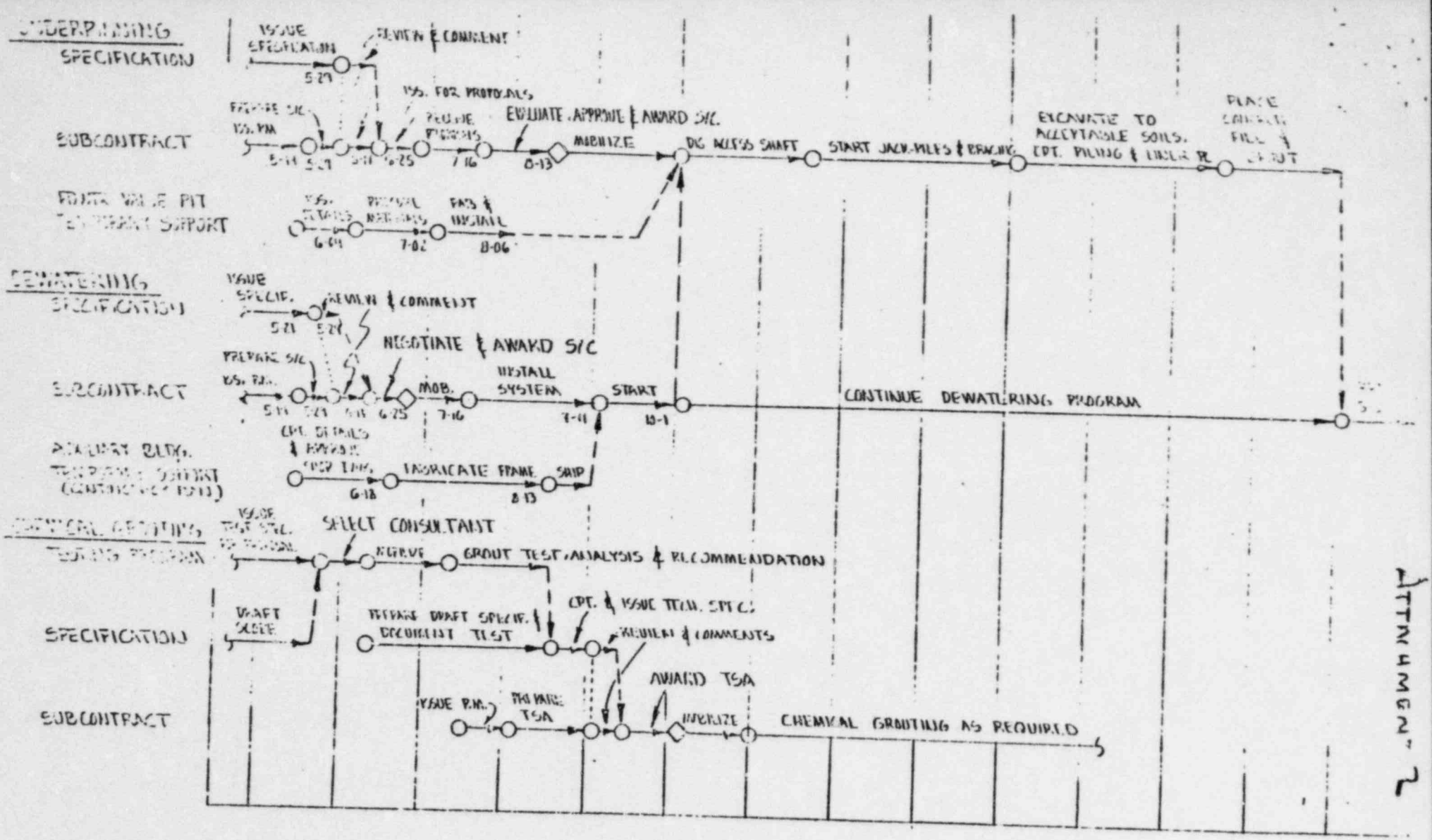
	S/C	FIELD	ENG & HO	TOTAL
1. Bearing piles for the Service Water Pump Structure, including a pile bearing test.	$ 100,000	$ 300,000	$ 100,000	$ 500,000
2. Underpinning of Electrical Penetration Rooms and the Main Feedwater Isolation Valve Pits, including pit temporary supports.	$ 3,250,000	$ 300,000	$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

Costs not indicated on this sheet:

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

S[illegible]

AAO - 5/11/79



ATTACHMENT 2

Bechtel Associates Professional Corporation

Inter-office Memorandum

BEBC-3053

To	J.F. Newgen	Date	June 27, 1979
Subject	Midland Plant Units 1 & 2 Job 7220 Plant Area Underground Electrical Duct Banks	From	R.L. Castleberry
		Of	Engineering
Copies to	File: 0274, [redacted]	At	Ann Arbor

K. Wiedner
B. Dhar
B.C. McConnel
Com Log
R. Schulman
L. Basinski
W. Terrell

To evaluate the adequacy of the electrical duct banks in the plant area fill, project engineering requires the following.

a) A summary of records for all cleaning and cable pulling operations regarding the electrical duct banks (Q and non-Q) will be transmitted to project engineering. The summary of records will include general observations and the location of any obstruction, snags, or excessive pulling tension that is encountered during:

1) The construction inspection with a rigid foam rabbit or cleaning mandrel just prior to cable pulling
2) The cable pulling operation

The summary records will be submitted to project engineering within 15 days of cable pulling.

b) Monitoring of duct banks by pulling a rigid fiber rabbit in both directions through each empty conduit and pressurizing each empty conduit to 100 psig with a 15-minute hold. Duct banks to be monitored comprise the following:

1) All of the duct banks from the auxiliary building to the diesel generator building and service water pump structure
2) All of the (Q) duct banks from the auxiliary building to the borated water storage tanks
3) All of the duct banks from the diesel generator building to the emergency diesel fuel oil tanks and service water valve pits
4) The duct banks from the turbine building to the main transformer pads shown in Sections B and C on Drawing E-530
5) The duct bank from the turbine building to manhole 1NMH016/2NMH016

S[illegible]

These duct banks will be monitored by July 1, 1979, and also just prior to cable pulling, except for the duct banks which are inaccessible because of the temporary surcharge which will be monitored within 2 weeks after the surcharge is removed.

If two or more of the conduits in a duct bank cannot maintain the pressure or have obstructions at a common location, project engineering will be notified immediately. In either case, a summary of the results will be transmitted to project engineering.

c) The following conduits will be placed on hold for future monitoring as directed by project engineering:

1) Diesel generator building
   a. 1BA 027
   b. 1AA 014
   c. 2AA 006
   d. 2BA 015

2) Service water pump structure: 1BA 038

3) Emergency diesel fuel oil tanks: 2NA 513

4) Borated water tanks
   a. 2NA 282
   b. 1NA 242

5) Turbine building to manhole 16: 2NA 106

for M.O. Rothwell
R.L. Castleberry

CM/pd
6/22/2

S7023573

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

bcc: S.S. Afifi
P. Martinez
J. Newgen
K. Wiedner
Com Log

June 27, 1979

BLC-7812

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

Attention: Mr. R.C. Bauman

Subject: Consumers Power Company
Midland Plant - Job 7220
Meeting Notes No. 957
Midland Diesel Generator
Meeting
File: 0270, 0279, [redacted]

Gentlemen:

Attached for your review and information are copies of the Meeting Notes No. 957 on the diesel generator building task group meeting held in Ann Arbor, Michigan on April 26, 1979.

Very truly yours,

for R.L. Castleberry
Project Engineer

AG/pd
6/26/2

Enclosure: Meeting Notes No. 957

cc: D.B. Miller w/a

S702360

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

MEETING NOTES NO. 957

MIDLAND PLANT UNITS 1 AND 2

CONSUMERS POWER COMPANY

BECHTEL JOB 7220-101

DATE: April 26, 1979

PLACE: Ann Arbor, Michigan

SUBJECT: Meeting of the Diesel Generator Building Task Group

FILE: 0279, [redacted]

ATTENDEES:

Bechtel		CPCo
S. Afifi	C. McConnel	D. Horn
A. Almuti	W. Natzella	C. Hunt
A. Boos	G. Tuveson	D. Sibbald
R. Castleberry	J. Wasylewski	T. Thiruvengadam
B. Dhar	K. Wiedner	
A. Ganguly		
W. Jones		

PURPOSE: The meeting was held at the Ann Arbor office to discuss the following items in relation to the diesel generator building settlement and other Seismic Category I structures on plant fill:

A) Review of action items initiated in the meeting of March 12, 1979. Identify future action items as required.

B) Corrective actions for Seismic Category I structures on plant fill, other than the diesel generator building

C) Corrective actions related to condensate storage tanks and diesel fuel oil tanks

D) Reactivation of backfill operations (revision of specifications, etc)

S 7702281

E) Comments on FSAR Section 2.5

F) Comments on response to the NRC's 22 questions (10 CFR 50.54 request)

G) Recommended actions regarding the letter from Mr. Keppler of the NRC's Region 3 office to Mr. S.H. Howell of CPCo, dated March 22, 1979

ITEMS DISCUSSED:

A) Review of prior action items

Action items from the previous meeting held on March 12, 1979 (Meeting Notes No. 934) were reviewed. (The numbers refer to the action items of those notes.) The current status of these items is as follows:

1) This item is closed. Activities regarding Q-listed utilities have been covered in the response to the NRC's 10 CFR 50.54 request of March 21, 1979.

2) This item is closed. Project engineering received the profile data for the Q-listed service waterlines.

3) This item is open. Profiling data for the surveyed service water lines have been plotted and compared against the previous profiles of the same lines as surveyed before surcharging. Comparison indicated that immediate rechecking of the reference elevations of those service water lines is necessary for accurate evaluation of the piping conditions.

4) This item is open. A revised cost estimate which will include corrective actions in other areas of fill in addition to the diesel generator building work will be issued 1 week after completion of the conceptual design of corrective work for the auxiliary building area.

5) This item is closed. Gallagher's question will be covered in the discussion of agenda item G of this meeting.

6) This item is complete. Milestone dates were incorporated in Drawing SK-C-628 on April 23, 1979. It was decided that before May 4, 1979, Geotech will discuss with GZD increasing the degree of accuracy of rebound anchor measurements and the measurement of settlement of the diesel building and foundations. Geotech indicated that plans for removal of surcharge or decisions regarding any additional surcharging requirement may be made by May 10, 1979, after the consultants' evaluation of currently available settlement data.

S 7902262

7) This item is closed. Results of evaluation of liquefaction potential of sand in the diesel generator building area was discussed with the consultants. Two methods of stabilizing the sand, grouting and vibratory compaction, were discussed as possible solutions for the liquefaction problem. Also discussed was the method of providing uniformly spaced sand piers to dissipate pore pressure buildup during liquefaction. Dr. Peck has recommended the method of stabilization by chemical grouting.

8) This item is closed. Actual loads experienced by the tie rods between the turbine building wall and diesel building wall were less than the designed value. Instrumentation results indicated that the deflection of the turbine building wall due to surcharge-earth pressure loads were not significant.

9) This item is open. Specification 7220-C-83 will be revised to include as-built information available to date and is scheduled to be reissued by May 4, 1979.

10) This item is closed. Adequacy of design of corbel with 4,750 psi concrete strength was checked by engineering, and continuation of surcharging was released by letter BEBC-2806 on March 22, 1979. Currently available concrete strength test results indicate that the average ultimate cylinder strength of concrete is approximately 4,950 psi.

11, 12) These items are closed. Surcharging was held at a level of 10 feet above final plant grade until March 16, 1979. Further surcharging to 20 feet was released by letter BEBC-2806 on March 22, 1979.

13, 14) These items are open. Construction reported that plots of density tests on plant fill have been completed for the diesel generator building, the service water structure area, and areas south of the power block. Plots for remaining portions of the power block will be completed (including back-checking) before May 18, 1979. Locations of borings will also be included in those plots.

15) This item is open. It was decided that separation of Canonie's work from Bechtel's work in the density test plots will be shown for the problem-related areas of fill. These areas are listed in Action Item 9 of these meeting notes.

16) This item is still open. Geotech will provide a projected schedule for activities regarding U.S. Testing's density tests.

S[illegible]

(Writer's Note: Geotech provided the following schedule on May 1, 1979:

Draft of preliminary report - June 4, 1979
(U.S. Testing's data only)

Start test pits - May 21, 1979

Preliminary report on test pits - June 11, 1979)

17) This item is closed. The acceptance procedure for the diesel generator building has been discussed in response to Question 4 of the NRC's 10 CFR 50.54 request.

18) This item is closed. At present the FSAR does not have any criteria for differential settlement in the utilities. This item has been covered in the response to Questions 17, 18, and 20 of the NRC's 10 CFR 50.54 request.

19) This item is closed. Letter BEBC-2792, dated March 19, 1979, from engineering requested the completion dates of pipe connections. Construction has already replied (letter BCBE-2255R) suggesting that installation dates for anchors and hanger supports for pipes, in addition to the already requested dates of welding to pentration, will be more useful in the determination of the effects of differential settlement in the pipes. Construction will provide these installation dates after project engineering provides more specific data point requiring information.

20) This item is open. General plans for the evaluation of most of the Q-listed utilities, except the duct banks, have been discussed in the response to the NRC's 10 CFR 50.54 request. In order to be able to make continuity checks in the duct banks after the removal of surcharge, project engineering will determine which conduits in select duct banks should be used for that purpose. Construction activities related to those duct banks shall be put on hold.

21) This item is open. Geotech will discuss the time versus settlement values in FSAR Section 2.5 with CPCo. Necessary clarification will be made in the July amendment of the FSAR.

22) This item is open. Construction of the condensate tanks has not been done because CPCo expressed concern regarding the adequacy of settlement monitoring by constructing and filling the tanks. It was decided that Geotech will establish an estimated value for differential settlement between the piping and the condensate tanks. The ring foundation may have to be raised to satisfy the tanks' suction head requirements. Project engineering will develop a conceptual design of flexible connections for piping which will accommodate 6 inches of differential settlement. This design will be submitted to

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CPCo for review on May 4, 1979. Construction and settlement monitoring of the condensate tanks will be discussed with the consultants on May 10, 1979.

23) This item is open. Surcharging and monitoring requirements for transformer foundation areas will be shown on Drawing C-1040 and will be issued by May 4, 1979.

24) This item is open. Project engineering will review the stator movement established by construction and then reevaluate the effect of stator load on the turbine building wall.

25) This item is open. Construction of borated water storage tanks has not been started because of delay in material delivery and hold on Q-listed fill. Cost and scheduling indicated that these tanks will also be used for flushing and hydrostatic testing of the piping system early in the fourth quarter of 1979.

There are potential schedule interferences between loading the tanks with water for settlement monitoring purposes and filling the tanks for hydrostatic testing of the pipes. Geotech requires that the tanks should stay full for at least 3 months for settlement monitoring.

It was decided that:

a) It will be verified whether use of one tank is sufficient for testing the piping system.

b) The feasibility of constructing both tanks simultaneously with interconnected piping and feasibility of preloading one tank when the other will be used for testing will be investigated.

c) The field will expedite construction of the tanks.

d) Flexibility of piping with respect to settlement of the tank will be evaluated.

26) This item is open. Construction found that a portion of clay at the dike had plugged the sand drain in the guardhouse area. Construction has already started the cleaning operation. No additional boring is required. Geotech will complete its investigation, discuss it with project engineering, and then finalize the remedial measures by May 4, 1979.

27) This item is open. Construction and CPCo will finalize and send their comments on FSAR Section 2.5 before May 31, 1979. Project engineering and Geotech will incorporate final comments on FSAR Section 2.5 for the July amendment by June 8, 1979.

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28) This item is open. Geotech and engineering will resolve issues on FSAR Q&R 362.15 by May 31, 1979.

29, 30) These items are open. Engineering will reanalyse the effect of hydrostatic pressure on the service water structure walls if liquefaction is to take place.

31) This item is open. Crack mapping has been done for the diesel building walls and roof slab, service water structure walls, and portions of the auxiliary building, including the auxiliary building control tower area, and railroad bay. Crack mapping will also be done for the valve pit beneath the railroad bay, feedwater isolation valve pit (Units 1 and 2), borated water storage tank foundation, and valve pit.

32) This item is closed. The boring plan for the service water structure has been shown on Drawing C-1145.

33) This item is closed. A memo regarding filling and monitoring of emergency diesel oil storage tanks was issued on March 19, 1979. Geotech indicated that there is no liquefaction potential in that area. Engineering will check the nozzle load requirements for the piping and release the construction of concrete over the tanks by April 30, 1979.

34, 35) These items are closed. Tentative borings shown on Drawing C-1145 have been released for drilling. Borings in the area of the emergency diesel fuel oil tanks have been completed.

Kepner-Tregoe Analysis

The task group will continue working on the action items listed in Meeting Notes No. 934. These will be discussed in the next task group meeting.

B) Discussion of corrective actions for other Category I structures on fill

A. Almuti of engineering summarized the corrective action plans for the auxiliary building penetration room, railroad bay, and service water structure, which were also discussed in the response to Question 12 of the NRC's 10 CFR 50.54 request.

1) Auxiliary building penetration room

Inadequate fill under this portion of the structure will be removed and replaced by lean concrete. The final depth up to which the fill will be replaced by concrete will be determined by Geotech based on soil investigations in the area as the repair activity progresses.

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During the removal and replacement of fill, the structure will be temporarily supported on jack piles. Dewatering will be done before the jack piles are placed. Project engineering will investigate and identify alternative methods of temporarily supporting the structure prior to the dewatering operation. They will also determine the forces in the temporary supports. The need for temporary supports depends on the extent of dewatering.

Investigation of temporary supports will be completed by May 7, 1979.

2) Railroad bay

There is no problem of static settlement and bearing in this area. The problem is the low blow counts in some areas of sand fill indicated by the boring results, which suggest liquefaction potential and settlement during an earthquake. The suspect area of sand fill will be stabilized by chemical grouting.

3) Service water structure

Project engineering is currently investigating two alternative solutions for supporting the portion of the structure on fill. These alternatives are:

a) Support the north wall of the building on piles which will support the structure from a concrete corbel along the outside of the wall. This investigation will be completed by May 4, 1979.

(Writer's Note: After the meeting it was decided that H-bearing piles driven from the top without dewatering will be considered.)

b) Dewater and provide jack piles (100-ton capacity) from underneath the north end wall instead of using the corbel.

4) Schedule for corrective actions

A preliminary schedule (Attachment 1) was handed out during the meeting by A. Almuti. It was decided that this schedule will be reviewed by the task group members and their comments will be forwarded to cost and scheduling by May 2, 1979. The revised schedule will be issued by May 11, 1979.

It was decided that two separate performance type specifications will be written for dewatering and underpinning. Engineering will issue a dewatering specification by May 25, 1979, and the underpinning specification by June 1, 1979, for in-house review.

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(Writer's Note: In a subsequent meeting held on May 1, 1979, at the jobsite, it was decided that the dewatering specification will be based on the results of a dewatering test to be conducted during the week of May 7, 1979.)

Geotech reported that a consultant for chemical grouting will be inspecting the site on May 6 and will help develop a procedure and technical services agreement for the purpose of developing a testing program. Geotech will send a copy of the consultant's input to project engineering for review and use. Geotech and engineering will develop the TSA scope by May 11, 1979. Engineering will establish what portion of the corrective work is to be Q-listed.

C) Corrective actions for the condensate storage tanks and diesel fuel oil storage tanks

This agenda item was covered during the review of prior action items.

D) Reactivation of backfill operation

A meeting was held on this subject on April 24, 1979, with CPCo at the Midland jobsite. A. Boos of construction summarized the meeting notes (Attachment 2).

E) FSAR Section 2.5

This agenda item was covered during the discussion of prior action items.

F) Comments on responses to the NRC's 22 questions (10 CPR 50.54 request)

K. Wiedner reported that Bechtel QA prepared a detailed matrix of responses to the NRC's 22 questions, which will include commitments made to the NRC on various subjects, the corresponding dates, and the necessary action items. A preliminary copy of this matrix is attached for review and discussion at the next task group meeting (Attachment 3).

G) NRC's (Keppler's) letter of March 22, 1979 and Gallagher's questions

CPCo will investigate necessary action to be taken on the NRC's investigation report and Gallagher's questions by April 30, 1979.

(Writer's Note: D. Horn of CPCo advised on April 30, 1979, that no further action is required at this time.)

The next task group meeting will be held approximately 2 weeks from April 26, 1979.

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ACTION ITEMS:

Construction	1) Recheck the reference elevations of the profiled service water lines and the coordinates of starting points.
Project Engineering	2) Provide a conceptual design on corrective actions for the auxiliary building area to cost and scheduling.
Cost & Scheduling	3) Issue a revised cost estimate within a week after receiving project engineering's input as specified in Action Item 2.
Geotech	4) Provide project engineering with the requirements for installing rebound anchors and discuss increasing the degree of accuracy of rebound anchor and diesel building settlement measurements with GZD.
Geotech	5) Discuss surcharge removal procedures with the consultants and finalize the plans by May 10, 1979.
Project Engineering	6) Issue revised Specification 7220-C-83 by May 4, 1979.
Construction	7) Send geotech coordinates of density test plots by May 4, 1979.
Construction	8) Complete density test plots by May 18, 1979.
Construction	9) By May 18, 1979, on density test plots, separate Canonie's work from Bechtel's work in the areas of diesel building, service water structure, auxiliary building penetration room, railroad bay, feedwater isolation valve pit, condensate tanks, diesel fuel oil tanks, and tank farm and critical portions of service water lines as designated by project engineering.
Project Engineering	10) Provide construction with the critical areas of service water lines for separation of Bechtel's and Canonie's work.

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Project Engineering	11)	Respond to construction's memo (BCBE-2255R) regarding installation dates for pipe anchors and pipe hangers by May 1, 1979.
Project Engineering	12)	Identify the conduits in select duct banks to be surveyed after surcharging, and request construction to put them on hold.
Geotech	13)	Provide explanation in the July amendment for the time versus settlement values in FSAR Section 2.5 after consulting with the client.
Project Engineering/ Geotech	14)	Establish an estimated value of differential settlement between pipe and condensate tanks. Then issue a conceptual design for flexible pipe connections to tanks for the client's review by May 11, 1979.
Project Engineering	15)	Establish condensate tanks' elevations to satisfy suction head requirements by May 11, 1979.
Project Engineering	16)	Issue Drawing C-1040 by May 4, 1979, showing surcharging and monitoring requirements for the transformer foundation area.
Project Engineering	17)	Review stator movement near the turbine building's south wall as proposed by construction and reevaluate the effect of stator load on the wall.
Cost & Scheduling	18)	Verify whether only one of the borated water tanks can store the water required for flushing and hydrostatic testing of pipes.
Construction/ Cost & Scheduling	19)	Check the feasibility of construction of both the borated water tanks and alternative use of the two tanks for settlement monitoring and hydrostatic testing of pipes by May 11, 1979.
Construction	20)	By May 1, 1979, check the feasibility of expediting construction of the borated water tanks.

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Construction	21)	Check the feasibility and cost required for providing an alternative storage area for water needed during hydrostatic testing by May 11, 1979.
Project Engineering	22)	Evaluate the flexibility of the piping connected to borated water tanks.
Geotech/Project Engineering	23)	Finalize and specify remedial measures for the guardhouse area by May 4, 1979.
Construction/CPCo	24)	Provide engineering with comments to FSAR Section 2.5 by May 31, 1979.
Geotech/Project Engineering	25)	Incorporate comments on FSAR Section 2.5 by June 8, 1979.
Geotech/Project Engineering	26)	Resolve comments on FSAR Q&R 362.15 by May 31, 1979.
Project Engineering	27)	Evaluate the effects of hydrostatic pressure on the service water structure wall during possible liquefaction of the soil around the structure.
Project Engineering	28)	Complete crack mapping for the valve pit below the railroad bay, feedwater isolation valve pit (Units 1 and 2), and valve pit under the borated water storage tanks and the ring foundation for those tanks.
Project Engineering	29)	Check the effect of settlement of the diesel fuel oil storage tank on the nozzle, and release the construction of concrete over the tanks by April 30, 1979.
Project Engineering	30)	Evaluate and finalize the alternative schemes of temporarily supporting the auxiliary building electrical penetration room during dewatering operation by May 2, 1979.
Project Engineering	31)	Finalize the pile design for the service water pump structure by May 4, 1979.
Task Group	32)	Forward comments on the schedule (Attachment 1) of activities for corrective actions on other structures to W. Jones by May 2, 1979.

Cost & Scheduling	33)	Issue an updated schedule for corrective actions for other structures by May 11, 1979.
Project Engineering	34)	Issue a draft of the dewatering specification for in-house review by May 25, 1979.
Project Engineering	35)	Issue an underpinning specification for in-house review by June 1, 1979.
Geotech/Project Engineering	36)	Issue a TSA scope draft to the task group by May 11, 1979, for testing of chemical grouting.
Geotech	37)	Provide project engineering with a copy of the chemical grouting consultant's input by May 4, 1979.
Project Engineering	38)	Establish what portion of the work related to corrective actions for other structures shall be Q-listed.
Task Group	39)	Continue working on action items in relation to K-T analysis given in Meeting Notes No. 934 for March 12, 1979.

Attachments: 1) Preliminary schedule for corrective actions for other structures
2) Meeting Notes (by A. Boos) for the meeting on April 24, 1979
3) Action items related to the response to the NRC's 10 CFR 50.54 request

A. Ganguly

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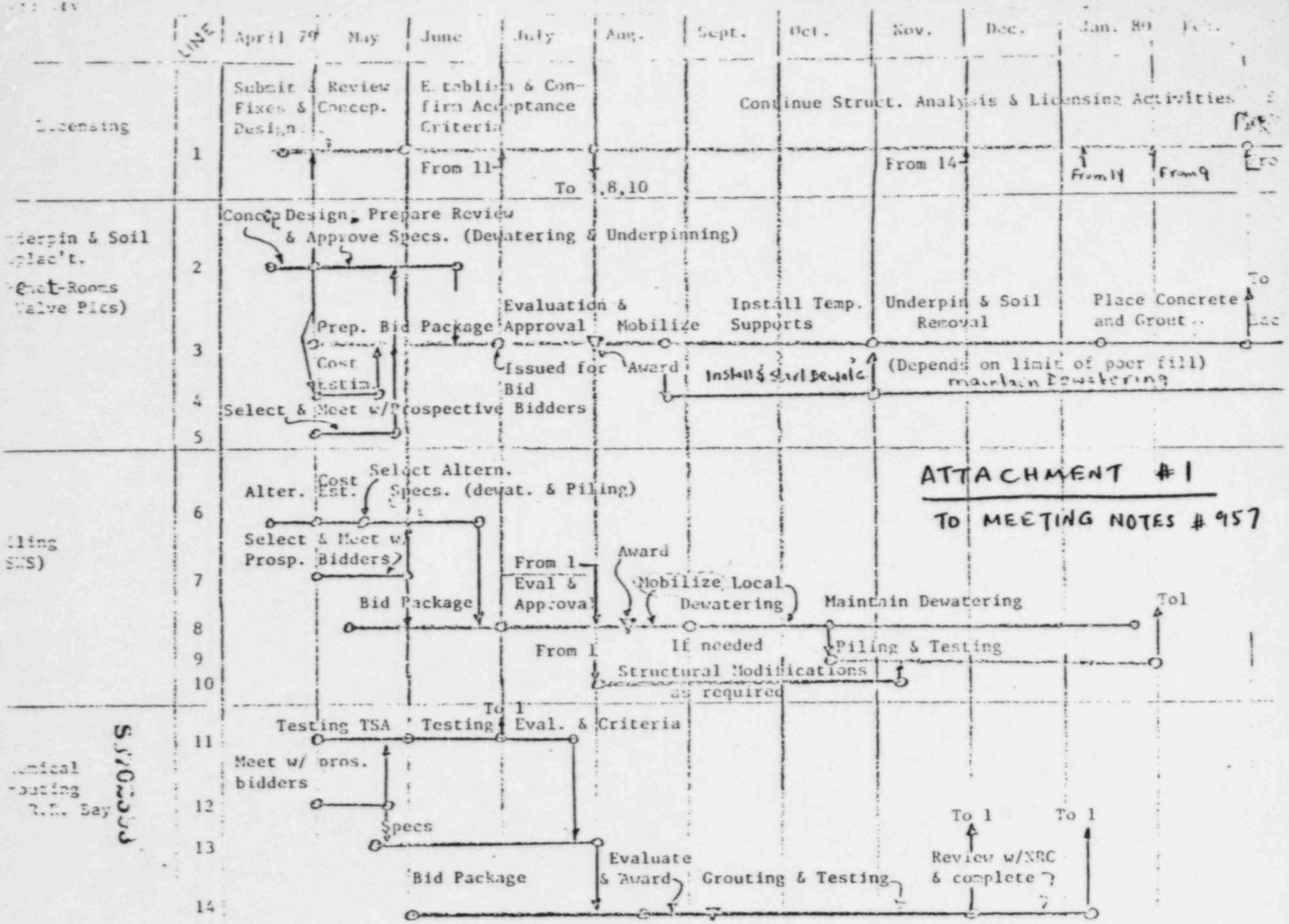


ATTACHMENT #1

TO MEETING NOTES #957

Acquired d.m.s. in conjunction C-2645

Change to Permanent Dewatering

Deletes

Grouting for liquifaction

D/G Building
RR Bay
Associated penetration of buildings, utilities, etc. (Below surcharge)
Sch. delay assoc with D/G grout (Jun/Jul) (High PSI)
Chem grout environmental problems

Mining Operation & Skyhook

AB wingwalls
Associated local dewatering

Cost of mining & chem grout

Req'd Work Remaining

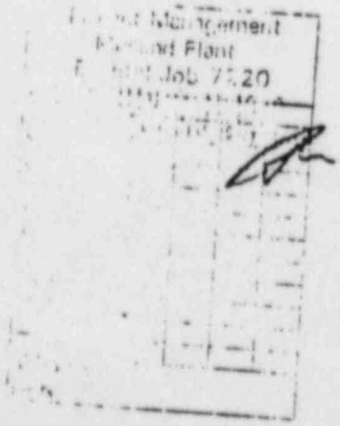
Possible quik grout RR Bay
Shear velocity ~~Sonic~~ testing AB wingwalls with possible quik grout
SW piling
Mtg w/NRC on Jul 10
Profiling of pipes before and after dewatering
Duct checks (assumed)

New Work

Quik design of perm. dewatering
Resolution of whether or not it would have to be safety system & structure
Possible interim dewatering
Monitoring wells
Monitor effluent for fines

Advantages

If we move quick, possible earlier removal of D/G? surcharge
Less cost, better schedule, less interferences
More viable with NRR & less chance of new problems
Deletion of assoc. grout problems



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TCC/6-21-79

XC - [redacted]

TELECOPY D. W. Halligan
Met 36 A 20
2 pages

Bechtel Power Corporation

Inter-office Memorandum

To D. W. Halligan

Subject Midland Units 1 and 2
Consumers Power Company
Bechtel Job 7220
PLANT FILL SETTLEMENT

Date June 22, 1979

From P. A. Martinez

Of Project Management

At Ann Arbor Office

File 0614

Copies to

R. D. Allen
P. A. Becnel
[redacted]
H. B. Friend
P. K. Hansen
F. A. Hollenbach
M. G. Johnson
L. C. McKillip
H. O. Reinsch
E. A. Rumbaugh
H. W. Wahl
K. Wiedner
R. K. Vassar

RECEIVED
JUN 22 1979
BECHTEL
A.A. 7220

JOB 7220

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PROC. MGR.			
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CONST. COORD.			
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ADMIN.			
FILE NO.	0670.2		

The following is a status report for the week ending June 22. No report was issued for the week ending June 15. Significant developments occurred in the Ann Arbor meeting with the consultants on June 18 and 19. This meeting had been planned as a working session and the changed recommendation took attendees by surprise on the afternoon of the second day. Following are the major points:

(1) Consultants have concluded that no remedial action will be required to preclude liquefaction of sands under the auxiliary building railroad bay.

(2) Having further reviewed data on the amount of sand under the diesel generator building, which is now believed to be significantly more than earlier reports had indicated, consultants are now very concerned about the feasibility of grouting to prevent liquefaction. They have therefore now recommended to Bechtel the use of a permanent dewatering system to eliminate all liquefaction potential of these sands.

(3) Consultants advise that if the permanent dewatering system encompasses the whole plant there is a possibility that underpinning of auxiliary building electrical penetration areas may not be required. Additional engineering analysis is under way to enable them to further evaluate this.

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A meeting of Consumers Power Company, Bechtel, and consultants is to take place in Denver on June 28 to further discuss the viability of the new recommendation. Evaluation of this is also under way now. The Project is presently continuing with the plan for remedial actions as described to the NRC in the 50.54(f) responses. This plan includes local dewatering for the underpinning operation for which the sole-source proposal is due on Monday, June 25, 1979.

One additional point to note which could have a bearing on liquefaction potential is that the NRC, as a totally separate issue to the "soils" issue, has stated that they have serious concerns about the amount of conservatism in the selection of basic ground acceleration levels for the Midland plant. A meeting is scheduled with the NRC in Washington, D. C., on July 19, 1979, to address NRC concerns.

PAM/pp

P. A. Martinez

SB702597

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

bcc: S. S. Afifi
P. Martinez
J. Newgen
K. Wiedner
Com Log

June 18, 1979

BLC- 7753

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

Attention: Mr. R. C. Bauman

Subject: Consumers Power Company
Midland Plant - Job 7220
Meeting Notes No 976
Midland Diesel Generator
Meeting
File: 0270, [redacted]

Gentlemen:

Attached for your review and information are copies of the meeting notes No. 976 on the diesel generator task force meeting held in Midland, Michigan on May 16, 1979.

Very truly yours,

for R. L. Castleberry
Project Engineer

AG/db

Enclosure: Meeting Notes No. 976

cc: D. B. Miller w/a

S3702683

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

MEETING NOTES NO. 976

MIDLAND PLANT UNITS 1 AND 2

CONSUMERS POWER COMPANY

BECHTEL JOB 7220-101

DATE: May 16, 1979

PLACE: Midland, Michigan

SUBJECT: Meeting of the Diesel Generator Building Task Group

FILE: 0279, C-2645 w/a

ATTENDEES:

Bechtel		CPCo
S. Afifi	P. Martinez*	D. Horn*
A. Almuti	C. McConnel	D. Sibbald*
J. Betts	G. Richardson	T. Thiruvengadam
A. Boos	J. Wanzeck	R. Wheeler*
R. Castleberry*	K. Wiedner	
B. Dhar		
A. Ganguly		
J. Lillywhite*		

*Part-time

PURPOSE: The meeting was held at the Midland jobsite to discuss the following items in relation to the diesel generator building settlement and other Seismic Category I structures on plant fill:

A) Review of action items initiated in the meeting of April 26, 1979. Identify future action items as required.

B) Resumption of Q-listed backfill placement. Review of status of the following site activities:

1) Compaction Test

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2) Permeability test
3) Test pits

C) Additional responses to the NRC's 10 CFR 50.54f questions which are due in May and June 1979

D) Contracts on the following subjects for remedial work:

1) Dewatering
2) Chemical grouting
3) Piling
4) Underpinning

E) Feasibility of using excavation and concreting in lieu of chemical grouting

F) Next issue of interim report for MCAR 24

G) Kepner-Tregoe analysis

H) Next task group meeting

SUMMARY OF DISCUSSION:

A) Review of prior action items:

The current status of action items identified in the previous meeting held on April 26, 1979 is as follows (the numbers refer to the action items of Meeting Notes No. 957):

1) This item is open. Rechecking the reference elevations of profiled service water lines will no longer be possible. The Goldberg-Zoino-Dunnicliff & Associates (GZD) profile devices record differences in height with respect to reference elevation at the time of profiling. The reference elevations used were difficult to establish during the initial profiling because of construction activities. Engineering will discuss with GZD a method of establishing more accurate reference elevations for profiling in the future.

2) This item is closed. A conceptual design on corrective actions for the auxiliary building area was given to cost and scheduling by project engineering on May 4, 1979.

3) This item is closed. A revised cost estimate, including the remedial work in the auxiliary building area, was issued on May 11, 1979.

S3702685

4) This item is open. Two types of rebound anchors have been considered for installation. Installation of the ring type, in which measurement is taken by electrical means, is in progress. Measurement can be taken accurately up to 0.02 inches. The second type of rebound anchor, which uses a dial gage for measurement, will also be installed. Accuracy of measurement for the second type of anchor is 0.001 inch. It was indicated that accuracy of settlement measurement by optical survey can be greatly improved by taking relative measurements. It was decided that:

   a) Geotech will decide the type of anchors for more accurate settlement measurement.

   b) Construction will improve the accuracy of settlement measurement by optical surveying.

   c) Construction, after discussion with geotech, will attach dial gages to the existing deep borros anchors inside the diesel building to obtain more accurate settlement values.

5) This item is still open. Settlement of the diesel generator building and foundations under the present surcharge load will be observed until June 6, 1979. On the basis of those observations, geotech will provide a projected date for the removal of the surcharge.

6) This item is closed. SCN C-83-9002 for Specification 7220-C-83 was issued on May 18, 1979.

7) This item is closed. Geotech received the coordinates of density tests.

8) This item is closed. Density test plots have been completed for the three areas of the power block. Test plots for an additional two areas to the north of the power block are in progress. These additional plots will be done by June 18, 1979.

9) This item is open. Separation of Canonie's work from Bechtel's work will be completed by May 30, 1979. It was decided that completion of this item has a higher priority than the completion of test plots in the additional two areas noted in Item 8.

10) This item is closed. Information regarding critical areas of service water lines for separation of Canonie's and Bechtel's work was given to construction in a letter (BEBC-2946), on May 10, 1979.

11) This item is closed as a task group action item. Project engineering indicated that installation dates of pipe hangers and anchors will be requested from construction on a case-by-case basis. Project engineering will issue a memo to construction relaying the above information.

12) This item is open. Project engineering reported that there are not sufficient spare conduits in Q-listed duct banks for future continuity checks of conduits. It was decided that immediately after the removal of surcharge, a single continuity check will be made for the conduits and duct banks in the diesel generator building area. In other areas project engineering will establish a surveillance requirement for duct banks and conduits as soon as possible. The surveillance program will be consistent with the responses to the NRC's 10 CFR 50.54f Question 12.

13) This item is open. After consulting with the client geotech will provide additional discussion on time-settlement in the July amendment of FSAR Section 2.5.

14) This item is closed. The conceptual design of flexible pipe connections to the condensate tanks has been approved by CPCo. Project engineering will issue the design details for construction by May 25, 1979.

15) This item is closed. There is no specific suction head requirement for the condensate tanks other than that the bottom of the tanks (i.e., the top of the concrete ring foundations) should be above grade. To accomplish the above requirement, project engineering will investigate the feasibility of regrading the area if the tank foundations undergo any settlement. (Writer's Note: Project engineering's investigation after the meeting indicated that the area around the condensate tank foundations can be regraded if necessary to keep the top of the foundation above grade. So, at present, the top of the ring-foundation will be as indicated in the design drawing.)

16) This item is closed. Revised Drawing C-1040, showing the surcharge requirements for the transformer foundation area, was issued on May 14, 1979.

17) This item is closed. Project engineering reviewed construction's proposal of Unit 1 stator movement and its effect on the turbine building south wall. Results of the review indicated that, in order to ensure the safety of the turbine building wall, the stator cannot be moved over the transformer area while the surcharge is on.

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18-21) These items are closed. Construction reported that there is an existing crossover connection between the two tanks. It is possible to construct and use either of the borated water storage tanks for preloading, flushing, and hydrostatic testing. Construction also mentioned that one tank must be available before November 1, 1979.

It was decided that:

a) The Unit 2 tank will be built as soon as possible and will be used for startup flushing and hydrostatic testing of pipes.

b) The Unit 1 tank will be built and test loaded for settlement monitoring for 3 months.

c) After 3 months the Unit 2 tank will be test loaded for settlement.

d) Piping connections to these tanks will be done before settlement monitoring. The response already made to the NRC's 10 CFR 50.54f Question 6 will be revised to indicate that piping connections will not be delayed until completion of the test load.

22) This item is open. Flexibility analysis of the piping connected to borated water tanks will be done assuming 4 inches of differential settlement between the tanks. Project engineering will also investigate the feasibility of eliminating link sealing at the pipe penetrations in the wall to provide room for settlement.

23) This item is closed. The sand drain and guardhouse problem has been solved. Guardhouse foundation work will be treated as normal project engineering work.

24,25) These items are open. Comments on FSAR Section 2.5 will be resolved and incorporated in the July ammendment of the FSAR.

26) This item is still open. Geotech and engineering will resolve comments on FSAR Q&R 362.15 by May 31, 1979.

27) This item is open. Project engineering indicated that the service water structure wall will be able to withstand the hydrostatic pressure due to liquefaction under SSE conditions. It was decided that project engineering will further analyze the service water structure wall, assuming the worst possible load condition due to liquifaction effect, in OBE condition by June 4, 1979.

S3702688

28) This item is open. Cracks in the valve pit west of the railroad bay, feedwater isolation valve pits, borated water storage tank foundations, and valve pit below those tanks have been measured and mapped. Plotting of these cracks in drawings will be completed by June 1, 1979.

29) This item is closed. Construction of concrete over the emergency diesel fuel oil storage tanks has been released by BEBC-2907, dated May 1, 1979. Nozzle load capacity to withstand settlement has been found to be very low. Necessary actions regarding the nozzles will be taken after the completion of the settlement program.

30) This item is closed. Project engineering finalized the method of temporarily supporting the auxiliary building penetration room during dewatering. If required, that portion of the auxiliary building will be supported by a temporary tower resting on the containment ring girder and turbine building crane column.

31) This item is closed. A preliminary pile design for the service water structure has been completed. Drawings are in the process of being completed.

32,33) These items are closed. An updated schedule for corrective actions in portions of the auxiliary building and service water structure has been issued.

34-36) Discussion of these items is included in the discussion of Agenda Item D.

37) This item is closed. Project engineering has received input regarding chemical grouting from geotech.

38) This item is closed. A preliminary listing of portions of the remedial work which is to be Q-listed has been completed. These items will be identified in the respective specifications.

39) This item (Kepner-Tregoe analysis) is covered in the discussion of Agenda Item G.

B) Resumption of Q-listed backfill placement (Reference Attachment 2 to Meeting Notes No. 957)

Action items listed in the referenced attachment were reviewed and discussed. It was decided that:

1) Project engineering and geotech will complete all action items assigned to them to enable starting Q-listed backfill placement by May 21, 1979. Revised Specification 7220-C-211 will be issued by May 18, 1979.

2) Placement of non-Q-listed backfill will begin immediately after completion of the qualification test, possibly by May 17, 1979.

3) Remedial actions, as required, will be taken in the area of the broken compressor air line under the tank farm.

4) Excavation of test pits in the tank farm, service water pump structure area, and the dike area will begin by May 18, 1979.

It was reported that the compaction test for 4-inch lift thickness in sand has been completed. The remainder of the compaction test program and the permeability test program are in progress.

C) Additional responses to the NRC's 10 CFR 50.54f questions due in May and June 1979.

Actions items related to responses to the NRC's 10 CFR 50.54f questions were discussed and assigned to members of the task group, as shown in Attachment 1 to these meeting notes.

Geotech and project engineering will prepare responses to Question 12. Responses will include remedial actions to be taken on the buried pipes and duct banks in areas other than the diesel generator building. If possible, references will be made to earlier responses to similar questions where the same rationale has been applied.

The following schedule was set for this item:

1) A draft of responses will be sent to CPCo on May 22, 1979, after Bechtel's in-house review.

2) CPCo will send its comments to Bechtel project engineering by May 25, 1979.

3) Updated responses to these 22 questions will be issued in the beginning of June 1979.

D) Contracts on remedial work

A preliminary schedule (Attachment 2) for four items i.e., dewatering, chemical grouting, piling, and underpinning work was presented to CPCo on May 11, 1979.

1) Dewatering

Dewatering will be a sole-source contract item. A draft of the specification has been given to construction for review. It was emphasized that early completion of the dewatering operation is important to accommodate removal of surcharge

from the diesel building area. Efforts will be made to expedite the dates shown in Attachment 2 for the dewatering contract package. (Writer's Note: Project engineering will try to issue the dewatering subcontract package for client review and bids by June 1, 1979.)

2) Chemical grouting

It was decided that the grouting consultant will provide equipment and operators, and Bechtel will provide all labor. (Writer's Note: Construction suggested that the feasibility of subcontracting this work should be investigated in order to facilitate the administrative part of the work.)

3) Piling

Project engineering reported that the preliminary piling design for the service water structure has been finalized. The specification will be issued for bids and client review by July 2, 1979. It was decided that an effort will be made to include this portion of the piling work as an add-on to the existing piling subcontract work in other areas. Project engineering will expedite the issue of the specification for that purpose. (Writer's Note: Construction reported that it is feasible to include service water structure piling work as an add-on to other piling work as long as the progress of other work is not affected.)

4) Underpinning

Preparation of the underpinning bid package is in progress. For this phase of remedial work in the auxiliary building wings and valve pit area, project engineering will issue the specification for in-house review by June 1, 1979.

A standby support system for these auxiliary building wings will be constructed prior to dewatering so that the wings can be supported if necessary. Project engineering will complete the design of the support system by June 4, 1979, and inform construction of the amount of structural steel to be procured for fabrication.

E) Chemical grouting versus excavation

Preliminary cost information indicates that the method of soil stabilization by chemical grouting is very expensive. As an alternative to grouting, excavation of bad soil and then filling with lean

concrete will be considered. A cost estimate and schedule impact study of the alternative method will be made. Geotech, along with the soil consultants will make a detailed review of the boring data and associated calculations made for establishing the liquefaction potential. Geotech will then define more precisely the areas of liquefaction potential.

F) MCAR 24 - Next interim report

It was decided that the next interim report on MCAR 24 should be ready by June 8, 1979, for the client review meeting. Details of remedial work in all areas other than the diesel generator building will be included in the report.

G) Kepner-Tregoe (K-T) Analysis

Geotech is preparing a report on the study of U.S. Testing's density tests. A separate meeting regarding action items related to K-T analysis will be held after the completion of the report.

H) The tentative date for the next task group meeting is June 6, 1979.

ACTION ITEMS:

Project Engineering	1) Discuss with GZD and develop a method of establishing accurate reference elevations for profiling utilities.
Geotech	2) Establish a criterion for rebound anchor measurement by May 18, 1979.
Construction	3) Investigate the feasibility of improving the accuracy of settlement measurement by optical surveying.
Geotech/Construction	4) Attach dial gages to the existing deep borros anchors inside the building for settlement measurements by June 1, 1979.
Geotech	5) Provide by June 6, 1979, a schedule and procedure for the removal of the surcharge.
Construction	6) Complete separation of Canonie's work from Bechtel's work on density test plots, including the service water pipe area, by May 30, 1979.

S3702632

Construction	7)	Complete density test plots in two additional areas north of the auxiliary building by June 18, 1979.
Project Engineering	8)	Establish surveillance requirements for Q-listed duct banks and conduits by June 1, 1979.
Geotech	9)	Provide additional discussion on time settlement in FSAR Section 2.5 in the July 1979 amendment.
Project Engineering	10)	Issue the final design of flexible pipe connections to the condensate tanks by May 25, 1979.
Project Engineering	11)	Issue a memo to construction indicating that installation dates of pipe supports will be requested from them on a case-by-case basis.
Construction	12)	Expedite erection of both the condensate tanks starting with the Unit 2 tank, by June 29, 1979.
Project Engineering	13)	Revise by May 22, 1979, the response to Question 6 of the NRC's 10 CFR 50.54f request indicating that piping connections to the borated water storage tanks will not be delayed.
Project Engineering	14)	Analyze the flexibility of piping connected to the borated water storage tanks, assuming 4 inches of differential settlement. Also investigate the feasibility of eliminating link sealing from the pipe penetrations in the wall.
Construction/CPCo	15)	Provide engineering with comments to FSAR Section 2.5 by May 31, 1979.
Geotech/Project Engineering	16)	Incorporate comments on FSAR Section 2.5 by June 8, 1979.
Geotech/Project Engineering	17)	Resolve comments on FSAR Q&R 362.15 by May 31, 1979.
Project Engineering	18)	Analyze the service water structure wall for the worst possible loading due to liquefaction in OBE condition by June 4, 1979.

Project Engineering	19)	Complete crack mapping in the areas of the railroad bay, feedwater isolation valve pit, and borated water storage tanks by June 1, 1979.
Project Engineering	20)	Identify Q-listed portions of remedial work in the respective specifications.
Geotech/Project Engineering	21)	Complete all open action items in accordance with Attachment 2 of Meeting Notes No. 957, to enable starting of Q-listed backfill on May 21, 1979.
Geotech/Construction	22)	Take necessary remedial action to solve the problem of the broken compressor air line under the tank farm by May 18, 1979.
Geotech/Project Engineering	23)	Prepare responses to Question 12 of the NRC's 10 CFR 50.54f questions and send a draft of responses to CPCo for review by May 22, 1979.
Project Engineering	24)	Prepare dewatering contract package and award the contract in accordance with the schedule given in Attachment 2.
Project Engineering	25)	Investigate the feasibility of sub-contracting the chemical grouting work.
Project Engineering	26)	Award a TSA or subcontract on chemical grouting by June 4, 1979.
Project Engineering	27)	Issue underpinning bid package for in-house review by June 1, 1979.
Project Engineering	28)	Complete design of temporary support for the auxiliary building penetration room by June 4, 1979.
Project Engineering	29)	Provide construction with the amount of structural steel to be procured for the fabrication of temporary support by June 1, 1979.

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Geotech	30) Review soil boring data and define more precisely the areas of the diesel generator building susceptible to liquefaction by June 11, 1979.
Cost & Scheduling/ Project Engineering	31) Provide a cost estimate and a schedule for using excavating and concreting, in lieu of chemical grouting in the diesel generator building area.
Project Engineering	32) Prepare the sixth interim report of MCAR 24 by June 8, 1979, for the client review meeting.
Geotech	33) Complete the report on U.S. Testing's density tests for review in the next meeting on K-T analyses.

A. Ganguly

AG/js
5/21/4

Attachments: 1) Action items from response to the NRC's 10 CFR 50.54f questions (8 pages)
2) Preliminary schedule for corrective actions dated May 12, 1979

S3702695

ATTACHMENT 1
TO MEETING NOTES NO. 976
dtd. 9-16-79

ACTION ITEMS FROM RESPONSE TO 50.54f QUESTION NO. 1

ACTION ITEM NO.	50.54f RESPONSE PAGE NO. (PARA.)	ACTION DISCRIPTION	RESPONSIBILITY	ACTION COMPLET-ION DATE	DATE COMPLE
		From response to Question 1			
1	1-3 (Item 1)	Perform a final review and update of the PSAR commitment list.	J. Clements	1-1-80 ~~9-28-79~~	
2	1-4 (Item 2)	Review sections of the FSAR determined to be inactive	J. Clements	1/1/80 ~~9-28-79~~	
3	1-4 (Item 3)	Review EDP 4.22	R. Baltazar	6-29-79	
4	1-4 (Item 4)	Audit action items 1-3	L. Dreisbach	10-26-79	
5	1-4 & 1-5 (Item 2)	Review specifications not included in the specificity study initially	R. Baltazar	6-29-79	
	App. I I-8 (D.2.C)	— —			
		FROM APPENDIX I			
6	I-6 (C.1.b)	Complete review of the Dames and Moore Report	J. Wanzeck B. Dhar	6-29-79	
7	I-6 (C.3)	Complete review of pertinent portions of the FSAR Sections 2.5 and 3.8	P. K. Chen B. Dhar	6-29-79	
8	I-6 (C-4.a)	Correct settlement calculations	P. K. Chen	Subse-quent to D.G.B. sur-charge	
9	I-7 (C.4.c)	Schedule audits of the geo-tech section on a six months basis.	L. Dreisbach	7-27-79 (first audit)	
10	I-7 (C.5.b)	Review drawing for possible effect of vertical duct bank restrictions	C. McConnel	6-~~1~~-79	
11	I-7/8 (D.1)	Complete actions in response to DRVCL audit	R. Baltazar	5-18-79	

S 702636

ACTION ITEMS FROM RESPONSE
TO
50.54f QUESTION NO. 1

ACTION ITEM NO.	50.54f RESPONSE PAGE NO. (PARA.)	ACTION DISCRIPTION	RESPONSIBILITY	ACTION COMPLET-ION DATE	DATE COMPL.
12	I-8 (D.2.d)	Revise EDP 4.49.1 to incorporate clarifications & instructions for use of SCN	M. O'Mara	5-1-79	5-4-7
13	I-8/9 (D.4)	Schedule audits of each design discipline calculations on a yearly basis.	L. Dreisbach	6-27-79	5-4-7
14	I-11 (C.1)	Re-evaluate construction equipment used for compaction	A. Boos	Prior to resuming soils work	
15	I-11 (C.2.a)	Assign field soils engineer and soils engineer from the design section	J. Newgen	Prior to resuming soils work	5-1-79 (approx.
16	I-11 (D.1)	Review cons't. specs and procedures to identify equip. requiring qualifications	A. Boos	6-29-79	
17	I-11 (D.2)	Review Field Procedure FPG-3.000 to assure clarity and completness.	A. Boos	5-31-79	
18	I-16 (C.1.a) (C.1.b) I-17 (C.3.b)	Revise PQCI C-1.02 to provide inspection rather than surveillance and to record inspections	R. Simanek	Prior to resuming soils work	
19	I-17 (C.3.a)	Complete indepth review of soil test results	S. Afifi	7-31-79	
20	I-18 (C.4.b) (D.3.c)	Perform indepth audit of U.S. Testing	L. Dreisbach	5-31-79	4-26-7
21	I-18 (D.1)	Review all active QCI's for surveillance callouts and modify where necessary.	R. Simanek	6-29-79 ~~5-15-79~~	
22	I-18	Evaluate documentation callouts on QCIs	R. Simanek	6-29-79	

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ACTION ITEMS FROM RESPONSE
TO
50.54f QUESTION NO. 1

ACTION ITEM NO.	50.54f RESPONSE PAGE NO. (PARA.)	ACTION DISCRIPTION	RESPONSIBILITY	ACTION COMPLET-ION DATE	DATE COMPL
23	I-20 (D.5.f)	Incorporate scientific sampling plans for inspection	R. Simanek	Continu-ous (QCI for receipt by 5-15-79)	
24	I-22 (D.1.a)	Complete indepth review of the Bechtel Trend Program	J. Milandin	6-1-79	
25	I-22 (D.1.b)	Conduct QA Training	J. Milandin	6-1-79	

S702698

ACTION ITEMS FROM RESPONSE
TO
50.54f QUESTION NO. 1

ACTION ITEM NO.	50.54f RESPONSE PAGE NO. (PARA.)	ACTION DISCRIPTION CPCO ACTIONS	RESPONSIBILITY	ACTION COMPLET-ION DATE	DATE COMPL
CPCo #1	I-11 (C.2.b) I-16 (C.1.c) I-17 (C.3.c)	Implement overinspection for soils placement and U.S. Testing Activities	CPCo - QA		
CPCo #2	I-22 (D.2)	Conduct QA Training	CPCo - QA	6-1-79	

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ACTION ITEMS FROM RESPONSE T.
50.54f
QUESITONS 2-22

50.54f QUESTION NO.	ACTION ITEM	ACTION DISCRIPTION	RESPONSIBILITY	ACTION COMPLET-ION DATE	DAT COMP
3	a	Clarify response to FSAR Question 362.12	J. Clements B. Dhar	5-79 FSAR Amend.	
4	a	Provide criteria for permissible residual settlement	B. Dhar S. Afifi	8-79	
	b.	Provide details of treatment of loose sands	B. Dhar S. Afifi	8-79	
	c	Take dynamic moduli measurements upon removal of preloads for D.G.B. and other buildings	S. Afifi	Open	
	d	Use data (c) to evaluate the seismic response of these structures	B. Dhar	Open	
	e	Prepare additional response to NRC for items 4a and 4b	B. Dhar S. Afifi	8-79	
6	a	Fill borated water storage tanks with water to demonstrate satis-factory fill	B. Dhar	Open	
	b	Delay piping connections on BWST's until most of the settle-ment has occurred	B. Dhar	Open	
	c	Use settlement data on BWST's to allow conservative piping conn-ection design	B. Dhar	Open	
	d	Evaluate settlement of diesel fuel oil tanks - provide precise corrective measures if required	S. Afifi	Open	
7	a	Perform continuity check on duck banks after completion of preload program	B. Dhar	Open	
	b	Make results of continuity checks and settlement surveys available	B. Dhar	8-79.	
	c	If further corrective action is required, determine corrective measures	B. Dhar	Open	

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ACTION ITEMS FROM RESPONSE TO
50.54f
QUESITONS 2-22

50.54f QUESTION NO.	ACTION ITEM	ACTION DISCRIPTION	RESPONSIBILITY	ACTION COMPLET-ION DATE	DATE COMPL
8	a	Realign diesel generators if manufacture's tolerances for pitch AND ~~and~~ roll are exceeded	B. Dhar	Open	
12	a	Complete one additional boring in middle of diesel fuel oil tanks area	J. Wanzeck	Open	
	b	Complete three additional borings in the auxilary building control tower area	J. Wanzeck	Open	
	c	Complete table 12-1 for soils investigation and planned remedial measures. Respond to NRC.	B. Dhar	5-79	
13	a	Complete seismic reanalysis of D.G.B. to account for current lack of compaction	B. Dhar	Open	
	b	Review D.G.B. design and Cat. 1 equipment, piping and elec. systems to the enveloped seismic responses	B. Dhar	Open	
	c	Service water pump structure - Conduct a seismic reanalysis to account for revised soil - structure interaction. - Review structural design and Cat. 1 equipment, piping and elec. systems and incorporate the seismic responses of the reanalysis	B. Dhar	Open	
	d	Auxilary Building - If significant change of found-ation properties results, conduct a seismic reanalysis. - Review structural design and cat. 1 equip, piping, and elec. systems and incorporate the seismic response of the re-analysis.	S. Afifi B. Dhar	Open	

S 702701

ACTION ITEMS FROM RESPONSE TO
50.54f
QUESITONS 2-22

50.54f QUESTION NO.	ACTION ITEM	ACTION DISCRIPTION	RESPONSIBILITY	ACTION COMPLET-ION DATE	DATE COMPL.
13	e	Underground Utilities - Investigate the change in differential displacement separately for buildings founded on fill pending results of seismic reanalysis	B. Dhar S. Afifi	Open	
14	a	Review estimated settlement values for borated water storage tanks upon completion of load test program	S. Afifi	Open	
	b	For flexable buildings - analyze for differential settlement based on stiffness at the time of distortion. Evaluate forces due to arching and combine with loads from Question 15	B. Dhar	Open	
	c	Examine auxiliary building, feed-water isolation valve pits and borated water storage tank ring foundations for cracks - map significant cracks.	B. Dhar	6-79	
	d	Analyze building effected by differential settlement for observed differential settlement plus predicted differential settlement.	B. Dhar S. Afifi	8-79	
	e	Prepare additional response to the NRC to provide analysis and evaluation	B. Dhar	8-79	
15	a	For Seismic Category I structures evaluate differential settlements in accordance with ACI 318-71	B. Dhar	12-79	
	b	Expand the Midland structural design criteria for Class I structures to include the differential settlement effects.	B. Dhar	12-79	
	c	Prepare additional response to the NRC	B. Dhar	12-79	

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ACTION ITEMS FROM RESPONSE TO
50.54f
QUESITONS 2-22

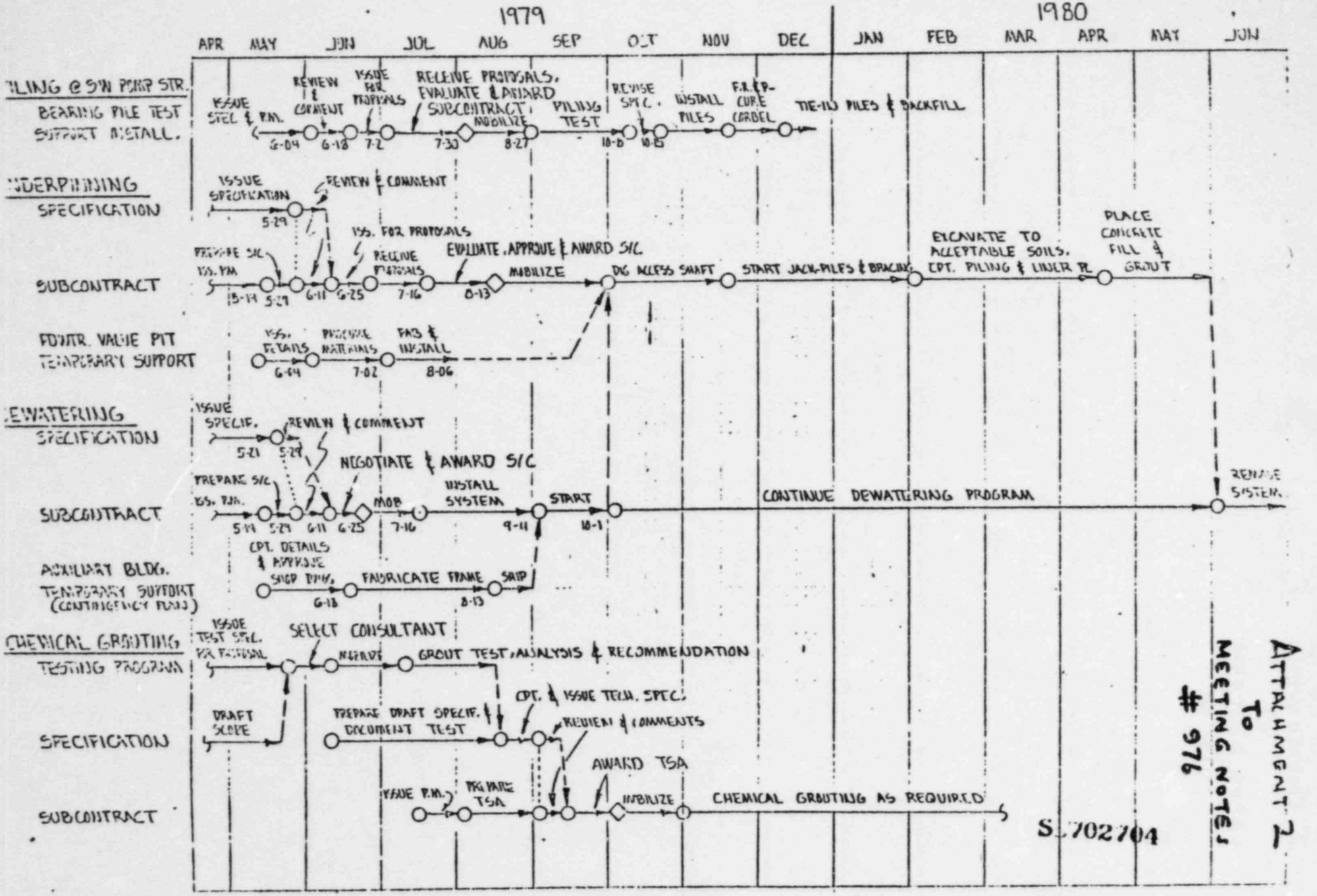
50.54f QUESTION NO.	ACTION ITEM	ACTION DISCRIPTION	RESPONSIBILITY	ACTION COMPLET-ION DATE	DATE COMPL
16	a	Perform soils borings in the areas of buried pipes.	J. Wanzeck	8-79	
17	a	Complete evaluation of impact of the failure of non-seismic Category I piping on safety-related structures, foundations and/or equipment.	B. Dhar	6-29-79	
	b	If future profiles show any extreme conditions, analyze the piping system and make necessary repairs.	B. Dhar	Open	
	c	Prepare additional response to the NRC	B. Dhar	6-29-79	
18	a	Perform re-examination of stresses in seismic Cat. I piping connecting between buildings as part of normal iteration of design. Consider stresses induced by differential settlement after connecting pipe and anticipated future settlement.	D. Riat	Open	
19	a	Profile pipes in vicinity of D.G.B. after removal of preload-evaluate as described in Response 17.	C. Connel	Open	
	b	Take additional gap measurements between embedded sleeves and pipes when surcharge is removed. Coordinate this information with the profile data.	C. McConnel	Open	
	c	Perform a complete evaluation of safety related piping after completion of the preload program.	D. Riat	8-79	
20	a	Analytically check affected pump and nozzle loadings. If necessary disassemble flange joints and evaluate separation.	D. Riat	6-29-79	
	b	Verify piping support loads for systems subjected to settlement induced loads.			
	c	Prepare additional response to the NRC.	D. Riat	6-29-79	

S 702703

JOB 7220
MIDLAND UNITS 1&2

ANO 5-12-79

PRELIMINARY SCHEDULE FOR CORRECTIVE ACTIONS



ATTACHMENT 2
TO
MEETING NOTES
976

S 702704

Bechtel Associates Professional Corporation

Inter-office Memorandum

To L. H. Curtis

Date [redacted]

Subject Midland Units 1/2-Job 7220-001
Estimated Residual Settlement
for the Plant Life (40 yrs)
of Diesel Generator Building

From S. S. Afifi

Of Geotechnical Services

At Ann Arbor 10 D 5
7220-79-264

Copies to S. L. Blue
P. K. Chen
[redacted]
R. Rixford
J. O. Wanzeck
K. Wiedner
1320, 3410

REFERENCE: IOM from S. S. Afifi to L. H. Curtis, dated 10/3/79, "50.43 (f) Response and Diesel Generator Building Task Group."

This is a completed response of Items 3 and 4 of the reference memo. The estimated 40 year (plant life) total residual settlement of the Diesel Generator Building will range from 1.5 inches in the southeast corner to 0.5 inch in the northwest corner. The estimated differential settlement will be about 3/4" from north to south and can be considered rigid body rotation. Continuation of settlement monitoring will be implemented.

If there are any questions, please contact P. K. Chen of this office.

S. S. Afifi

PKC/nm

S.7703282

NOV 13 1979
BECHTEL
A.A. 7220

Bechtel Power Corporation

Interoffice Memorandum

To L. H. Curtis

File No

Subject Job 7220 Midland Project
Diesel Generator Building
Concrete Topping Slab Mix
BCBE-2624

Date November 1[illegible], 1979

From L. E. Davis

Of Construction

Copies to

At Midland, M[illegible]

FIELD ENG.
CONSTR. MGR.
QA/QC
ADMIN.
FILE
C-2154/0

Reference: 1. FCR C-2085 dated September 10, 1979

Attached for your review, as requested per reference one, are the completed compressive strength test result sheets for the Diesel Generator Building concrete topping slab mix (designated with formula T-1c) which was placed at the below listed locations.

Placement Date	Pour Number	Placement Description	Specimen I.D. No.'s
9/19/79	DG(663.75)A	Bay #3 Topping Slab at elevation 663'-9"	4335 and 4336F
9/21/79	DG(663.67)A	Bay #4 Topping Slab at elevation 663'-8"	4346 and 4347F
9/28/79	DG(663.83)A	Bay #2 Topping Slab at elevation 663'-10"	4375 and 4376F
10/2/79	DG(663.83)B	Bay #1 Topping Slab at elevation 663'-10"	4390 and 4391F

L. E. Davis

LED/RDK/mkm

Attachments

8703284

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 7220
REPORT OF CONCRETE CYLINDERS

QC ACCEPTANCE | DATE
CONTROL NUMBER | FILE NUMBER

1. ARMY IDENTIFICATION: DG (463.75) A | DATE PLACED: 9-19-79

2. PLACEMENT LOCATION: DIG RM #3 TORUS SLAB

PLANT DATA | HOURS: Operation Intermittent | CEMENT BRAND AND TYPE: Medusa Materials Type II

3. MIX: THC | 4. CLASS: I | 5. AIR ENT: ☑ YES ☐ NO | 6. REQUIRED STRENGTH: 4000 PSI AT 28 DAYS

TEST DATA AT BATCH PLANT | Yield: 27.46

7. TICKET NO.: 33155 | 8. TRUCK NO.: 56 | 9. TIME OF HOLDING: 1013 HOURS AT 3 YARDS | 10. INITIALS: [illegible]

11. SLUMP ASSIGNED: 3 3/4 INCHES | 12. AIR CONTENT ASSIGNED LIMITS: 3.2 | 13. UNIT WEIGHT ASSIGNED LIMITS: 151.58 LBS./CU. FT. | 14. TEMP CONCRETE: 62 °F | 15. TEMP AIR: 44 °F

16. WATER REDUCING ADMIXTURE ASSIGNED LIMITS: 1.8 | 0.3 | 17. ITEM 2: N/A | 18. WATER/CEMENT + POZZOLAN RATIO: .40 MAX .31 ACT.

19. INITIAL CURING ASSIGNED LIMITS: 70 °F TO 77 °F | 20. STRIPPED ASSIGNED LIMITS: 9-28-79 AT 0727 HRS | 21. INITIALS: [illegible]

TEST DATA AT PLACEMENT

22. TICKET NO.: 33155 | 23. TRUCK NO.: 56 | 24. TIME OF TESTING: 1024 HOURS AT 3 YARDS | 25. TIME OF HOLDING: N/A HRS

26. SLUMP ASSIGNED: 1 3/4 INCHES | 27. AIR CONTENT ASSIGNED LIMITS: 3.1 | 28. TEMP CONCRETE: 64 °F | 29. TEMP AIR: 52 °F | 30. INITIALS: SAT AC

31. INITIAL CURING ASSIGNED LIMITS: N/A °F TO N/A °F | 32. STRIPPED ASSIGNED LIMITS: N/A AT N/A HRS | 33. INITIALS: N/A

COMPRESSIVE STRENGTH DATA | ASTM-C-39-71

37. SPECIMEN IDENTIFICATION	34. DATE MOLDED	35. DATE TESTED	36. AGE	38. TOTAL LOAD IN POUNDS	39. ACTUAL CYL DIAM.	40. ACTUAL CYL AREA	41. TYPE OF BREAK	42. CURE		43. STRENGTH PSI
								HRS	MIN	
4335-7075	9-19-79	9-22-79	3	114,000	6.00	28.27	A	1	2	4030
7076	"	-	3	113,500	6.01	28.37	A	1	2	4000
7077		9-26-79	7	129,000	6.01	28.37	B	1	6	4550
4335 7078		9-26-79	7	134,000	6.01	28.37	C	1	6	4720
4335 7079		10-3-79	14	153,000	6.01	28.37	A	1	13	5390
7080		"	14	150,000	6.01	28.37	A	1	13	5290
7081		10-17-79	28	170,500	6.00	28.27	B	1	27	6030
4335/7082	9-19-79	"	28	166,000	6.00	28.27	B	1	27	5870

44. ITEMS AFFECTED: ☑ SLAB ☐ BEAM ☐ CORE ☐ OTHER | 45. REMARKS

46. QUAN.	47. PATH	48. WEIGHED BY	49. CHECKED BY	50. CHECKED BY QC REP
3	THS	BV	[illegible]	10-3-79
7	GW TW	BV	[illegible]	10-7-79
14	KS TW NO	BV	TL	10-8-79
28	SAT	BV	TL	10-19-79

S5703285

51. REMARKS BY QA REVIEW | [illegible] DATE 10-19-79

52. TYPE OF BREAKS: A CONE, MORTAR FAILURE; B CONE, AGGREGATE FAILURE; C SHEAR, MORTAR FAILURE; D SHEAR, AGGREGATE FAILURE

UST 0-13 @ 7 | UST 0-77 @ 14 | UST 0-236 @ 28

7220-QCI-35 REV. 0

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT
REPORT OF CONCRETE CYLINDERS

DG (663.75)A — DATE PLACED 9-19-79

PLACEMENT LOCATION: DG Bldg #3 tornado slab

PLANT DATA — SOURCE: Champion Incorporated — CEMENT BRAND AND TYPE: Martin Marietta Type I

MIX: THC — CLASS: I — AIR ENT: Yes / No — REQUIRED STRENGTH: 4000 PSI AT 28 DAYS

TEST DATA AT BATCH PLANT — Yield: 27.46

TICKET NO. 33155	TRUCK NO. 56	TIME OF MIXING 1013 HOURS AT 3 YARDS			INITIALS TLW DE
SLUMP 3 1/4 INCHES	AIR CONTENT 2.2	UNIT WEIGHT 151.5 LBS/CU FT	TEMP CONCRETE 62 °F	TEMP AIR 68 °F	
WATER 1.8	AGGREGATE 1 0-3	AGGREGATE 2 N/A	WATER/CEMENT + POZZOLAN RATIO .40 MAX .31 ACT.		
INITIAL CURING N/A °F TO N/A °F		STARTED N/A AT N/A HRS			INITIALS N/A

TEST DATA AT PLACEMENT

TICKET NO. 33155	TRUCK NO. 56	TIME OF TESTING 1026 HOURS AT 3 YARDS			TIME OF MOLDING 1026 HRS
SLUMP 13/4 INCHES	AIR CONTENT 3.1	CONC. TEMP 64 °F	TEMP AIR 52 °F		INITIALS SAT DC
INITIAL CURING 54 °F TO 114 °F		STARTED 9-20-79 AT 0750 HRS			INITIALS LWK RS

COMPRESSIVE STRENGTH DATA — ACI 318-63-71

STRUCTURE IDENTIFICATION	DATE MOLDED	DATE TESTED	AGE	TOTAL LOAD IN POUNDS	ACTUAL CYL DIAM.	ACTUAL CYL AREA	TYPE FRACTURE	CURE FIELD	CURE LAB	STRENGTH PSI
423'E 7083	9-19-79	9-22-79	3	99,000	6.02	28.46	A	1	2	3480
7084		"	3	100,000	6.01	28.37	A	1	2	3520
7085		9-26-79	7	119,000	6.00	28.27	C	1	6	4210
7086		"	7	113,500	6.01	28.37	C	1	6	4000
7087		10-3-79	14	134,000	6.02	28.46	A	1	13	4710
7088		"	14	127,500	6.01	28.37	A	1	13	4490
7089		10-17-79	28	149,000	6.02	28.46	A	1	27	5240
423'E / 7090	9-19-79	"	28	153,500	6.01	28.37	A	1	27	5410

STANDARD CYLINDER: 6"x12" CUBE CORE OTHER

AGE (DAYS)	TESTED AT	CHECKED BY	CHECKED (INITIALS)	COMMENTS
3	TW SW	BV		
7	TW SW	BV		
14	KS TW	BV	TL 10-4-79	
28	SAT	BV	TL 10-19-79	

LABORATORY SUPERVISOR: [signature] DATE 10-19-79

TYPE OF BREAKS: A = CONC. MORTAR FAILURE; B = CONC. AGGREGATE FAILURE; C = SHEAR, MORTAR FAILURE; D = SHEAR, AGGREGATE FAILURE; E = OTHER

UST D-78 @14 UST D-237 @28

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 07220
REPORT OF CONCRETE CYLINDERS

QC ACCEPTANCE | DATE

CONTROL NUMBER | FILE NUMBER

1. CONCRETE IDENTIFICATION: DIESEL TRENCH SLAB | DATE PLACED: 9-21-79

2. PLACEMENT LOCATION: D/G TRENCH SLAB BAY 4

PLANT DATA | SOURCE: Champion Incorporated | CONCRETE SUPPLIED BY: Martin Marietta Type II

MIX: T-1C | CLASS: I | SLUMP: 2 INCHES | AIR ENTRAINED: NO | REQUIRED STRENGTH: 4000 PSI AT 28 DAYS

TEST DATA AT BATCH PLANT | YIELD:

TICKET NO.: 33185 | TRUCK NO.: 38 | TIME OF MIXING: 1040 HOURS AT 3 YARDS | INITIALS: C-U

SLUMP: 2 INCHES | AIR CONTENT: 4.4 | UNIT WEIGHT: 142 PCF | TEMP CONCRETE: 55 °F | TEMP AIR: 60 °F

W/C RATIO: 1.4 | 1.5 | STONE 2: N/A | CEMENT + POZZOLAN RATIO: .40 MAX. .31 ACT

SLUMP AT CURB: 68 °F | 70 °F | STARTED DISCHARGE: 9-22-79 AT 0940 HRS | INITIALS: GW

TEST DATA AT PLACEMENT

TICKET NO.: 33185 | TRUCK NO.: 38 | TIME OF TESTING: 1053 HOURS AT 3 YARDS | TIME OF HOLDING: N/A

SLUMP: 1¼ INCHES | AIR CONTENT: 3.3 | TEMP CONCRETE: 62 °F | TEMP AIR: 61 °F | INITIALS: RC TC

SLUMP AT CURB: N/A °F | N/A | STARTED DISCHARGE: N/A AT N/A HRS | INITIALS: N/A

COLOR CURVE STRENGTH DATA — ASTM - C - 39 - 71

CYLINDER IDENTIFICATION	DATE MOLDED	DATE TESTED	AGE	TOTAL LOAD IN POUNDS	ACTUAL CYL. DIAM.	ACTUAL CYL. AREA	TYPE BREAK	% CURE MIN	% CURE MAX	STRENGTH PSI
4344 7151	9-21-79	9-24-79	3	102,000	6.03	28.56	A	1	2	3570
7152	"	"	3	106,000	6.03	28.56	A	1	2	3710
7153	"	9-28-79	7	121,000	6.01	28.37	A	1	6	4270
7154	"	"	7	120,000	6.02	28.46	A	1	6	4220
7155	"	10-5-79	14	136,000	6.01	28.37	A	1	13	4790
7156	"	"	14	135,000	6.01	28.37	A	1	13	4760
7157	"	10-19-79	28	153,000	6.00	28.27	A	1	27	5380
4344 7158	9-21-79	"	28	149,500	6.00	28.27	A	1	27	5250

STANDARD CYLINDER: 6" x 12" | CUBE | CORE | OTHER | REMARKS

TEST DATE	TESTED BY	CHECKED BY	CHECKED BY QC REP
3	RC, ET	BV	TL 10-9-79
7	TPO, RC	BV	TL 10-9-79
14	HQRS	BV	TL 10-16-79
28	RC	BV	TL 10-25-79

LABORATORY SUPERVISOR: [signature] DATE: 10-2

TYPE OF BREAKS: A = CONE, MORTAR FAILURE; B = CONE, AGGREGATE FAILURE; C = SHEAR, MORTAR FAILURE; D = SHEAR, AGGREGATE FAILURE; E = OTHER

WST 0-103 G14 | WST 0-103 G15

7220-603- Rev. 0 5-18-79

S3703287

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 07203
REPORT OF CONCRETE CYLINDERS

QC ACCEPTANCE | DATE

CONTROL NUMBER | FILE NUMBER

1. CONCRETE IDENTIFICATION: DG(4273,47)A | 2. DATE PLACED: 9-21-79

3. PLACEMENT LOCATION: D/G FOOTING SLAB PAD W

PLANT DATA | SOURCE: Champion Incorporated | CEMENT BRAND AND TYPE: Martin Marietta Type II

MIX: T-1C | CLASS: I | AIR ENT: ☑ YES ☐ NO | 28 DAY REQUIRED STRENGTH: 4000 PSI AT 28 DAYS

TEST DATA AT BATCH PLANT | Yield: 27.91

TICKET NO: 33185 | TRUCK NO: 38 | TIME OF WEIGHING: 1040 HOURS AT 3 YARDS | INITIALS: GW

SLUMP ASSIGNMENT: 2 INCHES | AIR CONTENT ASSIGNMENT: 4.4 % | UNIT WEIGHT ASSIGNMENT: 146.2 LBS/CU FT | CONC TEMP: 45 °F | AIR TEMP: 60 °F

W/C RATIO ASSIGNMENT: 1.4 | .5 | STRENGTH: N/A | WATER/CEMENT + POZZOLAN RATIO: .46 MAX .31 ACT.

ACCELERATED CURING ASSIGNMENT: N/A HOURS N/A °F | STRENGTH ASSIGNMENT: N/A AT N/A HRS | INITIALS: N/A

TEST DATA AT PLACEMENT

TICKET NO: 33185 | TRUCK NO: 38 | TIME OF TESTING: 1053 HOURS AT 3 YARDS | TIME OF MOLDING: 1057 HRS

SLUMP ASSIGNMENT: 1¼ INCHES | AIR CONTENT: 3.3 % | TEMP CONCRETE: 63 °F | TEMP AIR: 61 °F | INITIALS: TC RC

INITIAL CURING ASSIGNMENT: 64 °F 11 HRS | STRENGTH ASSIGNMENT: 9-22-79 AT 0800 HRS | INITIALS: WH

COMPRESSIVE STRENGTH DATA ASTM-C-39-71

SPECIMEN IDENTIFICATION	DATE MOLDED	DATE TESTED	AGE	TOTAL LOAD IN POUNDS	ACTUAL CYL DIAM.	ACTUAL CYL AREA	CURE	STRENGTH PSI
4347F 7159	9-21-79	9-24-79	3	101 500	6.02	28.46	A 1 2	3570
7160	"	"	3	103,500	6.02	28.46	A 1 2	3640
7161	"	9-28-79	7	123 500	6.00	28.27	A 1 6	4370
7162	"	"	7	121,500	6.01	28.37	A 1 6	4280
7163	"	10-5-79	14	142,000	6.00	28.27	A 1 13	5020
7164	"	"	14	137,000	6.01	28.37	A 1 13	4830
7165	"	10-19-79	28	153 500	6.02	28.46	A 1 27	5390
4347F 7166	9-21-79	"	28	159,500	6.00	28.27	A 1 27	5610

STANDARD CYLINDERS ☑ 6 X 12 ☐ CUBE ☐ CORE ☐ OTHER | REMARKS

NO.	TESTED BY	CHECKED BY	CHECKED BY QC REP
3	RC ET	BV	TL 10-9-79
7	TP RC	BV	TL 10-9-79
14	RS TW	BV	TL 10-9-79
28	RC	BV	TL 10-24-79

LABORATORY SUPERVISOR: [signature] DATE: 10-22-79

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 07000
REPORT OF CONCRETE CYLINDERS

DE ACCEPT LINES | DATE
CONTROL NUMBER | FILE NUMBER

IDENTIFICATION: DG (663.8) A | DATE PLACED: 9-29-79

PLACEMENT LOCATION: DIG TROUGH SLAB BAY 2

PLANT DATA | SOURCE: Diamond Interstate | CEMENT BRAND AND TYPE: Martin Marietta Type II

MIX: 4 1.C | CLASS: I | AIR ENT: ☒ YES ☐ NO | REQUIRED STRENGTH: 4000 PSI AT 28 DAYS

TEST DATA AT BATCH PLANT | YIELD: 29.46

TICKET NO.: 33268 ST | TRUCK NO.: 51 | TIME OF MOULDING: 0758 HOURS AT 3 YARDS | INITIALS: RR ST
SLUMP: 3 1/4 INCHES | AIR CONTENT: 7.8 % | UNIT WEIGHT: 143.04 LBS./CU. FT. | TEMP CONCRETE: 64 °F | TEMP AIR: 53 °F
ADMIXTURE 1: 2.6 | ADMIXTURE 2: 0.6 | ITEM 3: N/A | BATCH WEIGHT / MIXER RATIO: 0.38 W/C | 0.36 ACT.
INITIAL SLUMP: 7 1/4 IN | TO: 7 8 IN | STRIPPED: 9-29-79 AT 0715 HRS | INITIALS: TBA KS

TEST DATA AT PLACEMENT

TICKET NO.: 33268 | TRUCK NO.: 51 | TIME OF TESTING: 0812 HOURS AT 3 YARDS | TIME OF MOULDING: N/A HRS.
SLUMP: 2 1/2 INCHES | AIR CONTENT: 5.6 % | TEMP CONCRETE: 65 °F | TEMP AIR: 56 °F | INITIALS: AC SAT
INITIAL SLUMP: N/A IN | TO: N/A IN | STRIPPED: N/A AT N/A HRS | INITIALS: N/A

COMPRESSIVE STRENGTH DATA — ASTM-C-39-71

SPECIMEN IDENTIFICATION	DATE MOLDED	DATE TESTED	AGE	TOTAL LOAD IN POUNDS	ACTUAL CYL DIAM.	ACTUAL CYL AREA	TYPE	CURE		STRENGTH PSI
4375-7319	9-28-79	10-1-79	3	78,500	6.01	28.37	C	1	2	2770
7320	"	"	3	80,000	6.02	28.46	C	1	2	2810
7321	"	10-5-79	7	93,000	6.02	28.46	A	1	6	3270
7322	"	"	7	95,000	6.02	28.46	A	1	6	3340
7323	"	10-12-79	14	102,000	6.01	28.37	A	1	13	3600
7324	"	"	14	104,000	6.01	28.37	A	1	13	3670
7325	"	10-26-79	28	112,500	6.01	28.37	A	1	27	3970
4375 7326	9-28-79	"	28	115,000	6.01	29.37	A	1	27	4050

STANDARD CYLINDER: ☒ 6"x12" ☐ CUBE ☐ CORE ☐ OTHER

AGE	DATE	TESTED BY	CHECKED BY	CHECKED BY QC REP	REMARKS
3	10-4-79	HM, JL	BV	TL 10-9-79	
7	10-8-79	HQ RS	BV	TL 10-9-79	
14	10-12-79	RQ	BV	TL 10-17-79	
28	10-26-79	MO	BV	TL 10-31-79	

LABORATORY SUPERVISOR: [signature] DATE: 10-29-79

TYPE OF FAILURE: A = CONE, MORTAR FAILURE; B = CONE, AGGREGATE FAILURE; C = SHEAR, MORTAR FAILURE; D = SHEAR, AGGREGATE FAILURE; E = OTHER
WST 0-105 @ 7 | WST 0-152 @ 14 | WST 0-357 @ 28

7220-QCI-, Rev. 0 5-18-79

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BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 07220
REPORT OF CONCRETE CYLINDERS

DG 1 (43.8) A — DATE PLACED 9-28-79

D/G Room Slab Base

PLANT DATA — SOURCE: Champion Incorporated — CEMENT BRAND AND TYPE: Martin Marietta Type II

MIX: T1-C — CLASS: I — AIR ENT: YES / NO — REQUIRED STRENGTH: 4000 PSI AT 28 DAYS

TEST DATA AT BATCH PLANT — Vebe: 29.46

TICKET NO. 33268	TRUCK NO. 51	TIME OF MIXING 0755	HOURS AT 3	YARDS	INITIALS RR S
SLUMP 2 1/4 INCHES	AIR CONTENT 7.8	UNIT WEIGHT 143.04 LBS/CU FT	TEMP CONCRETE 64 °F	TEMP AIR 53 °F
W/C RATIO: SAND 2.6	STONE 1: 0.6	STONE 2: N/A	WATER/CEMENT + ADMIXTURE RATIO 0.38 MAX	0.39 ACT
SLUMP AT BATCHING: MIN N/A	MAX N/A	STANDARD SLUMP N/A AT N/A HRS	INITIALS N/A

TEST DATA AT PLACEMENT

TICKET NO. 33268	TRUCK NO. 51	TIME OF TESTING 1912	HOURS AT 3	YARDS	TIME OF MIXING 0812
SLUMP 2 1/2 INCHES	AIR CONTENT 5.6	TEMP CONCRETE 65 °F	TEMP AIR 56 °F	INITIALS AC CE
SLUMP AT PLACEMENT: MIN 68	MAX 114	STANDARD SLUMP 9-29-79 AT 0730 HRS	INITIALS TAA

COMPRESSIVE STRENGTH DATA — ASTM - C - 39 - 71

SPECIMEN IDENTIFICATION	DATE MOLDED	DATE TESTED	AGE	TOTAL LOAD IN POUNDS	ACTUAL CYL DIAM.	ACTUAL CYL AREA	CURE: TYPE	CURE: HRS	CURE: MIN	STRENGTH PSI
4376F-7327	9-28-79	10-1-79	3	86,000	6.02	28.46	C	1	2	3020
7328		"	3	85,500	6.01	28.37	A	1	2	3010
7329		10-5-79	7	105,000	6.04	28.65	A	1	6	3660
7330		"	7	101,500	6.01	28.37	A	1	6	3580
7331		10-12-79	14	107,000	6.00	28.27	A	1	13	3780
7332		"	14	109,000	6.00	28.27	A	1	13	3860
7333		10-26-79	28	130,500	6.01	28.37	A	1	27	4600
4376F 7334	9-28-79	"	28	126,000	6.00	28.27	A	1	27	4460

CYLINDERS: 6" x 12" — MOLD: USED / CORE / OTHER

CHARGE	PART	SPECIMEN	SPECIMEN BY	SPECIMEN BY DATE/TIME
3	HQ RS		BV	TL 10-9-79
7	HQ RS		BV	TL 10-9-79
14	HQ	RC	BV	TL 10-17-79
28	HQ		BV	TL 10-31-79

LABORATORY WITNESSING — DATE 10-29-79

TYPE OF BREAK: A = CONE MORTAR FAILURE; B = LINEAR AGGREGATE FAILURE; C = CONE AGGREGATE FAILURE; D = LINEAR MORTAR FAILURE

1 - 0-358 @ 14 — 1 - 0-358 @ 28

7220-003-. Rev. 0

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BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 07220
REPORT OF CONCRETE CYLINDERS

QC ACCEPTANCE | DATE

CONTROL NUMBER | FILE NUMBER

STRUCTURE IDENTIFICATION: DG/EG3 ... 5 | DATE PLACED: 10-2-79

PLACEMENT LOCATION

PLANT DATA | SOURCE: Champion Incorporated | CEMENT BRAND AND TYPE: Martin Marietta Type I-II

MIX: T-1C | CLASS: I | AIR ENT: YES ☒ NO ☐ | REQUIRED STRENGTH: 4000 PSI AT 28 DAY

TEST DATA AT BATCH PLANT | Yield: 28.40

CONCRETE NO.: 33322 | TRUCK NO.: 39 | TIME OF MOLDING: 1014 HOURS AT 3 YARDS | INITIALS: GLH C

SLUMP ACTUAL/LIMIT: 2½ INCHES | AIR CONTENT ACTUAL/LIMITS: 6.8 | UNIT WEIGHT ACTUAL/LIMITS: 147.62 LBS./CU. FT. | TEMP CONCRETE: 62 °F | TEMP AIR: 58 °F

WATER/CEMENT RATIO ACTUAL/LIMITS: 2.3 | ADMIXTURE 1: H | ADMIXTURE 2: N/A | WATER/CEMENT + POZZOLAN RATIO: .43 MAX .34 AC

INITIAL CURING TEMP ACTUAL/LIMIT: 71 °F TO 77 °F | TIME/DATE STARTED: 10-2-79 AT 1005 HRS | INITIALS: PS IZ

TEST DATA AT PLACEMENT

CONCRETE NO.: 33322 | TRUCK NO.: 39 | TIME OF TESTING: 1025 HOURS AT 3 YARDS | TIME OF MOLDING: N/A

SLUMP ACTUAL/LIMIT: 1½ INCHES | AIR CONTENT ACTUAL/LIMITS: 5.2 | TEMP CONCRETE: 66 °F | TEMP AIR: 60 °F | INITIALS: GLH A

INITIAL CURING TEMP ACTUAL/LIMIT: N/A °F TO N/A °F | TIME/DATE STARTED: N/A AT N/A HRS | INITIALS: N/A

COMPRESSIVE STRENGTH DATA — ASTM-C-39-71

SPECIMEN IDENTIFICATION	DATE MOLDED	DATE TESTED	AGE	TOTAL LOAD IN POUNDS	ACTUAL CYL DIAM.	ACTUAL CYL AREA	TYPE OF BREAK	CURE		STRENGTH PSI
								FIELD	LAB	
4390 7425	10-2-79	10-5-79	3	88,500	6.01	28.37	A	1	2	3120
7426	"	"	3	82,500	6.02	28.46	A	1	2	2900
7427		10-9-79	7	108,000	6.02	28.46	A	1	6	3790
7428		"	7	113,500	6.01	28.37	A	1	6	4000
7429		10-16-79	14	119,000	6.00	28.27	A	1	13	4210
7430		"	14	119,500	6.01	28.37	A	1	13	4210
7431		10-30-79	28	132,500	6.00	28.27	A	1	27	4670
4390 7432	10-2-79	"	28	139,000	6.01	28.37	A	1	27	4900

CYLINDERS: ☒ 6"x12" ☐ CUBE ☐ CORE ☐ OTHER

REMARKS

3	MD ESI	RV	TL 10-11-79	
7	MD ESI	RV	TL 10-11-79	
14	MD ESI	RV	TL 10-15-79	
28	ET	RV	— 11-3-79	11-1-79

TYPE OF FAILURE: A = CONE, MORTAR FAILURE B = CONE, AGGREGATE FAILURE C = SHEAR, MORTAR FAILURE D = SHEAR, AGG. FAILURE E = OTHER

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BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 07210
REPORT OF CONCRETE CYLINDERS

QC ACCEPTANCE | DATE
CONTROL NUMBER | FILE NUMBER

NUMBER OF IDENTIFICATION: 6/663 (32) R | DATE PLACED: 10-2-79

LOCATION

CONCRETE DATA | SOURCE: Clemcon Incorporated | CONCRETE BRAND AND TYPE: Martin Marietta Type I

7:1C | CLASS: I | AIR ENT: ☑ YES ☐ NO | REQUIRED STRENGTH: 4000 PSI AT 28 DAYS

TEST DATA AT BATCH PLANT | Yield: 28.40

SET NO. 33322 | TRUCK NO. 39 | TIME OF MIXING: 10.14 HOURS AT 2 TURNS | INITIALS GWL ET

SLUMP: 3 1/2 INCHES | AIR CONTENT: 6.8 % | UNIT WEIGHT: 147.02 LBS. | TEMP CONCRETE: 62 °F | TEMP AIR: 58 °F

STONE 1: 2.3 % | STONE 2: 0.4 % | STONE 3: N/A % | ENTRAINMENT + POSSIBLE RATIO: .43 MAX .34 ACT.

MAN CHARGE ASSIGNMENT: N/A TO N/A | STARTED MIXING AT: N/A AT N/A HRS | INITIALS: N/A

TEST DATA AT PLACEMENT

SET NO. 33322 | TRUCK NO. 39 | TIME OF TESTING: 1025 HOURS AT 3 TURNS | TIME OF MIXING: 1025 HRS

SLUMP: 1 1/2 INCHES | AIR CONTENT: 5.2 % | TEMP CONCRETE: 66 °F | TEMP AIR: 60 °F | INITIALS GWL RSL

MAN CHARGE ASSIGNMENT: 10 C TO 100 | STARTED MIXING AT: 10-3-79 AT 1056 HRS | INITIALS: RS 12 E

COMPRESSIVE STRENGTH DATA — ASTM-C-39-71

IDENTIFICATION	DATE MOLDED	DATE TESTED	AGE	TOTAL LOAD IN POUNDS	ACTUAL CYL DIAM.	ACTUAL CYL AREA	TYPE	% CURE HRS	% CURE MIN	STRENGTH PSI
391 F 7433	10-2-79	10-5-79	3	95,000	6.01	28.37	A	1	2	3350
7434	"	"	3	96,500	6.02	28.46	A	1	2	3390
7435		10-9-79	7	114,000	6.00	28.27	A	1	6	4030
7436		"	7	111,000	6.01	28.37	A	1	6	3910
7437		10-16-79	14	126,500	6.03	28.56	A	1	13	4430
7438		"	14	127,500	6.01	28.37	A	1	13	4490
7439		10-30-79	28	144,500	6.01	28.37	A	1	27	5090
391 E 7440	10-2-79	"	28	147,000	6.00	28.27	A	1	27	5200

STANDARD CYLINDER: ☑ 6" X 12" ☐ CUBE ☐ CORE ☐ OTHER | REMARKS

3	HO RS	BV	TL 10-11-79
7	HO RS	BV	TL 10-11-79
14	HO RS	BV	TL 10-18-79
28	ET	BV	TL 11-2-79

CHECKED BY QC REP | CHECKED BY SUPERVISOR | DATE 11-1-79

TYPE OF BREAK: A=CONC. MORTAR FAILURE B=CONC. AGGREGATE FAILURE C=LINEAR, MORTAR FAILURE D=LINEAR AGGR. FAILURE E=OTHER

JIM BETTS

Telephone call

ROUTE Dinal Dhar

BY AMI GANGULY OF BECHTEL AAC

TO AL GILLESPIE (313-232-8752) OF STRUCTURAL BONDING CO.

DATE 11-14-79 TIME 9:15 AM.

SUBJECT MIDLAND PLANT UNITS 1 & 2 JOB NO 7220-101
DIESEL GENERATOR BUILDING. REPAIR OF GAPS UNDERNEATH THE FOOTINGS

FILE; C-2645

Al informed that the material "MAGNA ROCK", which he suggested earlier [on 11-12-79 at the jobsite] for use in the repair of gaps, cures too fast (in approx. 8 to 12 mins). Instead of "Magna Rock" he recommended, this time, a different material (mix: Portland Cement + Sand + Fly Ash + Aluminite Cement) which will be more suitable for the job. He will send us the properties and details of the procedure of filling the gaps including an estimate of cost for doing the job by Friday (11-16-79).

A. Ganguly

SU703203

(c) Requirement of additional surcharge and removal of existing surcharge.

(d) Liquefaction potential.

Item 2. Exploration Program for;

(a) Auxiliary Building

(b) Service Water Pump Structure

(c) Underground Utilities

Item 3. Corrective Measures for:

(a) Auxiliary Building Control Tower

(b) Auxiliary Building Wings & Feedwater Valve Pile

(c) Auxiliary Building Railroad Bay

(d) Service Water Pump Structure

(e) Diesel Generator Building (grouting)

(f) Underground Utilities (*piping and duct banks)

Item 4. Limits of Material Removal during Underpinning Operation

Item 5. Q Listed Piles for Service Water Pump Structure

(a) Installation Procedure for Piles

(b) Design of Piles

(c) Testing of Piles

Item 6. Possible Movement of Structures During Dewatering and Underpinning

ITEMS DISCUSSED:

A summary of main items discussed and the agreements reached during the meeting are presented below.

S.7705237

Item 1. Diesel Generator Building Surcharge

John Davie presented summaries of the diesel generator building surcharge, settlement and piezometer data. Particularly, the data included plots of rate of surcharge loading, rate of settlement at various points of building and piezometer levels response to surcharge loading vs. time. The Borros Anchors reading versus depth at different times and corresponding to surcharge loading levels were presented. This data was sent to Dr. Hendron and Dr. Peck in advance before the meeting.

Maximum settlement to date, at SE corner was about 0.59' and minimum settlement at NW corner was about 0.25'. However, there appears to be some minor fluctuations in the measurements. These fluctuations were caused by limited accuracy of the surveying instrument presently used. It appeared that most of the settlement measurements are stable, i.e., settlement readings has not changed during the last one week. Mainly an average reading from 33 settlement markers indicated that the settlement remained zero during the last one week.

It was agreed that no additional surcharge is required. Settlement and piezometer measurments should continue under the present level of surcharge loading for approximately six more weeks to arrive at a future definite date for surcharge removal.

Question concerning accuracy of heave (rebound) measurements during and after removal of the surcharge load was discussed. If was agreed that the heave measurements should be relatively precise. Presently proposed Sondex, instrument for measuring heave, appears to be less accurate. Further check into the accuracy of sondex need to be discussed with John Dunnicliff of

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GZD & Assoc., Inc. It was also suggested that a few extensometer may be used.

Liquefaction potential of sand, under the foundation of various structure, in gereral, was discussed by P. K. Chen. Based on this discussion it was decided to use a factor of safety of 1.5 in evaluating liquefaction potential. It was agreed where sand fill with liquefaction potential exist will be treated by grouting. The following steps will be taken:

(a) The depth and area extent of sand below the diesel generator building will be studied based on the data derived from borings and the construction records.

(b) Liquefaction potential will be evaluated for the fill sand under the auxiliary building and diesel generator building. The blow count required for a factor of safety of 1.5 will be computed at different depths accounting for the surcharge from the building where applicable. These computed blow count in turn will be compared with the appropriate record of blow count based on the exploration program.

(c) Fill sands will be grouted when the calcualted factor of safety is less than 1.5 unless it is evident that they are in isolated pockets. The grouting pattern will be based on blowcount from the borings and will extend all around applicable borings until it is established that the surrounding soil is not groutable (clay). Extended beyond the perimeter of the building.

It was agreed that crosshole shear wave velocity measurements will be made in the diesle generator building area before grouting but after removal of the surcharge. Measurements will also be made in the tank farm area and other locations as required by project engineering.

S.703259

Item 2. Exploration Program

Jim Wanzeck reported that the exploration program is essentially complete. This exploration program included all areas including Class I utilities and structures. At the present time no additional borings are planned. Installation of Sondex for the measurement of rebound (heave) were planned for next week.

Further it was reported by Jim Wanzeck that a pump test at the west side of the Unit 1 electrical penetration room is planned to assist in the determination of dewatering requirements. The test will be performed and results forwarded to Dr. M. T. Davisson, D.. A. J. Hendron, Jr., R. W. Loughney, and Dr. R. B. Peck. However, during the meeting the consultants consultants recommended that general dewatering be implemented as originally recommended by R. W. Loughney.

Item 3. Corrective Measures

Required corrective measures for various structures were discussed by A. Almuti. During the discussion with consultant followig steps were suggested:

1. It was recommended by Dr. T. M. Davisson that pilp piles should be used below the service water structures. The piles will be 14" in diameter with 3/8" wall thickness. They will be top driven with a hammer having a minimum energy of 24,000 ft. lb. The expected design pile load capacity will be 100 tons.
2. ACI specification 543 for concrete placement into the piles will be used.
3. Conservative estimate of blow counts for driving piles will be used.

SB7032440

4. Wave equation analysis will be performed.

Item 4. Limits of Material Removal

It was agreed the unsuitable soil under the auxiliary building wings be removed and replaced by concrete. The details of procedure for the replacement of unsuitable soil were discussed. Some concern relative to the deflection of cantilevered wings during the replacement operation were mentioned. No resolution was reached relative to the exact procedure to be used. With respect to the limits of material removal, was proposed that Dr. R. D. Woods be asked to help develop a procedure to determine the limits of accepatable material.

Item 5. Movement of Structures During Dewatering and Underpinning

Opinions relative to the movement of the structure during dewatering and underpinning were divided. Dr. Hendron, was of the opinion that sand movement will not be significant because effective stress changes are relatively small.

After some more discussion, all parties agreed that a back-up plan must be developed and should be ready for implimentation in case of anticipated settlements occur during dewatering operation. It was also suggested that jetting of dewatering wells will not be permitted within 50 feet of Class I structure.

Underpinning operations relative to various structures were discussed. The aspect of possible movement of the structures during underpinning was not addressed.

8703241

SUMMARY OF MEETING MINUTES
"RESUMPTION OF Q-LISTED BACKFILL PLACEMENT"
MIDLAND UNITS 1 & 2
APRIL 24, 1979

CPCo ITEM NO.	ACTION(S) TAKEN TO DATE	PLANNED ACTION(S) TO BE TAKEN BY (DATE)	IS COMPLETION OF PLANNED ACTION A RESTRAINT TO STARTING Q-LISTED BACKFILL PLACEMENT	PARTY RESPONSIBLE FOR PLANNED ACTION(S)
1. Identify all conflicts within FSAR, within the PSAR, or between the PSAR and the FSAR, and correct these inconsistencies via official changes to the appropriate documents.	Project Engineering and Geo Tech have revised FSAR Section 2.5.4 to correct inconsistencies pertinent to soils placement.	Project Engineering and Geo Tech will perform a review of other subsections of FSAR section 2.5 pertaining to backfill operations to eliminate inconsistencies, etc. (May 6, 1979)	Yes (As it applies to completion of review and changes to specification not processing of FSAR amendment.)	P.E. and Geo Tech
		Project Engineering and Geo Tech will perform a review of the Dames & Moore Soil Report and the	Yes (As it applies to completion of review and changes to specification not processing of FSAR amendment.)	P.E. and Geo Tech

SM703242

CPCo ITEM NO.	ACTION(S) TAKEN TO DATE	PLANNED ACTION(S) TO BE TAKEN BY (DATE)	IS COMPLETION OF PLANNED ACTION A RESTRAINT TO STARTING Q-LISTED BACKFILL PLACEMENT	PARTY RESPONSIBLE FOR PLANNED ACTION(S)
		"PSAR Committment List" pertaining to backfill placement to assure specs and FSAR are in conformance or are modified.		
		The review of "inactive" FSAR sections committed to in Appendix I, Section 1, Item C-3 (page 1-6) of the response to the NRC's 22 questions will identify and correct descrepancies in FSAR sections other than 2.5 which discuss backfill placement (Sept. 1979)	No	P.E. Geo Tech Construction
		Discuss and implement (as required) CPCo-PMO comments on FSAR Section 2.5.	Based on a preliminary review of the CPCo-PMO comments, the only restraint to resumption of backfill work is a revision to Spec. C-210 allowing the use of imported sands for Zone 2 Random Fill (May 6, 1979)	P.E. Geo Tech CPCo-PMO
2. Identify any inconsistencies between the PSAR/ FSAR and the		CPCo-QA will prepare their comments on Specifications C-210 and C-211 for discussion in conjunction with the CPCo-PMO comments listed in 1) above. (May 13, 1979)	Yes (As it applies to revising specification not processing of FSAR amendment.)	P.E. Geo Tech CPCo-QA

S.770124.3

CPCo ITEM NO.	ACTION(S) TAKEN TO DATE	PLANNED ACTION(S) TO BE TAKEN BY (DATE)	PLANNED ACTION A RESTRAINT TO STARTING Q-LISTED BACKFILL PLACEMENT	PARTY RESPONSIBLE FOR PLANNED ACTION(S)
detailed specifications or drawings, and correct these inconsistencies via official changes to the appropriate documents.				
3. Identify any inconsistencies omissions within the specications and correct these inconsistencies via official Specification Change Notices.	——SAME AS ITEM # 2 ABOVE——			
4. Re-evaluate the appropriateness of the continued use of "random fill" in Zone 2 areas.		Specification C-210 and C-211 will be revised to redefine random fill with special emphasis on soils supporting structure (May 6, 1979)	Yes	P.E. Geo Tech
5. Provide a flow diagram of the steps which are needed for the quality control and assurance		A combined flow chart will be prepared illustrating the backfill process and the responsibilities of Bechtel Field Engineering, Bechtel Quality Control,	Yes	Construction

CPCo ITEM NO.	ACTION(S) TAKEN TO DATE	PLANNED ACTION(S) TO BE TAKEN BY (DATE)	PLANNED ACTION A RESTRAINT TO STARTING Q-LISTED BACKFILL PLACEMENT	PARTY RESPONSIBLE FOR PLANNED ACTION(S)
of soils work and assure that for each step there is a designation as to the specific organization primarily responsible for the action; a designation of the specific procedure to be used; and a designation of the specific acceptance criteria for the p.		and U. S. Testing. (May 6, 1979)		
6. Assure that all "clarifications" and "interpretations" are resolved via official Specification Change Notices.		EDPI 4.4.9.1 will be revised. (May 4, 1979)	No	P.E.
7. Establish a single individual at the site to be responsible for each of the following: directing the construction aspects of the soils	The following positions have been established a) Soils Field Engineer b) Geo Tech Soils Engineer (Assigned to Job 7220) c) Soils Q.C. Field Engineer			

ITEM NO.	ACTION(S) TAKEN TO DATE	PLANNED ACTION(S) TO BE TAKEN BY (DATE)	RESTRAINT TO STARTING Q-LISTED BACKFILL PLACEMENT	PARTY RESPONSIBLE FOR PLANNED ACTION(S)
work; directing the design aspects; and directing the quality control aspects.	Their responsibilities are defined in the flow chart described in 5) above.			
8. Institute 100 percent inspection of each lift placement with a corresponding Inspection Record documentation of the specific characteristics inspected in each case.		Bechtel Q.C. will work with CPCo-QA to finalize the revised QCIR for backfill placement. (CPCo-QA has a draft of the revised QCIR which calls for Surveillance (5) of backfill work by a fulltime Q.C. Soils Engineer with generation of daily reports) May 6, 1979	Yes	Bechtel Q.C. CPCo-QA
9. Re-evaluate the capability of the equipment being used in relation to the maximum allowable lift thickness and the compaction requirements.		Project Engineering has received the procedure for test pad placement from Geo Tech. Project Engineering will forward said procedure to Construction for initiation of pad placement by 4/27/79. (April 27, 1979)	Yes	P.E. Construction
10. Re-evaluate the appropriateness of the continued use of the nuclear densometer, with	The use of the nuclear densometer has been discontinued for inspection of record use.			

CPCo ITEM NO.	ACTION(S) TAKEN TO DATE	PLANNED ACTION(S) TO BE TAKEN BY (DATE)	IS COMPLETION OF PLANNED ACTION A RESTRAINT TO STARTING Q-LISTED BACKFILL PLACEMENT	PARTY RESPONSIBLE FOR PLANNED ACTION(S)
its measurement accuracy being questionable relative to the moisture content specification limits of "plus or minus two percent of optimum".				
11. Re-evaulate the SAR's, specifications and produres relative their adequacy in specifying the points in the process at which the measurements or tests are to be made, the frequencies of these measurements or tests, and the conditions under which new laboratory standards must be acquired.		Geo Tech will review specification C-210 and C-211 requirements as related to adequacy of specified process and testing controls (May 6, 1979)	Yes	Geo Tech
		An audit will be performed on U.S. Testing by Bechtel to determine the adequacy of their soils testing procedures (April 26, 1979)	Yes (Results of audit will have to be evaluated.)	P.E. Geo Tech Bechtel QA
12. Assure that there is a method, on a three dimensional and volumetric basis, or identifying	SAME AS ITEM # 8 ABOVE			

CPCo ITEM NO.	ACTION(S) TAKEN TO DATE	PLANNED ACTION(S) TO BE TAKEN BY (DATE)	PLANNED ACTION A RESTRAINT TO STARTING Q-LISTED BACKFILL PLACEMENT	PARTY RESPONSIBLE FOR PLANNED ACTION(S)
the specific lifts which are inspected and tested.				
13. Assure that each nonconformance report (regardless of the type of report) is dispositioned.		For each Q-listed area where backfill is to be placed all Discrepancy Reports and NCR's (Bechtel and CPCo) will be fully dispositioned and closed out prior to placement of backfill.	Yes (As it relates to areas on an individual basis where backfill work is to be performed.) Note: This is an existing quality program requirement.	P.E. Construction, Behctel QC
		Additionally, P.E. will release areas for backfill which are listed in NCAR 24 as questionable areas on a case by case basis by memo or TWX.	Yes	P.E.

S.7703248

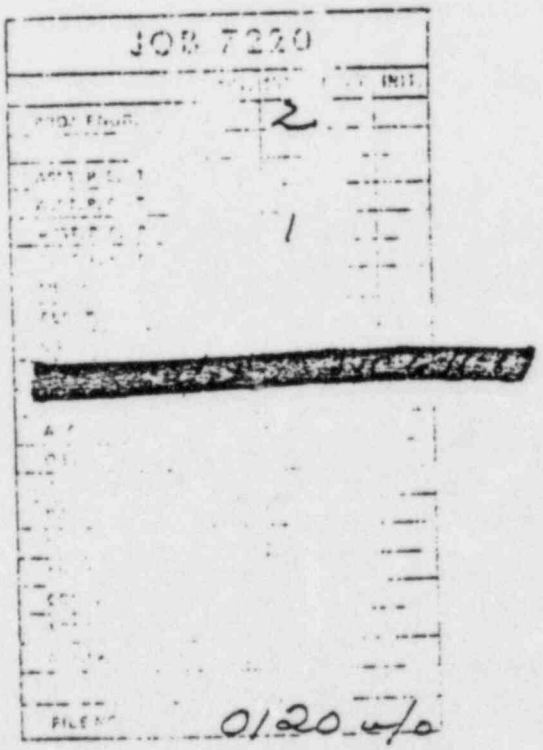
C-2645

Date: June 11, 1979

Company: Goldberg Zoino Dunnicliff & Ass.

P.O.:

Remarks: Field Summaries



C-79 PL

SJ703243

FIELD SUMMARY

FILE No. A2190F
REPORT No. 8 SHEET No. 1
DATE 5-31-79 DAY Thu.

PROJECT Midland Nuclear Plant LOCATION Midland MI

OWNER Consumer Power CONTRACTOR Bechtel

WEATHER CONDITIONS Fair 45-65°

REMARKS See attachments

REPORT

1. Arrived on site at 0630 hours.

2. Equipment working:

   a) 1-Cat 225 backhoe
   b) 2-dump truck

3. Attachments:

   a) 2-attached sketches
   b) 1-checklist for F.D. tests
   c) 1-F.D. Summary sheet
   d) 1-Daily Sand Calibration

4. Work being accomplished:

   a) Mr. M. Petersen of Bechtel Inc.,directed the undersigned to Test Pit #2 located east of the 2 starter-transformer pads. He stated that the testing for this test pit would follow procedures prescribed by Mr. J. Wanseck,which were employed during excavation of TP#1. That is,2 field density tests will be performed at each of the first and second levels and one test at every 12" increment of depth there after to a depth of approximately 12' from the existing ground surface.

   b) The backhoe excavated a total of 7' ± this date from the existing ground surface (elevation 634' ±). Two field density tests (20 and 21) were performed 2' ± from the existing ground surface. Also 2 tests (#22 and 23) were performed 3' ± from the existing ground surface. For the remaining 4' ±,one test was performed at each level (#24,25,26 and 27) See attached sketch. The insitu dry unit weights are tabulated on the attached summary sheet. Field density test results will be completed pending results of laboratory proctor tests.

ON-JOB TIME _____
TRAVEL TIME _____
OFFICE TIME _____
TOTAL TIME _____

PREPARED BY

S.703250

REVIEWED BY

GOLDBERG, NO DUNNIGLIFF & ASSOC., INC.

FIGURE 10-2

FIELD SUMMARY

FILE No. A2190F
REPORT No. 8 SHEET No. 2
DATE 5-31-79 DAY Thu.

PROJECT Midland Nuclear Plant LOCATION Midland MI

OWNER Consumer Power CONTRACTOR Bechtel

WEATHER CONDITIONS

REMARKS

REPORT

c) Six representative soil samples were obtained at each level for laboratory testing.

d) The elevations for the field density tests are being provided by Bechtel personnel and have an accuracy factor of 1" ±.*

e) The material excavated this date is predominately silty clay, trace Fine to coarse sand trace gravel with the last 2 levels being clayey glacial till.

4. Mr. John Sullivan, Associate and Director of Field Services for GZDA was on site this date to observe field and laboratory operations.

5. Left site at 1700 hours.

Dist: Mr. R.L. Castleberry

* Accuracy of survey determined by Mr. C. Wilson Chief of Survey, Bechtel Corporation.

ON-JOB TIME 10
TRAVEL TIME
OFFICE TIME
TOTAL TIME 10

J. Webber
PREPARED BY

D. W. Caprio
REVIEWED BY

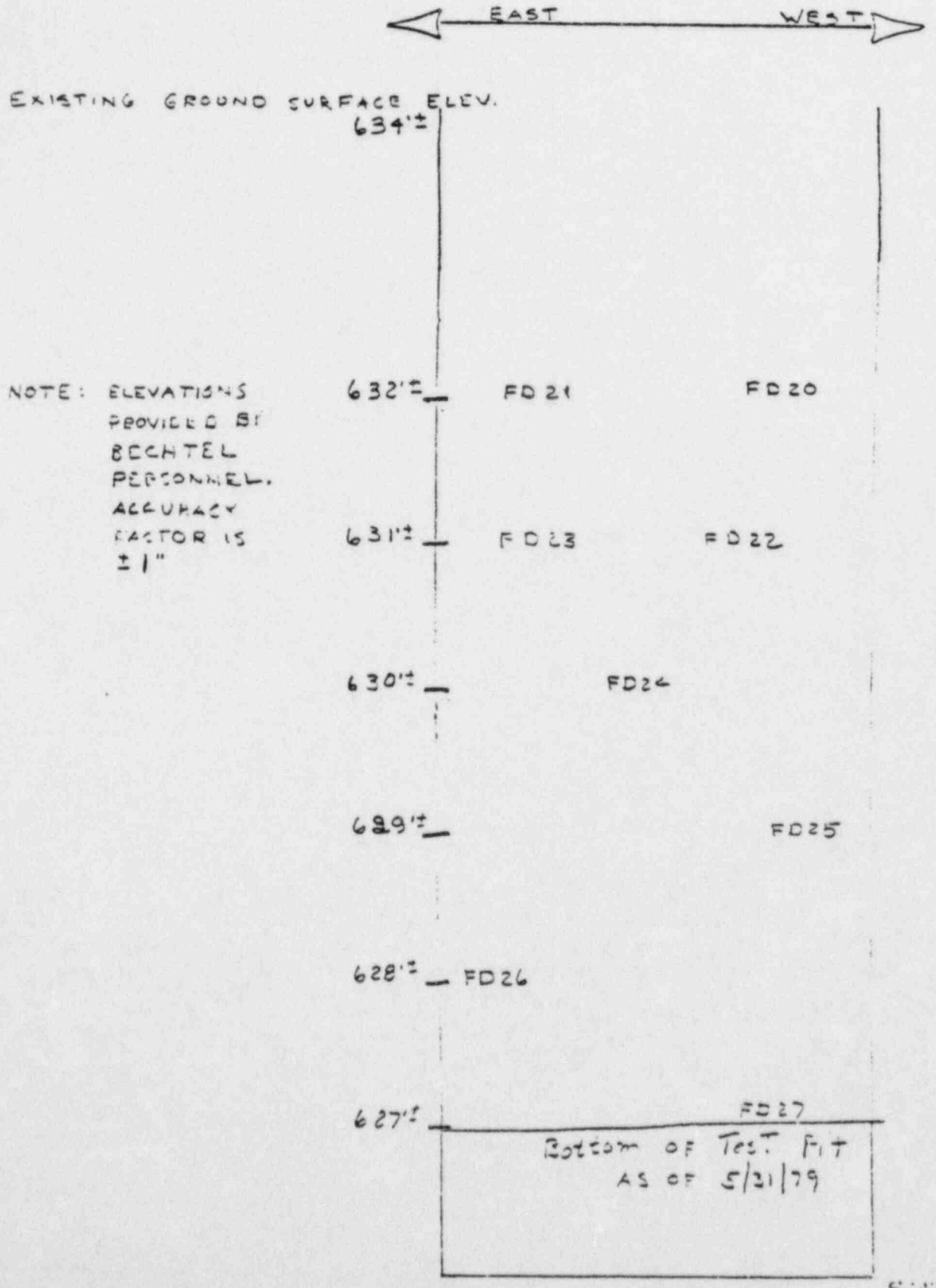
CC: DREBG 7 NO DUNNIGLIFF & ASSOC., INC. FIGURE IO-2

Goldberg, Zoino, Dunnicliff & Assoc., Inc.
Consultants in Geotechnical Engineering
Newton Upper Falls, Mass.

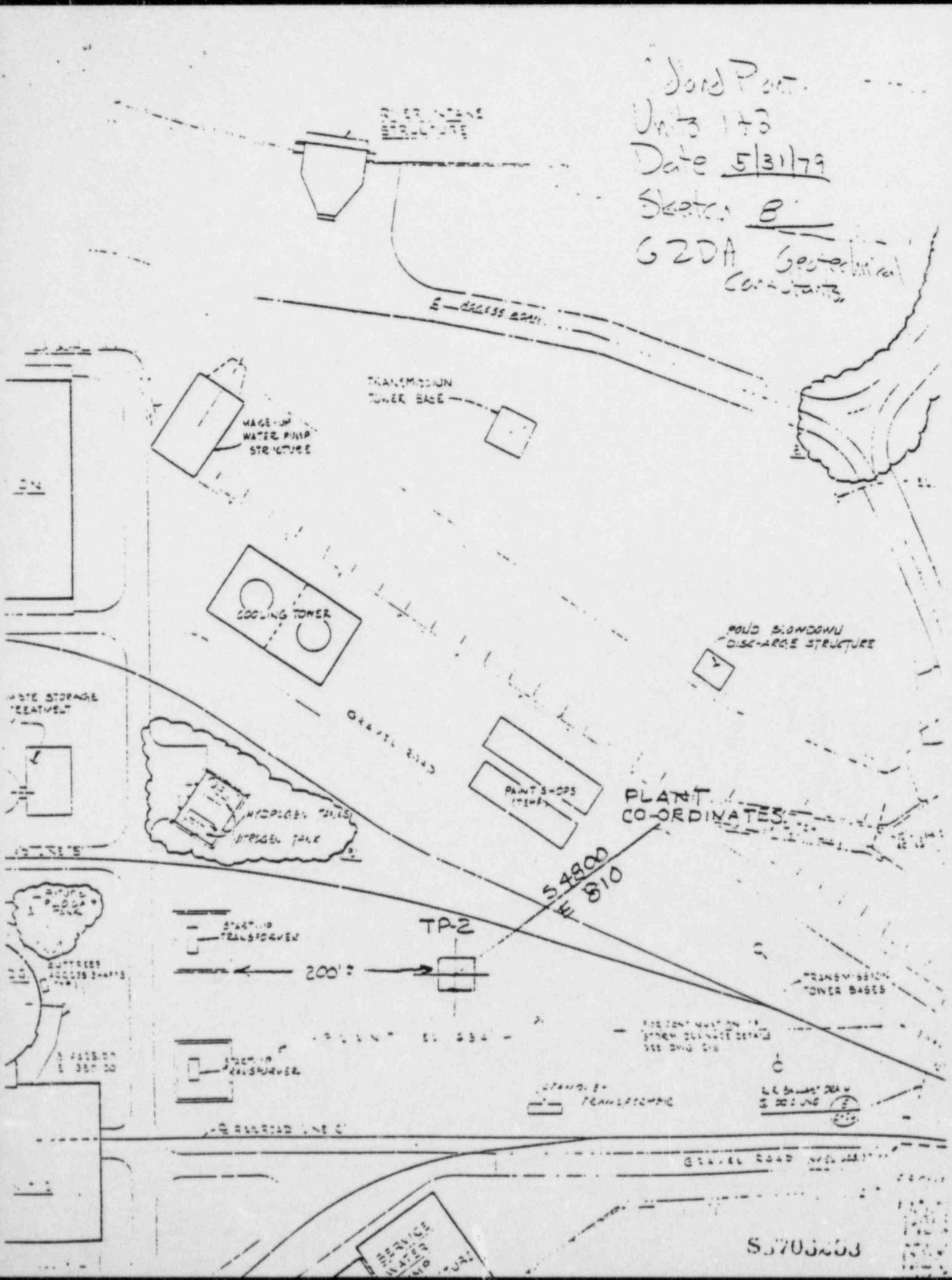
Project _____ Sheet _____ of _____
Date _____
File No. _____ By _____

TEST PIT 2

MIDLAND NUCLEAR POWER PLANT



S3703202


Unit 1 & 2
Date 5/31/79
Sketch: B
GZDA Geotechnical Consultants
E—ACCESS ROAD
TRANSMISSION TOWER BASE
MAKE-UP WATER PUMP STRUCTURE
COOLING TOWER
POND BLOWDOWN DISCHARGE STRUCTURE
GRAVEL ROAD
PLANT CO-ORDINATES
S 4900
E 810
TP-2
200'
TRANSMISSION TOWER BASES
S 570N03

FIELD DENSITY TEST RESULTS

FILE No. A2190F
REPORT No. 8 SHEET No. 1
DATE 5-31-79

PROJECT Midland Nuclear Plant LOCATION Midland MI

OWNER Consumer Power CONTRACTOR Bechtel

WEATHER CONDITIONS Fair 45-65°

REMARKS

FD Test No.	Approx. Elev. (ft.)	Max. Dry Dns. corr for + 3/4" stone (pcf)	Optimum Moisture Content (%)	In-Place Dry Dns. (pcf)	Moisture Content (%)	Compaction (%)	Remarks
20	632' ± 1"			113.4	15.4		3
21	"			109.7	20.3		"
22	631' ± "			113.0	17.0		"
23	" "			108.5	19.9		"
24	630' ± "			116.4	15.8		"
25	629' ± "			116.6	17.4		"
26	628' ± "			128.7	11.3		"
27	627' ± "			124.8	9.9		"
7	627' ± 1"	133.0	8	122.1	15.5	91.8	1-2
10	626' ± "	133.2	"	123.7	11.1	92.9	"
11	625' ± "	128.9	9.5	132.6	9.9	102.9	"
12	624' ± "	127.0	10	121.6	13.2	95.7	"
13	623' ± "	131.6	8.5	115.8	15.4	87.9	"
14	622' ± "	129.0	"	114.2	13.2	88.5	"

1. Results of tests performed on 5-22-79.
2. Bechtel Modified Proctor.
3. Results to be reported when lab proctors completed.

J. Webber
PREPARED BY

DWC
REVIEWED BY

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS

FIGURE 10-4

8703250354

SAND CALIBRATION RECORD

PROJECT Midland Nuclear Plant
FILE No. A2190F DATE 5-31-79
TESTED BY JCW
CHECKED BY DWC 5-31-79

	kilograms	lbs.
1. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs. (mold no. 1)	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.875	21.77
Weight of sand, in lbs.		7.11
Unit weight of sand, in pcf		94.5 pcf
2. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs.	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.875	21.77
Weight of sand, in lbs.		7.11
Unit weight of sand, in pcf		94.5 pcf
3. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs.	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.871	21.77
Weight of sand, in lbs.		7.11
Unit weight of sand, in pcf		94.5 pcf
Average of 1, 2 & 3		94.5 pcf
		Unit weight of sand

NOTE:
Sand calibration required once per day and each time a new bag of sand is opened.

S.7703255

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS

FIGURE 10-3
SIDE 2 of 2

MIDLAND NUCLEAR POWER PROJECT
MICHIGAN

Project MIDLAND NUC
File No. 2106.5 Date 5/3/79
Individual being checked
James C Weber
Checker DWC 5/3/79

CHECK SHEET FOR FIELD DENSITY TESTS

1. Equipment: Check to see if all equipment is in proper working condition and not damaged.

	Yes	No
a. Does the sand cone valve turn freely?	✓	
b. Is sand cone in good condition (not bent, dented, out of round, etc.)?	✓	
c. Is balance operative and all weights available for use?	✓	
d. Is the kit complete?		
.075 cubic ft. mold (*)	✓	
Glass jar	✓	
Cone (*)	✓	
Base plate (*)	✓	
Ottawa sand (*)	✓	
Plastic jar with cover	✓	
Screw driver	✓	
2" Paint brush	✓	
Balance (*)	✓	
Weights (*)	✓	
#4 Sieve	✓	
3/4" Sieve	✓	
Field Unit Weight forms (Calculation sheets)	✓	
Plastic sample bags	✓	
Sample Tags	✓	
(*) Requires use of calibrated equipment		
e. Is only calibrated equipment being used? (see * above)	✓	

2. Procedures: Observe procedures employed for calibration of sand and spot check field density test procedure by obervsing performance of a minimum of one test daily.

a. Were ASTM D-1556/GZD procedures used in calibrating the Ottawa sand?	✓	
b. Were ASTM D-1556/GZD procedures used in performing field density test?	✓	
c. Is cone calibrated as per ASTM/GZD procedures?	✓	

S.7703256

FIGURE 10-6
Page 1 of 2

3. Calculations: Check calculations of all field density tests and sand calibration.

a. Are all necessary data and calculations on the field unit weight sheet complete? (Soil sample description, Project Name, File No., Test No., Date, Tested by, Unit weight of calibrated sand, all blanks under sections titled Field Unit Weight of Soil and Water Content - Minus 3/4" fraction) Note that: Compaction Unit Weight, Results, Mathematical Rock Corrections and calculations at the page bottom will be completed after the appropriate laboratory tests have been performed (Compaction test and Specific gravity) ✓ 6/1/79

b. Is the sand calibration record completed as per GZD specifications (once per day and each time new bag of sand is opened)? ✓

c. Is the cone calibration record completed as per GZD specifications (minimum of once per week)? ✓

d. Are all calculations correct (checked)? If yes, initial and date "checked by" spaces for Field Unit Weight form, Sand Calibration Record, and Cone Calibration Record. ✓ 6/1/79

If any answer to the above questions is NO, request and obtain clarification and/or completion of the item or items in question from the technician whose work is being checked. Explain fully in the space provided below the nature of the discrepancy, its resolution, and pass these comments on to the project engineer.

Explanation: Checked 6/1/79 due to over drying of water content

This check list is to be attached to the daily field report.

S3703257

FIGURE 10-6
Page 2 of 2

FIELD SUMMARY

FILE No. A2190F
REPORT No. 10 SHEET No. 1
DATE 6-4-79 DAY Mon.

PROJECT Midland Nuclear Plant LOCATION Midland MI

OWNER Consumer Power CONTRACTOR Bechtel

WEATHER CONDITIONS Rain showers a.m. 65° Fair p.m. 75°

REMARKS See attachments

REPORT

1. Arrived on site at 0700 hours.

2. Equipment working:

   a) 1- Cat 225 backhoe
   b) 1-Dump truck

3. Attachments:

   a) 1-check sheet for Penetrometer Readings
   b) 1-Test Pit sketch of Penetrometer Readings
   c) 1-Daily Sand Calibrations
   d) 2-Weekly Cone Assembly Calibration for cones A+B
   e) 1-F.D. Summary sheet

4. Work accomplished:

   a) The backhoe was used to cut the south wall 6" deep in order that penetrometer readings could be taken along the entire face this date. Tests were performed by the undersinged and results recorded by Mr. Caprio. Penetrometer tests were performed 12" and 6" on center. See the attached sketch for the recorded data. A total of 368 readings were accomplished.

   b) Mr. Wanzeck of Bechtel Power informed the undersigned and Mr. Caprio that Test Pit #3 is scheduled to be excavated on 6-5-79.

   c) The results of field density tests #16 and 18 are tabulated on the attached summary sheet.

5. Left site at 1700 hours.

J. Webber
PREPARED BY

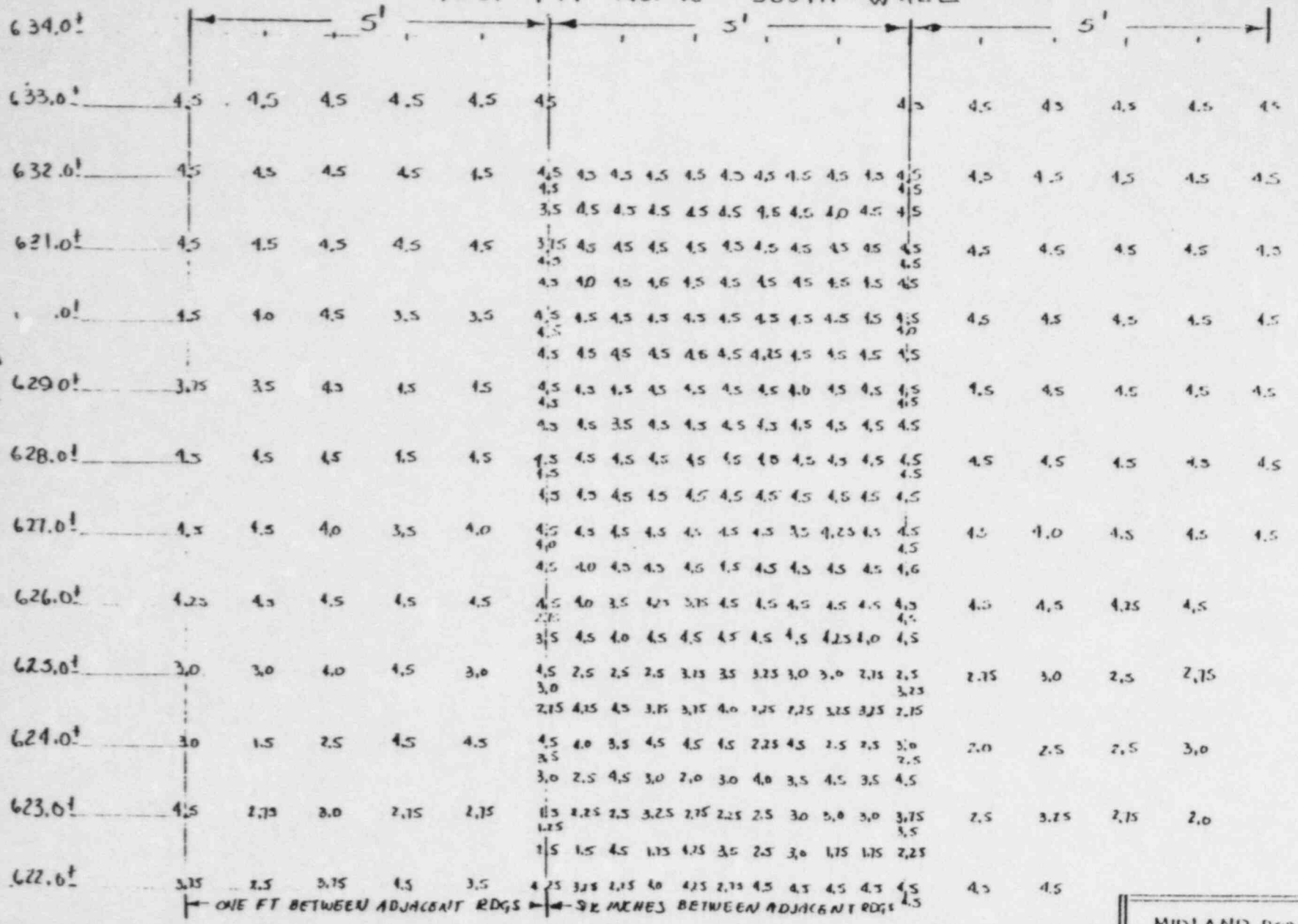
ON-JOB TIME 10
TRAVEL TIME
OFFICE TIME
TOTAL TIME 10

Dist: Mr. R. L. Castleberry

D. W. Caprio S.7703.55
REVIEWED BY

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC. FIGURE 10-2

TEST PIT No. 2 SOUTH WALL



NOTES: 1) Decimal points represent approximate locations of penetrometer readings

2) Numbers in grid represent hand penetrometer reading in tsf. 4.5 tsf is maximum reading that can be obtained.

MIDLAND POWER PLANT
2190F

DATE : 6/4/79

TESTED BY: DWC/JCW

TOTAL NUMBER OF PENETROMETER READINGS: 368

GZD ASSOCIATES, INC.

S270363

MIDLAND NUCLEAR POWER PROJECT

MICHIGAN

Project MIDLAND NUC
File No. 6190F Date JUNE 1979
Individual being checked
James Wetzel
Checker D McCarron 6/4/79

CHECK SHEET FOR POCKET PENETROMETER TESTS

		Yes	No
1.	Equipment		
a.	Is pocket penetrometer being used model CL-700 or CL-701?	✓	
b.	Is sequential numbering of each penetrometer reading recorded? Note: Pocket penetrometer shall be discarded when sequential number reaches 5000±50, unless otherwise specified by Bechtel.		✓ (1) (E)
2.	Procedures: Observe procedures used during performance of a minimum of 10 penetration determinations daily.		
a.	Are manufacturer's recommended procedures and/or those specified by Bechtel being followed?	✓	
3.	Calculations		
a.	Are all necessary data included on the data sheet for penetrometer tests, (Project Name, File No., Date, Tested by, location and elevation of test sites and penetrometer readings).	✓	
b.	Are readings recorded to nearest 0.5 tons per square foot?		✓ (2)

If any answer to the above questions is NO, request and obtain clarification and/or completion of the item or items in question from the technician whose work is being checked. Explain fully in the space provided below the nature of the discrepancy, its resolution and pass these comments on to the project engineer.

Explanation: (1) at completion of testing TP 2, number of readings will be summed to be included in field report
(2) reading recorded to nearest 0.05 tsf
(3) on this date 346 readings were taken.

This check list is to be attached to the daily field report.

FIGURE 10-7
Page 1 of 1

FIELD DENSITY TEST RESULTS

FILE No. A2190F
REPORT No. 10 SHEET No. _____
DATE 6-4-79

PROJECT Midland Nuclear Plant LOCATION Midland, MI.

OWNER Consumer Power CONTRACTOR Bechtel

WEATHER CONDITIONS Rain showers a.m. 65° Fair p.m. 75°

REMARKS _____

FD Test No.	Approx. Elev. (ft.)	Max. Dry Dns. corr for + 3/4" stone (pcf)	Optimum Moisture Content (%)	In-Place Dry Dns. (pcf)	Moisture Content (%)	Compaction (%)	Remarks T.P. 1
16	620 ± 1"	133.7	8	130.7	11.6	97.8	1.
18	617 ± "	129.8	9	122.3	12.8	94.2	"

1. Results of tests performed on 5-23-79 see report #3

J. Webber
PREPARED BY
David W. Caprio
REVIEWED BY

GOLDBERG, ZOINO, DUNNCLIFF & ASSOC., INC.

8703261

FIGURE 10-4

SAND CALIBRATION RECORD

PROJECT Midland Nuclear Plant
FILE No. A2190F DATE 6-4-79
TESTED BY JCW
CHECKED BY DWC

	kilograms	lbs.
1. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs. (mold no. 1)	6.651	14.67
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.867	21.76
Weight of sand, in lbs.		7.09
Unit weight of sand, in pcf		94.3 pcf
2. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs.	6.651	14.67
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.872	21.77
Weight of sand, in lbs.		7.10
Unit weight of sand, in pcf		94.4 pcf
3. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs.	6.651	14.67
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.867	21.76
Weight of sand, in lbs.		7.09
Unit weight of sand, in pcf		94.3 pcf
Average of 1, 2 & 3		94.3 pcf
		Unit weight of sand

NOTE:
Sand calibration required once per day and each time a new bag of sand is opened.

8703262

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GEOTECHNICAL CONSULTANTS

FIGURE 10-3
SIDE 2 of 2

CONE ASSEMBLY CALIBRATION RECORD

PROJECT Midland Nuclear Plant
FILE No. A2190E DATE 6-4-79
TESTED BY JCW
CHECKED BY DWC 6-4-79

CONE No. A
BALANCE No. 2

	kilograms	lbs.
1. Weight of full jar and cone, in lbs.	7.690	16.96
Weight of jar and cone after filling cone and base plate, in lbs.	5.934	13.09
* Weight of sand required to fill cone and base plate, in lbs.		3.88
Unit weight of sand, in pcf		94.3 pcf
Volume of cone & base plate in ft.^{3}	.0411	
2. Weight of full jar and cone, in lbs.	7.688	16.95
Weight of jar and cone after filling cone and base plate, in lbs.	5.934	13.08
* Weight of sand required to fill cone and base plate, in lbs.		3.87
Unit weight of sand, in pcf		94.3 pcf
Volume of cone & base plate in ft.^{3}	.0410	
3. Weight of full jar and cone, in lbs.	7.687	16.95
Weight of jar and cone after filling cone and base plate, in lbs.	5.934	13.08
* Weight of sand required to fill cone and base plate, in lbs.		3.87
Unit weight of sand, in pcf		94.3 pcf
Volume of cone & base plate in ft.^{3}	.0410	
* Average of 1, 2 & 3	.0410	
	Volume of cone, in ft.^{3}	

NOTE:
Cone calibration required once per week or more often if required by project engineer.

* - Average based on three determinations with a maximum variation of 0.01 lbs. (Weight of sand required to fill cone and base plate)

8703263

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GEOTECHNICAL CONSULTANTS

FIGURE 10-5

CONE ASSEMBLY CALIBRATION RECORD

PROJECT Midland Nuclear Plant
FILE No. A2190F DATE 6-4-73
TESTED BY JCW
CHECKED BY DWC

CONE No. B
BALANCE No. 2

	kilograms	lbs.
1. Weight of full jar and cone, in lbs.	7.537	16.61
Weight of jar and cone after filling cone and base plate, in lbs.	5.758	12.70
* Weight of sand required to fill cone and base plate, in lbs.		3.94
Unit weight of sand, in pcf		94.3 pcf
Volume of cone & base plate in ft.^{3}	.0418	
2. Weight of full jar and cone, in lbs.	7.544	16.63
Weight of jar and cone after filling cone and base plate, in lbs.	5.761	12.70
* Weight of sand required to fill cone and base plate, in lbs.		3.93
Unit weight of sand, in pcf		94.3 pcf
Volume of cone & base plate in ft.^{3}	.0417	
3. Weight of full jar and cone, in lbs.	7.547	16.64
Weight of jar and cone after filling cone and base plate, in lbs.	5.760	12.70
* Weight of sand required to fill cone and base plate, in lbs.		3.94
Unit weight of sand, in pcf		94.3 pcf
Volume of cone & base plate in ft.^{3}	.0418	
* Average of 1, 2 & 3	.0418	
	Volume of cone, in ft.^{3}	

NOTE:
Cone calibration required once per week or more often if required by project engineer.

* - Average based on three determinations with a maximum variation of 0.01 lbs. (Weight of sand required to fill cone and base plate)

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GEOTECHNICAL CONSULTANTS

FIGURE 10-5

FIELD SUMMARY

FILE No. AR19F
REPORT No. 9 SHEET No.
DATE 6-1-79 DAY Fri

PROJECT Midland Nuclear Plant LOCATION Midland MI

OWNER Consumer Power CONTRACTOR Bechtel

WEATHER CONDITIONS Cloudy 50-70° a.m Showers p.m. 70°

REMARKS See attachments

REPORT

1. Arrived on site at 0600 hours.

2. Wquipment working:

   a) 1-Cat 225 backhoe
   b) 2-dump trucks

3. Attachments:

   a) 1-sketch
   b) 1-Daily Sand Calibration
   c) 1-F.D. Summary
   d) 1-New bag Sand Calibration
   e) 1-check sheet for f.d. tests

4. Work accomplished:

   a) Test Pit #2 was completed this date. The total depth of the test pit is approximately 12' ± deep from the existing ground surface (elevation 634' ± (1'?) . Todays' excavation was from elevation 627' ± to elevation 622' ± (bottom of test pit 2). A total of 5 field density tests were performed at 12-18" ± intervals. The dry unit weights are tabulated on the attached summary sheet. Results of the tests will be completed pending the results of laboratory proctors.

   b) Five represenative soil samples were taken at each field density test location and returned to the field laboratory for testing.

   c) Elevations were provided by Bechtel personnel.

4. Left site at 1700 hours.

Dist: Mr. R.L. Castleberry
J. Webber

ON-JOB TIME 11
TRAVEL TIME
OFFICE TIME
TOTAL TIME 11

J. Webber
PREPARED BY

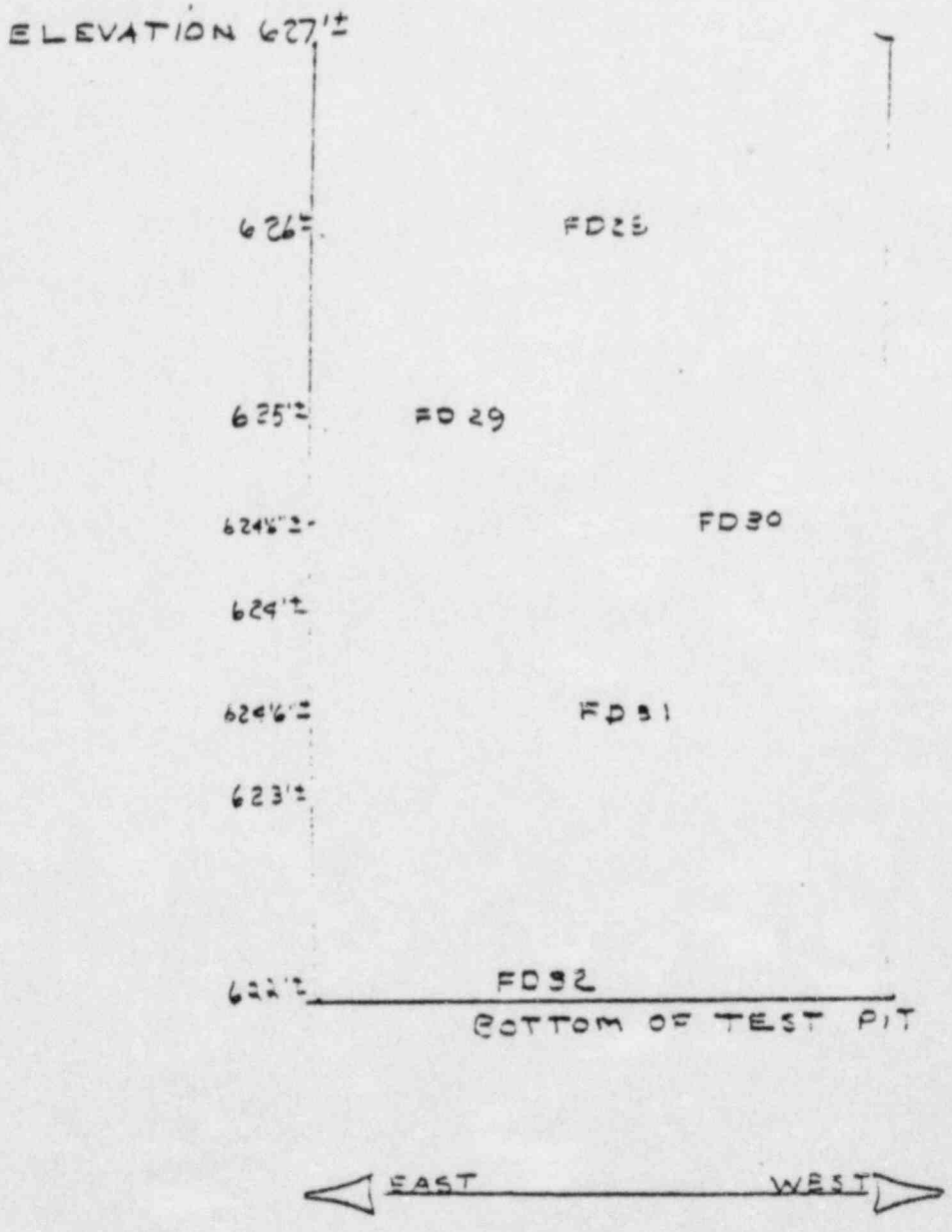
D.W. Caprio S.700366
REVIEWED BY

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC. FIGURE 10-2

TEST PIT #2

MIDLAND NUCLEAR PLANT

JUNE 1, 1979



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FIELD DENSITY TEST RESULTS

FILE No. A2190F
REPORT No. 9 SHEET No.
DATE 6-1-79

PROJECT Midland Nuclear Plant LOCATION Midland MI

OWNER Consumer Power CONTRACTOR Bechtel

WEATHER CONDITIONS Cloudy 50-70° a.m. showers 70° p.m.

REMARKS

FD Test No.	Approx. Elev. (ft.)	Max. Dry Dns. corr for + 3/4" stone (pcf)	Optimum Moisture Content (%)	In-Place Dry Dns. (pcf)	Moisture Content (%)	Compaction (%)	Remarks
							T.P. 1
28	626' ± 1"			129.5	9.9		1
29	625' ± "			117.5	17.1		"
30	624'6 ± "			119.3	14.3		"
31	623'6 ± "			113.8	16.6		"
32	622' ± "			117.6	15.6		"
							T.P. 2
15	621' ± 1"	132.5	9	127.6	11.4	96.3	2
17	618'6" ± "	133.4	"	121.5	14.9	91.1	"
19	616' ± "	135.0	7.5	135.4	8.2	100.3	"

1. Results of tests to be reported when labortory proctor is completed.
2. Test performed on 5-23-79.

J. Webber
PREPARED BY
David W. Capric
REVIEWED BY

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS

FIGURE 10-4

S.7703267

SAND CALIBRATION RECORD

PROJECT Midland Nuclear Plant
FILE No. A2190F DATE 5-23-79
TESTED BY JCW
CHECKED BY DWC 5-23-79

	kilograms	lbs.
1. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs. (mold no. 1)	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.870	21.76
Weight of sand, in lbs.		7.10
Unit weight of sand, in pcf		94.4
2. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs.	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.877	21.78
Weight of sand, in lbs.		7.12
Unit weight of sand, in pcf		94.7
3. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs.	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.877	21.78
Weight of sand, in lbs.		7.12
Unit weight of sand, in pcf		94.7
Average of 1, 2 & 3		94.7
		Unit weight of sand

NOTE:
Sand calibration required once per day and each time a new bag of sand is opened.

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FIGURE 10-3
SIDE 2 of 2

SAND CALIBRATION RECORD

PROJECT Midland Nuclear Plant
FILE No. A21F0F DATE 6-1-79
TESTED BY JCW
CHECKED BY DWC 6-1-79

	kilograms	lbs.
1. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs. (mold no. 1)	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.876	21.78
Weight of sand, in lbs.		7.12
Unit weight of sand, in pcf		94.7 pcf
2. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs.	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.872	21.77
Weight of sand, in lbs.		7.11
Unit weight of sand, in pcf		94.5 pcf
3. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs.	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.872	21.77
Weight of sand, in lbs.		7.11
Unit weight of sand, in pcf		94.5 pcf
Average of 1, 2 & 3	94.6	
	Unit weight of sand	

NOTE:
Sand calibration required once per day and each time a new bag of sand is opened.

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GEOTECHNICAL CONSULTANTS

FIGURE 10-3
SIDE 2 of 2

SAND CALIBRATION RECORD

PROJECT Midland Nuclear Plant
FILE No. A2190F DATE 6-1-79
TESTED BY JCW
CHECKED BY DWC 6-2-79

	kilograms	lbs.
1. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs. (mold no. 2)	6.628	14.61
Weight of ~~0.075~~ 0748 cu. ft proctor mold (w/o collar) full, in lbs.	9.817	21.65
Weight of sand, in lbs.		7.04
Unit weight of sand, in pcf		94.1 pcf
2. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs.	6.628	14.61
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.825	21.66
Weight of sand, in lbs.		7.05
Unit weight of sand, in pcf		94.3 pcf
3. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs.	6.628	14.61
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.825	21.66
Weight of sand, in lbs.		7.05
Unit weight of sand, in pcf		94.3 pcf
Average of 1, 2 & 3		~~94.2 pcf~~
		Unit weight of sand

NOTE:
Sand calibration required once per day and each time a new bag of sand is opened.

New Bag Calibration

SB7053270

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS

FIGURE 10-3
SIDE 2 of 2

MIDLAND NUCLEAR POWER PROJECT
MICHIGAN

Project MIDLAND NUC
File No. 2190.F Date 6/12/79
Individual being checked
James C. Gilbert
Checker DWC 6/12/79
DWC

CHECK SHEET FOR FIELD DENSITY TESTS

1. Equipment: Check to see if all equipment is in proper working condition and not damaged.

	Yes	No
a. Does the sand cone valve turn freely?	✓	
b. Is sand cone in good condition (not bent, dented, out of round, etc.)?	✓	
c. Is balance operative and all weights available for use?	✓	
d. Is the kit complete?		
.075 cubic ft. mold (*)	✓	
Glass jar	✓	
Cone (*)	✓	
Base plate (*)	✓	
Ottawa sand (*)	✓	
Plastic jar with cover	✓	
Screw driver	✓	
2" Paint brush	✓	
Balance (*)	✓	
Weights (*)	✓	
#4 Sieve	✓	
3/4" Sieve	✓	
Field Unit Weight forms (Calculation sheets)	✓	
Plastic sample bags	✓	
Sample Tags	✓	
(*) Requires use of calibrated equipment		
e. Is only calibrated equipment being used? (see * above)	✓	

2. Procedures: Observe procedures employed for calibration of sand and spot check field density test procedure by obervsing performance of a minimum of one test daily.

a. Were ASTM D-1556/GZD procedures used in calibrating the Ottawa sand?	✓	
b. Were ASTM D-1556/GZD procedures used in performing field density test?	✓	
c. Is cone calibrated as per ASTM/GZD procedures?	✓	

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FIGURE 10-6
Page 1 of 2

3. Calculations: Check calculations of all field density tests and sand calibration.

a.	Are all necessary data and calculations on the field unit weight sheet complete? (Soil sample description, Project Name, File No., Test No., Date, Tested by, Unit weight of calibrated sand, all blanks under sections titled Field Unit Weight of Soil and Water Content - Minus 3/4" fraction) Note that: Compaction Unit Weight, Results, Mathematical Rock Corrections and calculations at the page bottom will be completed after the appropriate laboratory tests have been performed (Compaction test and Specific gravity)	✓* ___
b.	Is the sand calibration record completed as per GZD specifications (once per day and each time new bag of sand is opened)?	✓ ___
c.	Is the cone calibration record completed as per GZD specifications (minimum of once per week)?	✓ ___
d.	Are all calculations correct (checked)? If yes, initial and date "checked by" spaces for Field Unit Weight form, Sand Calibration Record, and Cone Calibration Record.	✓* ___

If any answer to the above questions is NO, request and obtain clarification and/or completion of the item or items in question from the technician whose work is being checked. Explain fully in the space provided below the nature of the discrepancy, its resolution, and pass these comments on to the project engineer.

Explanation: to be checked on next work day 6/27. due to oven dried water content.

This check list is to be attached to the daily field report.

S3705272

FIELD SUMMARY

FILE No. A2190F
REPORT No. 7 SHEET No. 1
DATE 5-30-79 DAY Wed.

PROJECT Midland Nuclear Plant LOCATION Midland MI

OWNER Consumer Power CONTRACTOR Bechtel

WEATHER CONDITIONS Fair 45-65°

REMARKS See attachments

REPORT

1. Arrived on site at 0700 hours.

2. Attachments:

   a) Daily Sand Calibrations
   b) F.D. Summary results

3. Work being accomplished:

   a) Mr. M. Petersen, superintendent for Bechtel Inc. , informed the undersigned that test pit #2 excavation scheduled for today will be postponed until 5-31-79 and will be located east of the two Starter-transformer pads.

   b) The undersigned assisted Mr. Caprio in preparing soil samples and quality assurance of laboratory test calculations for this work day.

   c) Proctor results for field density tests #3,4,5,6,8, and 9 were completed this date. Results of the tests are summarized on the attached sheet (figure 10-4).

4. Left site at 1700 hours.

Dist: Mr. R.L. Castleberry

S5703273

ON-JOB TIME 10
TRAVEL TIME
OFFICE TIME
TOTAL TIME 10

J. Webber
PREPARED BY

David W. Caprio
REVIEWED BY

GOLDBERG, NO. DUNNIGOFF & ASSOC., INC.

FIGURE 10-2

FIELD DENSITY TEST RESULTS

FILE No. A2190[illegible]
REPORT No. 7 SHEET No. 1
DATE 5-30-79

PROJECT Midland Nuclear Plant LOCATION Midland, MI.

OWNER Consumer Power CONTRACTOR Bechtel

WEATHER CONDITIONS Fair 45-65°

REMARKS

FD Test No.	Approx. Elev. (ft.)	Max. Dry Dns. corr for + 3/4" stone (pcf) BMP	MC	Optimum Moisture Content (%) BMP	MC	In-Place Dry Dns. (pcf)	Moisture Content (%)	Compaction (%) BMP	MC	Remarks
3	631' ±	130.4	134.9	9	8	131.4	5.5	100.7	97.4	1+2+3
4	"	131.0	135.4	"	9	119.1	11.5	90.9	88.0	"
5	630' ±	128.2		9.2		134.5	9.2	105.0		1+3
6	629' ±	128.8		8.9		135.4	9.0	105.1		"
8	627' ±	117.4		14.2		120.2	13.1	102.4		1+4
9	626' ±	118.6		14.0		120.1	13.5	103.1		"

1) Bechtel Modified Proctor
2) ASTM 1557-70 method D
3) Test performed on 5-21-79 see report #1
4) Test performed on 5-22-79 see report #2

J. Webber
PREPARED BY

REVIEWED BY

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS

FIGURE 10-4

SAND CALIBRATION RECORD

PROJECT Midland Power Plant
FILE No. A2190F DATE 5-30-79
TESTED BY JCW
CHECKED BY DWC 5-30-79

	kilograms	lbs.
1. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs. (mold no. 1)	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.872	21.76
Weight of sand, in lbs.		7.10
Unit weight of sand, in pcf		94.4
2. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs.	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.872	21.76
Weight of sand, in lbs.		7.10
Unit weight of sand, in pcf		94.4
3. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs.	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.874	21.77
Weight of sand, in lbs.		7.11
Unit weight of sand, in pcf		94.5
Average of 1, 2 & 3		94.4
		Unit weight of sand

NOTE:
Sand calibration required once per day and each time a new bag of sand is opened.

S3703273

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS

FIGURE 10-3
SIDE 2 of 2

FIELD SUMMARY

FILE No. A2190F
REPORT No. 6 SHEET No. 1
DATE 5-29-79 DAY Tue

PROJECT Midland Nuclear Plant LOCATION Midland MI

OWNER Consumer Power CONTRACTOR Bechtel

WEATHER CONDITIONS Overcast 40-55°

REMARKS See attachments

REPORT

1. Arrived on site at 0700 hours.

2. Attachments:

   a) F.D. Summary Sheet
   b) Weekly Cone Calibrations
   c) Daily Sand Calibrations

3. Work accomplished:

   a) Met with Mr. John Wanzeck of Bechtel Inc., and was informed that the excavation of test pit #2 will not be excavated until the next work day (5-30-79). Location and depth are unknown as of this date.

   b) The undersigned and Mr. Robert Kelleher of GZDA assisted Mr. Caprio in setting up soil samples for laboratory testing in the field laboratory.

   c) Results of field density tests #1 and 2 are tabulated on the attached summary sheet. Mr. Wanzeck has been informed of these results.

4. Left site at 1700 hours.

Dist: Mr. R.L. Castleberry

S5703278

J. Webber
PREPARED BY

David W. Caprio
REVIEWED BY

ON-JOB TIME 10
TRAVEL TIME
OFFICE TIME
TOTAL TIME 10

FIELD DENSITY TEST RESULTS

FILE No. A2190F
REPORT No. 6 SHEET No.
DATE 5-29-79

PROJECT Midland Nuclear Plant LOCATION Midland MI

OWNER Consumer Power CONTRACTOR Bechtel

WEATHER CONDITIONS Overcast 40-55°

REMARKS

FD Test No.	Approx. Elev. (ft.)	Max. Dry Dns. corr for + 3/4" stone (pcf) BMP	MC	Optimum Moisture Content (%) BMP	MC	In-Place Dry Dns. (pcf)	Moisture Content (%)	Compaction (%) BMP	MC	Remarks
1	632' ±	128.5	135.0	8.7	7.9	124.6	10.9	97.0	92.3	1+2
2	"	128.1	134.6	"	"	122.2	10.0	95.3	90.8	"

BMP-Bechtel Modified Proctor

MC-Modified Proctor (ASTM 1557-70 method D)

PREPARED BY

REVIEWED BY

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS

FIGURE 10-4

CONE ASSEMBLY CALIBRATION RECORD

PROJECT Midland Nuclear Plant
FILE No. A2190F DATE 5-29-79
TESTED BY JCW
CHECKED BY DWC 5-29-79

CONE No. A
BALANCE No 2

	kilograms	lbs.
1. Weight of full jar and cone, in lbs.	7.339	16.18
Weight of jar and cone after filling cone and base plate, in lbs.	5.582	12.30
* Weight of sand required to fill cone and base plate, in lbs.		3.88
Unit weight of sand, in pcf		94.4
Volume of cone & base plate in ft.^{3}		0411
2. Weight of full jar and cone, in lbs.	7.319	16.14
Weight of jar and cone after filling cone and base plate, in lbs.	5.563	12.27
* Weight of sand required to fill cone and base plate, in lbs.		3.87
Unit weight of sand, in pcf		94.4
Volume of cone & base plate in ft.^{3}		0410
3. Weight of full jar and cone, in lbs.	7.321	16.14
Weight of jar and cone after filling cone and base plate, in lbs.	5.563	12.27
* Weight of sand required to fill cone and base plate, in lbs.		3.87
Unit weight of sand, in pcf		94.4
Volume of cone & base plate in ft.^{3}		0410
* Average of 1, 2 & 3		0410
		Volume of cone, in ft.^{3}

NOTE:
Cone calibration required once per week or more often if required by project engineer.

S.7703273

* - Average based on three determinations with a maximum variation of 0.01 lbs. (Weight of sand required to fill cone and base plate)

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS

FIGURE 10-5

CONE ASSEMBLY CALIBRATION RECORD

PROJECT Midland Power Plant
FILE No. A2180F DATE 5-29-79
TESTED BY JCW
CHECKED BY DWC 5-29-79

CONE No. B
BALANCE No. 2

	kilograms	lbs.
1. Weight of full jar and cone, in lbs.	7.502	16.54
Weight of jar and cone after filling cone and base plate, in lbs.	5.722	12.62
* Weight of sand required to fill cone and base plate, in lbs.		3.92
Unit weight of sand, in pcf		94.4
Volume of cone & base plate in ft.^{3}	.0415	
2. Weight of full jar and cone, in lbs.	7.485	16.50
Weight of jar and cone after filling cone and base plate, in lbs.	5.701	12.57
* Weight of sand required to fill cone and base plate, in lbs.		3.93
Unit weight of sand, in pcf		94.4
Volume of cone & base plate in ft.^{3}	.0416	
3. Weight of full jar and cone, in lbs.	7.484	16.50
Weight of jar and cone after filling cone and base plate, in lbs.	5.700	12.57
* Weight of sand required to fill cone and base plate, in lbs.		3.93
Unit weight of sand, in pcf		94.4
Volume of cone & base plate in ft.^{3}	.0416	
* Average of 1, 2 & 3	.0416	
	Volume of cone, in ft.^{3}	

NOTE:
Cone calibration required once per week or more often if required by project engineer.

S/703273

* - Average based on three determinations with a maximum variation of 0.01 lbs. (Weight of sand required to fill cone and base plate)

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS

FIGURE 10-5

SAND CALIBRATION RECORD

PROJECT Midland Nuclear Plant
FILE No. A2190F DATE 5-29-79
TESTED BY JCW
CHECKED BY DWC 5-29-79

	kilograms	lbs.
1. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs. (mold no. 1)	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.869	21.76
Weight of sand, in lbs.		7.10
Unit weight of sand, in pcf		94.4
2. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs.	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.873	21.77
Weight of sand, in lbs.		7.11
Unit weight of sand, in pcf		94.5
3. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs.	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.867	21.76
Weight of sand, in lbs.		7.10
Unit weight of sand, in pcf		94.4
Average of 1, 2 & 3		94.4
		Unit weight of sand

NOTE:
Sand calibration required once per day and each time a new bag of sand is opened.

S3703280

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS

FIGURE 10-3
SIDE 2 of 2

FIELD UNIT WEIGHT

SOIL SAMPLE

Project _____

Description _____

_____

File No. _____ Test No. _____

Location: Sta. _____ Offset _____

Date _____

Test Hole No. _____

Tested by _____

Specific Gravity _____

Checked by _____

Unit Weight of calibrated sand in lbs. per cubic ft. _____

☐ Check here if sand calibration record completed on back.

FIELD UNIT WEIGHT OF SOIL

Kit No. (Cone No. ____, Plate No. ____, Balance No. ____)	
Weight of jar and sand in lbs.	
Weight of jar and sand after filling hole and cone, in lbs.	
Weight of sand in hole and cone in lbs.	
Volume of hole and cone in cubic feet	
Volume of cone in cubic feet	
Volume of hole in cubic feet	

Can No.	
Weight of can and excavated soil in lbs.	
Weight of can in lbs.	
Weight of excavated soil in lbs.	
Wet unit weight in lbs per cubic foot	

WATER CONTENT - (MINUS 3/4" FRACTION)

Container No.	
Weight of container and wet soil in gm.	
Weight of container and dry soil in gm.	
Weight of water, Ww, in gm.	
Weight of container in gm.	
Weight of dry soil, Ws, in gm.	
Water content, W, in %	

COMPACTION UNIT WEIGHT

Type of Test	
Maximum unit weight at optimum moisture content in lbs per cubic foot, γ_o	
Optimum water content in %	

RESULTS

Field Compaction Method	
Maximum unit weight corrected for + 3/4"	
Percent of compaction	
Variation from optimum water content, %	

1) Total moist weight _____
2) Dry weight + 3/4" _____
3) Moist weight - 3/4" (1-2) _____
4) Dry weight - 3/4" _____
5) Total dry weight (2+4) _____

% + 3/4" _____ % - 3/4" _____

_____ %

Dry Unit Wt = Dry Wt. ÷ Volume = _____ pcf

MATHEMATICAL

+ 3/4 Correction: $(\gamma_o \text{ max.})_{corr.} = (\gamma_o \text{ max.})$ (% Finer than 3/4") + (% Retained on 3/4")(62.4)(S.G.)(0.9)

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS

FIGURE 10-3
SIDE 1 of 2

CSTC 3230A

TELECOPY

BEBC- 3464

Bechtel Associates Professional Corporation

Inter-office Memorandum

To L.E. Davis

Date [redacted]

Subject Midland Plant Units 1 & 2
Job 7220
Plant Area Dewatering
File: 0274, [redacted]

From L.H. Curtis

Of Engineering

At Ann Arbor

Copies to

S.S. Afifi
S.L. Blue
L.H. Curtis
B. Dhar
Com Log
W. Paris
M. Rung
J. Wanzeck
K. Wiedner

References:
1) Drawing 7220-C-1145(Q) Rev 4
2) BEBC-3294, 9/24/79
3) BEBC-3311, 10/3/79

To expedite the field investigation program for the plant area dewatering system, the following borings are needed to better define the location and thickness of the natural sands. Four previously eliminated borings have relocated, and six new borings have been added. the following is a tabulation of this additional work.

Boring Number	Location		Approximate Depth
PD-12	S 5200	E 65	45'
PD-16	S 5155	E 230	55'
PD-17	S 5280	E 235	55'
PD-18	S 5110	E 570	60'
PD-21	S 4970	E 625	65'
PD-22	S 4920	E 750	60'
PD-23	S 4850	E 580	50'
PD-24	S 4550	E 400	90'
PD-25	S 4640	E 550	90'
PD-26	S 4775	E 715	90'

These borings shall be plugged in accordance with Note 11 on Drawing 7220-C-1145(Q) or converted to an observation well as directed by the onsite geotechnical engineer. Wells shall be provided with permanent barrier protection.

All borings shall be made in accordance with Reference 1 and/or additional criteria specified in References 2 and 3.

This boring program requires your immediate attention and should be scheduled for completion by December 15, 1979.

L.H. Curtis

8703281

CR/sg
11/27/26

Bechtel Associates Professional Corporation

Inter-office Memorandum

To L. H. Curtis

Date [redacted]

Subject Midland Units 1/2-Job 7220-001
Estimated Residual Settlement
for the Plant Life (40 yrs)
of Diesel Generator Building

From S. S. Afifi

Of Geotechnical Services

At Ann Arbor 10 D 5
7220-79-264

Copies to S. L. Blue
P. K. Chen
[redacted]
R. Rixford
J. O. Wanzeck
K. Wiedner
1320, 3410

REFERENCE: IOM from S. S. Afifi to L. H. Curtis, dated 10/3/79, "50.43 (f) Response and Diesel Generator Building Task Group."

This is a completed response of Items 3 and 4 of the reference memo. The estimated 40 year (plant life) total residual settlement of the Diesel Generator Building will range from 1.5 inches in the southeast corner to 0.5 inch in the northwest corner. The estimated differential settlement will be about 3/4" from north to south and can be considered rigid body rotation. Continuation of settlement monitoring will be implemented.

If there are any questions, please contact P. K. Chen of this office.

S. S. Afifi

PKC/nm

S.7703282

Interoffice Memorandum

To J. A. Rutgers

File No.

Subject Consumers Power Company
Job 7220 - Midland Units 1&2
Soils Settlement

Date November 28, 1979

From P. A. Becnel

Of Legal Department

At SF 50/21/A4 # 4574

Copies to

Sometime ago an investigation was in progress regarding whether or not part of the compacted soil beneath the Diesel Generator Building and other plant structures was placed by Canonie. Have any conclusions been reached as to whether or not Canonie-placed fill was a significant contributing factor to the soils problem? If so, additional steps should be considered regarding reservations of rights against Canonie in this matter.

Please advise.

P. A. Becnel

PAB/dap

Not An engineering action item

RECEIVED
DEC 04 1979
BECHTEL
A.A. 7220

S:703283

JOB 7220	ACT	INFO ⇒	INT
PROJ ENGR			
ASST PE T			
ASST PE T			
ASST PE T			
ASST PE P			
ASST PE F			
MECH			
ELECT			
CS			
CIVIL			
PD			
ARCH			
OE			
CTR/ENGR PL			
PROJ MGR			
PROC MGR			
FIELD			
CONST COORD			
FSAR			
ADMIN			
FILE NO			

S-9274

NOV 13 1979
BECHTEL
A.A. 7220

Bechtel Power Corporation

Interoffice Memorandum

To L. H. Curtis

File No

Subject Job 7220 Midland Project
Diesel Generator Building
Concrete Topping Slab Mix
BCBE-2624

Date November 1[illegible], 1979

From L. E. Davis

Of Construction

Copies to

At Midland, MI

FIELD Ext
CONSTR
QA/QC
ADMIN.
FILE C-2754/0

Reference: 1. FCR C-2085 dated September 10, 1979

Attached for your review, as requested per reference one, are the completed compressive strength test result sheets for the Diesel Generator Building concrete topping slab mix (designated with formula T-1c) which was placed at the below listed locations.

Placement Date	Pour Number	Placement Description	Specimen I.D. No.'s
9/19/79	DG(663.75)A	Bay #3 Topping Slab at elevation 663'-9"	4335 and 4336F
9/21/79	DG(663.67)A	Bay #4 Topping Slab at elevation 663'-8"	4346 and 4347F
9/28/79	DG(663.83)A	Bay #2 Topping Slab at elevation 663'-10"	4375 and 4376F
10/2/79	DG(663.83)B	Bay #1 Topping Slab at elevation 663'-10"	4390 and 4391F

L. E. Davis

LED/RDK/mkm

Attachments

[redacted]

8703284

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 7220
REPORT OF CONCRETE CYLINDERS

QC ACCEPTANCE | DATE
CONTROL NUMBER | FILE NUMBER

PLACEMENT IDENTIFICATION: DG/163.75)A | DATE PLACED: 9-19-79

PLACEMENT LOCATION: DIESEL #3 FOUNDATION SLAB

PLANT DATA | SOURCE: Champion Incorporated | CEMENT BRAND AND TYPE: Marion Marquette Type II

SPEC: 4C | CLASS: I | AIR ENT: YES / NO | REQUIRED STRENGTH: 4000 PSI AT 28 DAYS

TEST DATA AT BATCH PLANT

Yield: 27.46

TICKET NO: 33155 | TRUCK NO: 56 | TIME OF MIXING: 1223 HOURS AT 3 YARDS | INITIALS: [illegible]

SLUMP: 3 3/4 INCHES | AIR CONTENT: 3.2 | UNIT WEIGHT: 151.58 LBS/CU FT | TEMP CONCRETE: 62 °F | TEMP AIR: 62 °F

WATER/CEMENT RATIO: 1.8 | 0.3 | ITEM 3: N/A | W/C RATIO: .40 MAX .31 ACT.

INITIAL CURING TEMP: 70 °F TO 77 °F | STARTED: 9-20-79 AT 0727 HRS | INITIALS: LWL

TEST DATA AT PLACEMENT

TICKET NO: 33155 | TRUCK NO: 58 | TIME OF TESTING: 1024 HOURS AT 3 YARDS | TIME OF MIXING: N/A HRS

SLUMP: 1 3/4 INCHES | AIR CONTENT: 3.1 | TEMP CONCRETE: 64 °F | TEMP AIR: 52 °F | INITIALS: SAT AC

INITIAL CURING TEMP: N/A °F TO N/A °F | STARTED: N/A AT N/A HRS | INITIALS: N/A

COMPRESSIVE STRENGTH DATA ASTM-C-39-71

SPECIMEN IDENTIFICATION	DATE MOLDED	DATE TESTED	AGE	TOTAL LOAD IN POUNDS	ACTUAL CYL DIAM.	ACTUAL CYL AREA	TYPE	CURE PROC	CURE LAB	STRENGTH PSI
4335-7075	9-19-79	9-22-79	3	114,000	6.00	28.27	A	1	2	4030
7076	"	-	3	113,500	6.01	28.37	A	1	2	4000
7077		9-26-79	7	129,000	6.01	28.37	B	1	6	4550
4335 7078		9-26-79	7	134,000	6.01	28.37	C	1	6	4720
4335 7079		10-3-79	14	153,000	6.01	28.37	A	1	13	5390
7080		"	14	150,000	6.01	28.37	A	1	13	5290
7081		10-17-79	28	170,500	6.00	28.27	B	1	27	6030
4335/7082	9-19-79	"	28	166,000	6.00	28.27	B	1	27	5870

CYLINDERS: CAST | CORE | OTHER

CLASS	PATH	WEIGHED BY	CHECKED BY	CHECKED BY QC REP
3	THS	BV	TL	10-2-79
7	GW TW	BV	TL	10-2-79
14	KS TW NQ	BV	TL	10-5-79
28	(SAT)	BV	TL	10-19-79

S3703285

CHECKED BY QA SUPERVISOR: [signature] 10-18-79

TYPE OF BREAKS: A-CONE, MORTAR FAILURE | B-CONE, AGGREGATE FAILURE | C-SHEAR, MORTAR FAILURE | D-SHEAR, AGGREGATE FAILURE | E-OTHER

UST 0-13 @ 7

UST 0-236 @ 28

7220-QCT-35 REV. 0

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 07000
REPORT OF CONCRETE CYLINDERS

QC ACCEPTANCE | DATE
CONTROL NUMBER | FILE NUMBER

SPECIFICATION NO. DG 1663.75)A | DATE PLACED 9-19-79

PLACEMENT LOCATION DG Bldg #3 tornado Slab

PLANT DATA | SOURCE Champion Incorporated | CEMENT BRAND AND TYPE Marion Marietta Type X I

MIX THC | CLASS I | FLY ASH? ☑ YES ☐ NO | REQUIRED STRENGTH 4000 PSI AT 28 DAYS

TEST DATA AT BATCH PLANT

SLUMP: 27.46

TICKET NO. 33155 | TRUCK NO. 56 | TIME OF MIXING 1013 HOURS AT 3 R/MIN | INITIALS RW RA

YARDAGE 3314 CU. YDS. | AIR CONTENT MEASURED IN PERCENTS 2.2 | UNIT WEIGHT MEASURED IN LBS./CU. FT. 151.5 | TEMP. CONCRETE 1.2 °F | TEMP. AIR 68 °F

WATER ADDED AT BATCH PLANT 1.8 GAL. | WATER ADDED AT JOBSITE 0.3 GAL. | ADMIXTURE NO. 2 N/A | WATER/CEMENT + POZZOLAN RATIO .40 MAX. .31 ACT.

ADMIXTURE CHARGE MEASURED IN CC/CWT N/A | N/A °F TO N/A °F | ADMIXTURE MIXING TIMED AT N/A HRS. AT N/A HRS. | INITIALS N/A

TEST DATA AT PLACEMENT

TICKET NO. 33155 | TRUCK NO. 56 | TIME OF TESTING 1026 HOURS AT 3 R/MIN | TIME OF HOLDING 1026 HRS.

YARDAGE 13/4 CU. YDS. | AIR CONTENT MEASURED IN PERCENTS 3.1 | TEMP. CONCRETE 64 °F | TEMP. AIR 52 °F | INITIALS SAT AC

SLUMP 5¼ IN. TO 11¼ IN. | ADMIXTURE MIXING TIMED 9:21-70 AT 0750 HRS. | INITIALS [illegible] PB

COMPRESSIVE STRENGTH DATA ACI 318-63-71

SPECIMEN IDENTIFICATION	DATE MOLDED	DATE TESTED	AGE	TOTAL LOAD IN POUNDS	ACTUAL CYL. DIAM.	ACTUAL CYL. AREA	TYPE OF BREAK	CURE HRS.	CURE DAYS	STRENGTH PSI
4031F 7083	9-14-79	9-22-79	3	99,000	6.02	28.46	A	1	2	3480
7084		"	3	100,000	6.01	28.37	A	1	2	3520
7085		9-26-79	7	119,000	6.00	28.27	C	1	6	4210
7086		"	7	113,500	6.01	28.37	C	1	6	4000
7087		10-3-79	14	134,000	6.02	28.46	A	1	13	4710
7088		"	14	127,500	6.01	28.37	A	1	13	4490
7089		10-17-79	28	149,000	6.02	28.46	A	1	27	5240
4031E / 7090	9-14-79	"	28	153,500	6.01	28.37	A	1	27	5410

STANDARD CYLINDERS ☑ 6" X 12" ☐ CUBE ☐ CORE ☐ OTHER

AGE (DAYS)	TESTED BY	CHECKED BY	CHECKED BY QC REP.
3	TDC	BV	[illegible] 10-3-79
7	TW GW	BV	[illegible] 10-3-79
14	KS TW NA	BV	TL 10-9-79
28	SAT	BV	TL 10-19-79

REMARKS [illegible] | REMOVED FROM MOLDS AT [illegible]

APPROVED BY [signature] DATE 10-19-79

TYPE OF BREAKS: A = CONE, MORTAR FAILURE; B = CONE, AGGREGATE FAILURE; C = SHEAR, MORTAR FAILURE; D = SHEAR, AGGREGATE FAILURE; E = OTHER

UST 0-78 @ 14 | UST 0-237 @ 28

TECC-QCT-[illegible] REV. 1 5-18-79

S:703286

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 07210
REPORT OF CONCRETE CYLINDERS

QC ACCEPTANCE | DATE
CONTROL NUMBER | FCL NUMBER

1. STRUCTURE IDENTIFICATION: DIESEL BUILDING | DATE PLACED: 9-21-79

2. FACILITY LOCATION: D/G TRAINING SLAB BAY 4

PLANT DATA | SOURCE: Dumpion Incorporated | CONCRETE BATCH PLANT: Marion Marietta Type 1

MIX: T-1C | CLASS: I | SLUMP LIMIT: 2 YES ☐ NO | REQUIRED STRENGTH: 4000 PSI AT 28 DAY

TEST DATA AT BATCH PLANT | YIELD:

3. TICKET NO. 33185 | 4. TRUCK NO. 38 | 5. TIME OF MIXING: 1040 HOURS AT 3 YARDS | 6. INITIALS CW

7. SLUMP ASSIGNMENT: 2 INCHES | 8. AIR CONTENT ASSIGNMENT LIMITS: 4.4 | 9. UNIT WEIGHT ASSIGNMENT LBS./CU. FT.: 140 #/ | 10. TEMP CONCRETE: 65 °F | 11. TEMP AIR: 60 °F

12. BREAKING LOAD ASSIGNMENT OR LOWEST AVERAGE: 1.4 | 13. : .5 | 14. ITEM 2: N/A | 15. WATER/CEMENT + POZZOLAN RATIO: .40 MAX. .31 AC

16. INITIAL CURING ASSIGNMENT: LB °F MIN | 70 °F MAX | 17. CURING ASSIGNMENT LOCATION: 9-22-79 AT 6940 HRS | 18. INITIALS GW

TEST DATA AT PLACEMENT

19. TICKET NO. 33185 | 20. TRUCK NO. 38 | 21. TIME OF TESTING: 1053 HOURS AT 3 YARDS | 22. TIME OF HOLDING: N/A

23. SLUMP ASSIGNMENT: 1¼ INCHES | 24. AIR CONTENT ASSIGNMENT LIMITS: 3.3 | 25. TEMP CONCRETE: 62 °F | 26. TEMP AIR: 61 °F | 27. INITIALS RC TR

28. INITIAL CURING ASSIGNMENT: N/A °F MIN | N/A °F MAX | 29. STRIPPED ASSIGNMENT: N/A | 30. AT N/A HRS | 31. INITIALS N/A

CONCRETE CYLINDER STRENGTH DATA — ASTM - C - 39 - 71

32. SPECIMEN IDENTIFICATION	33. DATE MOLDED	34. DATE TESTED	35. AGE	36. TOTAL LOAD IN POUNDS	37. ACTUAL CYL. DIAM.	38. ACTUAL CYL. AREA	39. TYPE OF BREAK	40. CURE		41. STRENGTH PSI
4344-7151	9-21-79	9-24-79	3	102,000	6.03	28.56	A	1	2	3570
7152	"	"	3	106,000	6.03	28.56	A	1	2	3710
7153	"	9-28-79	7	121,000	6.01	28.37	A	1	6	4270
7154	"	"	7	120,000	6.02	28.46	A	1	6	4220
7155	"	10-5-79	14	136,000	6.01	28.37	A	1	13	4790
7156	"	"	14	135,000	6.01	28.37	A	1	13	4760
7157	"	10-19-79	28	152,000	6.00	28.27	A	1	27	5380
4344-7158	9-21-79	"	28	148,500	6.00	28.27	A	1	27	5250

42. STANDARD CYLINDER: 6" x 12" ☐ CUBE ☐ CORE ☐ OTHER | 43. REMARKS

44. TECH. DATA TESTED BY	45. CHECKED BY	46. CHECKED BY QC REP
3 PC, ET	BV	TL 10-9-79
7 TPA, RC	BV	TL 10-9-79
14 MARS	BV	TL 10-19-79
28 PC	BV	TL 10-25-79

47. LABORATORY SUPERVISOR: [signature] | 48. DATE: 10-22

49. TYPE OF BREAKS: A = CONE, MORTAR FAILURE; B = CONE, AGGREGATE FAILURE; C = SHEAR, MORTAR FAILURE; D = SHEAR, AGGREGATE FAILURE; E = OTHER

UST D-103 G14 UST D-266 G8

7220-803 Rev. 0 5-18-79

S:703287

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 07220
REPORT OF CONCRETE CYLINDERS

QC ACCEPTANCE | DATE
CONTROL NUMBER | FILE NUMBER

1. CONCRETE IDENTIFICATION: DG/4427(7)2 | DATE PLACED: 9-21-79
2. PLACEMENT LOCATION: D/G TUNNEL SLAB #1 W
PLANT DATA | SOURCE: Champion Incorporated | CEMENT BRAND AND TYPE: Martin Marietta Type II
MIX: T-1C | CLASS: I | AIR ENT: YES NO | REQUIRED STRENGTH: 4000 PSI AT 28 DAYS
TEST DATA AT BATCH PLANT | Yield: 27.91
TICKET NO: 33185 | TRUCK NO: 38 | TIME OF WEIGHING: 1040 HOURS AT 3 YARDS | INITIALS: G W
SLUMP: 2 INCHES | AIR CONTENT: 4.4 % | UNIT WEIGHT: 146.2 LBS/CU FT | TEMP CONCRETE: 65 °F | TEMP AIR: 60 °F
% MOISTURE SAND: 1.4 | % ABSORPTION SAND: .5 | STONE 1: N/A | WATER/CEMENT + POZZOLAN RATIO: .46 MAX .31 ACT
ADMIXTURE CLASS: N/A | ADMIXTURE QTY: N/A | STORED AT: N/A AT N/A HRS | INITIALS: N/A
TEST DATA AT PLACEMENT
TICKET NO: 33185 | TRUCK NO: 38 | TIME OF TESTING: 1053 HOURS AT 3 YARDS | TIME OF WEIGHING: 1052 HRS
SLUMP: 1¼ INCHES | AIR CONTENT: 3.3 % | TEMP CONCRETE: 63 °F | TEMP AIR: 61 °F | INITIALS: TC, RC
ADMIXTURE CLASS: L4 | ADMIXTURE QTY: 112 | STORED AT: 9-22-79 AT 0800 HRS | INITIALS: W H

COMPRESSIVE STRENGTH DATA — ASTM-C-39-71

CYLINDER IDENTIFICATION	DATE MOLDED	DATE TESTED	AGE	TOTAL LOAD IN POUNDS	ACTUAL CYL DIAM.	ACTUAL CYL AREA	BREAK TYPE	CURE		STRENGTH PSI
4347F 7159	9-21-79	9-24-79	3	101 500	6.02	28.46	A	1	2	3570
7160	"	"	3	103,500	6.02	28.46	A	1	2	3640
7161	"	9-28-79	7	123 500	6.00	28.27	A	1	6	4370
7162	"	"	7	121,500	6.01	28.37	A	1	6	4280
7163	"	10-5-79	14	142,000	6.00	28.27	A	1	13	5020
7164	"	"	14	137,000	6.01	28.37	A	1	13	4830
7165	"	10-10-79	28	153 500	6.02	28.46	A	1	27	5390
4347F 7166	9-21-79	"	25	159 500	6.00	28.27	A	1	27	5610

TYPE OF CYLINDER: 2" x 12" CUBE CORE OTHER

NAME (INITIAL)	MOLDED BY	TESTED BY	CHECKED BY	CHECKED BY QC REP
3	RC ET	BV	TL	TL 10-9-79
7	TFO RC	BV	TL	TL 10-9-79
14	RS TW	BV	TL	TL 10-9-79
28	RC	BV	TL	TL 10-25-79

LABORATORY SUPERVISOR: [signature] DATE: 10-11-79

TYPE OF BREAKS: A = CORE, MORTAR FAILURE; B = CORE, AGGREGATE FAILURE; C = TOP; D = SHEAR, AGGREGATE FAILURE; E = SHEAR, MORTAR FAILURE
UT 0-267 @ 7 | UT 0-267 @ 14 | UT 0-267 @ 28

7220-QCF-. Rev. 1

S.J703288

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 07000
REPORT OF CONCRETE CYLINDERS

BECHTEL ACCEPTANCE	DATE
CONTROL NUMBER	FILE NUMBER

1. UNIT IDENTIFICATION: DG (663.8) A — DATE PLACED: 9-25-79

2. PLACEMENT LOCATION: DIG TOOLING SLAB BAY 2

PLANT DATA — SOURCE: Champion Incorporated — CEMENT BRAND AND TYPE: Martin Marietta Type II

3. MIX: ftl.c — CLASS: I — FT LIST: ☒ YES ☐ NO — REQUIRED STRENGTH: 4200 PSI AT 28 DAYS

TEST DATA AT BATCH PLANT — Yield: 29.46

TICKET NO. 33268	TRUCK NO. 51	TIME OF MOLDING 0758	HOURS AT 3	TAPED	INITIALS RR CT
SLUMP 3 1/4 INCHES	AIR CONTENT 7.8	UNIT WEIGHT 143.04 LBS./CU. FT.	CONC. TEMP 64 °F	AIR TEMP 53 °F
4. MONTH FOR SAND ADJUSTMENT 2.6	0.6	ITEM 5 N/A	6. AGGREGATE - MORTAR RATIO 0.38 MAX	9.36 ACT.
7. INITIAL CURING TEMP. 74 °F TO	78 °F	8. STRIPPED 9-29-79 AT	0715 HRS	9. INITIALS TBA KS

TEST DATA AT PLACEMENT

10. CIRCUIT NO. 33268	11. TRUCK NO. 51	12. TIME OF TESTING 0812	HOURS AT 3	TAPED	13. TIME OF MOLDING N/A
14. SLUMP 2 1/2 INCHES	15. AIR CONTENT 5.1	16. CONC. TEMP 65 °F	17. AIR TEMP 56 °F	18. INITIALS AC SA
19. INITIAL CURING TEMP. N/A °F TO	N/A °F	20. STRIPPED N/A AT	N/A HRS	21. INITIALS N/A

COMPRESSIVE STRENGTH DATA — ASTM - C - 39 - 71

22. SPECIMEN IDENTIFICATION	23. DATE MOLDED	24. DATE TESTED	25. AGE	26. TOTAL LOAD IN POUNDS	27. ACTUAL CYL. DIAM.	28. ACTUAL CYL. AREA	29. TYPE OF BREAK	30. CURE PERIOD	30. CURE USE	31. STRENGTH PSI
4375-7319	9-28-79	10-1-79	3	78,500	6.01	28.37	C	1	2	2770
7320	"	"	3	80,000	6.02	28.46	C	1	2	2810
7321	"	10-5-79	7	93,000	6.02	28.46	A	1	6	3270
7322	"	"	7	95,000	6.02	28.46	A	1	6	3340
7323	"	10-12-79	14	102,000	6.01	28.37	A	1	13	3600
7324	"	"	14	104,000	6.01	28.37	A	1	13	3670
7325	"	10-26-79	28	112,500	6.01	28.37	A	1	27	3970
4375 7326	9-28-79	"	28	115,000	6.01	28.37	A	1	27	4050

32. STANDARD CYLINDER ☒ 6" x 12" ☐ CUBE ☐ CORE ☐ OTHER — 33. REMARKS

34. AGE (DAYS)	35. TESTED BY (INITIALS)	36. CHECKED BY	37. CHECKED BY QA REP
3	HQ, RS	BV	TL 10-9-79
7	HQ RS	BV	TL 10-9-79
14	RQ	BV	TL 10-17-79
28	MO	BV	TL 10-31-79

38. LABORATORY SUPERVISOR — DATE 10-29-79

TYPE OF BREAKS: A = CONE, MORTAR FAILURE; B = CONE, AGGREGATE FAILURE; C = SHEAR, AGGREGATE FAILURE; D = SHEAR, MORTAR FAILURE; E = OTHER

WST 0-105 07 — WST 0-152 C 14 — WST 0-357 28 — 8703289

7220-QCF-1 Rev. 0 5-18-79

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 07210
REPORT OF CONCRETE CYLINDERS

DE ACCEPTANCE | DATE
CONTROL NUMBER | FILE NUMBER

STRUCTURE IDENTIFICATION: DG 1&2 3.87 A | DATE PLACED: 9-28-79

STRUCTURE LOCATION: D/G room Slab Rev 2

PLANT DATA | SOURCE: Champion Incorporated | CEMENT MANUFACTURER AND TYPE: Marion Manetta Type II

MIX: T1-C | CLASS: I | WET OR DRY: Wet | CYL: | REQUIRED STRENGTH: 4460 PSI AT 28 DAYS

TEST DATA AT BATCH PLANT

Yield: 29.46

TICKET NO. 33268	TRUCK NO. 51	TIME OF MOULDING 0758	HOURS AT 3	TARGS	INITIALS RS ST
SLUMP 3 1/4 INCHES	AIR CONTENT 7.8 %	UNIT WEIGHT 143.04 LBS./CU. FT.	TEMP CONCRETE 64 °F	TEMP AIR 53 °F	
MONTMORILLONITE CLAY 2.6 %	ITEM 1 0.6	ITEM 2 N/A	CEMENT + POZZOLITH RATIO 0.38 MAX. 0.29 ACT.		
TIME OF CURING 1 N/A °F TO	N/A	STRIPPED N/A AT N/A HRS.	INITIALS N/A		

TEST DATA AT PLACEMENT

TICKET NO. 33268	TRUCK NO. 51	TIME OF TESTING 0812	HOURS AT 3	TARGS	TIME OF MOULDING 0612 HRS.
SLUMP 2 1/2 INCHES	AIR CONTENT 5.6 %	TEMP CONCRETE 65 °F	TEMP AIR 58 °F		INITIALS A- SAT
TEMPERATURE CURING 68 °F TO	114	STRIPPED 9-29-79 AT 0730 HRS.			INITIALS TRA K

COMPRESSIVE STRENGTH DATA — ASTM-C-39-71

SPECIMEN IDENTIFICATION	DATE MOULDED	DATE TESTED	AGE	TOTAL LOAD IN POUNDS	ACTUAL CYL DIAM.	ACTUAL CYL AREA	TYPE	TYPE CURE		STRENGTH PSI
4276F-7327	9-28-79	10-1-79	3	86,000	6.02	28.46	C	1	2	3020
7328		"	3	85,500	6.01	28.37	A	1	2	3010
7329		10-5-79	7	105,000	6.04	28.65	A	1	6	3660
7330		-	7	101,500	6.01	28.37	A	1	6	3580
7331		10-12-79	14	107,000	6.00	28.27	A	1	13	3780
7332		"	14	109,000	6.00	28.27	A	1	13	3860
7333		10-26-79	28	130,500	6.01	28.37	A	1	27	4600
4276F 7334	9-28-79	"	28	126,000	6.00	28.27	A	1	27	4460

MOULDED CYLINDERS: 2" x 12" | CHARTS: CUBE CORE OTHER

3	HQ RS	BV	TL 10-9-79	
7	HQ RS	BV	TL 10-9-79	
14	(RC)	BV	TL 10-17-79	
28	HQ	BV	TL 10-31-79	

LABORATORY INSPECTION | DATE 10-29-79

TYPE OF BREAKS: A = CONE, MORTAR FAILURE; B = LINEAR, AGGREGATE FAILURE; C = CONE, AGGREGATE FAILURE; D = LINEAR, MORTAR FAILURE

1 @ 0-12% @ 7 | 1 @ 0-358 @ 28

7220-001-. Rev. 0

S.703200

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 7220
REPORT OF CONCRETE CYLINDERS

CONTROL NUMBER

PLACEMENT IDENTIFICATION: DG/163 (2) 5 — DATE PLACED: 10-2-79

PLACEMENT LOCATION

PLANT DATA — SOURCE: Champion Incorporated — CEMENT BRAND AND TYPE: Martin Marietta Type II

MIX: T-1C — CLASS: I — AIR ENT: YES / NO — REQUIRED STRENGTH: 4000 PSI AT 28 DAYS

TEST DATA AT BATCH PLANT — Yield: 28.40

TICKET NO. 33322	TRUCK NO. 39	TIME OF MOLDING 1014	HOURS AT 3	TAPOS	INITIALS GH		
SLUMP ACTUAL/SPEC 2½	INCHES	AIR CONTENT 6.8	UNIT WEIGHT 147.62	LBS/CU FT	TEMP CONCRETE 62	°F	TEMP AIR 58 °F
WEIGHTED LOAD ADJUSTMENTS 2.3	STONE 1 H	STONE 2 N/A	WATER/CEMENT + ADMIXTURE RATIO .43	MAX .34	A		
INITIAL CURING ADJUSTMENT 71 °F TO 77 °F	STRIPPED ADJUSTMENT 10-2-79	AT 1000	HRS	INITIALS PS			

TEST DATA AT PLACEMENT

TICKET NO. 33322	TRUCK NO. 39	TIME OF TESTING 1025	HOURS AT 3	TAPOS	TIME OF MOLDING N/A		
SLUMP ACTUAL/SPEC 1½	INCHES	AIR CONTENT 5.2	TEMP CONCRETE 66 °F	TEMP AIR 60 °F	INITIALS GW		
INITIAL CURING ADJUSTMENT 4 1/4 °F TO N/A °F	STRIPPED ADJUSTMENT N/A	AT N/A	HRS	INITIALS N/A			

COMPRESSIVE STRENGTH DATA — ASTM-C-39-71

SPECIMEN IDENTIFICATION	DATE MOLDED	DATE TESTED	AGE	TOTAL LOAD IN POUNDS	ACTUAL CYL DIAM.	ACTUAL CYL AREA	TYPE FRACTURE	CYL CURE		STRENGTH PSI
4390 7425	10-2-79	10-5-79	3	88,500	6.01	28.37	A	1	2	3120
7426	"	"	3	82,500	6.02	28.46	A	1	2	2900
7427		10-9-79	7	108,000	6.02	28.46	A	1	6	3790
7428		"	7	113,500	6.01	28.37	A	1	6	4000
7429		10-16-79	14	119,000	6.00	28.27	A	1	13	4210
7430		"	14	119,500	6.01	28.37	A	1	13	4210
7431		10-30-79	28	132,500	6.00	28.27	A	1	27	4670
4390 7432	10-2-79	"	28	139,000	6.01	28.37	A	1	27	4900

STANDARD CYLINDER: ☒ 6"x12" ☐ CUBE ☐ CORE ☐ OTHER

REMARKS

CAPPED BY	CHECKED BY	LOADED BY	CHECKED BY QC REP
3 MD RS	RV		TL 10-11-79
7 MD RS (RS TW)	RV		TL 10-11-79
14 (LC)	RV		TL 10-15-79
28 ET	RV		TL 10-31-79

LABORATORY SUPERVISOR: [signature] DATE: 11-1-79

TYPE FAILURE: A=CONE, MORTAR FAILURE; B=CONE, AGGREGATE FAILURE; C=SHEAR, MORTAR FAILURE; D=SHEAR, AGG. FAILURE; E=OTHER

FORM 7220-QCT-10 REV. 0 — 5-1-79

S3703231

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 07220
REPORT OF CONCRETE CYLINDERS

QC ACCEPTANCE | DATE
CONTROL NUMBER | PCE NUMBER

CYLINDER IDENTIFICATION: 6/CC3 [illegible] R | DATE POURED: 10-2-79

CYLINDER LOCATION

CONCRETE DATA | SOURCE: Champion Incorporated | CONCRETE BRAND AND TYPE: Martin Marietta Type I

T.C | CLASS: I | PUMP USED: ☑ YES ☐ NO | REQUIRED STRENGTH: 4000 PSI AT 28 DAYS

CONCRETE DATA AT BATCH PLANT | YIELD: 28.40

TICKET NO. 53322 | TRUCK NO. 39 | TIME OF MOLDING: 10:14 HOURS AT 2 YARDS | INITIALS: GW. ET

SLUMP: 3½ INCHES | AIR CONTENT: 6.8 % | UNIT WEIGHT: 147.02 LBS./CU. FT. | CONCRETE TEMP: 62 °F | AIR TEMP: 58 °F

WATER ADDED AT JOBSITE: 2.3 GAL. | 0.4 GAL. | STORAGE: N/A | CEMENT + POZZOLAN RATIO: .43 MAX .34 ACT.

MAX. CURING TEMP: N/A °F TO N/A °F | STARTED PLACING CONCRETE: N/A AT N/A HRS. | INITIALS: N/A

CONCRETE DATA AT PLACEMENT

TICKET NO. 53322 | TRUCK NO. 39 | TIME OF TESTING: 1025 HOURS AT 2 YARDS | TIME OF MOLDING: 1025 HRS.

SLUMP: 1½ INCHES | AIR CONTENT: 5.2 % | CONCRETE TEMP: 66 °F | TEMP AIR: 60 °F | INITIALS: GW. ET

MAX. CURING TEMP: 10 °F TO 100 °F | STARTED PLACING CONCRETE: 10-3-79 AT 10-3-[illegible] HRS. | INITIALS: RS 12 E

COMPRESSIVE STRENGTH DATA | ASTM-C-39-71

SPECIMEN IDENTIFICATION	DATE MOLDED	DATE TESTED	AGE	TOTAL LOAD IN POUNDS	ACTUAL CYL. DIAM.	ACTUAL CYL. AREA	CYL. BREAK	CURE		STRENGTH PSI
391F 7433	10-2-79	10-5-79	3	95,000	6.01	28.37	A	1	2	3350
7434	"	"	3	96,500	6.02	28.46	A	1	2	3390
7435		10-9-79	7	114,000	6.00	28.27	A	1	6	4030
7436		"	7	111,000	6.01	28.37	A	1	6	3910
7437		10-16-79	14	126,500	6.03	28.56	A	1	13	4430
7438		"	14	127,500	6.01	28.37	A	1	13 SV	4490
7439		10-30-79	28	144,500	6.01	28.37	A	1	27	5090
391F 7440	10-2-79	"	28	147,000	6.00	28.27	A	1	27	5200

STANDARD CYLINDER: ☑ 6"x12" ☐ CUBE ☐ CORE ☐ OTHER | REMARKS

CYL. ID	TYPE	TESTED BY	CHECKED BY	CHECKED BY QC REP
3	HC TH	RV	TL	10-11-79
7	HC TH	RV	TL	10-11-79
14	HC TH	RV	TL	10-16-79
28	ET	RV	TL	11-2-79

LABORATORY INSPECTION | DATE: 11-1-79

☐ CONC. BREAK | ☐ CONC. MORTAR FAILURE | ☐ CORE AGGREGATE FAILURE | ☐ SHEAR, MORTAR FAILURE
☐ SHEAR, AGGR. RETAINER | ☐ OTHER

S-703292

Telephone call

ROUTE Bimal Dhar

BY AMI GANGULY OF BECHTEL AAC — Sving to B

TO AL GILLESPIE (313-232-8752) OF STRUCTURAL BONDING Co. — Claude Mellott

DATE 11-14-79 TIME 9:15 A.M.

SUBJECT MIDLAND PLANT, UNITS 1 & 2 JOB NO T220-101
DIESEL GENERATOR BUILDING. REPAIR OF GAPS UNDERNEATH THE FOOTINGS

FILE: C-2645

Al informed that the material "MAGNA ROCK", which he suggested earlier [on 11-12-79 at the jobsite] for use in the repair of gaps, cures too fast (in approx. 8 to 12 mins). Instead of "Magna Rock" he recommended, this time, a different material (mix. Portland Cement + Sand + Fly Ash + Aluminite Cement) which will be more suitable for the job. He will send us the properties and details of the procedure of filling the gaps including an estimate of cost for doing the job by Friday (11-16-79).

A. Ganguly

AAO-522

S3703233

Bechtel Associates Professional Corporation

Inter-office Memorandum

BEBC- 3402

To L.E. Davis

Date November 6, 1979

Subject Midland Plant Units 1 & 2
Job 7220
Diesel Generator Building
and Plant Area Settlement Monitoring

From L.H. Curtis

Of Engineering

Copies to File: 0274, [redacted]

At Ann Arbor

S. Afifi
L. Basinski (field)
P. Chen
L. Curtis
J. Hook
B. McConnel
S. Rao
C. Wilson (field)
Com Log

The monitoring requirements for the diesel generator building instrumentation to establish long-term residual settlement are as follows:

1. The diesel generator building and pedestal markers (DG-1 through DG-29) shall be monitored by optical methods by Bechtel construction biweekly until October 31, 1979; monthly until December 31, 1979; and then bimonthly as required by Drawing 7220-C-994; except they shall be monitored weekly for the initial 2 operating months of the local dewatering (Loughney Inc P.O. 7220-C-88), then biweekly for the remaining period of operation.

2) Borros anchors BA-5 through 8, 13 through 16, 26, 28, 34 through 36, 45, 50, 51, 53, 54, and 61 through 64 shall be monitored by Bechtel construction biweekly until October 31, 1979; monthly until December 31, 1979; and then bimonthly; except they shall be monitored weekly for the initial 2 operating months of the local dewatering (Loughney Inc P.O. 7220-C-88), then biweekly for the remaining period of operation. All other borros anchors and settlement platforms may be grouted under the direction of geotechnical services and cut off to clear permanent facilities.

3) Piezometers 9 through 11, 15, 17 through 19, 21 through 25, 28, 30, 33, 35, 36, 39, 44 through 46, and 48 will be read by geotechnical services biweekly until October 31, 1979, and monthly thereafter. The piezometers inside of the diesel generator shall be capped flush with the top of the grade slab to allow monitoring. All other piezometers may be grouted under the direction of geotechnical services and cut off to clear permanent facilities.

8703234

4) Permanent plant area settlement markers for the transformer pads (XR 1 to 24), turbine building (T 1 to 15), radwaste building (RW 1 to 4), condensate tank (ST 1 to 8), and administration building (AD 1 to 4) shown on Drawing 7220-C-994 shall be monitored weekly for the initial 2 operating months of the local dewatering (Loughney Inc P.O. 7220-C-88) then biweekly for the remaining period of operation.

5) Borros anchors BA-61 through BA-64 and Sondex gages S1 to S5 shall be monitored by Goldberg-Zoino-Dunnicliff and Associates (GZD) monthly until commencement of the plant area dewatering. Borros anchors BA-62 and 64 and Sondex gage S-3 shall be recessed in the diesel generator building slab at el 634'. Details for the recess will be provided on engineering design drawings.

The monitoring requirement described herein condenses all previous directions. The monitoring is a Q-listed item and appropriate steps should be taken to adequately protect the devices described above. The above monitoring requirements will be incorporated into Specification 7220-C-76 by November 30, 1979.

for L.H. Curtis

BCM/sh
10/3/5

8703235

H. Chapman

Telephone call

ROUTE P. Julian

BY S. EMERSON OF BECHTEL File M18 P6

TO GEO. MADDEN Midland Johnson OF CPCo X534 File M6320

DATE [redacted] TIME

SUBJECT Emergency Diesel Generators JOB NO 7220

I asked George who the responsible test engineer was on the Diesel Generators. I also advised George that as part of the D/G foundation subsidence surveillance program the TASK FORCE (Diesel Bldg) was considering a two month run in test ~~used~~ to verify the adequacy of the foundation.

George said that the test engineer was Jim Williams. SB703298

George felt that this would require extensive coordination with CPCo to perform ~~such~~ such testing. I suggested that perhaps the standard field tests would contribute sufficient running time to significantly reduce the test time to achieve a two month run in. George feels that extensive coordination with CPCo testing & operations would be required and requested further info. By copy of this telecon to the [redacted] I request that [redacted] ~~Mr. Hon be contacted and necessary info be provided~~

[redacted]

AO-522

SOIL & ROCK INSTRUMENTATION

GEOTECHNICAL INSTRUMENTATION DIVISION OF
GOLDBERG • ZOINO • DUNNICLIFF & ASSOCIATES, INC.

October 19, 1979
File No. D-2010-C

Dr. Sherif Afifi,
Bechtel Associates Professional Corporation,
P.O. Box 1000,
Ann Arbor, Michigan 48106

Re: Midland Units 1 & 2
Diesel Generator Building
Settlement Measurements

Dear Sherif:

The purpose of this letter is to make a correction to my August 13, 1979 review of DGB settlement measurements in which settlement data for Modified Borros Anchor #44 were incorrectly calculated. I am enclosing revised versions of Table 1 and Figure 2. I apologize for this error.

Sincerely,

John Dunnicliff

JD:mc
Enclosures

John Dunnicliff
Geotechnical Instrumentation Consultant

cc: Walter R. Ferris, Bechtel, San Francisco

SB703237

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TABLE 1. MODIFIED BORROS ANCHOR DATA

MODIFIED B.A.#	ANCHOR ELEV. ft.	RELATIVE SETTLEMENT in. (1)	ABSOLUTE SETTLEMENT OF MEZZANINE FLOOR AT ANCHOR LOCATION in. (2)	ABSOLUTE SETTLEMENT OF ANCHOR in. (3)	ZONE (4)
2	616.0	.035	.170	.135	MID
3	606.5	.040	.163	.123	MID
9	607.4	.095	.186	.091	SE
10	615.0	.095	.181	.086	MID
12	591.5	.075	.170	.095	MID
17	584.5	.035	.110	.075	NW
20	612.0	.040	.125	.085	MID
25	611.0	.045	.196	.151	SE
29	622.0	.020	.170	.150	MID
30	615.3	.035	.163	.128	MID
31	615.0	?	.192	?	SE
33	609.0	.070	.156	.086	MID
37	606.2	.020	.094	.074	NW
38	613.0	0	.092	.092	NW
39	622.0	0	.010	.010	NW
40	615.0	.030	.076	.046	NW
41	608.0	.015	.083	.068	NW
42	591.4	.045	.074	.029	NW
44	599.1	.025	.100	.075	NW
49	599.5	.065	.175	.110	MID
52	586.0	.050	.121	.071	MID
61	535.0	.230	.230	0	SE
62	535.0	.140	.140	0	MID
63	535.0	.195	.195	0	SE
64	535.0	.095	.095	0	NW

(1) Relative settlement between anchor and mezzanine floor, between elapsed time 60 to 120 days, extrapolating as necessary on plots updated through August 2, 1979.

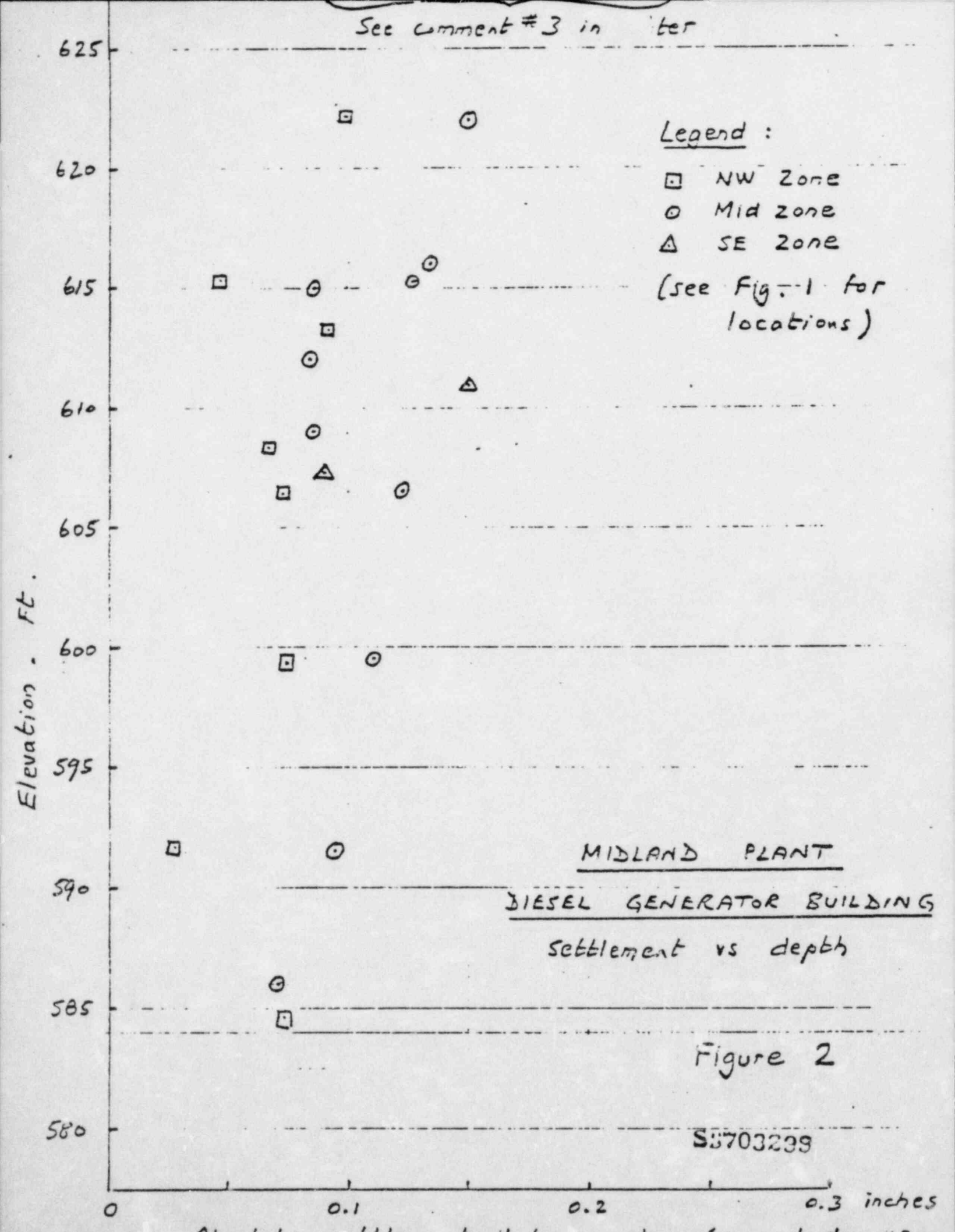
(2) Based on contours drawn using BA 61 through BA 64 data - See Figure 1.

(3) Difference between two previous columns.

(4) See Figure 1 for zone locations.

S3703239

See comment #3 in ter



MIDLAND PLANT

DIESEL GENERATOR BUILDING

Settlement vs depth

Figure 2

S5703239

Absolute settlement between day 60 and day 120

SOIL & ROCK INSTRUMENTATION

GEOTECH
GEOTECHNICAL INSTRUMENTATION DIVISION OF GOLDBERG • ZOINO DUNNICLIFF & ASSOCIATES, INC.
DISC | ACTION | INIT
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SOILS | XC-2 | 5
| 3
| 4
| FM
Proj Mgr |
Proj Eng | 1240
JOB 7220 FILE 3900
REC'D OCT 30 1979

October 19, 1979
File No. D-2010-C

Dr. Sherif Afifi,
Bechtel Associates Professional Corporation,
P.O. Box 1000
Ann Arbor, Michigan 48106

Re: Midland Units 1 & 2
Diesel Generator Building
Settlement Measurements

Dear Sherif:

In response to your request, I have reviewed your plots of initial elevation versus settlement at the 14 Borros anchor and settlement platform clusters sent to me on 9/20/79. The last date on these plots appears to be 6/15/79.

Cluster Plots

My approach has been:

(a) To look for irregularities in the cluster plots, recognizing particularly that, unless arching is taking place, settlement at a particular elevation must be greater than settlement at a point below that elevation.

(b) To judge irregularities on the basis of instrument plan positions: i.e. we should not expect a smooth cluster plot if the instruments are widespread in plan.

(c) To judge irregularities on the basis of anomolies noted on the installation record.

My review is summarized on Table 1. Note that I can in no case provide a conclusive explanation, but I believe the review does provide input to judging data quality.

S3703300

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Settlement Below Elevation 600 Ft.

During a telephone discussion on 9/20/79 you gave me the following data:

Elevation	Number of Anchors	Settlement Through 7/27/79
599'	2	0.8", 1.3"
592'	3	0.7", 0.7", 1.3"
585'	2	0.4", 0.5"

and questioned the scatter of data. I have evaluated as follows. Judge data on basis of regularity on cluster plot and notes on installation logs, and then assess data validity. The review is summarized on Table 2. As can be seen, there is reason to favor the smaller values of settlement and question the 1.3", 0.8" and 1.3" measurements.

Sincerely,

JD:mc

John Dunnicliff
Geotechnical Instrumentation
Consultant

cc: Walter R. Ferris, Bechtel, San Francisco)This letter supersedes
William R. Beloff)my review dated
October 11, 1979.

TABLE 1. REVIEW OF CLUSTER PLOTS

CLUSTER NO.	IRREGULARITIES	POSSIBLE EXPLANATION
1	None	--
2	BA-40	Error in computation of initial survey data (1)
2	PL-22, 45	Platforms not settling with top of fill (2)
3	PL-23, 46	Platforms not settling with top of fill (2). Note also that BA-59 is noted on installation log as "readings may be less accurate than normal", but for marginal reason of smaller than normal anchor drive. BA-59 data appears to be reasonable.
4	BA-47	Error in computation of initial survey data (1).
5	BA-44	Error in computation of survey data (1), downdrag on outer pipe (3).
6	BA-19 on 2/16/79	Minor survey inaccuracy.
6	PL-16	Platform not settling with top of fill (2).
7	BA-49	Noted on installation log as "readings may be less accurate than normal", due to anchor prongs being expelled only 1.5"
7	PL-17, 48 on 2/16/79	Platform not settling with top of fill (2).
8	BA-4	Noted on installation log as "readings may be less accurate than normal", due to grout in outer pipe
9	BA-22,23,24	BA-24 is not at same plan location as BA-22,23. However, BA-22 and 23 are close together and data are inconsistent. No explanation for this but suggest you check computations from survey data (1).
10	BA-12	Error in computation of initial survey data (1), downdrag on outer pipe(3).
12	BA-53	Noted on installation log as "readings may be less accurate than normal", due to anchor prongs being expelled only 1".

S8703302

CLUSTER NO	IRREGULARITIES	POSSIBLE EXPLANATIONS
12	BA-51 on 2/16/79 and 3/15/79	No explanation, but subseque data appear reasonable.
13	BA-6 on 6/15/79	Minor survey inaccuracy.
14	Throughout	Large spread of cluster in plan. Justified only in comparing BA-55 with BA-56, and that comparison appears reasonable. Interesting to not that the cluster with larges spread in plan gives the mos irregular plot, as would be expected.

NOTES:

(1) I recommend you check calculations, going back to raw data in the survey books. The initial readings appear to be the most questionable, because later incremental settlement generally look reasonable. If that does not reveal an error, I can think of no explanation for this irregularity.

(2) I understood that some settlement platforms were seated on the structure, some on the mud mat, some on the fill. If any of these platforms were not seated on the fill, and the fill settled away from the platform, data would be as shown on the cluster plots (i.e. platform settlement less than lower anchor settlement I do not have enough data to evaluate this, but you can do so or the basis of

(a) Platform elevations with respect to structure elevations see Table 2 in SRI DGB draft instrument report dated February 1979.

(b) Platform size. Platforms were 6" x 6", 1' x 1', or 2' x 2', depending I believe on underlying material (check with Austin Marshall). Sizes of platforms in question are:

PL-22	2' x 2'
PL-45	2' x 2'
PL-23	6" x 6"
PL-46	2' x 2'
PL-16	Not noted on log
PL-17	2' x 2'
PL-48	2' x 2'

(3) This is merely looking for a hypothesis that fits the data, and i<u>not</u> a sure explanation. If the bottom of the outer 1" pipe does not slide freely over the inner ¾" riser rod (i.e. if the greased hose plug does not prevent the annular space being plugge by soil), downdrag on the outer pipe will result in anchor settlement, and if the anchor is deep it will indicate large settlement

TABLE 2. REVIEW OF SETTLEMENT BELOW
ELEVATION 600 FT. AS GIVEN BY BORROS ANCHOR DATA

ANCHOR NO. (1)	ELEV. FT.	CLUSTER NO.	EVALUATION OF DATA ON BASIS OF			APPROX. SETTLEMENT THROUGH 6/15/79 Inches
			Cluster Pattern	Installation Log	Overall	
49	599.5	7	bad	bad	bad	1.3
44	599.1	5	bad (2)	good	bad (2)	0.8
53	598.0	12	good	bad	questionable	0.7
59	595.5	3	good	questionable	probably good	0.2
8	594.3	13	good	good	good	0.6
12	591.5	10	bad (2)	good	bad (2)	1.3
42	591.4	2	good	good	good	0.7
52	586.0	9	good	good	good	0.5
17	584.5	6	good	good	good	0.4

NOTE: (1) In decreasing elevation order.

(2) May be able to determine more reliable value of settlement if review of raw survey data and computations reveals an error. See notes in Table 1.

S3703304

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

MEETING NOTES NO. 866

MIDLAND PLANT UNITS 1 AND 2

CONSUMERS POWER COMPANY

BECHTEL JOB 7220

DATE: Friday, October 20, 1978

PLACE: Ann Arbor, Michigan

SUBJECT: Filling Of Cooling Pond And Diesel Generator Settlement Investigation Status

FILE: 0279, C-0280, C-2640

ATTENDEES:

Midland Project	Geotech	Staff	Construction
P. Martinez	S. Blue	K. Wiedner	A. Boos
M. Rothwell	J. Wanzeck	N. Swanberg	J. Betts
G. Tuveson	A. Marshall		
C. McConnel			
J. Simpson			
W. Moring			
G. Butler			
S. Godwin			

PURPOSE: Coordination of activities regarding filling of the Midland cooling pond and diesel generator building settlement investigation.

ITEMS DISCUSSED:

The following points regarding filling of the cooling pond were discussed.

1. CPCo has withdrawn its request for additional borings in the dike pending further review of the Bechtel position.

2. W. Ferris of geotechnical services and the consultants, Dr. Peck and Dr. Hendron, recommended filling the pond.

3. A. Marshall has made a preliminary inspection of the dike and will complete a final inspection by October 27, 1978. (A. Marshall action)

8703305

4. A. Boos stated that the pond could be filled using temporary facilities in a period of 2 weeks with approximately 4 weeks total time required including setup time. The field will present to CPCo the Bechtel recommendation to fill the pond with a target completion of November 30, 1978. (A. Boos action)

The status of the settlement investigation for the diesel generator building was reviewed. The following points were discussed.

1. The consultant's recommendation to preload the building is still firm.

2. A meeting will be held in Urbana, Illinois on November 6, 1978, with Dr. Peck and Dr. Hendron. W. Ferris and CPCo representatives will also attend.

3. The soils laboratory is currently working at maximum capacity to analyze the samples taken at the site. Current scheduled completion of testing is November 6, 1978.

4. Upgraded material is available for the preload fill. The field will explore the availability of frost protection material if it should be needed. (A. Boos action)

5. The instrumentation needed to monitor consolidation of underlying soil was reviewed, geotechnical services will develop a cost estimate for installation of this instrumentation. (Geotech action)

6. A specification will be needed to cover monitoring of the building and underlying soil during preloading. It was suggested that a similar specification from the Quanicassee Project be used as a model. (N. Swanberg action)

7. The feasibility of underpinning the structure should continue to be pursued. The feasibility of the removal of existing underlying material should be explored. (N. Swanberg action)

8. The option of installing a mat type foundation was discussed. Currently five methods are being evaluated on the basis of cost and schedule. The most favorable from a cost standpoint is to attach the mat to the building walls only, and leave the generator foundations free. The most favorable from a schedule standpoint is to remove the existing generator foundations and place a monolithic mat which attaches to the existing walls by drilled-in dowels.

9. The status of the fill and structures on the rest of the site was reviewed. Geotechnical services will provide a progress report on the entire site by November 24, 1978. (Geotech action) The frequency of settlement measurements on selected buildings will be increased based on direction from engineering. (G. Tuveson action)

10. Engineering will provide geotechnical services with acceptable deflections at tank and structure foundations. (C. McConnel action)

11. Engineering will review the need to grout under the structure foundations. (G. Tuveson action)

12. A meeting will be arranged with CPCo for next week. Items for discussion will include filling pond, construction of building settlement instrumentation, meeting with consultants, interim report, preliminary work for preloading, NRC meeting, and informal NRC contact.

ACTION ITEMS:

Geotech	1)	Complete final inspection of the site dike.
Construction	2)	Advise CPCo of Bechtel recommendation to fill pond.
Construction	3)	Determine availability of frost protection material.
Geotech	4)	Develop cost estimate for installation of soil instrumentation.
Engineering	5)	Develop specification for monitoring building and soil.
Engineering	6)	Investigate option of underpinning.
Geotech	7)	Issue progress report on geotechnical activities for entire site.
Engineering	8)	Provide direction for increased frequency of settlement monitoring.
Engineering	9)	Provide acceptable deflections at tank and structure foundations.
Engineering	10)	Review need to grout under structure.

B Charl M. Connel for

N. Swanberg

NS/sg
10/16/15

SB703307

Bechtel Associates Professional Corporation

Inter-office Memorandum

To J.A. Rutgers

Date October 30, 1979

Subject Midland Plant Units 1 & 2
Job 7220
MCAR 24
File: 0294, 0534 w/a, C-4065,

From L.H. Curtis

Of Engineering

At Ann Arbor

Copies to [redacted]

S. Afifi w/a (6)
R. Baltazar w/a
S. Blue
H.H. Burke/W.R. Ferris w/a
L.E. Davis
B. Dhar w/a
L. Dreisbach w/a
T. Johnson w/a
B.C. McConnell w/a
W. Moring w/a
K. Wiedner w/a
[redacted]

Reference: Letter (No. Howe-233-79, 9/5/79) from S.H. Howell (CPCo) to J.G. Keppler (NRC Region III Office)

Transmitted for your information and use is the eighth interim report submitted for the settlement of the diesel generator foundations and building. The next interim report is scheduled for issue by February 8, 1980.

In accordance with the instruction from Walter Bird of CPCo, received during the MCAR 24 review meeting on October 23, 1979, the current status of the four items (a, b, c and d) mentioned on Page 2 of the referenced letter is as follows.

a) Settlement Criteria for Borated Water Storage Tanks and the Lines into the Auxiliary Building: The settlement criteria and settlement monitoring program for the borated water storage tanks and pipes are being developed. The monitoring program will be issued for use by the end of November 1979, with the settlement time rate criteria to be completed in February 1980.

b) Dewatering Design Basis to comply with the Intent of the Draft Standard Review Plan on Dewatering: The draft of NRC Regulatory Guide FN 811-4 on dewatering dated September 1979 is currently being reviewed to determine the impact on the dewatering system design.

c) A Quality Assurance plan for Implementing the Permanent Site Dewatering System: The QA plan for implementing the permanent site dewatering system is still being developed.

d) Provisions made for the Train Bay Tracks Loading effect on Borated Water Lines: The borated water lines beneath the railroad

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tracks are encased by steel pipes. These steel encasements have been sized to carry the design train loads.

for W.L. Lovell
L.H. Curtis

AG/jt
10/25/4

SU703309

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

MEETING NOTES NO. 1061

MIDLAND PLANT UNITS 1 AND 2

CONSUMERS POWER COMPANY

BECHTEL JOB 7220-101

DATE: October 9, 1979

PLACE: Ann Arbor, Michigan

SUBJECT: Meeting of the Diesel Generator Building Task Group

FILE: 0279, C-2645 w/a

ATTENDEES:

Bechtel		CPCo
A. Boos*	M. Rung	T. Cooke
B. Dhar*	J. Wanzeck	D. Horn*
C. Martin	K. Wiedner	D. Sibbald
C. McConnel		T. Thiruvengadam
W. Paris*		
D. Reeves*		

*Part-time

PURPOSE: The meeting was held at the Ann Arbor office to discuss the items in relation to the diesel generator building settlement and other Seismic Category I structures on plant fill.

ITEMS DISCUSSED:

A) Review of Prior Action Items

The current status of action items identified in the previous meeting held on August 1, 1979, is as follows.

1) Action Item 1 of Meeting Notes No. 1018

This item is open. The analysis for the borated water lines has not been completed.

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2) Action Item 2 of Meeting Notes No. 1018

This item is closed. The FSAR change for Section 2.5 is now with the licensing group for action and tracking.

3) Action Item 3 of Meeting Notes No. 1018

This item is closed. Crack mapping for areas of the railroad bay, feedwater isolation valve chambers, and borated water storage tanks has been completed. Sketches SK-C-666 and SK-C-667 have been issued.

4) Action Item 4 of Meeting Notes No. 1018

This item is open. It was noted that the present method of analysis uses a stress amplification factor for elbows, tees, and reducers. This results in very large stresses at these points. It was suggested that two analyses be performed; one based on the difference between the design location and the location from the last survey and one based on the difference between the first survey and the last survey. Construction noted that if some of the lines are to be unearthed, it must be done soon or not until next spring, otherwise heated shelters must be provided during backfill operations.

5) Action Item 5 of Meeting Notes No. 1018

This item is closed. Specification 7220-C-94 and Drawing 7220-C-2000 for the piling subcontract were issued on August 29, 1979, and September 4, 1979, respectively.

6) Action Item 6 of Meeting Notes No. 1018

This item is open. Borated water storage tanks are under construction. The load test procedure, including water chemistry and protection of permanent plant facilities, will be issued by October 15, 1979.

7) Action Item 7 of Meeting Notes No. 1018

This item is closed. The conflict in the response to Question 6 of the NRC's 10 CFR 50.54(f) was resolved in Revision 3 of the response to the questions on September 13, 1979.

8) Action Item 8 of Meeting Notes No. 1018

This item is closed. The comments to FSAR Q&R 362.15 have been resolved. The response will remain as written.

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9) Action Items 9 and 10 of Meeting Notes No. 1018

These items have been combined and are open. Project engineering will revise and clarify the specifications and responses to the NRC's 10 CFR 50.54(f) questions to show requirements for a compaction of 95% ASTM D 1557 under buildings and 90% ASTM D 1557 at other locations.

10) Action Item 11 of Meeting Notes No. 1018

This item is closed. The report of the soil test program for the air line leak in the tank farm has been completed.

11) Action Item 12 of Meeting Notes No. 1018

This item is closed. The report on the air line leak was included in Revision 7 of MCAR 24.

12) Action Item 13 of Meeting Notes No. 1018

This item is open. Consultant R. Loughney is to submit a conceptual plan for the preliminary design and scope of work for the permanent dewatering.

13) Action Item 14 of Meeting Notes No. 1018

This item is open. The bid package for permanent dewatering will be issued by January 1980.

14) Action Item 15 of Meeting Notes No. 1018

This item is open. The contract for permanent dewatering will be awarded by March 1980.

15) Action Item 16 of Meeting Notes No. 1018

This item is open. There have been several discussions with mechanical and nuclear staff. The following subjects have been discussed:

a) A long recharge time is required because of systems that are required after safe shutdown earthquake (SSE).

b) A program is required to establish the reliability of the piezometers.

c) Demonstrate the capability to repair the system during recharge time.

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25) Action Item 26 of Meeting Notes No. 1018

This item is open. It is feasible to run the diesel generators to vibrate the pedestals but is is not presently included in the specifications. Project engineering and geotechnical services will establish a procedure and run duration for the diesels and a settlement monitoring program by December 1, 1979. This activity will have to be coordinated with the startup test program.

26) Action Item 27 of Meeting Notes No. 1018

This item is closed. None of the surcharge sand will be used as Q-listed fill.

27) Action Item 28 of Meeting Notes No. 1018

This item is closed. Pile stiffnesses for the service water building have been finalized. It was verified during the meeting that the original values provided would not change.

28) Action Item 29 of Meeting Notes No. 1018

This item is closed. Removal of fill in the tank farm has been resolved. Refer to report on tank farm.

29) Action Item 30 of Meeting Notes No. 1018

This item is closed. The temporary air line in the tank farm that had a leak has been grouted. All other temporary lines in the tank farm will be abandoned and grouted as soon as they can be rerouted around the tank farm.

30) Action Item 31 of Meeting Notes No. 1018

This item is open. A summary of the data from the test pits and soil borings will be incorporated into the January amendment of the FSAR.

31) Action Item 32 of Meeting Notes No. 1018

This item is closed. Letters BEBC-3294 and BEBC-3311 which were sent on September 24, 1979, and October 3, 1979, respectively describe the plan that will be used to determine the permanent dewatering system parameters.

32) Action Item 33 of Meeting Notes No. 1018

This item is closed. All items relevant to the MCAR 24 scope were discussed in Revision 7 of MCAR 24.

33) Action Item 34 of Meeting Notes No. 1018

This item is closed. TWX BEBC-3176 was sent on August 13, 1979, describing the surcharge removal procedure.

34) Action Item 35 of Meeting Notes No. 1018

This item is closed. Density plots for the dike area north of the auxiliary building have been completed.

B) Status of Site Activities

1) Backfill operation and compaction tests

Backfill operations are proceeding at the site. An extensive program of documentation of material placement has been developed. Two soils engineers are presently onsite to assist in the control of backfill placement.

The questionable fill material in the tank farm has been removed and replaced. The tank farm is backfilled to el 630'-0".

Geotechnical services has given a response to NCRs 1004 and 2294. NCR M-01-5-9-012 has been partially resolved.

All compaction equipment being used at the site has been qualified for technique and can be included in the FSAR if required.

2) Temporary dewatering

In area 3 (see Attachment 1), all of the dewatering wells outside of the turbine building have been installed. Only a couple of wells, including observation wells, are left to be installed inside the turbine building. For the temporary construction dewatering in Areas 1 and 2 (see Attachment 1), almost all of the dewatering wells are installed.

The schedule for temporary dewatering is as follows (see Attachment 1):

October 15 - Start installing deep pump test well in Area 4
October 22 - Start pumping deep pump test well in Area 4 for 3 days
October 25 - Start pumping Areas 1 and 2
October 25 - Approval of Loughney procedures
November 1 - Start pumping Area 3

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There are three more procedures from Loughney that must be reviewed by project engineering before dewatering in Area 3 can start. A meeting with project engineering, subcontracts and construction will be scheduled to discuss these and the other Loughney procedures.

3) Test program for permanent dewatering

Locations and directions for the borings for the well pump tests were established in the letter, BEBC-3299, sent on September 24, 1979. They were modified by letter BEBC-3311 on October 3, 1979, to expedite construction. This letter deleted and relocated some wells and established the test well diameter and requirements for piezometers and borros anchors. Based on the present schedule in Item 2 above (temporary watering), more piezometers are needed near Areas 1 and 2 prior to pumping. Their locations will be coordinated by the onsite geotechnical representative.

C) Status of Remaining Subcontracts

The status of the remaining subcontracts was not discussed as an individual item but was covered during the discussions on the various action items. The following is a summary:

1) Piling - Specification 7220-C-94 and Drawing 7220-C-2000 were issued on August 29, 1979, and September 4, 1979, respectively, for the piling subcontract. The service water building piles will be added to the underpinning contract. (See Items 5, 19, and 20 of the Review of Prior Action Items.)

2) Underpinning - The underpinning bid package was sent out in August 1979. The preaward meeting will be on October 22, 1979. Construction will review the insurance requirements concerning underground work. (See Items 22 and 23 of Review of Prior Action Items.)

3) Permanent dewatering - The consultant, R. Loughney, will submit a conceptual plan for the preliminary design and scope of work. The bid package will be issued by January 1980, and the contract will be awarded by March 1980. The Q-listed and non-Q-listed portions of the permanent dewatering system still have to be determined. (See Items 12 through 18 and 21 of Review of Prior Action Items.)

D) Cost Estimate and Schedule for Remaining Work

Schedules were provided for:

1) Service water pump structure piling (see Attachment 2)

2) Auxiliary building underpinning (see Attachment 3)

3) Permanent and temporary dewatering (see Drawings EP-101 and EP-102)

4) Overall cost and schedule status (see Attachment 4)

E) NRC 10 CFR 50.54(f) questions were not discussed.

F) MCAR Report

The scope of the MCAR will be limited to soil exploration and the diesel generator building. The settlement records and pipe profile figures will be submitted for the last time.

The MCAR will not contain the final results of the future predicted settlement because the meeting with J. Peck and A.J. Hendron, Jr. will not be held until October 25, 1979. No additional borings or cross-sections will be included because they will go into the January 1980 FSAR amendment.

The schedule section will be revised or shortened to one paragraph with no dates.

G) Diesel Generator Building

The grout requirements under the footings were discussed. Portions of the footings in Bays 3 and 4 were exposed and a maximum gap of 3/4 inch was found. The gap penetrated up to 2-1/2 feet under the footing. It was decided that more exploration would be performed and the information would be presented to J. Peck and A.J. Hendron, Jr.

H) Diesel Fuel Oil Lines

A design change notice (DCN) was issued requiring the diesel fuel lines to be buried 6 feet below grade. It was questioned whether the design requirements could be satisfied.

ACTION ITEMS:

Project Engineering	1) Analyze the flexibility of piping connected to the borated water storage tanks assuming 4 inches of differential settlement. Set up meeting with stress group (K. Wiedner and J. Betts to attend) to discuss analysis. Investigate eliminating link seals at penetrations by October 30, 1979.
Project Engineering	2) Evaluate stress conditions in the resurveyed pipes. The following two analyses were suggested: a. Difference between original design location and latest survey b. Difference between first survey and latest survey
Geotechnical Services/ Project Engineering	3) Issue program for load test of borated water storage tanks by October 15, 1979.
Project Engineering	4) Revise and clarify the specifications and responses to the NRC's 10 CFR 50.54(f) questions to show requirements for a compaction of 95% ASTM D 1557 under buildings and 90% ASTM D 1557 at other locations.
Consultant, R. Loughney	5) Submit conceptual design and scope of work for the permanent dewatering sytem.
Geotechnical Services/ Project Engineering	6) Permanent dewatering system a. Design permanent dewatering system and have it reviewed in-house (SF) or by an outside consultant. b. Issue bid package by January 1980. c. Award contract by March 1980. d. Establish a program to determine the reliability of the piezometers. e. Determine Q-listed items for the following two options.

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1. Complete cutoff wall, long recharge time (Q-listed monitoring of inspection procedure)

2. Partial cutoff wall with local grouting, shorter recharge time (all Q-listed monitoring and pumping equipment)

f) Establish program to demonstrate capability to repair dewatering system during recharge time.

g) Establish elevations and locations at which liquefaction would occur for 0.12 g and 0.20 g seismic events.

h) Continue review of NRC regulations with respect to permanent dewatering.

i) Continue docket search for information on permanent dewatering at other plants.

j) Estimate costs for two options discussed in Item e above.

Construction — 7) Determine terminology to be used for dewatering with respect to union jurisdictions and transmit to project engineering by November 1, 1979.

Construction — 8) Review insurance requirements concerning underground work associated with underpinning and inform project engineering by November 1, 1979.

Geotechnical Services/ Project Engineering — 9) Review diesel fuel tank settlements and issue release for removal of water from fuel tanks by October 15, 1979. Determine cleaning procedures that will be required.

Geotechnical Services/ Project Engineering — 10) Establish a procedure and time period for running the diesel generators. Establish a settlement monitoring program including readings:

a) Before placement of generators

b) After placement of generators

c) After operation of generators

Geotechnical Services/ Project Engineering	11)	Incorporate a summary of data from test pits and soil borings into the January FSAR amendment.
Project Engineering	12)	Disposition NCRs 1004 and 2294.
Geotechnical Services	13)	Resolve remaining portions Consumers Power Company NCR M-01-5-9-012.
Project Engineering	14)	Determine if compaction requirements for current onsite compaction equipment need to be included in the FSAR.
Construction/ Subcontracts	15)	Expedite U.S. Testing's response to Bechtel's Review of U.S. Testing's Field and Laboratory Construction Test Data on Soils Used as Fill.
Geotechnical Services	16)	Establish locations for more observation wells near the construction temporary dewatering areas.
Geotechnical Services/ Project Engineering	17)	Develop a combined schedule for the temporary dewatering and pump tests for the permanent dewatering.
Construction/ Project Engineering	18)	Schedule a meeting between project engineering, construction, and subcontracts to discuss Loughney Dewatering procedures.
Project Engineering	19)	Revise the schedules (Attachments 2 through 4) to reflect the interface with the temporary dewatering.
Project Engineering	20)	Provide a procedure for grouting under the diesel generator building footings by October 12, 1979.
Project Engineering	21)	Establish the requirements for additional investigation of gaps under the diesel generator building footings both inside and outside the building.

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Project Engineering	22)	Review the design requirements for the diesel fuel lines and determine if the DCN is satisfactory as issued.

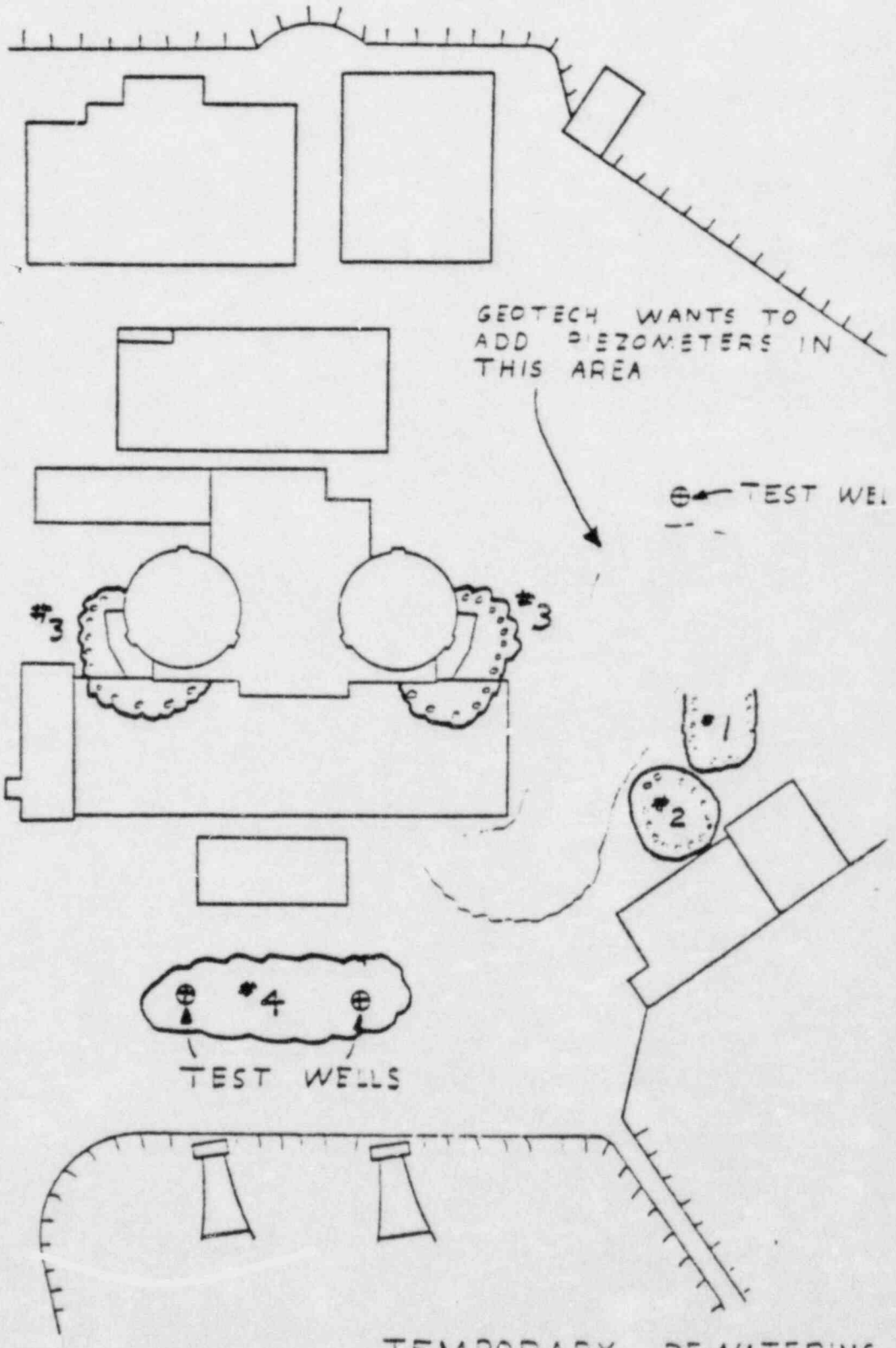
D. Reeves

DR/js
10/17/7

Attachments
1) Temporary dewatering and test well locations
2) Schedule for service water pump structure piling
3) Schedule for auxiliary building underpinning
4) Overall cost and schedule status

SB703408

Meeting Notes No. 1061
Attachment 1
Temporary Dewatering and
Test Well Locations

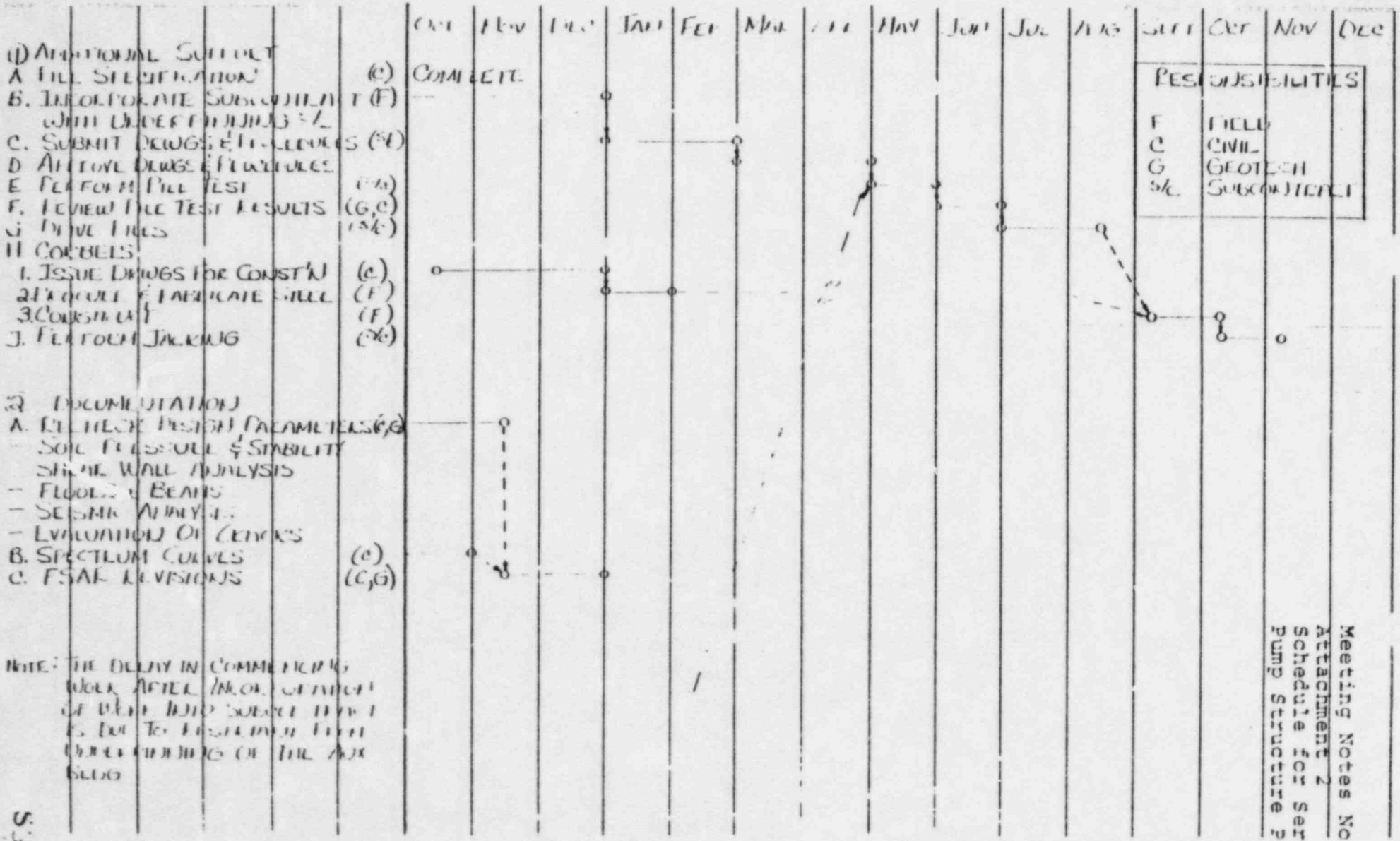


DRAWN BY D. REEVES

TEMPORARY DEWATERING AND TEST WELL LOCATIONS

SB703409

C.L.M
10/6/11



NOTE: THE DELAY IN COMMENCING WORK AFTER APPROVAL OF WORK INTO SOUTH WALL IS DUE TO RESTRICTION FROM CONSTRUCTING ON THE NORTH SIDE

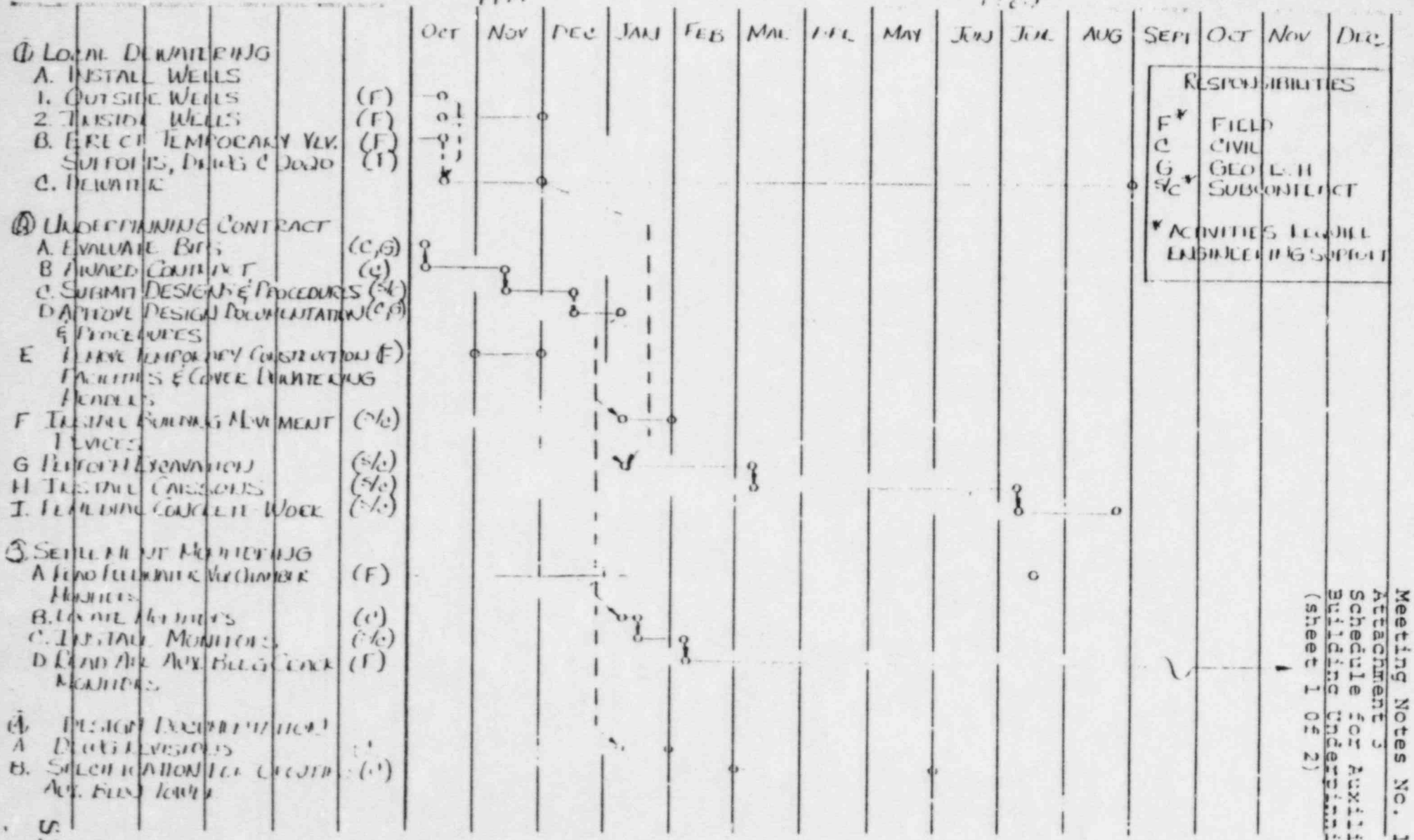
Meeting Notes No. 1061
Attachment 2
Schedule for Service Water Pump Structure Piling

S-703410

C.E.M
10/4/71
REV 10/11/71

MCAR 24 SETTLEMENT OF THE AUX. BLDG. ENGINEERING SCHEDULE

1 OF 2



Meeting Notes No. 1061
Attachment 3
Schedule for Auxiliary Building Underpinning
(sheet 1 of 2)

S.J.703411

Meeting Notes No. 1061
Attachment 3
(sheet 2 of 2)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5 DOCUMENTATION															
A AUX. BLDG ANALYSES	(c)														
B SPECTRA CURVES	(d)														
C FSAR REVISIONS	(c,6)														

SB703412

COST AND SCHEDULE STATUS

COST

Total estimated cost has increased from $14,500,000 to $15,200,000. This increase is due to:

Item 1: Pricing increase on C-95, underpinning developed from bids received ($400,000)

Item 2: Change in seismic acceleration criteria for underpinning design ($300,000)

The total estimated cost includes an allowance of $6,000,000 for the investigation, design, procurement, and installation of a permanent plant dewatering system.

SCHEDULE

Corrective actions currently outlined for this MCAR are not expected to impact the construction and testing project shcedule as now being formulated. However, since the licensing schedule necessary to support the anticipated revised fuel load will require final FSAR submittal on open items due to this MCAR by September 1, 1980. Consumers and Bechtel do not want any of these MCAR items still open at that time.

Specific corrective actions and surcharge requirement for the borated water storage tanks needs to be firmed up so a schedule can be developed.

S3703413

bcc: D. Anderso
L. Curtis
S. Dhar
S. Emerson
B.C. McCon
K. Wiedner
[redacted]

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

Transamerica Delaval Inc.
550 85th Avenue
Oakland, California 94621

October 5, 1979

Attention: C. Renfro

Subject: Consumers Power Company
Midland Plant - Job 7220
Emergency Diesel Generators
File: M18PR, C2645

References: 1) Telecon, S. Emerson (Bechtel) to C. Renfro (DeLaval), 4/16/79
2) Telecon, S. Emerson (Bechtel) to C. Renfro (DeLaval), 9/7/79

Gentlemen:

Delaval was informed in the referenced telephone conversations that the emergency diesel generators foundations have experienced settlements. The settlements have been both general and differential in nature. Commitments have been made to the NRC that the diesel generators will be installed in a level plane.

A grout leveling schema has been developed to allow installation of the diesel generators. The diesel engine crank-shaft elevation shown in Table I of the attached sketch was established on the basis of the as-built concrete elevation in the engine area. The average grout thickness provided under the engine is shown at location K in the sketch and averages from 1-3/8 inch to 1-5/8 inch. The variations in leveling grout thickness at other locations for the engine, generator, and auxiliary equipment skid are shown at locations A through J, along with the original Delaval design grout thickness.

Your concurrence or recommendations on the following conditions are requested.

1. Locations A and B indicate that either little or no grouting allowance exists. In these cases, the concrete will be chipped as required to provide a minimum of 1/2 inch of leveling grout.

2. At location G of bays 1 and 2 and location I of bay 2, the leveling grout thickness exceeds the Delaval grout requirement by approximately 7/16 inch and 7/8 inch, respectively. This increase in

SB703414

grout thickness could require additional bolt length to allow nut engagement. Verify whether the existing bolts have sufficient length, or indicate how the extra length could be accommodated (special nuts, lengthening etc). If replacement bolts are required, may these bolts be fabricated onsite in accordance with Delaval's revised shop detail drawings?

3. In conjuction with Item 2, the only nonremovable bolts on the generator end of the foundation are for the pneumatic barring device. Provide your recommendations for fit-up modifications or adaptors if the existing anchor bolts are not long enough.

Our immediate need is to establish the crank shaft elevations for the Unit 2 diesel generators which are located in bays 3 and 4 on the sketch. Therefore, your concurrence with the scheme is requested by October 12, 1979. Please provide your recommendation on bolt length adjustments (Item 2) and fit-up requirements (Item 3) by October 26, 1979. Your immediate attention to this matter will be greatly appreciated.

Very truly yours,

for L.H. Curtis
Project Engineer

BCM/sg
9/27/2

Enclosure: Sketch Plan of Diesel Generator Foundation

S3703415

C-2645

TO File

FROM TCCooke/RMW

DATE August 6, 1979

SUBJECT MIDLAND PROJECT GWO 7020
GENERAL MEETING WITH CONSULTANTS
File: B3.0.3 Serial: CSC-4255 UFI#-00234-S

Consumers Power Company

INTERNAL CORRESPONDENCE

CC Attendees
GSKeeley, P14-408B
DBMiller
KCBrooks (2)

Attendees:

Karl Wiedner, Bechtel
Phil Martinez, Bechtel
Sherif Afifi, Bechtel
Bimal Dhar, Bechtel
Al Boos, Bechtel
Art Arnold, Bechtel
Dr. Ralph Peck, Consultant
Dr. A. Hendron, Jr., Consultant
Dr. M. T. Davisson, Consultant
Chuck Gould, Consultant
Dick Loughney, Consultant
Tom Cooke, Consumers Power Co.
Don Sibbald, Consumers Power Co.
Don Horn, Consumers Power Co.
Thiru Thiruvengadam, Consumers Power Co.

Introduction

P. A. Martinez noted that this meeting was being held to finalize the consultants' recommendations for information to be sent to the NRC on July 6 in preparation for the July 18 meeting. Mr. Martinez also stated that liquefaction and treatment of material below the Class I structures were the main topics and he briefly reviewed the discussion of the previous evening.

Liquefaction Potential and Sand Backfill around Category I Containment Structures

There is no problem with dewatering since the till can easily support the containment load of 10KSF. Containment Building diameter change of approximately 1/4" due to pre-stressing is too trivial to consider and should be deleted from any concerns. The consultants stated that the permanent dewatering system should be designed to do the job regardless of site conditions (dike locations). After completion of the conceptual design, the initial wells should be installed and dewatering should quickly determine (a few weeks after start of pumping) what is required for the minimum practical design. The permanent dewatering system should contain sufficient redundancy, with more units than required for maintenance purposes. Routine maintenance and renovation over the years will take up a certain number of wells. Total system redundancy would not be required because there would be a time lag from the cessation of pumping before water in an area could rise to a critical level. It would probably be a good idea to have some standby (non-Q) power available for the pumps. To be practical, all power block areas should be dewatered whether problems are known or not. It was noted that Regulatory Guides overlooked the pumping of fines, however, this was thought to be key point and wells generally should be kept 50' minimum from structures on the permanent dewatering system. Continuous sand zones in till would be advantageous for drainage,

8702972

however, that condition cannot be assured. Mr. Loughney stated that we should put a ring of wells around the power block. The wells should extend to the clay till. Some of the temporary dewatering wells should be made permanent to allow draining of any crown water (rain, etc). It was again noted that the water would take a week or two to return to the power block area if the system stopped pumping. Since we would have time to make repairs or shut the plant down, only the piezometers need to be Q-listed. Mr. Loughney estimated that the wells should be at about 12' centers with sand vertical drains possibly to help drain crown and perched water tables and some wells in the middle for balance (critical area). The designer would have to plan his systems so as to prevent fines extraction (proper screens and/or distance). For an area of 600' x 500', Mr. Loughney estimate that 250 to 300 wells maximum with submersible pumps would be required on the perimeter. They could be of the type that has heavy wall plastic well screen which woul be good for about 40 years. The pumps would normally have a five-year life and cost about $300 each. It could be assumed that about 20 to 30 pumps would go out each year. Timers would be required for the pumps and 440V would be the best voltag The total well cost would be approximately $3,000 per well. Added to that would have to be the piezometers (Q-listed) and temporary or observations wells. Non-Q standby generators, if desired, could be purchased and installed for about $40,000. The cost of that, the piping and the electrical should be around $2 Million. It was estimated that $25,000 to $35,000 a year maintenance cost would be required after, say, 25 wells go out, and to take care of acid treatment of the wells at three-month intervals. A chemical grout curtain in sand around some pipes could be considered at a later date. However, this should not be a problem. If local clay areas are encountered, the wells should still remain at 12' intervals. The additional settlement due to the dewatering would be in the range of 0-1/2". The design changes required for a wet versus dry fill would be primarily administrative in nature in the FSAR below Elevation 618'. The bearing capacity and sliding friction would be enhanced. The settlement calculations have to be revised in any event. Wells should extend down to till. It was noted that the wells would be much more positive than grouting to prevent liquefaction. It would not be possible to ensure the grouting effectiveness. Dewatering totally eliminates the liquefaction problem.

Removal of Surcharge

The consultants noted that it would take approximately eight weeks of accurate readings prior to removal of the surcharge to obtain required evidence, even though an accurate prediction could probably be made at this time by bracketing the residual settlement expected. Although rebound is independent of long-term settlement, the data will be useful. The consultants need to see the trend on the settlement fir Dewatering of the Auxiliary Building would change the trend conditions slightly. That would be the earliest time (present schedule) to remove the surcharge with dependable information. It was noted that about 0.032" has been the maximum deflection in the last three weeks, however, all of the data needs to have temperature correctio applied. Goldberg-Zoino-Dunnicliff are working on correcting the data for temperature It was also noted that due to long-term settlement, some flexibility in the utilities may have to be designed into the connections based on the settlement predictions which could include differential settlement.

Chemical Grouting

Art Arnold noted that because of verification problems with chemical grout, it would not be necessary unless a very permeable trench was encountered during dewatering. Silica grout in the sand may be acceptable for that situation. It can be deleted as a remedial action from the responses because it is too much of a problem to prove to everyone's satisfaction that adequate grouting has been performed.

Need for Removal of Loose Sands Under the Diesel-Generator Structures

This requirement disappears with Option 5, however, settlement of sand due to vibration has to be calculated. The diesel generator should be started as soon as possible to induce the maximum settlement due to vibration. It is expected that this will be in the range 1/2 to 1" and take place in a few weeks. It would be better for predicting long-term settlement if the water table was not lowered. No other vibratory means approach the use of the diesel generator for pre-vibrating the foundations. Mr. Davisson noted that he needed the diesel generator rpm for his information. Mr. Afifi noted that the running of the generators would also help the seismic calculations. The exact amount of settlement will be determined at a later date based on refined data. At present, a refined calculation is needed because old calculations were based on saturated sand. Mr. Davisson noted that we should look hard at connections of utilities to the diesel generator and the building and that allowance should be made for a maximum of one-foot movement in any direction. This allowance would be over kill for any potential problems. The problem was further complicated because of the fact that there is sand on the north side of the foundation and clay on the south side of the foundation. The pre-load would predict an additional long-term settlement of the clay, then after the diesel generator run, any settlement due to vibration could be determined. We could then add seismic settlement of sand from the earthquake motion and dewatering settlement.

Need for Removal of Loose Sands and/or Soft Clays under Electrical Penetration Areas of FW Valve Pits

B. Dhar summarized the Auxiliary Building electrical penetration areas analysis. He included static and dynamic loads, horizontal and torsional loads. Mr. Dhar noted that the horizontal shear of approximately 1,200 to 1,300 Kips would be transferred to the soil and possibly through the soil to the Turbine Building and/or Containment Building which are analyzed as separate structures. It was noted that the upper floors of the Auxiliary Building wingwalls have a two-inch styrofoam cushion between the two floors and the Containment Building. The shear modulus is calculated from a composite 1,200 foot per second shear wave velocity. The cantilever portion of the structure is probably resting partially on the till and some load is being taken up by the structure. Based on preliminary analysis, a deflection of 1/4" to 1/2" is anticipated based on an uncracked section and ACI 381 "E" Value. The steel would reach a tensile stress of 50 KSI. 1,500 Kips vertical support at the end of wingwall would eliminate any serious cracking problem. This assumes that the soil would be taking zero load. If the structure is required to take the total moment load, two areas would be over-stressed. One would be the wall framing at the southwest area of the control tower and the other would be at the diaphram wall. At 3,000

Kips, there would be zero deflection in the structure (3,000 Kips vertical support applied at the end of the wingwall). A detailed analysis is in progress which will take approximately two to three weeks. The wingwalls could be tied to the Turbine Building slab for the horizontal support. We would also have to change the Auxiliary Building seismic analysis model to some extent. Chuck Gould then outlined the options for taking care of the Auxiliary Building electrical penetration areas problem as follows:

a. Temporary support of valve pit

b. Possible sky hook for the 1,500 Kip load contingent on further structure analysis

c. Excavate 7' beyond the bottom of the slab

d. Grout the loose sand to stabilize the working face

e. Start temporary Turbine Building slab support

f. After stabilizing, start work on five 4' diameter jacking caissons

g. Transfer the load from the sky hook and move to Unit 2

h. Install the remaining caissons for the 3,000 Kip load

i. Possibly drift east and soldier pile to support the excavation when the mass is removed (also serves as bearing support for the Turbine Building)

j. Excavate the fill

k. Fill the material back with lean concrete and then dry pack or grout afterwards. The maximum depth of lean concrete would be about 29'. It would take a long time to dry pack. The possibility of caissons settling would be discussed.

It was noted that the work could stop at Step h. Davisson then discussed some other options to include using the valve pit for access, removal of the soil under the valve pit to the till, and a tie to the electrical penetration area for horizontal shear. Possibly tying into the access gallery or mining valve pit fill, filling with concrete and tying in for horizontal loads would be a way to proceed. It was decided that we should install the caissons and transfer the horizontal load to the valve pit or Turbine Building slab with mining the balance of material under the electrical penetration area only if required by analysis.

The meeting then broke to allow the consultants time to write their preliminary report, a copy of which is attached. This report was briefly discussed following the break.

pp

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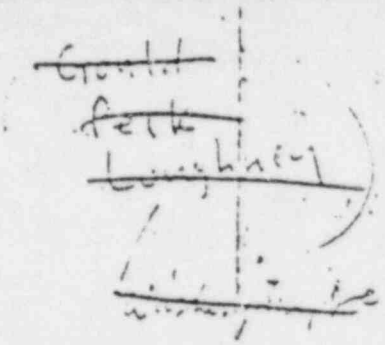

28 June 1979

Re: Midland Units 1 and 2

The following comments are made by the consultants with respect to items of the agenda discussed today. The ~~items~~ numbers of the headings corresponding to the agenda items

cc: T.E. Johnson.
J.C. Hink.
B. Dhar
R.L. Rinford
K. Wiedner
P.A. Martinez
R.L. Castleberry
P.K. Chen.
W.R. Ferris
T. C. Cook (CPCo.)
T. Thiruvengadam (CPCo.)

CONSUMERS POWER COMPANY
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MIDLAND PLANT PROJECT
MIDLAND, MICHIGAN

S.S702976

~~Permanent Dewatering System Preliminary~~

An exterior deep well dewatering system can be used to dewater the plant site, with a top dewatering system being used to remove the crown of the ground water within the dewatered area.

Sufficient redundancy can be provided to assure that the ground water will remain within the desired levels in the event of a disruption or failure of any part of the system.

It is anticipated that after the dewatering system has been operational for over six months that the system could be down from 1 to 2 weeks without the ground water rising above critical level.

The nature of the site, existing soil and backfilled soil is such that after the initial dewatering of the site, the quantity of flow entering into the dewatered area would be ~~about~~ less than ~~300~~ 200 gpm.

As determined ~~by~~ during the initial dewatering installation the spacing of the dewatering wells ~~would~~ be adapted to compensate for any unforseen soil conditions encountered and/or any sources of recharge from the backfill placed around pipe lines extending to the pond and or any source of ~~water~~ recharge water from leaky

S.70297

operational pipes located at critical points

Any equipment used to mop up the water within the exterior dewatering system would be left in place.

The required observation wells would be installed with the necessary controls at the proper locations to ascertain that the ~~desired~~ desired dewatered conditions are being obtained. (The observation system would be O, but as a part of the built-in conservatism, the dewatering system would get) ~~Daily~~ frequent monitoring of the ground water levels and the operating deep wells would be scheduled.

Repair, or replacement of non functioning pumps would be done when sufficient pumps are down.

Scheduled cleaning of the well screens would be performed about every 3 to 6 months period

Assuming a perimeter of 3000 feet the rough estimated cost of an exterior deepwell system complete with the ~~the~~ necessary discharge, electrical controls and wiring and standby generators would be about $1,200,000. This assumes 250-300 deepwells.

To this should be added the cost of the interior mop up system, the observation wells and their controls, (probably $20,000) and the yearly maintenance cost.

The estimated yearly ~~maintenance~~ cost for treading the wells and repairing and or replacing the deepwell pumps is about $35,000.

To the above the cost of the monitoring should be added.

S.702378

2) Liquefaction Potential

Liquefaction analyses have been conducted by Bechtel, on the basis of Standard Penetration Tests, of the sands below the Diesel Generator Building and various portions of the Auxiliary Building. These analyses have shown that the sands are not dense but do have a Factor of Safety against liquefaction of at least 1.5 for an SSE with a maximum ground acceleration of 0.12g. Nevertheless, due to the erratic nature of the backfill, there is the possibility that some loose pockets could liquefy under the

SSV02373

SSE = $\frac{0.12q}{n}$ and if the SSE will result in a higher level to ~~0.32q~~, then liquefaction of much of the sand backfill could be a problem.

General area dewatering is recommended to eliminate the liquefaction potential. The goal would be to lower the piezometric levels from the ground over to somewhere near the top of the till. Dewatering in a more positive fix than chemical grouting because the area can be positively monitored by piezometers wherein it may not be possible to positively prove the beneficial effects of grouting.

SJ702980

Even though liquefaction of loose sands is eliminated by densifying, the seismic shaking will result in some residual settlement after an earthquake. The magnitude of these settlements should be estimated by Boulanger, and should account for the effect of sampling disturbance on the free-field surface.

~~5/23~~

(1/4)

~~Re:~~ Agenda Item 5

Support of Auxiliary Building

Date: 28 June 1979 Denver Holiday Inn Airport

By: ~~M. T. Davisson~~ C. H. Gould

Information furnished to consultants is listed below: (approximate)

1. Containment analyzed as though free of other structures
2. Auxiliary " " " " " " " "
3. Turbine " " " " " " " "
4. Peak surge amplitude of auxiliary structure at cg is 0.38 in. for 0.12 g.
5. Auxiliary wings figure OK on uncracked section, but steel stress is 40 ksi on cracked sect.
6. 1500K at E & W ends of wings relieves overstress
7. 3000K " " " " " " " restores original zero deflection
8. Horizontal force in each wing is 1250K

Methods of fix considered by consultants are:

S 702982

A. Remove ~~& replace~~ unsuitable material under valve pits and wings and permanently support R line of Turbine building on jack piles. Temporary support of wings with caissons at E & W ends and replace with mass conc

up to 3000 kips each.

B. Permanent support by caissons of E & W ends of wing wall with 3000 kips each end. Remove unsuitable material under valve pit and replace with mass concrete. Support K-line of Turbine Bldg with jack piles as required. Options are:

(1) Tie auxiliary building to Turbine mat for lateral seismic resistance

(2) Tie auxiliary building to valve pit and the concrete fill beneath it. Option is:

(a) Also tie valve pit to buttress access shafts for additional lateral resistance.

Construction procedures for jacked caissons have been thoroughly reviewed ~~by~~ in prior meetings. However, concept B above calls for permanent category I caissons; jack piles are not recommended. ~~The following items are pertinent to jacked caissons:~~

8702283

(3/4)

1. Steel casing is ignored for permanent load carrying.

2. Concrete is now Q

3. Till is the supporting material.

4. Design pressure on till is twice that under the ~~conditions~~ PSAR commitment. This is offset by following advantages:

   a. Proof load test to 1.5 times working load greatly exceeds the 1.12 (perhaps more 1.20) times working load in a seismic event. Analysis shows bearing value ~~capacity~~ has adequate factor of safety exceeding 2.5.

   b. Procedure calls for regacking piles to assure proper load sharing, as with temporary caissons.

We feel that solution B(1) above represents sound engineering. However, if NRC requirements dictate solution B(2) involves taking category I to category I

~~Specifically~~ The consultants request the answers to the following:

1. Static deflection configuration of auxiliary wings under full cantilever + Seatmont, cracked and uncracked.

2. Seismic analysis of auxiliary building with deflection configuration, acceleration at each floor level, edge forces due to rocking, horizontal forces to be resisted and locations.

3. Analysis of auxiliary wing stresses and deflections with 1500K and 3000K ea at E and W ends.

~~4. If available, Static History Analysis~~

M.T. Darisson
C.H. Gould
A.J. Hendron, Jr
L. Loughney
R.B. Peck

3. Diesel Generator Building

Removal of Surcharge. The longer the full surcharge can remain on the area, the more reliable will be the prediction of the clay-seated portion of the long-time settlement. In this reason we would prefer to maintain constant conditions as long as ~~possible~~ practicable. We realize, however, that practical considerations do not permit an indefinite delay in surcharge removal. If a suitable means for making reliable temperature corrections to the readings of the piezometer gages, which we believe that removal could, if necessary, begin by in August. ¶ To this end, we suggest the fabrication and use of possibly four dummy gages, each consisting of a pair of rods in a casing of the same type as that in the actual gages. One rod of each pair would be of identical size and material to that in the actual gages, and the other of invar of the same dimensions. Each assembly would terminate in a block of concrete placed on top of the fill ~~adjacent to~~ inside the building, adjacent to an active gage. The locations would be selected to

(over) S.702986

provide a range in length of dummy gages corresponding to the maximum range of the actual gages in the building.

In addition, ~~no reading~~ all readings should be interpreted carefully and corrected for thermal effects. To the extent possible, readings should be made under constant conditions, as in the early morning.

Loose sands beneath the building will not compromise the static bearing capacity or lead to settlement under static loads applied after surcharge removal. Some settlement must be expected due to vibration of the ~~gas~~ diesel engines; this should preferably be induced by operating the machines before general dewatering of the area, whereupon the settlement will be correspondingly reduced during use of the machines in the future. Earthquake-induced settlements are discussed under Liquefaction Potential

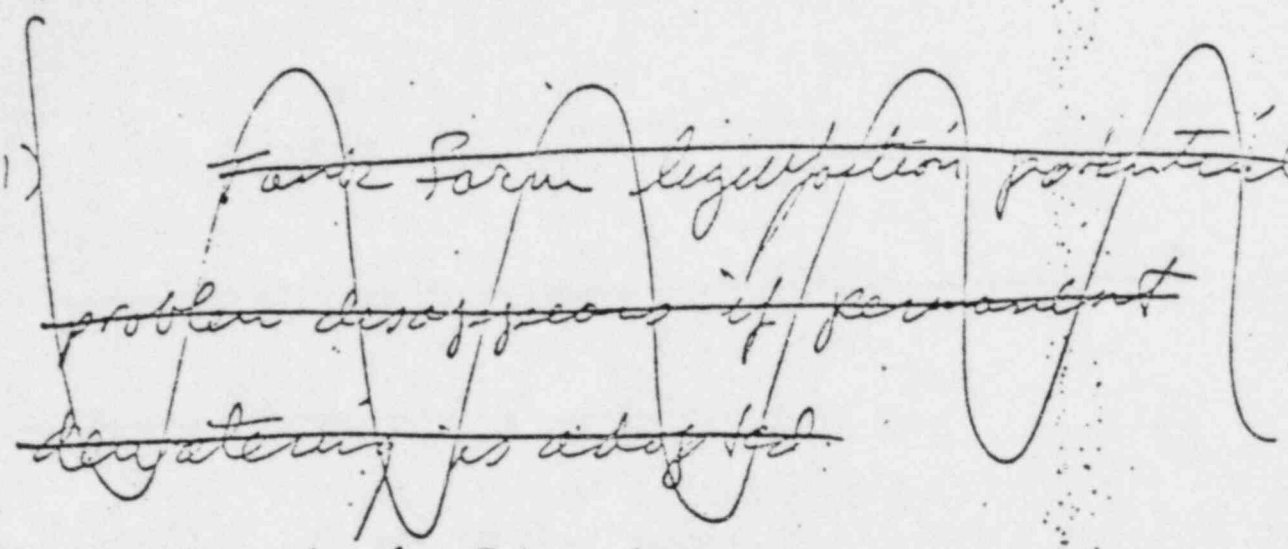
5) Need for Removal of Soft Sandy Underlying Diesel Generator Structure

As general, permanent bearing is desired, there is no need to excavate the loose sand under the diesel generator building. Their stiffness and bearing capacity is fully adequate for the structural dynamic bearing pressure. The connection of pipes and the building, as against which the building must be capable of taking the differential settlement arising from the fact that the sands on the north side of the Diesel generator building will undergo more seismic shaking settlement than the south

S.702988

soil of the structure supported on adequate backfill is not likely to settle significantly under the seismic loading."

SJ702989



(-1) ~~Basic form liquefaction potential problem disappears if permanent displacements is adopted~~

7. Service Water Structure

(-2) Service water structure underpinning with driven piles and a cortel is a positive solution. Even if liquifaction occurs, the piles maintain their buckling load as a minimum. The analysis of the structure should treat ~~the~~ piles in the normal manner; if the buckling load is ~~not~~ lower bound, the analysis should treat the piles as applying an upward load equal to the buckling load to the structure. The horizontal forces act

S.702990

main portion of the structure.

S8702931

C-2645

Bechtel Associat , Professional Corporation

Inter-office Memorandum

To	R. L. Castleberry	Date	31 July 1979
Subject	Midland 1 & 2-Job 7220-101 NRC Meeting July 18, 1979	From	S. S. Afifi
		Of	Geotechnical Services
Copies to	S. L. Blue H. H. Burke/W. R. Ferris w/a J. O. Wanzeck w/a K. Wiedner w/a 1320, 2140, 3130	At	Ann Arbor 10(D)5 7220-79-138

Attached you will find R. W. Loughney's summary of his presentation at the July 18, 1979 meeting with the NRC.

JOW wanzeck for/SSA
S. S. Afifi

JOW/lap
Attachment

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S3703012

LOUGHNEY DEWATERING INC.

Dewatering and Soil Stabilization Services and Systems

P. O. BOX 1388, ANN ARBOR, MICHIGAN 48106
313-761-3481

2280 GRAND AVENUE
BALDWIN, N. Y. 11510
516-223-9500

July 26, 1979

Bechtel Associates Professional Corp.
P.O. Box 1000
777 E. Eisenhower Parkway
Ann Arbor, Michigan 48106

Attention: Mr. Sherif S. Afifi, P.E. Re: Midland Power Plant
Permanent Dewatering System

Dear Sir:

Per your request attached please find a written description of the slide presentation of the proposed Permanent Dewatering System for the Midland Power Plant that was presented at the N.R.C. meeting, July 18, 1979.

We trust that this is sufficient for your present needs. Please call should any part require further clarification.

Very truly yours,
LOUGHNEY DEWATERING INC.

Richard W. Loughney
President

RWL/rr
Attachment

S5703013

PRESENTATION AT N.R.C. MEETING JULY 18, 1979

MIDLAND POWER PLANT

Slide 1 - Plan View of Area Dewatering System. The soil as described before by others generally consists of sand and or clay fill placed on the original sand or clay strata. The original sand generally extends from elevation 570 to elevation 600 with clay beneath the sand - though in a few areas the underlying clay extends to the original ground surface.

The present ground water level is about elevation 627 - the cooling pond level.

An impervious cut off wall has been constructed around the West, North and East sides of the area. The cut off wall, a slurry trench or clay core, extends into the original clay till. The source of recharge for ground water within the Q listed area is rainfall and the cooling pond water from the South side of the area, and some minor seepage through the cut off wall.

The coefficient permeability of the soil as determined from the initial pumping test conduct in Auxiliary Building area is less than 0.007 feet per minute. Additional data about the permeability of the soil and total yield will be obtained during temporary dewatering of the Valve Pits and Electrical Penetration Rooms. Also there are considerable grain size data available from the extensive boring program that has been carried out at the site.

The present conception is to enclose the Q listed area with a permanent exterior dewatering system. The dewatering system would consist of submersible deepwells that would extend to the original clay till. Approximately 200 to 300 deepwells would be installed. The number required to maintain the ground water at the desired level would be operated and the remainder would be redundant. There would be sufficient redundancy to provide for interruption of parts of the system, also 100 percent standby diesel powered generators would be provided.

The pumps would be wired electrically such that they are staggared and sectioned so that one interruption does not affect a continuous length of the dewatering system.

The permanent interior dewatering system would be used to mop up ground water remaining within the area enclosed by the perimeter dewatering system. The wells would be pumped as required to remove ground water that collects within the exterior perimeter system because of the recharge from rain, shut down etc.

The ground water removed would be monitored to assure that no fine lines are being removed from the soil.

8703014

After an initial pumping period of about six months the basin that is dewatered should be large enough that the permanent dewatering system could be down completely from one to two weeks before a significant rise in the water level within the dewatered area would occur. The principal source of recharge is the cooling pond and the rate the ground water flows through the soil from the pond is low.

Piezometers would be located at key points to monitor the ground water level and alert the plant when the ground water has risen above a predetermined elevation.

Slide 2 - A N-S section through the area to be dewatered. The deepwells would extend to the original clay till, they would be spaced close enough to cut off the flow of water into and remove the water from within the Q listed area.

Slide 3 - The dewatering system would be buried below the frost depth. The necessary disconnections would be provided to permit screening the deepwells. In area of heavy traffic a manhole would be provided for access to the deepwells.

The capacities of the well screens (6" diameter) are considerably in excess of the anticipated equilibrium flow of 1 to 10 gpm per well. The well screen diameter, 6 inches, is necessary to provide the clearance required for the submersible pump.

The well screens would extend the full depth of the soil to be dewatered and they would be encased in a select sand filter for their full depths.

Slide 4 - For areas where there is no objection to having a slight protrusion above the ground surface, pitless adaptors would be used to provide access to the wells and pumps instead of manholes.

Slide 5 - A sketch of an interior permanent deepwell. Smaller diameter wells would be used to remove the water perched within the Q listed area. These wells would be pumped initially and occasionally therefore as required.

In my judgment the system would be fool proof.

S3703015

Bechtel Associates Professional Corporation

Inter-office Memorandum

To R. [illegible] tleberry

Date 25 July 1979

Subject Midland Units 1 & 2
Job Number 7220-001
NRC Meeting - July 18, 1979

From S. S. Afifi

Of Geotechnical Services

At Ann Arbor 10 D 5
7220-79-130

Copies to S. L. Blue w/o
H. H. Burke/W. R. Ferris w/a
J. O. Wanzeck w/o
K. Wiedner w/a
1320, 3130

Attached you will find C. H. Gould's summary of his presentation at the July 18, 1979 meeting with the NRC. The summary has been requested by the NRC.

J. O. Wanzeck for/SSA
S. S. Afifi

JOW/nm
Attachments

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XC [redacted]

XC 8-15-79

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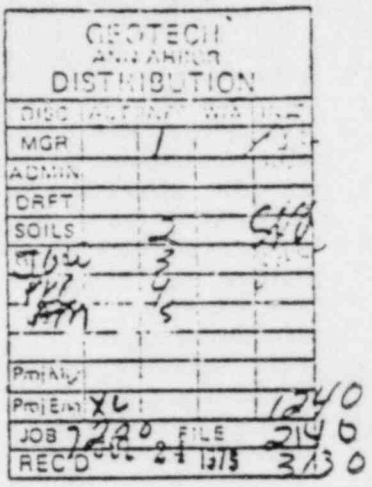
C. H. GOULD, P.E.
1165 Bardstown Trail
Ann Arbor, Mi 48105
313/663-5028



July 23, 1979

Bechtel Associates Professional Corporation
777 East Eisenhower Parkway
P. O. Box 1000
Ann Arbor, Michigan 48106

Attention: Dr. S. Afifi

Reference: Meeting with NRC, July 18, 1979

Dear Sherif:

Enclosed is an outline summary of my presentation at the referenced meeting. The outline correlates to the overhead slide sequence previously furnished the NRC.

Yours very truly,

C H Gould

C. H. Gould, P.E.
State of New York

CHG/nm
Enclosure

S/703026

C. H. GOULD, P.E.

1. Chuck Gould, private consultant to Bechtel on underpinning.

2. Remedial measures for "Wings"

   A. Locate on plan
   B. Explain 1/2 plan and symetry.
   C. Electrical penetration area of auxillary building equals "wings"

3. Design of Remedial Measure

   A. Area to be supported equal crosshatched area
   B. Underpinning design

      1) Permanent, positive and tested support

         a. Passing thru fill
         b. Founded in undisturbed till.

      2) Provide installation procedure capable of

         a. Passing thru

            (1) Loose sands
            (2) Soft clays
            (3) Dewatered state
            (4) Man-made (concrete) obstructions
            (5) Highly compacted sand and/or clay

         b. Minimizing loss of ground

         c. Jacked caissons

            (1) Push thru loose and soft materials without excavation
            (2) Man-size access for demolition of obstructions and excavation of compacted soils.

4. Plan of Attack

   A. Temporary support of valve pit at ground surface.

      1) Bearing on turbine foundation walls and buttress access shaft

   B. Excavate access shaft
   C. Mine drift under valve pit
   D. Install permanent caissons under end of wing

      1) Control settlement to 1/2 inch
      2) Stress, test and transfer load.

   E. Install temp support caissons and tangent caissons in vicinity of isolation valve pit.
   F. Mine excavate all fill under isolation valve pit down to till
   G. Fill excavation and drift under wing with concrete
   H. Transfer valve pit to mass concrete

SB703027

5. Questions

NOTE: For the record Dr. R. Peck stated that a group load test to 1.5 times design load* would be performed on the caissons which support the wing. I communicated to both Dr. Peck and Lyman Heller that it was our intention to load test each caisson individually to 1.5 times design load and group test to 1.0 times design load or a maximum upward vertical movement** of the structure not to exceed 1/4"; whichever occurrs first.

* Design load = calculated dead and line load.
** Movement = distance travelled during the test period of time.

Telecopy D. W. HALLIGAN
MET 36

Bechtel Power Corporation

Inter-office Memorandum

To D. W. Halligan

Subject Midland Units 1 and 2
Consumers Power Company
Bechtel Job 7220
PLANT FILL SETTLEMENT

Copies to
R. D. Allen
P. A. Becnel
R. L. Castleberry
H. B. Friend
P. K. Hansen
F. A. Hollenbach
M. G. Johnson
L. C. McKillip
H. O. Reinsch
E. A. Rumbaugh
H. W. Wahl
K. Wiedner
R. K. Vassar

Date July 2, 1979

From P. A. Martinez JOB 7220

Of Project Management

At Ann Arbor office

File 0614

	ACT.	INFO COPY	INIT.
ASST. P. E.			
ASST. P. E. P		1	MC
ASST. P. E. F			
MECH.			
ELECT.			
CS			
CIVIL	3		
P.D.			
ARCH.			
Q.E.			
C.TR./ENGR. PL.			
PROJ. MGR.			
PROC. MGR.			
FIELD			
CONST. COORD.			
FSAR			
ADMIN.			
FILE NO.	0670.2		

XC 7-30-79

A meeting between Consumers Power Company, Bechtel, and consultants was held in Denver as planned on June 28, 1979. The following conclusions were reached.

(1) Although a safety factor of 1.5 against liquefaction does not exist in all areas, consultants believe that there is no liquefaction problem; however, because of the difficulty of proving this to NRC and others and because of the possibility of an increase in the basic ground acceleration from .12g to .20g, which would aggravate the liquefaction potential, consultants recommended, and it was concluded, that areal dewatering is the most appropriate solution.

(2) Dewatering would be by a deep well system of approximately 300 wells to be operational for the life of the plant. The steady state in flow from the pond and precipitation was estimated by consultants to be about 400 gpm. Consultants felt that the dewatering system need not be Q listed and would cost on the order of $1 to 2 million installed. A Q listed instrumentation system for ground water level observation will be used.

S 7703049

(3) Since liquefaction potential is totally eliminated, chemical grouting will not be required.

(4) Contrary to the June 22 report item (3) which stated that possibly underpinning of the electrical penetration room may not be required, it has now been concluded that due to the presence of soft clay under the foundation, underpinning will be required.

A meeting has been scheduled with NRC in Bethesda on July 18 rather than July 10 as previously scheduled to review the remedial action program. The July 19 meeting for NRC to review conservatism in the selection of the basic ground acceleration levels is still on.

P. A. Martinez

PAM/pp

S.703050

ANN ARBOR

bcc S. BLUE w/o
bcc S. AFIFI w/o
bcc R. CASTLEBERRY w/o
bcc S. LO w/o

MEMORANDUM

TO P. K. CHEN LOCATION AAO - GEOTECH.

FROM S. C. FOELBER DATE 13 JULY 19 7

SUBJECT EARTHQUAKE ACCELERATION TIME HISTORY RECORD JOB NO ~~7220-101~~ C-2645

FILE [redacted] w/a

IN RESPONSE TO YOUR REQUEST (MEMO TO S. FOELBER FROM P.K. CHEN RE EARTHQUAKE ACCELERATION TIME HISTORY RECORD, 13 JULY 1979, FILE 1320) THE FOLLOWING INFORMATION IS ATTACHED.

A. A LISTING OF THE OUTPUT EARTHQUAKE ACCELERATION TIME HISTORY AT THE FOUNDATION OF THE DIESEL GENERATOR BUILDING FOR EACH OF TWO (2) SOIL CONDITIONS

1. SOIL WITH A SHEAR WAVE VELOCITY OF 1360 FT/SEC (MEAN SOIL CASE).

2. SOIL WITH A SHEAR WAVE VELOCITY OF 500 FT/SEC.

SB703051

B. A LISTING OF THE OUTPUT EARTHQUAKE ACCELERATION TIME HISTORY AT THE FOUNDATION LEVEL OF THE AUXILIARY BUILDING CONTROL TOWER AND RAILROAD BAY. THE LOCATION OF THE CONTROL TOWER FOUNDATION CORRESPONDS TO MASS POINT 5 IN THE COMPUTER

- ANN ARBOR

MEMORANDUM

TO P.K. CHEN LOCATION AAO-GEOTECH

FROM J.C. FOELBER DATE 15 JULY 19 7

SUBJECT EARTHQUAKE ACCELERATION TIME HISTORY RECORD JOB NO 7220-101

FILE C-2645 w/a

LISTING. THE LOCATION OF THE RAILROAD BAY FOUNDATION CORRESPONDS TO MASS POINT 4 IN THE COMPUTER LISTING.

EARTHQUAKE ACCELERATION TIME HISTORIES ARE PROVIDED FOR THE OBE CONDITION IN THE NS, EW AND VERTICAL DIRECTIONS FOR BOTH BUILDINGS.

THE TIME INCREMENT BETWEEN SUCCESSIVE ACCELERATIONS IS 0.01 SECONDS FOR THE TIME HISTORIES OF THE AUXILIARY BUILDING. THE TIME INCREMENT FOR THE TIME HISTORIES OF THE DIESEL GENERATOR BUILDING IS 0.01 SECONDS FOR SOIL CONDITION 1 AND 0.005 SECONDS FOR SOIL CONDITION 2.

John C. Foelber

S3703052

REVISED 02-15-76

SOIL CONDITION 1

MIDLAND DIESEL BLDG-SEISMIC ANALYSIS N-S ORE= 6% G MEAN SOIL CASE

MASS PT 4 TIME HISTORY

S5703053

-.000[illegible]	-.0[illegible]711	-.001347	-.002339	-.002875	-.002371	-.001270	-.000795	4	1
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S2703054

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-.017575	-.013545	-.012849	-.009955	-.010273	-.011121	-.007152	-.004744	4	143
-.008783	-.010227	-.011235	-.013691	-.008353	-.005862	-.002823	.002241	4	144
.009271	.014317	.017240	.022961	.026259	.027722	.020893	.027752	4	145
.013541	.011337	.008372	.012136	-.003456	-.014287	-.011607	-.014741	4	146
-.015740	-.017469	-.017407	-.023555	-.019023	-.006895	.000965	.011661	4	147
.013735	.016467	.024467	.024021	.021949	.021784	.021343	.014178	4	148
.008664	.010345	-.007221	-.013597	-.014530	-.011951	-.019527	-.014459	4	149
-.012369	.001139	.002587	.000394	.004143	.009511	.014035	.015661	4	150
.011121	.003556	-.004165	-.008240	-.004234	-.007053	-.005606	.000683	4	151
.033295	.008569	.012423	.003465	.029251	.018277	.021868	.011006	4	152
.006587	.003605	.003935	-.003796	-.004237	-.004650	-.006044	-.003295	4	153
-.001475	.001552	-.013369	-.008915	-.005780	-.001905	-.007807	-.014244	4	154
-.015570	-.016404	-.006577	-.000760	-.000845	-.002203	-.004916	.014968	4	155
.002276	.013520	.019113	.014795	.018623	.010275	.013603	-.010719	4	156
-.032973	-.032604	-.033133	-.034990	-.033514	-.029650	-.029650	-.014345	4	157
-.006703	.007119	.025460	.024033	.030114	.034494	.025042	.032514	4	158
.024423	.007314	.006398	-.002992	-.001352	.004273	.028536	.015401	4	159
.021765	.015133	.048700	.049363	.043966	.041464	.012175	-.001664	4	160
-.014401	-.025711	-.035115	-.043697	-.040100	-.038577	-.031289	-.022255	4	161
-.000718	.007424	.018653	.017465	.010410	-.002762	-.006605	-.011830	4	162
-.021529	-.034152	-.045605	-.043647	-.042418	-.029893	-.020009	.014571	4	163
.017242	.033575	.042017	.043004	.042642	.033164	.046393	.025535	4	164
.033381	-.015329	-.027182	-.031744	-.033811	-.033657	-.029575	-.033932	4	165
-.022927	-.015349	.003755	.003549	.003873	.004303	.001325	-.000172	4	166
-.004657	-.008515	-.021713	-.015143	-.018697	-.022743	-.023324	-.016041	4	167
-.033933	-.031644	.003435	.005481	.005148	.005187	-.000351	-.006162	4	168
-.010977	-.015414	-.023273	-.026192	-.026958	-.023303	-.011173	-.000391	4	169
.010722	.022324	.037272	.036265	.044958	.047472	.037986	.032299	4	170
.025726	.013951	.000326	-.006596	-.013275	-.016296	-.012410	-.000168	4	171

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[illegible]	[illegible]	.017695	.018469	.018866	.015678	.017759	.021259	4	172
[illegible]	[illegible]	-.000751	[illegible]	-.010547	[illegible]	-.007993	-.009414	4	173
[illegible]	[illegible]	[illegible]	-.010777	-.011344	-.011669	-.012177	-.020331	4	174
[illegible]	[illegible]	[illegible]	-.030473	-.027967	[illegible]	-.021677	-.008986	4	175
[illegible]	[illegible]	[illegible]	.025857	.035057	.041583	.028866	.028365	4	176
[illegible]	[illegible]	-.027753	-.022354	-.033554	[illegible]	-.042585	-.043826	4	177
[illegible]	[illegible]	-.020413	-.020479	-.013476	-.005931	.002034	.006859	4	178
[illegible]	[illegible]	.009394	.014555	.007579	.010874	.007738	.013001	4	179
[illegible]	[illegible]	.020547	.014552	.017630	.013834	.013246	.009662	4	180
[illegible]	[illegible]	-.011569	-.013712	-.011348	-.009033	-.009744	-.013125	4	181
[illegible]	[illegible]	.001679	.011297	.014733	.013498	.013200	.007632	4	182
[illegible]	[illegible]	.006292	-.000424	-.007935	-.013576	-.016554	-.006157	4	183
[illegible]	[illegible]	-.005353	.002373	.007849	.012690	.016437	.009089	4	184
[illegible]	[illegible]	.006154	.003507	.000946	[illegible]	.000675	.001065	4	185
[illegible]	[illegible]	[illegible]	.014869	.014713	.010411	.012386	.012507	4	186
[illegible]	[illegible]	.005947	-.003120	-.003739	-.007822	-.007102	-.007806	4	187
[illegible]	[illegible]	-.001723	.003292	.007614	.010697	.009389	.009622	4	188
[illegible]	[illegible]	[illegible]	-.001619	-.007326	-.013342	-.014705	-.015943	4	189
[illegible]	[illegible]	[illegible]	-.012553	-.012343	-.010580	-.007518	-.004195	4	190
[illegible]	[illegible]	[illegible]	[illegible]	-.001781	.001114	.001988	.003820	4	191
[illegible]	[illegible]	.008136	.011291	.012149	.011195	.009934	.009297	4	192
[illegible]	[illegible]	[illegible]	-.001432	-.002177	-.002021	-.002073	-.001958	4	193
[illegible]	[illegible]	[illegible]	[illegible]	.007714	.007724	.006353	.005004	4	194
[illegible]	[illegible]	[illegible]	-.009677	-.009654	-.012642	-.017469	-.015293	4	195
[illegible]	[illegible]	[illegible]	-.012437	-.010094	[illegible]	-.002383	-.000433	4	196
[illegible]	[illegible]	.003725	.005794	.007154	.006596	.007745	.008694	4	197
[illegible]	[illegible]	[illegible]	-.001231	-.001495	-.001935	-.003072	-.004415	4	198
[illegible]	[illegible]	[illegible]	.000131	.000559	.000852	.002015	.004211	4	199
[illegible]	[illegible]	[illegible]	.002913	.007448	.006660	.006592	.008554	4	200
[illegible]	[illegible]	.003139	.001213	.001592	.003527	.004271	.006619	4	201
[illegible]	[illegible]	[illegible]	.007917	.009522	.010790	.010477	.008244	4	202
[illegible]	[illegible]	[illegible]	.003558	.001493	.000155	.001817	.000079	4	203
[illegible]	[illegible]	[illegible]	-.003314	-.002139	[illegible]	-.005399	-.008506	4	204
[illegible]	[illegible]	[illegible]	-.002311	-.001456	[illegible]	.004974	.004453	4	205
[illegible]	[illegible]	[illegible]	.001164	-.000224	[illegible]	-.008532	-.011828	4	206
[illegible]	[illegible]	[illegible]	-.003309	-.006343	-.003901	-.000535	.002633	4	207
[illegible]	[illegible]	[illegible]	.003605	.003675	.001882	.000950	.000142	4	208
[illegible]	[illegible]	[illegible]	-.001299	.000630	.002575	.004068	.004895	4	209
[illegible]	[illegible]	[illegible]	.003945	.003449	.002557	.000079	-.000208	4	210
[illegible]	[illegible]	[illegible]	[illegible]	.000080	.000273	.000555	-.000152	4	211
[illegible]	[illegible]	[illegible]	-.001750	-.002449	[illegible]	-.004171	-.004532	4	212
[illegible]	[illegible]	[illegible]	-.001904	-.001347	-.000601	.000420	.000803	4	213
[illegible]	[illegible]	.000143	-.001270	-.001493	-.001819	-.002213	-.002504	4	214
[illegible]	[illegible]	[illegible]	-.004567	-.003367	-.003397	-.002572	-.002876	4	215
[illegible]	[illegible]	[illegible]	-.002754	-.002423	-.001778	-.001428	-.002025	4	216
[illegible]	[illegible]	[illegible]	[illegible]	.000571	.000143	-.000333	-.000663	4	217
[illegible]	[illegible]	[illegible]	-.001943	-.001954	[illegible]	-.002334	-.001757	4	218
[illegible]	[illegible]	.000372	.000770	.001032	.000987	.001724	4	219
[illegible]	[illegible]	.001469	.001677	.001600	.001541	.001538	.001277	4	220
[illegible]	[illegible]	.001997	.001065	.000939	.000812	.001212	.000681	4	221
[illegible]	[illegible]	.001183	.000505	.000701	.000384	.000279	.000323	4	222
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	223
[illegible]	[illegible]	[illegible]	.001635	.001672	.002912	.002553	4	224
[illegible]	[illegible]	.001379	.001551	.001586	.001024	.000804	-.000732	4	225
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	226
[illegible]	[illegible]	.000734	.000791	.000451	.000135	.000075	.000043	4	227
[illegible]	[illegible]	.000147	.000172	[illegible]	[illegible]	.000079	.000439	4	228
[illegible]	[illegible]	[illegible]	.000256	.000329	.000430	.000301	-.000247	4	229
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	230
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.000452	.000536	4	231

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.033244	.000662	.000351	-.000113	-.000572	-.000777	-.000574	-.000512	4	232
.002217	.000527	.000492	.000573	.000947	.001194	.001263	.001367	4	233
.001243	.001180	.000764	.000541	.000366	.000299	.000370	.000544	4	234
.000674	.000680	.000716	.000849	.001431	.001837	.001771	.001454	4	235
.001461	.001264	.001199	.000569	.000917	.001123	.000714	-.000093	4	236
.000461	.000235	.000419	.000463	.000751	.000341	-.000189	.000359	4	237
.000244	.000063	.000498	.000341	.000331	.000237	-.000972	-.000315	4	238
-.000411	-.000466	-.000793	-.000873	-.000579	-.000573	-.000460	-.000256	4	239
-.000212	-.000163	.000419	.000252	.000289	.000183	-.000389	-.000215	4	240
-.000245	-.000285	-.000439	-.000563	-.000513	-.000435	-.001217	-.001065	4	241
-.000242	.000221	.000423	.000356	.000332	.000344	.001195	.001293	4	242
.000232	.000233	-.000166	-.000354	-.000535	-.000744	-.000915	-.001093	4	243
-.000225	-.000263	-.000360	-.000187	-.000043	-.000557	-.000731	-.000674	4	244
-.000356	-.000247	-.000413	-.000341	.000036	.000241	.000379	.000392	4	245
.000159	.000171	.000163	.000191	.000020	.000333	.000342	.000543	4	246
.000524	.000451	.000199	.000152	.000194	.000444	.000527	.000457	4	247
.000174	.000179	.000179	.000134	.000127	.000135	.000043	.000093	4	248
-.000168	-.000213	-.000125	.000215	.000247	.000413	.000353	.000262	4	249
.000275	.000217	.000062	.000027	.000174	.000743	.000652	.000743	4	250
.000123	.000127	.000536	.000383	.000381	.000671	.000274	.000255	4	251
.000156	.000247	-.000394	-.000385	-.000265	-.001017	-.000997	-.000515	4	252
-.000227	-.000183	-.000191	-.000131	-.000133	.000313	.000333	.000557	4	253
.000248	.000252	-.000033	-.000139	-.000465	-.000515	-.000565	-.000376	4	254
-.000265	-.000197	-.000379	-.000157	.000191	.000319	.000617	.000723	4	255
.000177	-.000165	.000396	-.000253	-.000342	-.000371	-.000385	.000178	4	256
.001421	.001253	.001156	.001226	.001440	.001555	.001453	.001296	4	257
.000253	.000783	.000463	.000307	-.000215	-.000372	-.000479	-.000428	4	258
-.000255	-.000232	-.000275	.000059	.000113	.000352	.000467	.000499	4	259
.000213	.000121	-.000343	-.000229	-.000476	-.000581	-.000452	-.000755	4	260
-.001137	-.001248	-.001336	-.000917	-.000823	-.000724	-.000752	-.000898	4	261
-.000425	-.000465	.000333	.000255	-.000133	-.000203	.000330	-.000012	4	262
.000441	.000376	.000371	-.000063	.000022	.000179	.000215	.000325	4	263
.000185	.000159	.000167	.000212	.000192	-.000305	-.000303	-.000543	4	264
-.000246	-.000265	-.000553	-.000089	-.000619	-.000462	-.000252	.000435	4	265
.000283	.000142	.000154	.000243	.000135	.000371	.000525	.000525	4	266
.000355	.000189	-.000101	.000025	-.000168	.000099	.000246	.000384	4	267
.000139	.000299	.000145	.000352	.000739	.000458	.000253	-.000073	4	268
-.000334	-.000185	-.000712	-.001303	-.001045	-.001183	-.000735	-.000591	4	269
-.000283	-.000168	-.000351	-.000102	.000114	.000183	.000349	.000336	4	270
.000123	.000114	-.000293	-.000209	.000063	-.000171	-.000235	-.000403	4	271
-.000243	-.000355	-.000346	-.000444	-.000375	-.000354	-.000394	-.000356	4	272
-.000524	-.000523	-.000388	-.000295	-.000249	-.000287	-.000259	-.000202	4	273
-.000148	-.000373	.000005	.000052	.000073	.000122	.000182	.000203	4	274
.000222	.000206	.000141	.000226	.000139	.000275	.000171	-.000034	4	275
-.000352	-.000352	-.000551	-.000431	-.000325	-.000139	-.000772	-.000912	4	276
-.000217	-.000535	-.000327	-.000133	.000167	.000271	.000235	.000215	4	277
.000235	.000255	.000169	.000379	-.000000	-.000123	-.000249	-.000163	4	278
-.000073	.000092	.000243	-.000099	.000036	-.000043	.000045	.000167	4	279
.000166	.000164	.000012	-.000078	-.000083	-.000034	.000026	.000031	4	280
-.000025	-.000119	.000049	.000075	.000110	.000134	.000058	.000013	4	281
.000043	.000011	-.000134	-.000275	-.000356	-.000435	-.000476	-.000434	4	282
-.000249	-.000525	-.000525	-.000337	-.000445	-.000522	-.000537	-.000469	4	283
-.000538	-.000579	-.000570	-.000867	-.000577	-.000398	-.000104	-.000129	4	284
-.000011	.000093	.000139	-.000150	.000031	.000154	-.000205	-.000252	4	285
-.000259	-.000413	-.000461	-.000337	-.000243	-.000093	.000204	.000492	4	286
.000455	.000756	.000845	.001006	.001113	.001144	.001459	.001274	4	287
.001127	.001161	.001064	.001023	.001154	.001193	.000957	.000625	4	288
.000625	.000451	.000537	.000373	.000255	.000104	-.000010	.000044	4	289
.000133	.000229	.000361	.000354	.000343	.000537	.000564	.000719	4	290
.000464	.000633	.000664	.000747	.000855	-.000114	-.000261	-.000142	4	291

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.000171	.000174	.000127	.000211	.000187	.000111	-.000010	-.000160	4	293
-.000003	.000000	-.000021	.000255	.000108	.000232	.000061	.000297	4	294
.000000	.000171	.000123	.000023	-.000023	-.000329	-.000315	-.000366	4	295
-.000179	.000003	.000003	-.000829	.000109	.000246	.000428	.000519	4	296
.000002	.000002	.000001	-.000349	-.000313	-.000498	-.000594	-.000621	4	297
.000295	-.000264	-.000017	-.000375	-.000072	.000162	.000132	.000492	4	298
.000264	.000143	.000000	.000532	.000423	.000361	.000266	.000515	4	299
-.000143	-.000000	-.000021	-.000271	-.000019	-.001031	-.001071	.000000	4	300

SOIL CONDITION 2

MIDLAND DIESEL BLDG-SEISMIC ANALYSIS E-W DBE= .33 G MEAN SOIL CASE

MASS PT 4 TIME HISTORY

-.	-.	-.033315	-.002223	-.002956	-.002751	-.001774	-.001329	4	1
-.	-.	-.000133	.003570	.001513	.001791	.001569	.000514	4	2
-.	-.	-.003512	-.003603	.002323	.003837	.006359	.003341	4	3
.	.	.013562	.014447	.014927	.013582	.011565	.005733	4	4
.	-.	-.014323	-.011781	-.023553	-.005191	-.002215	4	5	
.	.	.002127	.004454	.005593	.004134	.004554	4	6	
.	-.	-.004197	-.003913	-.001423	.002313	4	7		
.	.	.003953	.002724	.005434	-.003117	4	8		
-.	-.	-.015329	-.014244	-.011464	-.007273	-.004477	4	9	
-.	-.	.003524	.006718	.003583	.003711	-.001572	4	10	
-.	-.	-.004771	-.003424	-.002569	-.003387	-.005379	-.001175	4	11
-.	-.	-.013941	-.013361	-.007773	-.006717	-.003573	4	12	
-.	-.	-.014334	-.014631	-.003556	-.003754	.003333	.001537	4	13
-.	-.	.007951	.015169	.013471	.014737	.006481	4	14	
-.	-.	-.004743	-.013943	-.005137	.002933	.003283	4	15	
.	.	.013335	.013331	.003167	.003775	.005769	.002559	4	16
-.	-.	-.004744	-.013483	-.011224	-.004491	-.005567	4	17	
-.	-.	.005136	.007715	.008581	-.003534	-.007713	4	18	
-.	-.	-.013331	-.007763	-.003464	.001744	.003523	.003395	4	19
.	-.	-.003563	-.000133	-.001129	-.002495	-.005711	-.003513	4	20
-.	-.	-.005327	-.002500	.002931	.003305	.004412	.002264	4	21
.	.	.007937	.005334	.004936	-.007541	-.013925	4	22	
-.	-.	-.011753	-.005758	-.001593	-.003542	.005553	-.001793	4	23
.	.	.003771	.004123	.003771	.003711	-.002593	-.011349	4	24
-.	-.	-.011621	-.009523	-.009739	-.001137	-.011113	-.013255	4	25
-.	-.	-.003554	-.003931	-.003365	-.009419	-.011133	4	26	
-.	-.	-.005571	.002971	.003237	.003735	.001325	-.003256	4	27
-.	-.	-.013353	-.013192	-.005543	.001131	.002753	.002773	4	28
.	.	.004432	.011023	.005131	-.005321	-.005154	4	29	
-.	-.	-.005534	-.003911	-.001111	-.002735	-.003757	4	30	
-.	-.	-.013792	-.009870	-.011023	-.010733	-.011522	4	31	
-.	-.	-.011351	-.007502	-.002922	.002724	.005533	.002241	4	32
-.	-.	-.009763	-.006350	-.001135	.000532	-.003135	-.002343	4	33
-.	-.	-.011533	-.004537	.001657	.003334	.002343	-.003335	4	34
-.	-.	-.005231	.000579	.005695	.005192	.006129	-.001372	4	35
-.	-.	.001331	.002521	.011411	.013515	.013977	.002123	4	36
-.	-.	-.011733	-.009511	.003444	.003742	.005541	.002771	4	37
-.	-.	.003537	.003534	.011172	.012377	.013115	.012335	4	38
.	.	.013541	.015773	.021719	.021723	.013393	.003373	4	39
-.	-.	-.022517	-.024183	-.013797	-.005640	-.000445	.000223	-.003398	4	40
-.	-.	-.014563	-.012183	-.007893	-.001660	.001795	-.003774	-.011258	4	41
-.	-.	-.022724	-.014701	-.005531	.003196	.010551	.014191	.003674	4	42
.	.	.003533	.003273	.003033	.001134	-.012225	-.023542	4	43	
-.	-.	-.021122	-.011773	.003429	.005521	.012354	.012173	4	44
.	.	.015564	.012743	.013172	.014664	.014714	.007372	.000535	4	45
-.	-.	-.005038	-.001315	.002551	.007795	.013537	.009505	.007713	4	46
.	.	.007437	.003523	.010135	.006152	-.002501	-.012715	-.022123	4	47
-.	-.	-.015715	-.013744	.005494	.001170	.003721	.007555	4	48	
.	.	.011113	.014473	.014137	.010513	-.002530	-.013912	4	49	
-.	-.	-.017751	.013025	.006732	.010111	.003375	-.010553	4	50	
.	.	.021732	.023633	.011111	.009534	.006437	4	51	

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[illegible]	[illegible]	-.033295	.033115	.020733	.025462	.021220	.010511	4	112
[illegible]	[illegible]	-.012543	.009345	-.009735	-.009716	-.002653	-.014330	4	113
[illegible]	[illegible]	-.017525	.011631	-.012332	.021978	.009364	-.011736	4	114
[illegible]	[illegible]	-.039821	.024721	.012574	.007482	-.008352	-.023655	4	115
[illegible]	[illegible]	-.041277	-.018547	-.017385	-.023353	-.028482	-.033035	4	116
[illegible]	[illegible]	.026123	.037731	.033095	.043772	.040927	.028136	4	117
[illegible]	[illegible]	.032532	.038963	.024643	.013432	-.000234	-.013454	4	118
[illegible]	[illegible]	.017395	.041324	.022415	.043344	.031349	.015413	4	119
[illegible]	[illegible]	.012500	.017030	.013537	.023569	-.011295	-.015174	4	120
[illegible]	[illegible]	.014163	.033756	.013477	.033434	.015723	-.002276	4	121
[illegible]	[illegible]	-.033364	-.033427	-.025520	-.015059	-.029225	-.034433	4	122
[illegible]	[illegible]	-.013358	-.001761	-.011143	-.009212	-.020355	-.029919	4	123
[illegible]	[illegible]	-.033894	.009279	.027738	.015429	-.002273	-.009243	4	124
[illegible]	[illegible]	-.031344	.034953	-.021953	-.013359	-.024257	-.033436	4	125
[illegible]	[illegible]	-.022711	-.014027	-.014333	-.013352	-.023146	-.024925	4	126
[illegible]	[illegible]	-.002753	.018581	.017333	.015678	.023182	.020337	4	127
[illegible]	[illegible]	.025324	.033554	.027171	.043191	.045053	.047748	4	128
[illegible]	[illegible]	.009364	.034208	.021343	.024431	-.002578	-.009521	4	129
[illegible]	[illegible]	-.014926	-.012644	-.018534	-.025044	-.027521	-.027231	4	130
[illegible]	[illegible]	-.023051	-.023529	-.026279	-.024126	-.013545	-.012072	4	131
[illegible]	[illegible]	.010242	-.011763	-.009449	-.007714	-.003373	-.004355	4	132
[illegible]	[illegible]	.002453	-.009079	-.009681	-.006539	-.003442	.000781	4	133
[illegible]	[illegible]	.017329	.023315	.012224	.020281	.007700	.013525	4	134
[illegible]	[illegible]	.025918	.012955	.009095	-.008525	-.003753	-.003489	4	135
[illegible]	[illegible]	.019471	.021553	.019975	.021043	-.003823	-.002953	4	136
[illegible]	[illegible]	-.008033	-.015748	-.020627	-.021733	-.019729	-.014449	4	137
[illegible]	[illegible]	.009231	.013725	-.010632	-.009939	-.011177	-.008177	4	138
[illegible]	[illegible]	.006782	.013243	.005837	.009931	.002574	-.001130	4	139
[illegible]	[illegible]	.003739	-.005915	-.020141	-.025334	-.020092	-.022951	4	140
[illegible]	[illegible]	.037544	.041729	.031430	.024437	.017371	.019167	4	141
[illegible]	[illegible]	.009235	-.008751	-.023801	-.028239	-.027252	-.017721	4	142
[illegible]	[illegible]	.007435	.013677	-.012313	-.022900	-.022737	-.015455	4	143
[illegible]	[illegible]	-.026257	-.012044	-.014533	-.013543	-.011524	.004591	4	144
[illegible]	[illegible]	.031411	.021417	.013131	.005334	.015555	4	145
[illegible]	[illegible]	.013333	-.013333	-.022567	-.020134	-.017521	-.012417	4	146
[illegible]	[illegible]	-.013017	-.022225	-.023348	-.016004	.005732	4	147
[illegible]	[illegible]	.027655	.013947	.006521	.008113	-.012039	4	148
[illegible]	[illegible]	.002773	-.014057	-.027731	-.029002	-.028479	-.011977	4	149
[illegible]	[illegible]	.016439	.016131	-.003803	-.014879	.002597	.013011	4	150
[illegible]	[illegible]	.009442	-.013772	-.025632	-.029625	-.015787	.005341	4	151
[illegible]	[illegible]	.033453	.015593	.013043	.003575	.009519	.010447	4	152
[illegible]	[illegible]	-.001296	-.017793	-.021347	-.015778	-.003597	.013373	4	153
[illegible]	[illegible]	-.012191	-.014555	-.025517	-.025659	-.021182	-.013455	4	154
[illegible]	[illegible]	-.008563	-.007532	-.023519	-.021933	.006194	.027451	4	155
[illegible]	[illegible]	.015402	.013717	-.013259	-.003551	.009725	.000670	4	156
[illegible]	[illegible]	-.021703	-.025103	-.023374	-.014579	-.025373	-.001959	4	157
[illegible]	[illegible]	.032945	.025695	.023035	.029112	.019349	.026393	4	158
[illegible]	[illegible]	-.001774	-.013332	-.015053	-.004879	.027693	.037584	4	159
[illegible]	[illegible]	.043131	.052143	.036743	.013572	-.001764	-.016954	4	160
[illegible]	[illegible]	-.049767	-.043446	-.040175	-.025772	-.010181	.004338	4	161
[illegible]	[illegible]	.027499	.018513	.003451	-.015377	-.027745	-.037696	4	162
[illegible]	[illegible]	-.050794	-.045527	-.015169	-.017576	-.000244	.034033	4	163
[illegible]	[illegible]	.057263	.043277	.033564	.027264	.017479	.003812	4	164
[illegible]	[illegible]	-.035329	-.037353	-.031711	-.019293	-.003127	.002031	4	165
[illegible]	[illegible]	.032343	-.011927	-.017243	-.013837	-.013719	-.021947	4	166
[illegible]	[illegible]	-.022074	-.014941	-.009272	-.015548	.000343	.003967	4	167
[illegible]	[illegible]	-.012447	-.002536	-.006223	-.006731	-.013564	-.015054	4	168
[illegible]	[illegible]	-.025636	-.023055	-.021742	-.014918	-.001353	.010660	4	169
[illegible]	[illegible]	.040954	.036943	.033274	.036200	.028324	.023253	4	170
[illegible]	[illegible]	-.015305	-.011435	-.013024	-.013257	-.004553	.007261	4	171

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.017255	-.020776	-.026927	.020563	-.013077	.004175	.002113	.005679	4	172
.009223	.006438	.000057	-.007275	-.011793	-.019479	-.004497	.002561	4	173
-.013531	-.011316	-.003220	-.018435	-.023238	-.030732	-.030460	-.029557	4	174
-.030254	-.026539	-.027735	-.031703	-.032182	-.027382	-.017472	.004735	4	175
-.017734	-.028542	.017274	.027312	.023636	.026451	.019503	.022545	4	176
-.024556	.013968	-.027153	-.026775	-.042572	-.044877	-.045470	-.035432	4	177
-.032716	-.012234	-.012960	-.015469	-.017911	-.019231	-.011351	-.000259	4	178
.009552	.019419	.005776	.008336	-.008447	.000379	.006513	.021584	4	179
.024436	.031972	.034635	.028727	.011091	.002565	-.000373	.000591	4	180
-.009535	-.006525	-.006563	-.018756	-.017315	-.016726	-.011459	-.005356	4	181
.000771	.003295	.005571	.008439	.007753	.007030	.009113	.007416	4	182
.018139	.027485	.022557	-.001624	-.012034	-.016262	-.016727	-.005721	4	183
-.030038	-.026911	.003541	.004455	.008754	.009513	.011514	.007136	4	184
.035236	.042176	-.008555	-.035037	-.035511	-.033560	.002270	.007340	4	185
.015451	.016643	.015693	.017273	.014173	.013173	.009169	.004032	4	186
-.002139	-.002734	.003515	-.010387	-.008125	-.007214	-.005043	-.003127	4	187
-.000156	.004159	.004197	.009911	.011974	.010335	.007776	.006595	4	188
.004227	.002183	-.006712	-.005753	-.009648	-.011378	-.013332	-.013525	4	189
-.021769	-.023432	-.025531	-.029103	-.031561	-.032356	-.030685	-.027747	4	190
-.033741	-.036524	-.032434	-.033714	-.033797	-.031711	-.030227	.003347	4	191
-.000483	-.014725	-.015429	.015313	.013123	.004721	.005244	.003273	4	192
.001118	.003379	.000675	-.001732	-.003336	-.003517	-.002421	.000735	4	193
.006857	.007814	.006764	.005531	.007551	.005014	.002456	.000511	4	194
-.020735	-.021315	-.023383	-.026532	-.027850	-.027879	-.016553	-.015479	4	195
-.018523	-.021280	-.020197	-.023434	-.023417	-.023533	-.005380	-.003344	4	196
.006224	.006726	.006873	.007225	.006538	.004557	.005134	.007436	4	197
.008162	.009925	.008517	.008351	-.003747	-.005179	-.006537	-.005424	4	198
-.003143	-.002529	-.006457	-.003029	-.000571	-.000395	.001454	.004762	4	199
.008824	.009218	.010934	.009812	.006970	.004262	.005643	.007672	4	200
.013353	.011556	.008432	.002757	-.003713	-.001436	.000164	.005533	4	201
.010037	.013235	.012033	.009553	.006552	.005849	.006514	.007946	4	202
.003223	.006761	.003133	.000569	-.003526	-.003715	.000223	.003065	4	203
.000716	.003545	.002330	-.002037	-.005206	-.005231	-.003275	-.001770	4	204
-.004743	-.004731	-.007967	-.006553	-.002318	.001135	.002043	.000472	4	205
.000310	.002852	.000551	-.002167	-.005703	-.006459	-.011733	-.013262	4	206
-.012749	-.011476	-.010235	-.013734	-.008185	.001025	.004903	.007321	4	207
.000726	.000544	.004472	.001113	-.001637	-.002977	-.002859	-.002905	4	208
-.001062	.000150	.000731	.002531	.004073	.005105	.007547	.007519	4	209
.001141	.001540	.000381	-.000543	-.001674	-.002064	-.002355	-.000950	4	210
-.004437	.003032	.003377	.001935	.002997	.003577	.003493	.001917	4	211
.000333	-.000161	-.000543	-.003833	-.006221	-.006151	-.004910	-.003357	4	212
-.003417	-.001987	-.000472	.000627	.001341	.001572	.001470	.000727	4	213
-.002125	-.001471	-.002969	-.004370	-.003791	-.003038	-.002073	-.001150	4	214
-.000929	-.001337	-.001623	-.002582	-.002774	-.003672	-.002703	-.003160	4	215
-.000162	-.000513	-.000752	-.000587	-.004237	-.002563	-.000123	.000135	4	216
.001112	.000762	.000293	.000064	.000034	.000140	-.000097	-.000011	4	217
-.003754	-.002598	-.003765	-.003369	-.002197	-.000673	.000055	.000344	4	218
-.000259	-.000794	-.000232	-.000577	.000419	.001295	.001521	.001537	4	219
.000752	.000287	-.000041	.000744	.001848	.002903	.003417	.002914	4	220
.001856	.000674	.000334	.000049	.000577	.001112	.001473	.001656	4	221
.000593	.000260	.000134	.000259	.001206	.001545	.001451	.001114	4	222
-.000335	-.001741	-.002402	-.003139	-.001931	-.001142	-.000284	-.000353	4	223
-.000432	-.000273	-.001336	.000251	.001734	.002779	.004113	.003506	4	224
.003415	.000724	.000137	.000327	.000710	.001530	.001416	.000496	4	225
-.000777	-.001164	-.002551	-.001773	-.000143	.001155	.001489	.000757	4	226
-.000556	-.001540	-.001613	-.000715	.000408	.001439	.001747	.001042	4	227
-.000637	-.001067	-.001256	-.000573	.000567	.001457	.001502	.001072	4	228
.000264	-.000758	-.000771	-.001323	.000479	.001432	.001452	.000377	4	229
-.002552	-.001373	-.002255	-.001354	-.000227	.000469	.000755	.000239	4	230
-.000519	-.001153	-.000771	.000175	.001257	.002111	.001774	.000930	4	231

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-.000357	-.001301	-.001342	-.000719	-.000008	.000498	.000469	-.000112	4	232
-.000342	-.000526	.000101	.001016	.001928	.002373	.002015	.001173	4	233
-.000134	-.000256	-.000241	.000253	.000953	.001339	.001171	.000768	4	234
.000113	.000206	.000518	.001321	.002184	.002473	.002233	.001354	4	235
.000342	.000153	.000272	.000329	.001174	.001633	.001355	.000372	4	236
.000207	-.000133	.000171	.000343	.001323	.001179	.000333	-.000223	4	237
-.000126	-.000376	-.000142	.000547	.001522	.001453	.000325	-.000325	4	238
-.000184	-.001744	-.001433	-.000424	-.000205	-.000352	-.000138	-.000577	4	239
-.000331	-.000747	.000013	.000741	.001344	.001177	.000359	-.001277	4	240
-.000181	-.002567	-.002335	-.001463	-.000690	-.000334	-.000471	-.000369	4	241
-.000162	-.000163	.000783	.001563	.002541	.001783	.001119	.000278	4	242
-.000457	-.000123	-.000525	-.000105	.000221	.000072	-.000402	-.000276	4	243
-.000316	-.001147	-.001126	-.000660	-.000303	-.000387	-.000921	-.001554	4	244
-.000287	-.001040	-.000334	.000111	.000363	.001113	.000844	.000513	4	245
.000183	.000109	.000502	.000229	.001018	.000753	.000253	-.000152	4	246
-.000153	-.000212	.000177	.000575	.001030	.001189	.000871	.000252	4	247
-.000193	-.000236	-.000045	.000166	.000330	.000210	.000302	-.000245	4	248
-.000332	-.000488	-.000113	.000517	.000879	.001011	.000722	.000234	4	249
-.000183	-.000305	.000323	.000967	.001134	.001166	.000352	.000531	4	250
.000133	.000463	.000744	.001331	.001365	.001250	.000533	-.000651	4	251
-.000424	-.000523	-.000353	-.000319	-.000330	-.000732	-.001071	-.001268	4	252
-.000226	-.000170	-.000110	.000565	.000665	.000749	.000252	.000641	4	253
-.000113	.000162	.000312	-.000581	-.000314	-.000433	-.001097	-.000839	4	254
-.000183	-.000251	.000224	.000559	.000719	.000561	.000426	-.000221	4	255
-.000287	-.000435	-.000254	-.000444	-.000541	-.000615	-.000546	.000037	4	256
.000159	.000531	.000373	.000312	.001592	.001533	.000736	.000520	4	257
.000146	.000211	.000267	.000333	-.000215	-.000475	-.000565	-.000358	4	258
.000181	.000479	.000459	.000696	.001244	-.000025	-.000237	-.000151	4	259
-.000133	.000329	.000359	-.000150	-.000541	-.000699	-.001051	-.000810	4	260
-.000271	-.000596	-.000483	-.000572	-.000635	-.001055	-.001211	-.001275	4	261
-.000171	-.000764	-.000333	.000134	.000345	-.000059	.000041	.000033	4	262
.000113	.000731	.000763	.000335	.000902	-.000295	-.000469	-.000262	4	263
.000159	.000547	.000759	.000813	.000437	-.000143	-.000382	-.000734	4	264
-.000112	-.000556	-.000433	-.000457	-.000777	-.000774	-.000573	.000139	4	265
-.000183	-.000581	-.000267	.001109	.001397	.000820	.000215	-.000134	4	266
-.000316	-.000418	-.000037	.000141	-.000060	.000383	.000255	.000873	4	267
.000183	.001751	.001321	.000436	-.000301	-.000800	-.000779	4	268
-.000284	-.000839	-.000541	-.000735	-.000732	-.001108	-.000757	-.000431	4	269
.000112	.000131	.000121	-.000129	-.000459	-.000679	-.000520	-.000142	4	270
.000171	.000419	.000417	.000267	.000611	-.000155	-.000256	-.000215	4	271
-.000183	-.000383	-.000405	-.000636	-.000621	-.000847	-.000704	-.000401	4	272
-.000265	-.000193	-.000137	-.000295	-.000432	-.000591	-.000252	-.000260	4	273
.000256	.000279	-.000003	-.000131	-.000203	-.000133	.000264	.000278	4	274
.000243	.000434	.000273	.000152	.000628	-.000019	.000355	.000071	4	275
-.000142	-.000457	-.000553	-.000136	-.000143	-.000122	-.000115	-.000731	4	276
-.000185	-.000449	-.000293	-.000772	.000139	.000498	.000467	.000373	4	277
.000214	.000200	-.000255	-.000174	-.000177	-.000037	-.000025	.000243	4	278
.000214	.000151	.000241	.000113	.000179	.000185	.000025	-.000015	4	279
-.000183	-.000157	-.000157	-.000147	-.000083	.000145	.000112	.000159	4	280
.000135	.000042	.000100	.000075	.000075	.000067	.000036	-.000024	4	281
-.000132	-.000283	-.000209	-.000314	-.000383	-.000418	-.000454	-.000401	4	282
-.000214	-.000434	-.000337	-.000343	-.000444	-.000567	-.000657	-.000567	4	283
-.000184	-.000413	-.000551	-.000721	-.000664	-.000459	-.000139	.000032	4	284
.000142	.000348	.000337	-.000951	-.000879	-.000136	-.000372	-.000358	4	285
-.000153	-.000447	-.000525	-.000470	-.000331	-.000140	.000368	.000181	4	286
.000173	.001115	.001014	.000747	.000740	.000661	.001059	.001175	4	287
.000132	.001217	.001127	.000785	.001063	.001203	.001139	.001035	4	288
.000214	.000533	.000273	.000003	-.000102	-.000048	-.000391	.000159	4	289
.000161	.000256	.000356	.000377	.000445	.000516	.000414	.000297	4	290
.000185	.000559	.000171	-.000117	-.000311	-.000348	-.000364	-.000272	4	291

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				.000273	.000370	4	292
				.000214	.000057	4	293
				.000256	.000374	4	294
				-.000491	-.000333	4	295
				.000379	.000442	4	296
				-.000794	-.000422	4	297
				.000251	.000079	4	298
				.000153	-.000218	4	299
				-.000139	.000000	4	300

SOIL CONDITION 1

MIDLAND DIESEL BLDG-SEISMIC ANALYSIS V-V DBE* 4% G MEAN SOIL CASE

S 703065

MASS PT 4 TIME HISTORY

[illegible]	-.000854	-.001177	-.001672	-.002176	-.002252	-.001557	-.000258	4	1
[illegible]	.001335	.001412	.000421	-.000554	-.001038	-.002104	-.001857	4	2
[illegible]	-.000436	-.000012	.000632	.001725	.003057	.004284	.005725	4	3
[illegible]	.008455	.009190	.008713	.007412	.005435	.003166	.000855	4	4
[illegible]	-.002117	-.002129	-.002173	-.002363	-.002551	-.002565	-.002092	4	5
[illegible]	-.000831	-.000104	.000182	.000371	.000799	.001131	.001457	4	6
[illegible]	[illegible]	-.001441	-.001554	-.001792	-.000799	.000727	.002595	4	7
[illegible]	[illegible]	.002153	.002062	.001106	.000073	-.000826	-.001759	4	8
[illegible]	-.006787	-.006739	-.007349	-.005622	-.004757	-.003239	-.002001	4	9
[illegible]	-.003274	-.003283	-.003523	-.003562	-.002395	-.000573	.000952	4	10
[illegible]	[illegible]	.000419	-.002073	-.005128	-.007875	-.009226	-.009324	4	11
[illegible]	-.004174	-.004317	-.007455	-.008665	-.009662	-.009647	-.008610	4	12
[illegible]	[illegible]	-.005455	-.008176	-.009144	-.007874	-.006626	.000512	4	13
[illegible]	.000073	.000314	.006174	.002800	-.001448	-.005022	-.007319	4	14
[illegible]	[illegible]	-.005909	-.007586	-.005265	-.002472	.000664	.003599	4	15
[illegible]	[illegible]	.006511	.005549	.004244	.002474	.000161	-.002355	4	16
[illegible]	-.005826	-.006308	-.005784	-.004507	-.002555	-.002094	-.003636	4	17
[illegible]	[illegible]	-.004247	-.003123	-.002367	-.002594	-.003191	-.003008	4	18
[illegible]	[illegible]	-.002157	-.000792	.000317	.000412	-.000363	-.001655	4	19
[illegible]	-.004124	-.004554	-.003873	-.002304	-.000738	.000144	-.000765	4	20
[illegible]	[illegible]	-.003462	-.003302	-.002142	.000127	.002668	.004071	4	21
[illegible]	.002579	.000611	-.001051	-.001827	-.002607	-.003703	-.004442	4	22
[illegible]	-.005457	-.005332	-.004787	-.003435	-.001583	.000599	.002429	4	23
[illegible]	[illegible]	-.003508	-.002335	-.000629	-.000914	-.000595	-.000340	4	24
[illegible]	[illegible]	-.007185	-.007139	-.007023	-.007233	-.007597	-.008110	4	25
[illegible]	[illegible]	-.006272	-.005612	-.005477	-.007298	-.005976	-.002941	4	26
[illegible]	[illegible]	.003343	.001327	-.001727	-.004544	-.006725	-.007151	4	27
[illegible]	[illegible]	-.002780	-.001744	-.000746	.001749	.003968	.004110	4	28
[illegible]	[illegible]	.000799	-.000168	-.000219	-.000107	-.001645	-.001631	4	29
[illegible]	[illegible]	.000867	.000815	-.000757	-.003487	-.006635	-.009155	4	30
[illegible]	-.010231	-.009479	-.011370	-.012100	-.011729	-.010058	-.008065	4	31
[illegible]	-.008392	-.007046	-.007412	-.006602	-.004932	-.002230	.000351	4	32
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.006704	.011370	4	38
[illegible]	.015352	.014344	.010223	.005433	.000793	-.002605	-.004109	4	39
[illegible]	-.003519	-.002829	-.001989	-.001382	-.002386	-.004490	-.006080	4	40
[illegible]	-.007669	-.007753	-.007579	-.007360	-.006521	-.006080	-.005952	4	41
[illegible]	-.005645	-.004762	-.002703	.000017	.002292	.004592	.005853	4	42
[illegible]	.002195	-.000419	-.003445	-.005913	-.006795	-.008772	-.010739	4	43
[illegible]	[illegible]	-.005703	-.002314	.000796	.002644	.003453	.003679	4	44
[illegible]	.005234	.007170	.008654	.009507	.009531	.008209	.006054	4	45
[illegible]	.001325	.000914	.001348	.003160	.005957	.008129	.008475	4	46
[illegible]	.003375	-.000591	-.003702	-.005310	-.005917	-.005503	-.005112	4	47
[illegible]	-.004457	-.003932	-.002799	-.000760	.001957	.004558	.006244	4	48
[illegible]	.005527	.004525	.003309	.002453	.002425	.002717	.001763	4	49
[illegible]	-.003838	-.003631	-.003457	-.001833	-.000608	.001697	.004032	4	50
[illegible]	.007323	.006748	.005281	.003294	.000576	-.000659	-.002537	4	51

-.037951	.006179	.006343	.003408	.003007	.002819	.004812	.007989	4	52
.010387	.011592	.012443	.011527	.010854	.011295	.012188	.013740	4	53
.014704	.016176	.016451	.015415	.014167	.012521	.011042	.010127	4	54
.010135	.011283	.011160	.009728	.008968	.009319	.010210	.013278	4	55
[illegible]	[illegible]	.020331	.021003	.020866	.020251	.020027	.019753	4	56
[illegible]	.017574	.016147	.014994	.014613	.015322	.016602	.017763	4	57
[illegible]	.015464	.013055	.010350	.008478	.008119	.008715	.009156	4	58
.037259	.035163	.032027	.028207	.026616	.002345	.006336	.011771	4	59
.016745	.017920	.017544	.016969	.016234	.015293	.016715	.017135	4	60
.014478	.013517	.012172	.009704	.002452	.000314	-.000133	.001277	4	61
[illegible]	[illegible]	.001362	-.002391	-.005552	-.009411	-.009584	-.008129	4	62
-.[illegible]	-.[illegible]	-.005493	-.008162	-.009003	-.007676	-.002724	.005178	4	63
.012473	.017778	.017920	.013428	.008190	.003260	-.000345	-.002176	4	64
-.[illegible]	-.[illegible]	-.006519	-.007366	-.009065	-.010105	-.011295	-.012412	4	65
-.013813	-.014331	-.014330	-.013225	-.011458	-.010325	-.008663	-.007125	4	66
-.005726	-.[illegible]	-.004988	-.[illegible]	-.002337	-.000400	.000974	.001487	4	67
[illegible]	-.[illegible]	-.002169	-.003852	-.005895	-.007710	-.008831	-.010166	4	68
-.[illegible]	-.[illegible]	-.004102	-.000812	.001749	.002680	.001991	.000330	4	69
-.[illegible]	-.[illegible]	-.007540	-.009241	-.010195	-.010518	-.010477	-.010179	4	70
-.[illegible]	-.[illegible]	-.005321	-.003135	-.001426	-.000774	-.000269	-.000547	4	71
-.[illegible]	-.[illegible]	-.022315	-.019358	-.014958	-.011519	-.009779	-.008188	4	72
.[illegible]	.[illegible]	.008528	.004575	-.000156	-.004716	-.006435	-.007555	4	73
-.[illegible]	-.[illegible]	-.021346	-.015792	-.008743	-.001708	.002999	.006147	4	74
.[illegible]	.[illegible]	.011630	.012339	.013576	.013776	.012613	.012003	4	75
.[illegible]	.[illegible]	.013076	.010333	.007486	.004583	.003779	.001435	4	76
-.[illegible]	-.[illegible]	-.007692	-.009722	-.010913	-.012429	-.012259	-.010174	4	77
-.[illegible]	-.[illegible]	.001925	.006579	.011360	.014549	.013761	.010390	4	78
.[illegible]	.[illegible]	-.005143	-.008614	-.011465	-.013732	-.014744	-.016782	4	79
-.017121	-.017541	-.017190	-.016250	-.014288	-.013682	-.019119	-.021535	4	80
-.021[illegible]	-.[illegible]	-.018710	-.015104	-.010943	-.007230	-.004768	-.001627	4	81
-.[illegible]	-.[illegible]	-.002870	-.003202	-.003023	-.001992	-.002277	-.003651	4	82
.[illegible]	.[illegible]	.002149	.002129	-.000009	-.004981	-.009202	-.009955	4	83
-.[illegible]	-.[illegible]	-.004534	-.001745	.000291	.002247	.003692	.004473	4	84
.[illegible]	.[illegible]	.002277	.000384	-.001563	-.002819	-.000775	.002005	4	85
.[illegible]	.[illegible]	.013901	.015721	.017038	.016890	.012779	.009037	4	86
.[illegible]	.002104	-.002113	-.005488	-.010494	-.012249	-.012597	-.010721	4	87
-.[illegible]	-.[illegible]	-.015015	-.018990	-.022322	-.023649	-.021885	-.018555	4	88
-.[illegible]	-.[illegible]	-.010855	-.011009	-.011912	-.012233	-.010127	-.008405	4	89
-.[illegible]	-.[illegible]	.002533	.004815	.006546	.007447	.005821	.005003	4	90
.[illegible]	-.[illegible]	-.[illegible]	.002960	.005649	.005384	.003031	-.000794	4	91
-.005072	-.007215	-.007513	-.007801	-.006748	-.002804	.001818	.005560	4	92
.006265	.009720	.008663	.006550	.004125	.000930	-.002332	-.003208	4	93
-.006438	-.000265	.004025	.008990	.012096	.012431	.011075	.009659	4	94
.[illegible]	.007537	.007926	.008128	.008264	.009163	.008900	.007037	4	95
.[illegible]	.[illegible]	-.000481	.000367	.002073	.003704	.004589	.005513	4	96
.[illegible]	-.[illegible]	-.011103	-.020109	-.026906	-.029876	-.029057	-.027091	4	97
-.[illegible]	-.[illegible]	-.017693	-.014067	-.010651	-.007133	-.003415	.000139	4	98
.[illegible]	.004380	.006441	.006569	.009187	.011291	.013167	.012372	4	99
.010051	.005815	-.002140	-.013437	-.019800	-.019683	-.015015	-.006561	4	100
.002123	.007197	.013594	.019508	.021498	.021196	.020940	.013721	4	101
.004505	-.[illegible]	-.011717	-.017229	-.018060	-.016435	-.014602	-.011038	4	102
-.006434	-.[illegible]	-.[illegible]	-.[illegible]	.002126	.005406	.008020	.013335	4	103
.[illegible]	.021964	.023197	.021605	.017849	.013459	.007615	.003363	4	104
.[illegible]	-.[illegible]	-.006509	-.006893	-.006334	-.004940	-.002294	-.001094	4	105
-.[illegible]	-.[illegible]	.000532	.004052	.007264	.008613	.011268	.013705	4	106
.[illegible]	.012410	.011082	.005309	.000517	-.000295	.001534	.004828	4	107
.[illegible]	.010350	.010518	.013491	.017083	.019376	.020559	.019428	4	108
.[illegible]	.[illegible]	.004037	-.001744	-.006223	-.009437	-.011322	-.013119	4	109
-.[illegible]	-.016961	-.018239	-.019978	-.021854	-.022886	-.023494	-.023775	4	110
-.[illegible]	-.[illegible]	-.025270	-.025133	-.023823	-.021566	-.018938	-.016360	4	111

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-.008523	-.004076	-.001176	-.000354	-.000778	-.000841	.000488	.002423	4	112
.004110	.003642	-.000256	-.002562	-.004254	-.005313	-.002380	.001041	4	113
.001458	-.001196	-.007754	-.009047	-.006965	-.003743	.000681	.001616	4	114
-.000053	-.003757	-.000603	-.001625	-.003236	-.004902	-.007589	-.010245	4	115
-.013749	-.013425	-.024805	-.027745	-.025839	-.021975	-.015235	-.007582	4	116
-.000237	.004763	.008794	.012725	.016499	.019438	.021018	.019801	4	117
.017 92	.014412	.012939	.011187	.009743	.009226	.009526	.010075	4	118
.012047	.010459	.011019	.013175	.015878	.016709	.015299	.012735	4	119
.003435	.007754	.004102	.004524	.003364	.002861	.002791	.004949	4	120
.000134	.002265	.007556	.007191	.006384	.005162	.003653	.001451	4	121
-.011063	-.012305	-.004478	-.005551	-.006962	-.007935	-.008242	-.010846	4	122
-.011552	-.013589	-.015549	-.016114	-.015823	-.014807	-.012989	-.010852	4	123
-.008156	-.008917	-.002501	-.001270	-.001157	-.001729	-.002563	-.003271	4	124
-.003730	-.006702	-.005524	-.005525	-.006672	-.006253	-.010675	-.013391	4	125
-.014235	-.015928	-.015514	-.016741	-.016568	-.015596	-.013384	-.010464	4	126
-.007525	-.005862	-.004737	-.003941	-.003175	-.002055	.001090	.005914	4	127
.018259	.015135	.021117	.020383	.022494	.021233	.020165	.026064	4	128
.022033	.022353	.021039	.019135	.015644	.010783	.005469	.000450	4	129
-.008163	-.008058	-.005411	-.010151	-.012357	-.016581	-.021258	-.023098	4	130
-.012739	-.010370	-.016057	-.012330	-.010242	-.008995	-.008345	-.005506	4	131
-.004470	-.004205	-.007059	-.005159	-.003084	-.001061	-.000145	-.000013	4	132
-.000307	-.001107	-.001572	-.001354	-.000877	.000179	.000912	.001941	4	133
.002512	.003305	.002479	.000693	.012243	.017590	.017944	.012964	4	134
.003750	.003393	.002663	.003745	.004805	.004817	.006190	.006776	4	135
.003747	.003551	.008201	.006379	.003406	-.001121	-.004534	-.005579	4	136
-.000731	-.003393	-.006186	-.005270	-.005897	-.004354	-.002565	-.003603	4	137
-.003749	-.003350	-.004621	-.[illegible]554	-.006165	-.005537	-.004259	-.001769	4	138
.000695	.001790	.004771	.009141	.010794	.007685	.002500	-.005292	4	139
-.010741	-.011880	-.009520	-.005496	-.001111	.002941	.006026	.008995	4	140
.011503	.013233	.013911	.015494	.016313	.015941	.012904	.008533	4	141
.009255	.008525	.002870	.001607	.000162	-.000747	-.002427	-.005421	4	142
-.000523	-.003900	-.009779	-.008624	-.007552	-.008019	-.008943	-.009275	4	143
-.003427	-.003710	-.008966	-.005551	-.002969	.001198	.004795	.007529	4	144
.008537	.011063	.011847	.012042	.012246	.012626	.011207	.010933	4	145
.010566	.009813	.008279	.008038	.005845	-.001153	-.008032	-.013061	4	146
-.014355	-.015922	-.011409	-.007055	-.003620	.000189	.002820	.005205	4	147
.007785	.008002	.010350	.012759	.012654	.011116	.009088	.006124	4	148
.003 [illegible]	.003455	-.001553	-.003723	-.005415	-.005213	-.006042	-.006784	4	149
-.003587	-.002751	.003318	.005343	.005982	.004792	.002425	.000272	4	150
-.001432	-.002649	-.003459	-.002616	-.000892	.001070	.003168	.006419	4	151
.003468	.011517	.012006	.008910	.004648	.005313	-.000829	-.001466	4	152
-.000969	.000743	.004838	.007008	.006692	-.011572	.002086	-.001383	4	153
-.004542	-.003740	-.008049	-.012001	-.013894	-.002558	-.007525	-.004171	4	154
-.001563	-.001135	-.001199	-.000883	-.001379	.007146	-.004107	-.000056	4	155
.003832	.009555	.014427	.015923	.013276	-.007337	.000802	-.009331	4	156
-.014706	-.022745	-.023112	-.019585	-.013966	.011553	-.002318	.001970	4	157
.009955	.006729	.009494	.011595	.011753	.017314	.006042	.005144	4	158
.004424	.002258	.002702	.005646	.010601	-.000587	.028882	.035579	4	159
.003287	.007266	.020231	.012545	.005168	-.007062	-.005444	-.008720	4	160
-.010586	-.011877	-.012784	-.012748	-.010718	-.012034	-.003765	-.002389	4	161
-.002511	-.002774	-.002507	-.003230	-.006289	-.001513	-.017744	-.021305	4	162
-.022341	-.020280	-.018057	-.013779	-.008049	.008546	.003262	.011293	4	163
.014731	.022550	.025029	.021644	.015305	-.005287	.003960	.001175	4	164
-.008430	-.008925	-.002375	-.002995	-.003905	-.008098	-.006253	-.009253	4	165
-.012722	-.015461	-.014631	-.012879	-.011281	-.007312	-.004789	-.004310	4	166
-.005355	-.004366	-.007749	-.009912	-.009017	-.004457	-.005732	-.003329	4	167
-.001359	.000101	.000650	-.000087	-.002099	-.002510	-.008723	-.013122	4	168
-.013586	-.015727	-.014441	-.011263	-.006967	.002545	.002545	.008005	4	169
.013411	.016567	.020456	.022207	.020967	.019041	.013984	.007553	4	170
.003574	.004295	.002474	.004532	.007072	.007914	.007370	.005433	4	171

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.001391	.002365	.005253	.007020	.006284	.003903	.002476	4	172
.002249	.003151	.003504	.003332	.002610	.000984	-.002037	4	173
-.006213	-.007449	-.009101	-.011225	-.013424	-.014959	-.016853	4	174
-.019424	-.017090	-.013639	-.009705	-.006445	-.003990	4	175
.016525	.020711	.020515	.019529	.014332	.006422	4	176
-.008574	-.010936	-.012597	-.013927	-.015262	-.017451	4	177
-.016882	-.014685	-.011926	-.009552	-.007195	-.004733	4	178
.004799	.009644	.013452	.015566	.016030	4	179
.008300	.006717	.005333	.004686	.004338	4	180
-.006255	-.009706	-.009584	-.006754	-.003170	4	181
.003710	.006375	.006218	.004106	4	182
-.003509	-.003872	-.003576	-.003400	-.000567	4	183
.004862	.003157	.001675	.000577	.000867	.000576	4	184
.001793	.003316	.004368	.005037	.005877	.006524	4	185
.005654	.005591	.006127	.006773	.006657	.005890	4	186
.001127	-.000826	-.002326	-.002712	-.002016	-.000716	4	187
.002505	.003879	.005034	.005225	.004268	.002288	4	188
-.002447	-.002568	-.002497	-.002311	-.003043	-.004060	4	189
-.008647	-.008087	-.007412	-.006726	-.006149	-.005588	4	190
-.003381	-.002520	-.001183	.001058	.003238	.004972	4	191
.007130	.006741	.006212	.005085	.003760	.002315	4	192
.000944	.000649	.000459	.000823	.001458	.001910	4	193
.002322	.002794	.002747	.002564	.002144	.001367	4	194
-.002623	-.004087	-.005497	-.006656	-.008344	-.009591	4	195
-.007842	-.006468	-.005057	-.003793	-.002518	-.001703	4	196
.003383	.004677	.005237	.005018	.004266	.003854	4	197
.001058	-.000172	-.001028	-.001611	-.001940	-.002075	4	198
-.000137	.000800	.001175	.001239	.001490	4	199
.004825	.006999	.007933	.007239	.005859	.004131	4	200
.002609	.002817	.003075	.003751	.004261	.004841	4	201
.006079	.005565	.004871	.004230	.003784	.003392	4	202
.002098	.002328	.002594	.002328	.002491	.002484	4	203
-.001700	-.004121	-.005912	-.006658	-.006218	-.005051	4	204
.000143	.001002	.001705	.001781	.002310	4	205
-.000983	-.002819	-.004336	-.004805	-.005041	-.005258	4	206
-.002115	-.001316	-.000767	-.000367	-.000045	4	207
.000810	.000975	.000889	.000867	.001020	4	208
.001892	.002141	.002445	.002606	.002467	4	209
.000532	.000663	.000158	.000379	.000904	4	210
.000781	.000507	.000106	-.000272	-.000840	4	211
-.002200	-.002156	-.002110	-.001088	-.001568	4	212
-.000565	-.000481	-.000839	-.000904	-.000939	4	213
-.000500	-.000741	-.000973	-.001217	-.001346	4	214
-.001954	-.002400	-.002904	-.003152	-.003032	4	215
-.002107	-.001657	-.001177	-.000691	-.000490	4	216
-.000427	-.000478	-.000499	-.000495	-.000481	4	217
-.001162	-.001335	-.001296	-.001084	-.000735	4	218
.000011	.000092	.000191	.000278	.000535	4	219
.001278	.001261	.001179	.001100	.000996	4	220
.000595	.000578	.000559	.000472	.000731	4	221
.000669	.000342	.000003	-.000305	-.000393	4	222
-.000788	-.001004	-.001043	-.000907	-.000630	4	223
.000621	.000772	.000795	.001037	.001395	4	224
.000759	.000378	.000178	.000053	-.000018	4	225
-.000408	-.000593	-.000574	-.000457	-.000320	4	226
.000106	.000187	.000178	.000161	.000139	4	227
.000086	.000146	.000188	.000222	.000310	4	228
.000149	-.000077	-.000201	-.000212	-.000217	4	229
-.000358	-.000337	-.000317	-.000230	-.000132	4	230
.000154	.000270	.000396	.000411	.000255	4	231

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.000038	-.000226	-.000373	-.000332	-.000200	-.000042	.000133	.000243	4	232
.000105	.000382	.000429	.000450	.000461	.000483	.000499	.000513	4	233
.000319	.000519	.000540	.000550	.000529	.000491	.000463	.000487	4	234
.000368	.000670	.000771	.000539	.000486	.000321	.000225	.000816	4	235
.000477	.000588	.000518	.000407	.000425	.000287	.000947	.000893	4	236
.000410	.000433	.000264	-.000229	-.000241	-.000342	.000893	.000374	4	237
.000437	.000496	.000513	.000451	.000361	-.000257	-.000319	-.000428	4	238
-.000476	-.000496	-.000496	-.000344	-.000427	-.000514	-.000987	.000103	4	239
.000175	.000197	-.000825	-.000159	-.000344	-.000327	-.000514	-.000637	4	240
-.000400	-.000400	-.000824	-.000785	-.000669	-.000503	-.000329	-.000239	4	241
.000157	.000264	.000312	.000429	.000456	.000433	.000367	.000367	4	242
-.000295	.000209	.000074	-.000332	-.000105	-.000191	-.000309	-.000436	4	243
-.000491	-.000519	-.000665	-.000892	-.000995	-.000945	-.000798	-.000608	4	244
-.000326	-.000203	-.000032	.000097	.000166	.000172	.000205	.000205	4	245
-.000434	-.000229	.000242	.000373	.000389	.000327	.000248	.000239	4	246
.000229	.000242	.000169	.000353	.000271	.000223	.000194	.000171	4	247
.000292	.000169	.000404	.000669	.000828	.000512	.000312	.000265	4	248
.000144	.000118	.000059	.000549	.000691	.000672	.000269	.000316	4	249
.000119	.000105	.000050	.000411	.000481	.000541	.000578	.000587	4	250
.000321	.000336	.000351	.000515	.000530	.000519	.000405	.000191	4	251
.000574	.000545	.000497	.000429	.000469	-.000483	-.000477	-.000460	4	252
-.000338	-.000234	-.000344	.000643	.000194	.000191	.000110	-.000031	4	253
-.000374	-.000265	-.000252	-.000252	-.000270	-.000254	-.000253	-.000163	4	254
-.000160	-.000126	-.000180	.000186	.000150	.000034	-.000056	-.000249	4	255
-.000243	-.000155	.000136	.000066	.000066	.000308	.000460	.000565	4	256
-.000437	-.000330	-.000418	-.000185	-.000166	.000632	.000573	.000455	4	257
.000557	.000711	.000725	.000702	.000664	.000111	-.000029	-.000148	4	259
-.000311	-.000369	.000349	.000201	.000220	.000144	.000138	.000094	4	260
-.000179	-.000125	-.000369	.000028	.000111	.000315	.000379	.000347	4	261
-.000104	-.000113	-.000211	-.000272	-.000753	-.000350	-.000622	-.000545	4	262
-.000346	-.000465	-.000612	-.000710	-.000709	-.000158	-.000203	-.000191	4	263
-.000560	-.000462	-.000276	-.000609	.000062	.000195	.000253	-.000295	4	264
-.000131	-.000225	.000219	.000623	.000614	-.000134	-.000155	.000306	4	265
.000372	.000325	.000213	-.000496	-.000659	-.000333	.000242	.000123	4	266
-.000534	-.000345	-.000496	-.000497	.000402	.000631	.000619	.000553	4	267
.000455	.000193	.000229	.000367	.000550	.000034	.000041	.000116	4	268
.000477	.000132	.000253	.000187	.000118	.000480	-.000540	-.000518	4	269
.000470	.000353	.000179	-.000265	-.000379	-.000087	.000923	.000113	4	270
-.000173	-.000203	-.000269	-.000172	-.000087	-.000037	-.000190	-.000205	4	271
-.000341	-.000345	-.000119	.000111	-.000311	-.000170	-.000389	-.000352	4	272
.000133	.000190	.000157	-.000236	-.000183	-.000033	-.000151	-.000115	4	273
-.000191	-.000140	-.000252	-.000269	-.000022	.000014	.000065	.000113	4	274
-.000308	-.000286	-.000005	.000014	.000088	.000006	-.000053	-.000084	4	275
-.000072	-.000036	.000176	.000143	-.000652	-.000625	-.000500	-.000348	4	276
.000163	.000193	-.000431	-.000571	-.000622	-.000046	-.000035	.000603	4	277
-.000152	-.000305	-.000375	-.000360	-.000046	.000128	.000172	.000116	4	278
-.000221	-.000123	-.000027	-.000056	-.000039	-.000042	-.000046	-.000024	4	279
.000068	.000015	.000008	-.000614	-.000026	-.000001	-.000015	-.000014	4	280
.000145	.000034	.000049	.000049	.000099	.000107	.000074	.000000	4	281
.000012	.000034	.000008	.000061	.000242	.000250	.000252	.000236	4	282
-.000008	-.000018	-.000166	-.000212	-.000292	.000393	-.000508	-.000554	4	283
-.000074	-.000121	-.000243	-.000267	-.000162	-.000119	-.000260	-.000037	4	284
-.000229	-.000243	-.000462	-.000333	-.000227	-.000119	-.000255	-.000326	4	285
-.000442	-.000462	-.000025	-.000038	-.000146	.000193	.000218	.000262	4	286
-.000240	-.000014	-.000398	.000036	.000585	.000615	.000726	.000857	4	287
-.000391	-.000212	.000440	.000513	.000624	.000561	.000561	.000459	4	288
.000320	.000376	.000385	.000777	.000670	.000624	.000990	.000967	4	289
.000231	.000335	.000263	.000239	.000184	.000139	.000388	.000342	4	290
.000339	.000318	.000255	.000355	.000434	.000409	-.000089	-.000089	4	291
.000275	.000192	.000089	.000002	-.000046	-.000072				

-.000077	-.000059	-.000051	-.000055	-.000061	-.000062	-.000042	-.000004	4	292
-.000080	.000023	.000023	.000023	.000045	.000068	.000079	.000058	4	293
.000041	.000064	.000082	.000148	.000205	.000228	.000173	.000089	4	294
.000032	-.000103	-.000163	-.000149	-.000115	-.000088	-.000055	-.000054	4	295
-.000044	.000025	.000121	.000173	.000186	.000171	.000135	.000098	4	296
.000083	-.000015	-.000068	-.000175	-.000279	-.000346	-.000389	-.000360	4	297
-.000227	-.000194	-.000118	-.000048	.000009	.000053	.000027	.000147	4	298
.000212	.000357	.000382	.000301	.000163	.000015	-.000061	-.000203	4	299
-.000113	-.000437	-.000506	-.000550	-.000576	-.000555	-.000536	.000000	4	300

S-703070

MIDLAND(7229) NS PLOT @ OBE=6%G WITH VS=500FT/SEC&SOIL DENSITY=120PCF

SOIL CONDITION 2

MASS PT @ TIME HISTORY

-.000738	-.000918	-.000619	-.000605	-.000770	-.000946	-.001182	-.001404	@	1
-.001185	-.001503	-.001207	-.000922	-.000355	.000183	.000597	.000966	@	2
.[illegible]71	.[illegible]43	.000636	.000397	-.000165	-.000552	-.001265	-.001859	@	3
-.[illegible]03	-.[illegible]41	-.003082	-.003295	-.003091	-.002855	-.002592	-.002291	@	4
-.[illegible]24	-.[illegible]39	-.001511	-.001573	-.001375	-.001179	-.000962	-.000746	@	5
.[illegible]23	.[illegible]77	.001630	.002056	.002359	.002657	.003378	.004095	@	6
.[illegible]15	.[illegible]10	.005135	.005360	.004999	.004579	.004357	.004105	@	7
.[illegible]5	.[illegible]516	.002939	.002666	.002578	.002604	.002658	.002809	@	8
.[illegible]27	.[illegible]19	.005451	.006435	.007425	.008381	.009217	.009984	@	9
.[illegible]24	.[illegible]57	.011313	.011626	.012187	.012577	.012652	.012524	@	10
.[illegible]15	.[illegible]71	.011256	.010253	.009195	.008008	.006631	.005182	@	11
.[illegible]21	.[illegible]59	.001049	-.000236	-.001545	-.002853	-.004192	-.005417	@	12
.[illegible]27	-.[illegible]27	-.009195	-.010347	-.011263	-.012002	-.012177	-.012178	@	13
-.[illegible]11	-.[illegible]79	-.009278	-.008176	-.007007	-.005417	-.005122	-.004436	@	14
.[illegible]15	-.[illegible]33	-.003845	-.002438	-.002264	-.002157	-.002212	-.002313	@	15
.[illegible]39	-.[illegible]41	-.002250	-.002291	-.002305	-.002456	-.002706	-.003056	@	16
.[illegible]25	-.[illegible]15	-.004473	-.004482	-.004747	-.005565	-.003755	-.002922	@	17
.[illegible]24	-.[illegible]45	.000262	.001216	.001587	.002052	.002358	.002553	@	18
.[illegible]24	.[illegible]19	.001594	.000801	.000462	.000075	-.000286	-.000697	@	19
.[illegible]1	-.[illegible]37	-.000441	-.000008	-.000180	-.000391	-.000857	-.001314	@	20
.[illegible]1	-.[illegible]78	-.003528	-.004426	-.005735	-.006949	-.008158	-.009281	@	21
.[illegible]5	-.[illegible]57	-.011179	-.011243	-.010466	-.009576	-.008998	-.008401	@	22
.[illegible]21	-.[illegible]91	-.005078	-.005469	-.005587	-.005805	-.006269	-.006827	@	23
.[illegible]23	-.[illegible]35	-.008005	-.008367	-.008212	-.008158	-.008331	-.008610	@	24
.[illegible]5	-.[illegible]41	-.010095	-.012062	-.011143	-.010280	-.011737	-.012171	@	25
.[illegible]50	-.[illegible]29	-.013264	-.013234	-.013220	-.013132	-.012681	-.012163	@	26
.[illegible]55	-.[illegible]32	-.010137	-.010038	-.010004	-.011041	-.012285	-.012802	@	27
.[illegible]53	-.[illegible]39	-.013455	-.013043	-.012202	-.011231	-.009654	-.007981	@	28
.[illegible]1	-.[illegible]53	-.005567	-.001870	.000569	.003512	.005208	.006769	@	29
.[illegible]5	.[illegible]53	.012059	.013452	.013558	.013572	.013658	.013498	@	30
.[illegible]71	.[illegible]45	.010261	.012436	.010035	.008370	.007115	.005934	@	31
.[illegible]53	.[illegible]45	.000590	-.000958	-.002734	-.004205	-.004946	-.005451	@	32
.[illegible]93	-.[illegible]45	-.004946	-.004125	-.002907	-.001615	-.000105	.001418	@	33
.[illegible]79	.[illegible]13	.006271	.007736	.006806	.005622	.004876	.003918	@	34
.[illegible]42	.[illegible]34	.003726	.003562	.002267	.000935	-.000173	-.001476	@	35
.[illegible]13	-.[illegible]98	-.008359	-.010759	-.012819	-.014723	-.016160	-.017375	@	36
.[illegible]24	-.[illegible]51	-.013771	-.015214	-.015983	-.015513	-.015134	-.014564	@	37
.[illegible]24	-.[illegible]24	-.013753	-.016813	-.016177	-.015438	-.014583	-.013637	@	38
.[illegible]18	-.[illegible]18	-.010096	-.009461	-.007135	-.005515	-.003680	-.001968	@	39
.[illegible]38	.[illegible]05	.001935	.002570	.002875	.003032	.002601	.002070	@	40
.001422	.[illegible]37	.000226	-.000270	.000261	.000809	.000871	.000934	@	41
.[illegible]01	.[illegible]11	.003200	.004321	.004759	.005191	.004669	.004594	@	42
.[illegible]61	.[illegible]33	.003532	.003323	.003011	.002754	.003279	.003837	@	43
.[illegible]61	.[illegible]76	.004838	.004566	.004559	.004525	.004705	.004824	@	44
.[illegible]19	.[illegible]49	.004369	.004732	.004559	.004251	.003200	.003023	@	45
.[illegible]52	.[illegible]57	.003256	.002621	.002560	.002425	.000683	-.001221	@	46
.[illegible]77	-.[illegible]12	-.007208	-.009037	-.010980	-.012057	-.013538	-.014435	@	47
.[illegible]78	-.[illegible]35	-.015510	-.014942	-.015883	-.016083	-.016192	-.015552	@	48
.[illegible]1	-.[illegible]75	-.014285	-.013082	-.012253	-.011430	-.010420	-.009092	@	49
.[illegible]5	-.[illegible]3	-.008001	-.007431	-.007729	-.007715	-.007871	-.008137	@	50
.[illegible]77	-.[illegible]27	-.008226	-.007047	-.007251	-.[illegible]	-.007459	-.[illegible]	@	51

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.022174	.021510	.020959	.020905	.021068	.020662	.020441	112
.020589	.022985	.020809	.021704	.022721	.023802	.024995	113
.024512	.030895	.032479	.034534	.036070	.036675	.037079	114
.032300	.036665	.035774	.034831	.033696	.032470	.031115	115
.032360	.028040	.028549	.027500	.026367	.023919	.021413	116
.029040	.014914	.009957	.009457	.007353	.007323	.007455	117
.017220	.006673	.006632	.006450	.004767	.003678	.002928	118
.006256	.007862	.006450	.004491	.003642	.003154	.002513	119
.004554	.000207	-.000648	-.000969	.001460	.000441	-.000295	120
.000543	.000541	.000536	.000715	.001715	.001155	.021455	121
.000503	.007125	.009717	.012235	.014715	.018155	.021455	122
.024450	.024650	.024523	.024601	.024417	.022586	.020376	123
.024450	.024650	.017114	.017499	.017650	.016094	.014554	124
.011121	.016250	.009459	.009236	.009003	-.003605	-.000013	125
.013685	.009960	.005459	-.000783	-.001134	-.006025	-.002099	126
-.000345	-.003872	-.010358	-.011903	-.016284	-.018584	-.020857	127
-.000642	-.007123	-.007448	-.022754	-.021671	-.020452	-.019857	128
-.022287	-.023387	-.023387	-.021282	-.018316	-.020404	-.020670	129
-.016264	-.015609	-.014022	-.011164	-.009148	-.007784	-.005245	130
-.009126	-.009078	-.009138	-.009951	-.009340	-.009232	-.009962	131
-.002515	-.002235	-.002954	-.003353	-.003627	-.004536	-.011402	132
-.005247	-.005247	-.005076	-.009533	-.011670	-.010057	-.010212	133
-.001782	-.001782	-.010251	-.011704	-.013683	-.015255	-.011722	134
-.013827	-.015120	-.015940	-.015940	-.011879	-.011635	-.011799	135
-.017275	-.016774	-.012936	-.012749	-.011479	-.007846	-.006793	136
-.018135	-.018367	-.013946	-.008453	-.009830	-.002169	.002455	137
-.010245	-.009254	-.009121	-.008625	-.001697	-.003624	-.004679	138
-.005452	-.001717	-.000552	-.001276	-.002450	-.005675	-.006285	139
-.000224	.001060	-.001102	-.009675	-.009514	-.009237	-.007274	140
-.000429	-.000727	-.009441	-.009474	-.009854	-.005937	-.001945	141
-.000814	-.007228	-.006318	-.009504	-.009005	-.003539	-.010475	142
-.000240	-.000552	-.003194	-.000424	-.017119	-.018353	-.022990	143
-.000211	-.000064	-.002354	-.000604	-.027103	-.025040	-.011770	144
-.022949	-.026000	-.026424	-.027078	-.016230	-.013450	-.022704	145
-.021193	-.023943	-.020075	-.020022	-.021954	-.031140	146
-.018539	-.014869	-.017698	-.023274	-.020552	-.026094	-.002560	147
-.023562	-.025371	-.025011	-.023569	-.016599	-.009529	-.006053	148
-.023715	-.022697	-.023569	-.016914	-.011943	-.012544	-.013619	149
-.006326	-.008735	-.010914	-.012584	-.011559	-.010145	-.008741	150
.014914	.013129	.012584	.002273	.000905	-.002985	-.005523	151
.006524	.009394	.003422	.010105	.010331	.012652	.015104	152
.005515	.006255	.006255	.024277	.031415	.030508	.029324	153
.017020	.021654	.021737	.027943	.032782	.031520	.029850	154
.033015	.032588	.031737	.032474	.032782	.031126	.011494	155
.025179	.022674	.019879	.018344	.016494	.006315	-.006762	156
.007453	.004891	.002015	-.002165	-.002123	-.030663	-.007010	157
-.016125	-.016255	-.018017	-.023762	-.023518	-.035471	-.033524	158
-.033112	-.032140	-.032588	-.034518	-.034553	-.031864	-.017269	159
-.027749	-.028247	-.027749	-.021582	-.018453	-.017864	-.003096	160
-.007930	-.002730	-.001934	-.002608	-.002764	-.000095	-.021431	161
-.005441	-.011059	-.016478	-.017451	-.018417	-.019934	-.025598	162
-.023843	-.025130	-.026191	-.026426	-.026520	-.027170	-.018092	163
-.022350	-.022418	-.021473	-.020403	-.019170	-.018753	-.013289	164
-.015038	-.015054	-.015561	-.015059	-.015327	-.008693	-.004130	165
-.004469	-.007723	-.008621	-.008535	-.007187	-.002711	-.001216	166
-.002582	-.000734	-.001240	-.000535	-.003741	-.000378	-.000119	167
-.000227	-.003457	-.004010	-.003741	-.000478	-.010078	-.010995	168
.000421	.004230	.006572	.012199	.011432	-.009631	169
.011934	.012471	.012789	.009573	-.001583	170
.009243	.009561	.009982	.002790	.000455	-.001518	.000879	171
-.005234	-.009643	-.008634	-.004131	-.003455	.000603	.000609	
.001006	.002256	.002411	.005973	.005359			

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-.021933	-.024393	-.024570	-.024723	-.024129	-.023699	-.024691	-.024060	a	232
-.027739	-.029354	-.031051	-.032970	-.035588	-.038180	-.038988	-.039531	a	233
-.041268	-.042932	-.044222	-.044971	-.046089	-.046708	-.048965	-.049661	a	234
-.044716	-.046440	-.044307	-.041213	-.037378	-.032958	-.029425	-.023454	a	235
-.011448	-.011215	-.009212	.003091	.010309	.017388	.023049	.030491	a	236
.035650	.042473	.048285	.053496	.058168	.062333	.067551	.072120	a	237
.070223	.075618	.079578	.084578	.088213	.091396	.096598	.097359	a	238
.096947	.099598	.100447	.098489	.095584	.092738	.090375	.088081	a	239
.085701	.083429	.082125	.080782	.079176	.077430	.078505	.079606	a	240
.035941	.033122	.032321	.031425	.029887	.028865	.028160	.021651	a	241
.015481	.015214	.011969	.008892	.008757	.006926	-.004114	-.009160	a	242
-.012776	-.016342	-.020073	-.023510	-.027595	-.031048	-.034356	-.037011	a	243
-.039729	-.042172	-.044422	-.045822	-.047882	-.048998	-.050096	-.050989	a	244
-.051893	-.052473	-.052672	-.052611	-.052017	-.051279	-.049359	-.047302	a	245
-.045253	-.043520	-.042360	-.040053	-.037918	-.035804	-.033781	-.031895	a	246
-.029521	-.027165	-.025426	-.023910	-.022329	-.021738	-.020545	-.019310	a	247
-.013129	-.013358	-.011910	-.010723	-.015958	-.015030	-.013377	-.011598	a	248
-.013217	-.009819	-.009726	-.007538	-.002475	-.000106	.002579	.005338	a	249
.007176	.008950	.010872	.012751	.014018	.015112	.016545	.017760	a	250
.019327	.020548	.021841	.022451	.022283	.021762	.021371	.020599	a	251
.013081	.017376	.015614	.015165	.013670	.011907	.009584	.006935	a	252
.003742	.006916	-.003354	-.006599	-.010323	-.013969	-.017209	-.020260	a	253
-.023185	-.025771	-.027632	-.029165	-.028829	-.028386	-.028059	a	254
-.027173	-.025977	-.023461	-.022671	-.022048	-.021193	-.018446	-.007391	a	255
-.010205	-.013301	-.011753	-.010134	-.008939	-.007619	-.003323	.000877	a	256
.002409	.004513	.006182	.012155	.015451	.018960	.021942	.025126	a	257
.027404	.027914	.032086	.036526	.037288	.039815	.042458	.044631	a	258
.047373	.049528	.052610	.055128	.055204	.054839	.056368	.057001	a	259
.055419	.052782	.049537	.045845	.043183	.040087	.038584	.036593	a	260
.032785	.028595	.026025	.023031	.019256	.015115	.009448	.003563	a	261
-.002442	-.005514	-.010082	-.019510	-.025348	-.031031	-.036704	-.042162	a	262
-.045520	-.050634	-.054158	-.057020	-.059894	-.062315	-.063526	-.064277	a	263
-.065434	-.066135	-.065959	-.065312	-.065014	-.063906	-.064586	-.062959	a	264
-.061508	-.059343	-.056463	-.053671	-.053557	-.050525	-.047316	-.044006	a	265
-.041913	-.037757	-.034151	-.030495	-.026707	-.022931	-.019558	-.016175	a	266
-.012701	-.009240	-.005708	-.002206	-.000407	.001378	.011275	.021207	a	267
.022592	.023702	.033231	.036854	.033337	.029591	.031970	.034239	a	268
.035721	.037394	.040272	.042922	.046046	.049271	.052531	.055548	a	269
.058057	.057422	.059433	.059302	.062306	.058915	.065632	.065985	a	270
.064415	.062433	.061504	.060259	.056754	.052991	.050773	.048269	a	271
.052348	.037209	.032579	.027426	.024095	.020706	.017591	.014460	a	272
.009932	.005239	.001838	-.001497	-.004914	-.008251	-.012035	-.015749	a	273
-.018631	-.020135	-.022175	-.024098	-.026670	-.029177	-.033310	-.037314	a	274
-.038573	-.039868	-.041949	-.043889	-.046040	-.048017	-.049590	-.050922	a	275
-.051353	-.051579	-.051275	-.050735	-.050315	-.049581	-.047562	-.045236	a	276
-.042573	-.043532	-.042272	-.040411	-.038056	-.035486	-.028193	-.024836	a	277
-.029397	-.023799	-.023495	-.023767	-.021618	-.019264	-.020673	-.020688	a	278
-.018418	-.006672	-.003950	.000771	.006826	.011969	.016474	.020836	a	279
.025809	.029587	.032982	.036072	.038704	.040918	.043572	.045806	a	280
.046638	.047129	.047512	.047537	.046293	.044855	.045867	.044769	a	281
.043529	.040758	.039592	.038538	.038041	.029648	.028317	.027211	a	282
.026119	.025315	.025376	.025509	.025108	.024968	.023904	.022956	a	283
.023038	.023069	.023051	.022959	.021395	.019531	.017500	.015304	a	284
.013716	.011954	.010951	.009716	.007494	.005020	.002931	.000518	a	285
-.003311	-.007339	-.012098	-.015988	-.020621	-.024299	-.027882	-.031355	a	286
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-.048553	-.047715	-.047120	-.046237	-.045473	-.044461	-.042997	-.041286	a	288
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-.018206	-.016083	-.011130	-.007534	-.006092	-.[illegible]479	.001434	.007859	a	290
.009327	.011019	.015118	.019222	.021273	.[illegible]532	.024654	.033825	a	291

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.033015	.032089	.031397	.030541	.033067	.035565	.036670	.037892	a	292
.033393	.031052	.043998	.000689	.049440	.051665	.050724	.049312	a	293
.049177	.048539	.047679	.046515	.042883	.039073	.036901	.038442	a	294
.029818	.025045	.020742	.015421	.013973	.011630	.008863	.002208	a	295
-.005018	-.007887	-.011898	-.015474	-.018309	-.020790	-.023941	-.025563	a	296
-.027398	-.027965	-.025598	-.022439	-.028220	-.027685	-.027099	-.026329	a	297
-.024047	-.022371	-.019654	-.016894	-.017370	-.018054	-.015597	-.013091	a	298
-.011815	-.010556	-.008447	-.003145	-.002989	-.003138	-.005200	-.007570	a	299
-.008180	-.008600	-.011371	-.013217	-.015600	-.016788	-.017911	-.018703	a	300
-.014093	-.019276	-.019220	-.018647	-.017849	-.016714	-.013034	-.009057	a	301
-.307163	-.004917	-.001304	.002343	.005859	.009483	.014161	.018709	a	302
.021643	.023334	.025988	.027410	.029199	.030675	.028134	.025255	a	303
.025815	.027450	.025808	.023735	.025152	.026274	.024707	.023040	a	304
.023530	.023889	.025067	.023055	.024563	.025984	.022570	.019124	a	305
.016991	.016961	.015076	.013182	.010374	.007630	.006568	.005658	a	306
.004943	.004299	.004524	.003420	-.001771	-.008410	-.007076	-.005604	a	307
-.005015	-.005675	-.004004	-.002503	-.003096	-.003582	-.004513	-.005753	a	308
-.007062	-.008340	-.011298	-.014329	-.015076	-.016762	-.018794	-.020716	a	309
-.023421	-.024115	-.024536	-.030519	-.032277	-.033979	-.028712	-.023148	a	310
-.025153	-.025998	-.024474	-.022654	-.020589	-.018196	-.019236	-.020188	a	311
-.020331	-.020038	-.020782	-.021294	-.018813	-.016069	-.020030	-.023721	a	312
-.017374	-.012034	-.010177	-.008367	-.001733	.000652	.003642	.012340	a	313
.017269	.021052	.024590	.027218	.027921	.027991	.029371	.030229	a	314
.029470	.029235	.028268	.021944	.022188	.022339	.017499	.012530	a	315
.003612	.000582	.000036	.001334	-.003927	-.009410	-.008496	-.005510	a	316
-.307235	-.007355	-.008819	-.009308	-.009913	.000644	.003595	.005224	a	317
.019987	.015932	.021000	.025930	.030979	.033509	.039599	.035396	a	318
.030658	.032331	.030832	.029253	.027862	.026323	.023398	.020457	a	319
.015527	.013965	.015642	.018352	.012837	.011983	.011881	.011035	a	320
.011628	.011537	.011676	.011771	.012198	.012518	.013469	.014239	a	321
.015997	.017521	.018403	.018458	.017843	.016450	.014010	.011217	a	322
.000575	.005524	.002990	.000197	-.002685	-.005697	-.010569	-.015337	a	323
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-.025969	-.347388	-.026512	-.045451	-.044491	-.043102	-.040950	-.035601	a	325
-.035690	-.032773	-.030065	-.027849	-.027130	-.025872	-.019729	-.012671	a	326
-.014395	-.015608	-.013504	-.011517	-.013092	-.016389	-.018077	-.019504	a	327
-.021511	-.022037	-.022173	-.021159	-.018911	-.016099	-.013480	-.010389	a	328
-.003743	-.002828	.001486	.000155	.010939	.015796	.020578	.025372	a	329
.023563	.033737	.037516	.040783	.044384	.047586	.046998	.045584	a	330
.047009	.047870	.046700	.043939	.040910	.038216	.043989	.039259	a	331
.037094	.034035	.031551	.028568	.023481	.019202	.012000	.008776	a	332
.001149	-.002198	-.007731	-.013104	-.020631	-.027781	-.028769	-.029198	a	333
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-.033719	-.033379	-.033576	-.033426	-.034794	-.034766	-.035063	-.035239	a	335
-.035067	-.035188	-.036219	-.035165	-.035547	-.040900	-.040308	-.039682	a	336
-.037714	-.037035	-.036437	-.035270	-.033524	-.031686	-.028909	-.026106	a	337
-.025928	-.021570	-.019350	-.017084	-.013470	-.009926	-.007487	-.004092	a	338
-.002654	-.000266	.002008	.004274	.007845	.011525	.010568	.009652	a	339
.011612	.013814	.015167	.016751	.015599	.014571	.016673	.019186	a	340
.023029	.026953	.030518	.033078	.037782	.041505	.046238	.050628	a	341
.053255	.055592	.056747	.057485	.058041	.055696	.057879	.057256	a	342
.055213	.054645	.052232	.049433	.050232	.049733	.047636	.044097	a	343
.040990	.035937	.030262	.026513	.019919	.015325	.012121	.009165	a	344
.005284	.001494	-.000773	-.002746	-.005653	-.008302	-.010695	-.012913	a	345
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-.026713	-.026585	-.026452	-.027015	-.027478	-.027970	-.028942	-.029809	a	347
-.030590	-.031360	-.032009	-.032727	-.032643	-.032998	-.034567	-.035193	a	348
-.036397	-.036093	-.037281	-.037834	-.036617	-.035415	-.034682	-.033420	a	349
-.032592	-.031484	-.030569	-.029631	-.029243	-.028816	-.028404	-.026316	a	350
-.018503	-.018701	-.017457	-.016857	-.016525	-.015367	-.014878	-.009350	a	351

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-.008219	-.006187	-.004166	-.001889	-.000878	-.007768	-.005793	-.003100	a	352
-.000241	.002713	.005317	.008111	.011818	.015809	.019721	.023271	a	353
.025039	.027658	.033032	.035943	.037618	.038657	.039225	.039414	a	354
.040734	.041251	.041111	.040365	.038395	.035827	.033953	.031408	a	355
.027995	.023245	.018686	.013740	.008963	.004068	-.000939	-.005814	a	356
-.011375	-.015241	-.020870	-.025079	-.029394	-.033152	-.032355	-.031043	a	357
-.033292	-.037056	-.039919	-.039299	-.037764	-.035090	-.037769	-.036408	a	358
-.035212	-.035570	-.033104	-.032488	-.029954	-.027178	-.024862	-.021597	a	359
-.018402	-.015106	-.012256	-.009337	-.005512	-.001785	.000893	.003380	a	360
.006115	.008726	.010573	.014270	.011422	.008284	.009253	.010201	a	361
.012413	.014557	.017017	.019217	.021240	.023197	.024202	.024908	a	362
.025947	.025121	.024105	.022997	.024205	.025246	.025418	.025555	a	363
.024411	.024131	.022740	.021333	.020308	.019439	.018452	.018429	a	364
.018631	.017082	.016693	.009412	.008914	.007447	.006773	.006215	a	365
.005722	.005243	.004723	.004216	.003456	.002619	.004833	.005912	a	366
.007395	.005504	.002993	.002123	-.001519	-.005225	-.006563	-.007900	a	367
-.011654	-.011756	-.013202	-.014567	-.014903	-.015256	-.017759	-.020183	a	368
-.020659	-.019741	-.020001	-.020363	-.019002	-.017735	-.017174	-.016342	a	369
-.015481	-.013458	-.013253	-.011900	-.009943	-.007939	-.006601	-.005267	a	370
-.003710	-.002078	-.000635	.000770	.001896	.002202	.005052	.007894	a	371
.009947	.009862	.011734	.013492	.013725	.013896	.014970	.015957	a	372
.015854	.015195	.016423	.016561	.017484	.018319	.017729	.016981	a	373
.015796	.019257	.019740	.020176	.021309	.022271	.022478	.022573	a	374
.022851	.023007	.022712	.022227	.020846	.019329	.020121	.020775	a	375
.015458	.015933	.014525	.013079	.010265	.007313	.005050	.002817	a	376
-.000525	-.001557	-.003070	-.004471	-.005496	-.006367	-.007412	-.008338	a	377
-.009122	-.009721	-.010333	-.010723	-.012125	-.013099	-.014613	-.015645	a	378
-.015554	-.015555	-.016446	-.017049	-.016302	-.015521	-.015628	-.015428	a	379
-.015973	-.016193	-.016448	-.016711	-.017049	-.017498	-.017871	-.018229	a	380
-.019587	-.019995	-.019236	-.019472	-.019496	-.019411	-.019687	-.019919	a	381
-.019078	-.019087	-.016905	-.015719	-.015079	-.014356	-.013299	-.012045	a	382
-.011559	-.009168	-.007939	-.006655	-.005747	-.004653	-.002552	-.000370	a	383
.001154	.002597	.004107	.005661	.007452	.009264	.011503	.013727	a	384
.015179	.016524	.018177	.019739	.021534	.023179	.024029	.024950	a	385
.025833	.026551	.027393	.027998	.028148	.028072	.027027	.027004	a	386
.025536	.025912	.024766	.023492	.022118	.020648	.019185	.017665	a	387
.016675	.014506	.012748	.011083	.009335	.007649	.005848	.004131	a	388
.002591	.000700	-.000793	-.002115	-.003288	-.004379	-.005695	-.006908	a	389
-.008722	-.009640	-.009817	-.010227	-.011832	-.013450	-.013545	-.013644	a	390
-.013301	-.014424	-.014687	-.015033	-.015662	-.016368	-.016896	-.017527	a	391
-.018369	-.019305	-.020184	-.021090	-.021839	-.022561	-.023845	-.025044	a	392
-.025123	-.025269	-.024716	-.024193	-.023921	-.023476	-.023762	-.023922	a	393
-.022962	-.021844	-.021334	-.020595	-.019125	-.017397	-.015097	-.012588	a	394
-.010549	-.008462	-.006603	-.004618	-.002229	.000199	.002485	.005542	a	395
.008638	.010569	.012757	.015132	.017219	.019110	.020795	.022235	a	396
.023537	.024427	.025184	.025634	.026401	.026852	.026916	.026742	a	397
.026721	.026902	.026047	.026252	.026921	.026517	.026352	.026155	a	398
.025943	.024742	.023635	.022577	.022319	.022130	.021286	.020500	a	399
.019756	.018096	.016502	.014839	.013155	.011387	.009294	.007306	a	400
.005134	.003068	.001293	-.000502	-.002709	-.004864	-.006883	-.008892	a	401
-.010358	-.012540	-.014778	-.016921	-.018520	-.020045	-.021145	-.022207	a	402
-.023102	-.024043	-.024929	-.025231	-.025195	-.025131	-.025365	-.025308	a	403
-.025477	-.025297	-.025488	-.025561	-.025511	-.025327	-.025142	-.024820	a	404
-.024378	-.023420	-.023073	-.022213	-.021327	-.020373	-.019429	-.018272	a	405
-.017085	-.015875	-.014522	-.013172	-.011411	-.010042	-.010429	-.010058	a	406
-.009819	-.008961	-.007724	-.006444	-.005219	-.003872	-.002783	-.001596	a	407
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.010158	.011107	.012482	.013876	.015078	.016378	.017599	.018704	a	409
.019854	.020958	.021636	.022342	.023138	.023905	.024510	.025711	a	410
.026945	.027249	.027472	.027652	.027813	.027957	.028063	.028224	a	411

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.001020	.001277	.001475	.001668	.001719	.001760	.001574	.001399	a	472
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.001454	.001589	.001647	.001605	.001691	.001673	.001828	.001962	a	474
.001459	.001582	.001533	.001376	.001188	.000997	.000852	.000762	a	475
.000436	.000296	.000102	-.000087	-.000187	-.000280	-.000402	-.000514	a	476
-.000525	-.000631	-.000718	-.000797	-.000825	-.000848	-.000854	-.000857	a	477
-.000824	-.000850	-.000840	-.000855	-.000780	-.000707	-.000727	-.000755	a	478
-.000965	-.000979	-.001098	-.001213	-.001296	-.001376	-.001452	-.001579	a	479
-.001561	-.001671	-.001656	-.001651	-.001720	-.001777	-.001745	-.001780	a	480
-.001735	-.001578	-.001507	-.001527	-.001433	-.001335	-.001191	-.001078	a	481
-.000491	-.000739	-.000596	-.000462	-.000349	-.000247	-.000242	-.000249	a	482
-.000121	-.000001	.000130	.000209	.000209	.000320	.000224	.000124	a	483
.000123	.000124	.000034	-.000051	-.000056	-.000048	-.000065	.000051	a	484
.000053	.000065	.000048	.000038	.000083	.000181	.000245	.000353	a	485
.001454	.000556	.000651	.000764	.000788	.000850	.000750	.000908	a	486
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.000706	.000373	.000630	.000554	.000473	.000369	.000251	.000116	a	488
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-.001525	-.001479	-.001628	-.001759	-.001871	-.001961	-.001971	-.001959	a	490
-.002004	-.002027	-.001979	-.001907	-.001800	-.001672	-.001556	-.001428	a	491
-.001537	-.001255	-.001149	-.001033	-.000893	-.000739	-.000515	-.000340	a	492
-.000126	.000041	.000212	.000376	.000462	.000540	.000601	.000653	a	493
.000734	.000809	.000900	.000983	.001038	.001088	.001130	.001167	a	494
.001198	.001225	.001259	.001291	.001322	.001350	.001361	.001370	a	495
.001373	.001394	.001430	.001470	.001493	.001491	.001550	.001606	a	496
.001578	.001535	.001409	.001393	.001337	.001274	.001271	.001260	a	497
.001148	.001109	.001071	.001025	.000931	.000836	.000693	.000552	a	498
.000428	.000305	.000207	.000112	.000004	-.000099	-.000150	-.000194	a	499
-.001284	-.000566	-.000415	-.000453	-.000513	-.000562	-.000583	-.000698	a	500
-.000623	-.000624	-.000615	-.000591	-.000583	-.000565	-.000429	-.000285	a	501
-.000274	-.000262	-.000158	-.000068	-.000113	-.000159	-.000131	-.000102	a	502
-.000078	-.000042	.000023	.000082	.000173	.000262	.000271	.000311	a	503
.000375	.000431	.000459	.000499	.000531	.000549	.000519	.000530	a	504
.000382	.000574	.000537	.000528	.000556	.000579	.000631	.000578	a	505
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-.000455	-.000594	-.000553	-.000549	-.000663	-.000764	-.000754	-.000735	a	507
-.000745	-.000650	-.000620	-.000577	-.000563	-.000508	-.000389	-.000229	a	508
-.000209	-.000134	-.000136	-.000079	-.000050	-.000048	-.000043	-.000039	a	509
-.000136	-.000223	-.000258	-.000357	-.000380	-.000360	-.000568	-.000773	a	510
-.000753	-.000725	-.000735	-.000740	-.000562	-.000381	-.000335	-.000286	a	511
-.000192	-.000079	-.000069	.000061	.000081	.000099	.000177	.000256	a	512
.000359	.000398	.000414	.000434	.000458	.000472	.000487	a	513
.000515	.000589	.000590	.000638	.000643	.000651	.000683	.000722	a	514
.000788	.000957	.000932	.001008	.001052	.001158	.001187	.001210	a	515
.001251	.001249	.001298	.001302	.001247	.001283	.001301	.001311	a	516
.001351	.001394	.001410	.001409	.001349	.001275	.001283	.001278	a	517
.001154	.001019	.000914	.000862	.000656	.000585	.000357	.000207	a	518
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-.001128	-.001197	-.001280	-.001300	-.001366	-.001369	-.001360	-.001358	a	521
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-.001525	-.001585	-.001567	-.001593	-.001241	-.001087	-.001053	-.001042	a	523
-.001158	-.001182	-.001221	-.001250	-.001241	-.001223	-.001317	-.001375	a	524
-.001251	-.001109	-.000995	-.000871	-.000757	-.000630	-.000543	-.000447	a	525
-.000251	-.000011	.000242	.000415	.000552	.000681	.000826	.000967	a	526
.001078	.001179	.001239	.001286	.001316	.001335	.001408	.001468	a	527
.001435	.001413	.001360	.001301	.001310	.001313	.001166	.001012	a	528
.001052	.000859	.000939	.000980	.001019	.001090	.001065	.001054	a	529
.001031	.001015	.000965	.000919	.000799	.000673	.000648	.000506	a	530
.000378	.000352	.000217	.000101	-.000059	-.000210	-.000355	-.000396	a	531

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-.000722	-.000658	-.000720	-.000771	-.000856	-.000927	-.000962	-.000978	a	532
-.000900	-.000822	-.000715	-.000600	-.000518	-.000431	-.000250	-.000049	a	533
-.000313	.000036	.000118	.000194	.000199	.000198	.000233	.000303	a	534
.000133	.000200	.000300	.000299	.000323	.000309	.000371	.000374	a	535
.000144	.000179	.000397	.000398	.000427	.000457	.000469	.000483	a	536
.000150	.000178	.000032	.000084	.000757	.000826	.000711	.000549	a	537
.000051	.000119	.000053	.000085	.000015	.000036	.000026	.000049	a	538
.000137	.000158	.000004	.000432	.000356	.000278	.000130	.000103	a	539
-.000082	-.000189	-.000282	-.000378	-.000457	-.000531	-.000613	-.000679	a	540
-.000917	-.000959	-.001013	-.001072	-.001203	-.001323	-.001365	-.001329	a	541
-.001100	-.001393	-.001638	-.001333	-.001282	-.001216	-.001136	-.001052	a	542
-.000555	-.000775	-.000725	-.000658	-.000525	-.000594	-.000531	-.000459	a	543
-.000159	-.000557	-.000307	-.000269	-.000223	-.000183	-.000116	-.000051	a	544
-.000026	-.000039	-.000101	-.000198	-.000099	-.000096	-.000108	-.000120	a	545
-.000134	-.000159	-.000198	-.000197	-.000198	-.000188	-.000167	-.000134	a	546
-.000156	-.000114	-.000092	-.000066	-.000036	-.000048	.000024	.000055	a	547
.000100	.000121	.000155	.000208	.000262	.000314	.000357	.000375	a	548
.000123	.000149	.000155	.000155	.000128	.000189	.000189	.000188	a	549
.000134	.000133	.000093	.000092	.000105	.000189	.000164	.000153	a	550
-.000052	-.000106	-.000176	-.000185	-.000192	-.000277	-.000343	-.000331	a	551
-.000114	-.000239	-.000215	-.000149	-.000088	-.000106	-.000117	-.000117	a	552
-.000125	-.000140	-.000177	-.000219	-.000248	-.000355	-.000419	-.000487	a	553
-.000052	-.000076	-.000054	-.000711	-.000780	-.000843	-.000895	-.000939	a	554
-.000072	-.000095	-.001099	-.001010	-.001037	-.001053	-.000910	-.000755	a	555
-.000053	-.000075	-.000055	-.000509	-.000525	-.000495	-.000424	-.000352	a	556
-.000054	-.000212	-.000113	-.000011	.000115	.000238	.000290	.000247	a	557
.000053	.000144	.000091	.000513	.000559	.000558	.000638	.000651	a	558
.000071	.000112	.000103	.000088	.000087	.000083	.000651	.000515	a	559
.000041	.000051	.000092	.000073	.000055	.000058	.000058	.000024	a	560
.000044	.000145	.000051	.000318	.000354	.000393	.000383	.000379	a	561
.000055	.000036	.000085	.000273	.000224	.000172	.000119	.000059	a	562
.000028	-.000030	-.000010	-.000077	-.000130	-.000193	-.000230	-.000279	a	563
-.000111	-.000145	-.000371	-.000399	-.000441	-.000482	-.000493	-.000532	a	564
-.000055	-.000099	-.000093	-.000075	-.000715	-.000752	-.000762	-.000731	a	565
-.000045	-.000077	-.000948	-.001017	-.001059	-.001053	-.001017	-.000979	a	566
-.000057	-.000055	-.000085	-.000818	-.000769	-.000727	-.000721	-.000717	a	567
-.000078	-.000091	-.000071	-.000050	-.000011	-.000568	-.000600	-.000632	a	568
-.000048	-.000052	-.000545	-.000563	-.000477	-.000450	-.000532	-.000607	a	569
-.000055	-.000145	-.000430	-.000400	-.000411	-.000417	-.000328	-.000254	a	570
-.000117	-.000083	.000093	.000187	.000279	.000367	.000463	.000551	a	571
.000555	.000612	.000022	.000022	.000047	.000066	.000070	.000108	a	572
.000067	.000100	.000087	.000073	.000071	.000068	.000062	.000057	a	573
.000053	.000058	.000013	.000576	.000706	.000845	.000840	.000958	a	574
.000141	.000156	.000096	.000098	.000085	.000022	.000089	.000085	a	575
.000075	.000120	.000125	.001206	.001205	.001200	.001232	.001255	a	576
.001121	.001343	.001377	.001364	.001411	.001459	.001425	.001397	a	577
.001379	.001350	.001396	.001253	.001191	.001119	.001074	.001022	a	578
.000971	.000913	.000850	.000792	.000745	.000697	.000604	.000507	a	579
.000397	.000288	.000187	.000091	.000003	-.000080	-.000174	-.000257	a	580
-.000329	-.000391	-.000456	-.000512	-.000563	-.000604	-.000601	-.000590	a	581
-.000572	-.000587	-.000522	-.000498	-.000463	-.000432	-.000384	-.000334	a	582
-.000301	-.000269	-.000233	-.000203	-.000198	-.000199	-.000192	-.000190	a	583
-.000258	-.000214	-.000219	-.000229	-.000231	-.000235	-.000243	-.000251	a	584
-.000274	-.000316	-.000335	-.000350	-.000355	-.000354	-.000344	-.000329	a	585
-.000303	-.000271	-.000237	-.000198	-.000168	-.000132	-.000109	-.000082	a	586
-.000119	.000045	.000158	.000236	.000274	.000308	.000337	.000343	a	587
.000054	.000066	.000117	.000089	.000061	.000033	.000002	.000026	a	588
.000041	.000078	.000062	.000026	.000038	.000041	.000059	.000074	a	589
.000041	.000045	.000087	.000069	.000057	.000040	.000029	.000017	a	590
.000029	.000025	.000029	.000023	.000025	.000025	.000018	.000011	a	591

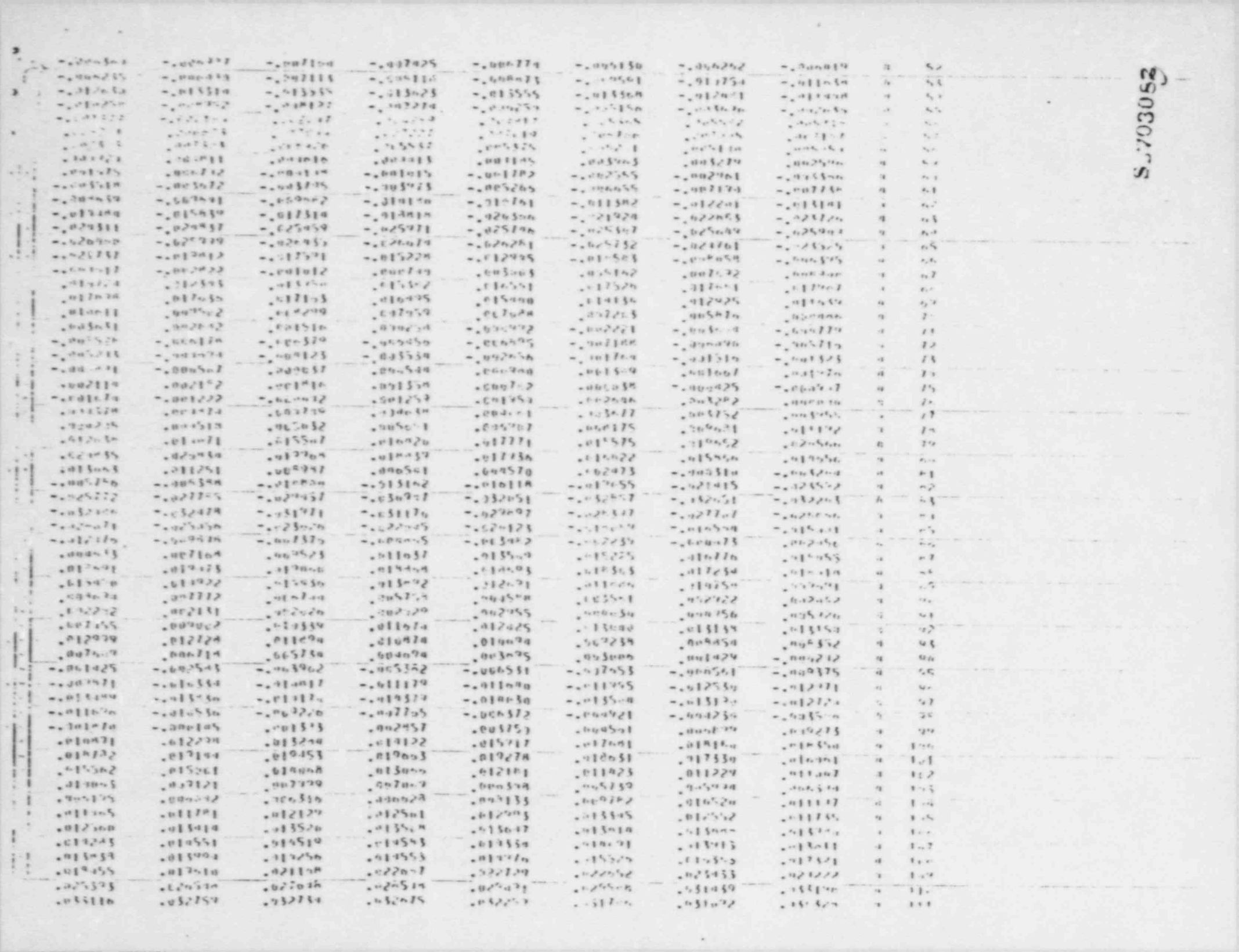
.000072	.000038	-.000019	-.000071	-.000111	-.000150	-.000185	-.000215	a	592
-.000259	-.000299	-.000343	-.000383	-.000381	-.000375	-.000469	-.000562	a	593
-.000527	-.000496	-.000498	-.000569	-.000484	-.000459	-.000395	-.000329	a	594
-.000244	-.000246	-.000235	-.000226	-.000202	-.000182	-.000178	-.000181	a	595
-.000189	-.000195	-.000214	-.000235	-.000325	-.000415	-.000236	-.000051	a	596
-.000162	-.000279	-.000240	-.000132	-.000276	-.000352	-.000377	-.000399	a	597
-.000451	-.000453	-.000432	-.000397	-.000314	-.000220	-.000287	-.000346	a	598
-.000228	-.000104	-.000039	.000013	.000098	.000167	.000221	.000270	a	599
.000356	.000431	.000476	.000504	.000502	.000438	.000470	.000409	a	600

S.7C3051

SOIL CONDITION 2

887C3C57

SJ703052



S.703064

S/N703085

S/370356

5703087

SJ703055

SU703089

SU703030

S7703031

S/703032

REVISED 12-15-76

MIDLAND(722a) VERT PLOT # OBE=42% WITH VS=500FT/SEC&SOIL DENSITY=120PCF

SJ703033

SOIL CONDITION 2

MASS PT # TIME HISTORY

-.000133	-.000230	-.000319	-.000403	-.000500	-.000622	-.000770	-.000905	#	1
-.001159	-.001331	-.001493	-.001598	-.001625	-.001553	-.001411	-.001197	#	2
-.000947	-.000693	-.000456	-.000252	-.000095	.000068	.000048	.000020	#	3
-.000858	-.000207	-.000376	-.000555	-.000714	-.000825	-.000891	-.000912	#	4
-.000478	-.000420	-.000751	-.000880	-.001025	-.001087	-.001032	-.000958	#	5
-.000815	.000307	.000755	.001145	.001552	.001814	.002531	.003135	#	6
.003791	.004474	.005159	.005951	.006478	.006995	.007413	.007754	#	7
.007998	.007997	.007931	.007731	.007411	.006995	.006462	.005853	#	8
.004509	.004589	.003968	.003231	.002622	.002059	.001475	.000927	#	9
.000342	-.000172	-.000713	-.001223	-.001668	-.001921	-.002295	-.002537	#	10
-.002742	-.002971	-.002899	-.002666	-.002414	-.002158	-.001926	-.001737	#	11
-.002171	-.002068	-.001813	-.001579	-.001319	-.001044	-.000757	-.000519	#	12
-.000215	-.000072	.000239	.000379	.000538	.000692	.000849	.000911	#	13
-.000552	-.000578	-.000587	-.000528	-.000455	.000291	.000694	.001025	#	14
.001357	.001547	.001708	.002033	.002222	.002346	.002397	.002370	#	15
.002744	.002158	.001942	.001791	.001568	.001348	.000995	.000517	#	16
.000161	-.000503	-.001049	-.001718	-.002428	-.003169	-.003425	-.003370	#	17
-.002389	-.002805	-.003210	-.003234	-.003188	-.003015	-.002855	-.002798	#	18
-.002651	-.002585	-.002456	-.002269	-.002080	-.001990	-.001998	-.001997	#	19
-.001858	-.001322	-.000695	-.000318	-.000253	-.000247	-.000225	-.000178	#	20
-.000219	-.000172	-.000197	-.000119	.000025	.000065	-.000179	-.000525	#	21
-.001614	-.001826	-.002322	-.002655	-.002758	-.002844	-.002871	-.002559	#	22
-.002752	-.002809	-.002619	-.002415	-.002288	-.002224	-.002254	-.002047	#	23
-.001876	-.001537	-.001350	-.001316	-.001259	-.001220	-.001265	-.001256	#	24
-.000510	-.000242	-.000053	-.000138	-.000226	-.000275	-.000258	-.000207	#	25
-.000258	-.000315	-.000174	-.000191	-.000194	-.000179	-.000277	-.000400	#	26
-.001799	-.001589	-.001257	-.001053	-.000238	-.000129	-.000369	-.000164	#	27
-.000512	-.000248	-.000343	-.000436	-.000469	-.000171	-.000435	-.000709	#	28
-.000844	-.000931	-.001164	-.001511	-.001558	-.001420	-.001333	-.001771	#	29
-.000813	-.000819	-.000871	-.000831	-.000752	-.000625	-.000728	-.000756	#	30
-.001325	-.000469	.000374	.001168	.001892	.002348	.002795	.003230	#	31
.003592	.003799	.003842	.003805	.003700	.003351	.002874	.002311	#	32
.001478	.000998	.000254	-.000408	-.001059	-.001646	-.002157	-.002579	#	33
-.002988	-.003112	-.003137	-.003148	-.003144	-.003378	-.003788	-.004211	#	34
-.004548	-.004999	-.005218	-.005286	-.005278	-.005289	-.005043	-.004480	#	35
-.003078	-.004511	-.004814	-.004974	-.004821	-.004476	-.003815	-.004505	#	36
-.003448	-.003345	-.003203	-.003028	-.003786	-.003449	-.003452	-.003423	#	37
-.002200	-.001615	-.001096	-.001263	-.001116	-.001058	-.001071	-.001159	#	38
-.001308	-.001509	-.001738	-.001968	-.002198	-.002361	-.002447	-.002455	#	39
-.002327	-.002123	-.001878	-.001637	-.001413	-.001221	-.001100	-.001042	#	40
-.001164	-.001344	-.001591	-.001881	-.002121	-.002237	-.002240	-.002287	#	41
-.002218	-.002048	-.001725	-.001246	-.000677	-.000073	.000493	.000963	#	42
.001323	.001560	.001691	.001725	.001653	.001467	.001235	.001026	#	43
.000853	.000563	.000442	.000111	-.000295	-.000747	-.001221	-.001673	#	44
-.002156	-.002603	-.003020	-.003428	-.003780	-.003996	-.004043	-.004087	#	45
-.004318	-.004425	-.004230	-.003953	-.003540	-.002951	-.002336	-.001619	#	46
-.001379	-.001087	-.000772	-.000478	-.000197	.000073	.000429	.001148	#	47
-.001349	-.001582	-.001758	-.001919	-.002424	-.002359	-.002756	-.003147	#	48
-.003498	-.003974	-.004454	-.004914	-.005216	-.005567	-.005488	-.004185	#	49
-.003415	-.002669	-.001911	-.001314	-.000744	-.000167	-.000320	-.000238	#	50
-.000525	-.000853	-.001154	-.001457	-.001757	-.002027	-.002227	-.002345	#	51

S/703095

.017357	.017866	.018307	.018713	.019113	.019532	.019902	.020166	a	112
.020326	.020380	.020321	.020139	.019850	.019588	.019239	.018852	a	113
.018499	.018269	.017999	.017884	.017836	.017838	.017821	.017726	a	114
.017565	.017383	.017016	.016549	.015967	.015287	.014528	.013670	a	115
.012972	.012140	.011511	.011002	.010583	.010233	.009841	.009316	a	116
.008738	.008038	.007298	.006868	.006515	.006410	.006343	.006219	a	117
.005855	.005052	.004411	.004337	.004579	.004218	.004153	.004310	a	118
.003533	.003128	.002850	.002455	.002729	.003052	.003169	.003056	a	119
.003206	.003595	.003817	.004298	.004908	.005849	.006398	.007569	a	120
.008312	.008252	.008220	.007972	.007525	.006958	.006627	.006269	a	121
.005250	.004802	.004623	.004407	.004351	.004333	.004484	.004879	a	122
.005379	.005874	.005286	.005547	.005710	.005814	.005781	.005604	a	123
-.003032	-.003594	-.003890	-.004115	-.004318	-.004575	-.004884	-.004941	a	124
-.005757	-.006956	-.007141	-.007335	-.007534	-.007998	-.008409	-.008893	a	125
-.009191	-.009357	-.009297	-.009271	-.009231	-.008958	-.008235	-.007185	a	126
-.005448	-.004629	-.003653	-.003365	-.003429	-.003233	-.003071	-.002653	a	127
-.002269	-.002026	-.001896	-.001831	-.001877	-.001874	-.001878	-.001759	a	128
-.001099	-.000270	-.000395	-.000800	-.001331	-.001225	-.000693	-.001052	a	129
-.002139	-.003301	-.004462	-.005508	-.006608	-.007658	-.008762	-.009777	a	130
-.011781	-.011654	-.012519	-.013341	-.014068	-.014660	-.015065	-.015240	a	131
-.015253	-.015138	-.015057	-.014873	-.014562	-.014215	-.013776	-.013337	a	132
-.012753	-.012201	-.011685	-.011061	-.010495	-.009706	-.008969	-.008208	a	133
-.007371	-.006460	-.005893	-.004469	-.003517	-.002636	-.001838	-.001167	a	134
-.000515	-.000110	.000142	.000263	.000325	.000386	.000318	.000021	a	135
-.001005	-.000341	-.001379	-.001871	-.002063	-.002235	-.002042	-.001772	a	136
-.005253	-.005739	-.005912	-.005938	-.005743	-.005585	-.005088	-.004355	a	137
-.003744	-.003078	-.002496	-.002024	-.001659	-.001387	-.001219	-.001132	a	138
-.001158	-.001406	-.001766	-.002251	-.002807	-.003388	-.003849	-.004081	a	139
-.005214	-.005816	-.006396	-.006943	-.007460	-.007951	-.008596	-.009583	a	140
-.010425	-.010557	-.011108	-.010850	-.010125	-.009644	-.008938	-.008597	a	141
-.008008	-.008327	-.008001	-.008152	-.008217	-.007905	-.007872	-.007548	a	142
-.013727	-.013189	-.012915	-.014068	-.015128	-.016004	-.016539	-.016578	a	143
-.015579	-.015152	-.015891	-.015573	-.014866	-.013584	-.011659	-.009500	a	144
-.007322	-.005390	-.003583	-.001781	-.000272	.000544	.001248	.001595	a	145
.001921	.001892	.001659	.001256	.000945	.000779	.000656	.000135	a	146
-.006184	-.005839	-.007459	-.009400	-.011023	-.011795	-.012087	-.012156	a	147
-.011751	-.011508	-.010395	-.009333	-.008213	-.007119	-.005962	-.004577	a	148
-.003335	-.001823	-.000427	.001548	.002543	.003482	.004530	.005099	a	149
.006535	.008034	.010067	.011442	.012668	.013212	.013783	.013610	a	150
.015409	.016079	.016513	.017116	.017357	.017183	.016781	.016301	a	151
.015645	.014927	.014060	.013144	.012290	.011591	.010679	.009263	a	152
.007693	.006208	.004677	.002970	.001281	-.000235	-.001688	-.003161	a	153
-.006047	-.006139	-.007592	-.008975	-.010154	-.011022	-.011618	-.011958	a	154
-.011995	-.011593	-.011046	-.010255	-.009328	-.008414	-.007209	-.005170	a	155
-.003548	-.001716	.000129	.002059	.003675	.004653	.005334	.005480	a	156
.006345	.006393	.006038	.005358	.004538	.003599	.002593	.001547	a	157
.000392	-.000961	-.002378	-.003787	-.005148	-.006426	-.007821	-.009493	a	158
-.011011	-.012035	-.012511	-.012398	-.012003	-.011626	-.011467	-.011710	a	159
-.012123	-.012534	-.013243	-.014088	-.015035	-.016041	-.017874	-.018676	a	160
-.019336	-.019836	-.020213	-.020493	-.020627	-.020578	-.020282	-.019691	a	161
-.018961	-.017988	-.016960	-.015827	-.014682	-.013299	-.011851	-.010587	a	162
-.009265	-.008038	-.006981	-.006008	-.005230	-.004605	-.004085	-.003477	a	163
-.002480	-.002230	-.001569	-.000928	-.000461	-.000296	-.000005	.000750	a	164
.001498	.001470	.002148	.002689	.003119	.003291	.003412	.003547	a	165
.003651	.003153	.002280	.001133	-.000070	-.001205	-.002156	-.002756	a	166
-.003322	-.004033	-.004646	-.004971	-.005023	-.004809	-.004506	-.004256	a	167
-.003978	-.003618	-.003147	-.002564	-.001935	-.001318	-.000802	-.000463	a	168
-.000178	.000178	.000543	.001046	.001427	.001619	.001611	.001439	a	169
.001183	.000916	.000715	.000687	.000704	.000883	.001294	.002022	a	170
.002828	.003748	.004615	.005093	.005586	.005[illegible]5	.005511	.[illegible]5547	a	171

.011601	.012474	.013222	.013808	.014118	.014053	.013775	.013383	a	172
.012876	.012251	.011456	.010452	.009219	.007738	.006067	.004252	a	173
.002373	.000498	-.001281	-.002867	-.004338	-.005750	-.006923	-.007714	a	174
-.004399	-.009193	-.010175	-.011415	-.012828	-.014354	-.015885	-.017335	a	175
-.019758	-.020179	-.021439	-.022397	-.023030	-.023313	-.023350	-.023223	a	176
-.022730	-.022506	-.021946	-.021282	-.020583	-.019908	-.019310	-.018435	a	177
-.018599	-.017940	-.017434	-.016961	-.016071	-.014938	-.013619	-.012232	a	178
-.010907	-.009378	-.007929	-.006471	-.004987	-.003467	-.001958	-.000498	a	179
.000928	.002352	.003642	.004799	.005769	.006485	.007000	.007323	a	180
.007476	.007476	.007271	.006819	.006174	.006520	.006837	.007339	a	181
.007413	.007644	.007109	.007802	.007371	.006761	.005922	.004782	a	182
.003529	.002311	.001169	.000141	-.000775	-.001575	-.002383	-.003296	a	183
-.004050	-.004975	-.005525	-.006199	-.006651	-.007007	-.007269	-.007488	a	184
-.000556	.000373	.001364	.002203	.002921	.003537	.003624	.003917	a	185
.000165	.000103	.000911	.000532	.000010	-.000378	-.001047	-.001584	a	186
.001013	.001197	.001116	.001318	.001776	.002093	.002402	.002858	a	187
.005491	.006545	.007048	.007583	.007985	.008280	.008533	.008800	a	188
.009015	.009130	.009211	.009369	.009463	.009703	.009892	.009921	a	189
.009916	.009975	.010097	.010283	.010363	.010199	.009860	.009395	a	190
.008725	.008053	.007235	.006389	.005527	.004655	.004012	.003793	a	191
.003698	.003443	.003180	.002941	.002942	.003137	.003400	.003598	a	192
.003498	.002673	.001773	.000199	-.001695	-.003785	-.006150	-.008805	a	193
-.011590	-.014116	-.016402	-.018388	-.020165	-.021822	-.023349	-.024706	a	194
-.025885	-.026969	-.027105	-.027197	-.027025	-.026654	-.026096	-.025368	a	195
-.024939	-.023511	-.021940	-.020465	-.018778	-.016928	-.014963	-.012922	a	196
-.010877	-.008890	-.006980	-.005169	-.003511	-.002056	-.000470	.001516	a	197
.003513	.005221	.006831	.008494	.010097	.011551	.012738	.013569	a	198
.014023	.014149	.014059	.013870	.012929	.010715	.007931	.005124	a	199
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-.008536	-.007328	-.006926	-.006203	-.005067	-.003869	-.003048	-.005035	a	201
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-.002072	-.003760	-.005257	-.006574	-.007891	-.009230	-.010152	-.010597	a	204
-.010720	-.010658	-.010501	-.010368	-.010149	-.009789	-.009292	-.008643	a	205
-.007752	-.006519	-.005580	-.004138	-.002672	-.001293	.000423	.002815	a	206
.005321	.007497	.009598	.011779	.013819	.015509	.016880	.017951	a	207
.018543	.019015	.019137	.019043	.018566	.017555	.016424	.015501	a	208
.014529	.013679	.011782	.010036	.008153	.006223	.004514	.003245	a	209
.002273	.000757	-.000425	-.001238	-.001806	-.002226	-.002633	-.003158	a	210
-.003581	-.004218	-.004601	-.004712	-.004503	-.004236	-.003623	-.002705	a	211
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.007275	.008197	.008901	.009425	.009891	.010404	.010378	.009350	a	213
.008193	.007597	.007215	.006791	.006532	.006611	.006823	.007011	a	214
.007255	.007617	.008024	.008419	.008680	.008710	.009055	.010151	a	215
.011409	.012371	.013259	.014239	.015181	.015977	.016527	.016746	a	216
.016537	.016337	.015655	.015101	.014033	.012604	.010908	.009258	a	217
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-.007216	-.009019	-.010783	-.012527	-.014178	-.015679	-.017150	-.018658	a	219
-.020182	-.021551	-.022780	-.023857	-.024822	-.025708	-.026487	-.027136	a	220
-.027699	-.028211	-.028657	-.029027	-.029392	-.029808	-.030084	-.030068	a	221
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-.021932	-.020327	-.018050	-.016011	-.013993	-.012099	-.010353	-.008779	a	223
-.007348	-.006043	-.004783	-.003504	-.002182	-.000796	.000599	.001958	a	224
.003295	.004277	.005102	.005621	.005706	.005251	.004766	.004658	a	225
.004494	.003982	.003313	.002453	.002715	.003030	.003434	.003645	a	226
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-.002329	-.002579	-.002889	-.003293	-.003489	-.003619	-.003467	-.003287	a	230
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.005432	.005522	.006085	.008604	.010985	.013153	.014979	.016556	a	234
.017429	.018311	.019008	.019531	.019908	.020167	.020287	.020193	a	235
.019412	.019437	.019030	.018635	.018237	.017828	.017397	.016954	a	236
.016448	.015924	.015415	.014959	.014558	.014216	.013972	.013836	a	237
.013534	.013464	.013061	.012709	.012490	.012390	.012287	.012088	a	238
.011324	.010535	.011859	.011239	.010599	.009878	.009121	.008350	a	239
.007526	.006700	.006049	.005425	.004856	.004292	.003978	.004112	a	240
.004233	.004236	.004103	.004178	.004289	.004324	.004556	.004570	a	241
.004378	.004524	.004223	.004085	.003907	.003686	.003520	.002736	a	242
.002047	.001505	.000758	.000121	-.000565	-.001541	-.002150	-.002874	a	243
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-.009550	-.010317	-.011419	-.012344	-.013267	-.014159	-.014952	-.015513	a	245
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-.008542	-.009410	-.010331	-.011297	-.012094	-.012997	-.013661	-.014352	a	251
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.001733	.001915	.002111	.002321	.002556	.002824	.003021	.003327	a	266
.003542	.003749	.003953	.004168	.004236	.004052	.004339	.004575	a	267
.004249	.004427	.004736	.011575	.013021	.013335	.013130	.012975	a	268
.012486	.011903	.011252	.010637	.010110	.009715	.009486	.009209	a	269
.008131	.008327	.008432	.007978	.007675	.007593	.007592	.007817	a	270
.008569	.008379	.008339	.008356	.008271	.007948	.007563	.007253	a	271
.006787	.006383	.006936	.006717	.006486	.006370	.006391	.006426	a	272
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.012276	.013199	.013943	.014678	.015076	.014697	.014437	.013929	a	282
.013351	.012598	.012028	.011418	.010799	.010143	.009367	.008410	a	283
.007592	.006434	.005485	.004516	.003508	.002337	.001024	-.000016	a	284
-.001901	-.003357	-.004596	-.005792	-.006730	-.007568	-.008250	-.008735	a	285
-.009133	-.009558	-.009990	-.010585	-.011083	-.011514	-.011943	-.012073	a	286
-.012253	-.012421	-.012558	-.012652	-.012622	-.012408	-.011991	-.011357	a	287
-.010548	-.009981	-.009211	-.008462	-.007482	-.006335	-.005259	-.004036	a	288
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.014937	.014957	.014836	.014759	.014543	.014124	.013526	.013008	a	291

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-.009781	-.007654	-.009271	-.008624	-.007880	-.007171	-.006326	-.005215	a	294
-.004027	-.002909	-.001809	-.000698	.000604	.002189	.003818	.005300	a	295
.006569	.007567	.008335	.008943	.009393	.009726	.009842	.009586	a	296
.009322	.008908	.008399	.007718	.007045	.006205	.005251	.004180	a	297
.003094	.002060	.001163	.000459	-.000333	-.001431	-.002513	-.003527	a	298
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-.001029	-.000491	-.000052	.000004	.000121	.000132	.000102	.000012	a	300
-.000119	-.000272	-.000457	-.000673	-.000905	-.001264	-.001429	-.001274	a	301
-.001027	-.000865	-.000665	-.000334	.000102	.000622	.001321	.002273	a	302
.003341	.004413	.005415	.006242	.007079	.007851	.008272	.008078	a	303
.007679	.007398	.006951	.006284	.005611	.005266	.004821	.004267	a	304
.003761	.003475	.003332	.003271	.003461	.004037	.004569	.004713	a	305
.004694	.004694	.004521	.004419	.004018	.003358	.002588	.001836	a	306
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-.005232	-.004930	-.004716	-.004559	-.004496	-.004515	-.004652	-.002618	a	310
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.008325	.009596	.008510	.010053	.009791	.009736	.008361	.008900	a	317
.009434	.010408	.011593	.013270	.015514	.018726	.021774	.023758	a	318
.025027	.025826	.026225	.026273	.026015	.025494	.024619	.023325	a	319
.021729	.019429	.017967	.015883	.013657	.011283	.008878	.006539	a	320
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-.011530	-.011356	-.011107	-.010753	-.010299	-.009747	-.009264	-.008944	a	323
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-.016325	-.017171	-.017759	-.018105	-.018365	-.018373	-.018131	-.017594	a	325
-.016743	-.015551	-.014083	-.012338	-.010535	-.008842	-.006650	-.003476	a	326
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-.014028	-.014665	-.014934	-.014105	-.013539	-.012877	-.012336	-.012096	a	332
-.011831	-.011289	-.010698	-.010233	-.010099	-.010462	-.010797	-.010692	a	333
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-.005790	-.005013	-.004233	-.003392	-.002802	-.002206	-.001738	-.001427	a	335
-.001265	-.001329	-.001468	-.001728	-.002261	-.003259	-.004431	-.005543	a	336
-.006558	-.007552	-.008430	-.009213	-.009854	-.010316	-.010541	-.010484	a	337
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.004208	.004328	.004295	.003996	.003557	.003076	.002662	.002406	a	344
.002200	.001963	.001816	.001859	.001961	.002028	.002070	.002092	a	345
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-.019521	-.019033	-.018353	-.017531	-.016549	-.015553	-.014196	-.012225	a	350
-.009936	-.007791	-.005609	-.003952	-.000988	.002419	.005612	.007969	a	351

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.001417	.001545	.001673	.001808	.001930	.002025	.002108	.002192	a	a17
.002255	.002324	.002507	.002615	.002716	.002771	.002836	.002841	a	a18
.002423	.002702	.002738	.002652	.002535	.002356	.002199	.001971	a	a19
.001743	.001550	.001327	.001292	.001200	.001095	.001029	.001044	a	a20
.001054	.001039	.000984	.000960	.000921	.000839	.000750	.000686	a	a21
.000523	.000543	.000436	.000329	.000206	.000096	-.000062	-.000262	a	a22
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-.001899	-.001950	-.002091	-.002198	-.002267	-.002289	-.002283	-.002271	a	a24
-.002247	-.002212	-.002160	-.002089	-.002000	-.001892	-.001778	-.001650	a	a25
-.001534	-.001434	-.001355	-.001300	-.001251	-.001194	-.001141	-.001104	a	a26
-.001059	-.000955	-.000892	-.000785	-.000684	-.000604	-.000556	-.000508	a	a27
-.000551	-.000553	-.000549	-.000621	-.000666	-.000721	-.000775	-.000820	a	a28
-.000951	-.000963	-.000951	-.001009	-.001066	-.001112	-.001197	-.001358	a	a29
-.001512	-.001739	-.001878	-.002076	-.002261	-.002401	-.002508	-.002592	a	a30
-.002651	-.002695	-.002708	-.002729	-.002755	-.002794	-.002799	-.002734	a	a31
-.002656	-.002534	-.002413	-.002258	-.002085	-.001904	-.001725	-.001561	a	a32
-.001405	-.001251	-.001121	-.000987	-.000864	-.000758	-.000663	-.000575	a	a33
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-.000329	-.000270	-.000207	-.000138	-.000059	-.000003	.000080	.000197	a	a38
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.001137	.001200	.001250	.001285	.001329	.001346	.001361	.001361	a	a40
.001359	.001330	.001302	.001265	.001224	.001183	.001140	.001097	a	a41
.001058	.001010	.000966	.000919	.000886	.000878	.000870	.000840	a	a42
.000829	.000791	.000745	.000791	.000797	.000795	.000770	.000705	a	a43
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-.000959	-.000880	-.000770	-.000670	-.000564	-.000458	-.000349	-.000258	a	a47
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.000951	.001073	.001171	.001242	.001288	.001308	.001297	.001252	a	a49
.001132	.001134	.001076	.001017	.000951	.000877	.000800	.000724	a	a50
.000652	.000587	.000532	.000488	.000424	.000312	.000180	.000049	a	a51
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-.000059	-.000034	-.000010	.000012	.000030	.000044	.000059	.000081	a	a55
.000190	.000150	.000153	.000172	.000189	.000208	.000232	.000265	a	a56
.000351	.000337	.000358	.000390	.000400	.000392	.000368	.000330	a	a57
.000298	.000236	.000190	.000151	.000117	.000090	.000061	.000025	a	a58
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-.000362	-.000274	-.000242	-.000208	-.000167	-.000134	-.000094	-.000036	a	a61
.000025	.000079	.000132	.000189	.000234	.000251	.000256	.000258	a	a62
.000219	.000220	.000177	.000125	.000075	.000035	.000006	-.000008	a	a63
-.000015	-.000019	-.000017	-.000008	.000008	.000031	.000054	.000072	a	a64
.000090	.000110	.000142	.000176	.000210	.000239	.000267	.000297	a	a65
.000325	.000351	.000378	.000407	.000434	.000456	.000478	.000499	a	a66
.000519	.000535	.000538	.000560	.000573	.000588	.000601	.000609	a	a67
.000612	.000612	.000608	.000602	.000594	.000587	.000584	.000587	a	a68
.000595	.000614	.000626	.000645	.000669	.000693	.000717	.000739	a	a69
.000762	.000780	.000810	.000834	.000855	.000871	.000875	.000862	a	a70
.000812	.000823	.000802	.000777	.000753	.000735	.000708	.000660	a	a71

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.000621	.000615	.000633	.000672	.000716	.000757	.000775	.000754	a	472
.000721	.000634	.000662	.000598	.000515	.000420	.000326	.000243	a	473
.000177	.000135	.000199	.000091	.000080	.000072	.000082	.000124	a	474
.000172	.000207	.000232	.000249	.000256	.000250	.000237	.000222	a	475
.000139	.000155	.000132	.000068	.000013	-.000037	-.000087	-.000138	a	476
-.000158	-.000252	-.000275	-.000319	-.000361	-.000397	-.000426	-.000447	a	477
-.000460	-.000464	-.000491	-.000453	-.000433	-.000395	-.000347	-.000276	a	478
-.000251	-.000215	-.000178	-.000175	-.000167	-.000158	-.000168	-.000191	a	479
-.000179	-.000219	-.000259	-.000255	-.000276	-.000309	-.000349	-.000390	a	480
-.000461	-.000457	-.000532	-.000575	-.000615	-.000653	-.000693	-.000734	a	481
-.000711	-.000719	-.000702	-.000642	-.000653	-.000618	-.000584	-.000558	a	482
-.000527	-.000480	-.000417	-.000338	-.000248	-.000155	-.000069	.000002	a	483
.000055	.000136	.000136	.000228	.000262	.000295	.000327	.000361	a	484
.000392	.000413	.000423	.000417	.000401	.000377	.000350	.000322	a	485
.000272	.000254	.000219	.000173	.000122	.000066	.000007	-.000053	a	486
-.000213	-.000173	-.000228	-.000274	-.000332	-.000415	-.000510	-.000600	a	487
-.000461	-.000787	-.000798	-.000833	-.000855	-.000863	-.000863	-.000850	a	488
-.000850	-.000758	-.000775	-.000768	-.000711	-.000659	-.000596	-.000527	a	489
-.000455	-.000347	-.000320	-.000258	-.000199	-.000148	-.000089	-.000029	a	490
.000024	.000077	.000122	.000167	.000213	.000261	.000309	.000354	a	491
.000333	.000413	.000455	.000443	.000448	.000442	.000441	.000438	a	492
.000454	.000384	.000420	.000474	.000505	.000507	.000501	.000456	a	493
.000405	.000345	.000424	.000406	.000389	.000370	.000351	.000331	a	494
.000309	.000283	.000293	.000241	.000219	.000198	.000176	.000152	a	495
.000128	.000103	.000050	.000062	.000047	.000032	.000024	.000026	a	496
.000031	.000033	.000031	.000023	.000013	.000001	-.000006	-.000002	a	497
.000020	.000015	.000029	.000052	.000079	.000106	.000131	.000152	a	498
.000171	.000148	.000205	.000220	.000247	.000268	.000293	.000320	a	499
.000355	.000347	.000416	.000408	.000477	.000502	.000525	.000546	a	500
.000563	.000576	.000585	.000598	.000597	.000594	.000595	.000608	a	501
.000619	.000619	.000615	.000613	.000609	.000566	.000517	.000462	a	502
.000394	.000324	.000254	.000180	.000109	.000048	-.000021	-.000090	a	503
-.000157	-.000218	-.000275	-.000328	-.000376	-.000419	-.000456	-.000489	a	504
-.000515	-.000531	-.000542	-.000555	-.000550	-.000512	-.000459	-.000402	a	505
-.000368	-.000329	-.000284	-.000224	-.000197	-.000177	-.000161	-.000149	a	506
-.000150	-.000133	-.000124	-.000109	-.000100	-.000107	-.000119	-.000130	a	507
-.000158	-.000148	-.000149	-.000153	-.000159	-.000169	-.000170	-.000153	a	508
-.000130	-.000111	-.000091	-.000066	-.000039	-.000013	.000013	.000039	a	509
.000054	.000065	.000062	.000053	.000043	.000037	.000018	-.000031	a	510
-.000087	-.000134	-.000176	-.000218	-.000244	-.000241	-.000223	-.000201	a	511
-.000171	-.000129	-.000079	-.000024	.000031	.000082	.000134	.000193	a	512
.000254	.000315	.000375	.000433	.000486	.000534	.000577	.000614	a	513
.000635	.000672	.000696	.000715	.000729	.000732	.000727	.000716	a	514
.000701	.000645	.000617	.000668	.000628	.000608	.000583	.000550	a	515
.000513	.000472	.000421	.000375	.000319	.000257	.000195	.000135	a	516
.000083	.000030	.000007	-.000019	-.000041	-.000063	-.000077	-.000076	a	517
-.000071	-.000070	-.000068	-.000068	-.000059	-.000057	-.000057	-.000059	a	518
-.000075	-.000077	-.000094	-.000115	-.000136	-.000158	-.000178	-.000197	a	519
-.000217	-.000238	-.000260	-.000282	-.000303	-.000325	-.000340	-.000345	a	520
-.000351	-.000368	-.000395	-.000430	-.000477	-.000519	-.000559	-.000596	a	521
-.000629	-.000654	-.000679	-.000692	-.000676	-.000693	-.000688	-.000685	a	522
-.000681	-.000678	-.000654	-.000652	-.000622	-.000563	-.000499	-.000418	a	523
-.000341	-.000275	-.000215	-.000163	-.000115	-.000079	-.000037	-.000024	a	524
-.000018	.000004	.000028	.000054	.000079	.000102	.000120	.000128	a	525
.000137	.000156	.000182	.000216	.000249	.000277	.000302	.000326	a	526
.000347	.000363	.000372	.000374	.000365	.000350	.000330	.000313	a	527
.000291	.000261	.000221	.000171	.000120	.000073	.000017	-.000057	a	528
-.000132	-.000175	-.000251	-.000307	-.000348	-.000365	-.000368	-.000362	a	529
-.000345	-.000317	-.000278	-.000232	-.000184	-.000138	-.000095	-.000070	a	530
.000249	.000211	.000172	.000231	.000293	.000353	.000348	a	531

.000407	.000424	.000437	.000447	.000448	.000439	.000422	.000398	a	532
.000375	.000357	.000347	.000345	.000347	.000351	.000363	.000390	a	533
.000422	.000447	.000470	.000494	.000512	.000519	.000522	.000525	a	534
.000523	.000516	.000501	.000481	.000459	.000435	.000411	.000387	a	535
.000359	.000326	.000299	.000269	.000208	.000167	.000125	.000079	a	536
.000033	-.000008	-.000047	-.000082	-.000112	-.000133	-.000163	-.000214	a	537
-.000258	-.000311	-.000352	-.000401	-.000446	-.000481	-.000506	-.000525	a	538
-.000537	-.000559	-.000536	-.000524	-.000517	-.000502	-.000482	-.000456	a	539
-.000425	-.000392	-.000357	-.000327	-.000293	-.000251	-.000205	-.000155	a	540
-.000104	-.000067	-.000029	.000007	.000035	.000049	.000056	.000056	a	541
.000058	.000049	.000041	.000032	.000020	.000008	-.000005	-.000018	a	542
-.000050	-.000039	-.000045	-.000057	-.000054	-.000075	-.000101	-.000128	a	543
-.000156	-.000185	-.000213	-.000239	-.000263	-.000285	-.000309	-.000307	a	544
-.000312	-.000319	-.000326	-.000331	-.000333	-.000330	-.000324	-.000315	a	545
-.000307	-.000299	-.000290	-.000281	-.000270	-.000257	-.000241	-.000223	a	546
-.000203	-.000183	-.000162	-.000141	-.000121	-.000100	-.000080	-.000062	a	547
-.000045	-.000029	-.000013	.000003	.000020	.000039	.000060	.000082	a	548
.000103	.000125	.000146	.000164	.000176	.000183	.000186	.000189	a	549
.000189	.000181	.000167	.000150	.000132	.000115	.000099	.000082	a	550
.000059	.000029	-.000019	-.000070	-.000123	-.000173	-.000227	-.000291	a	551
-.000353	-.000402	-.000441	-.000472	-.000492	-.000496	-.000492	-.000486	a	552
-.000475	-.000459	-.000438	-.000415	-.000391	-.000369	-.000346	-.000322	a	553
-.000297	-.000270	-.000231	-.000211	-.000182	-.000155	-.000129	-.000105	a	554
-.000082	-.000061	-.000040	-.000021	-.000006	.000002	.000016	.000048	a	555
.000080	.000102	.000121	.000144	.000163	.000171	.000173	.000171	a	556
.000150	.000155	.000140	.000136	.000131	.000131	.000128	.000111	a	557
.000073	.000041	.000072	.000060	.000047	.000036	.000028	.000023	a	558
.000022	.000021	.000020	.000019	.000018	.000020	.000020	.000019	a	559
.000016	.000011	.000006	.000001	-.000003	-.000007	-.000008	-.000009	a	560
-.000010	-.000019	-.000012	-.000017	-.000018	-.000019	.000001	.000012	a	561
.000022	.000033	.000041	.000048	.000050	.000048	.000041	.000029	a	562
.000014	.000000	-.000013	-.000027	-.000033	-.000361	-.000081	-.000102	a	563
-.000123	-.000142	-.000160	-.000175	-.000190	-.000205	-.000218	-.000225	a	564
-.000233	-.000243	-.000254	-.000264	-.000275	-.000286	-.000295	-.000298	a	565
-.000302	-.000314	-.000334	-.000362	-.000393	-.000424	-.000450	-.000469	a	566
-.000484	-.000495	-.000500	-.000493	-.000479	-.000459	-.000437	-.000415	a	567
-.000398	-.000371	-.000348	-.000323	-.000294	-.000261	-.000229	-.000205	a	568
-.000195	-.000159	-.000133	-.000105	-.000077	-.000049	-.000032	-.000053	a	569
-.000040	-.000031	-.000042	-.000047	-.000059	-.000082	-.000107	-.000127	a	570
-.000140	-.000146	-.000145	-.000140	-.000130	-.000115	-.000095	-.000068	a	571
-.000039	-.000012	.000013	.000035	.000057	.000081	.000108	.000139	a	572
.000171	.000204	.000238	.000272	.000306	.000343	.000380	.000419	a	573
.000458	.000497	.000532	.000560	.000595	.000649	.000707	.000758	a	574
.000803	.000842	.000876	.000903	.000924	.000937	.000941	.000933	a	575
.000920	.000907	.000895	.000884	.000868	.000840	.000805	.000765	a	576
.000725	.000688	.000648	.000602	.000556	.000516	.000477	.000434	a	577
.000391	.000349	.000307	.000266	.000225	.000186	.000149	.000119	a	578
.000094	.000077	.000066	.000061	.000065	.000078	.000096	.000115	a	579
.000134	.000151	.000167	.000182	.000196	.000209	.000219	.000226	a	580
.000228	.000228	.000223	.000214	.000199	.000179	.000156	.000134	a	581
.000113	.000092	.000072	.000051	.000031	.000010	-.000009	-.000025	a	582
-.000039	-.000052	-.000063	-.000071	-.000079	-.000087	-.000095	-.000101	a	583
-.000107	-.000112	-.000116	-.000118	-.000117	-.000112	-.000105	-.000095	a	584
-.000084	-.000076	-.000069	-.000062	-.000055	-.000048	-.000040	-.000031	a	585
-.000021	-.000010	.000002	.000014	.000026	.000035	.000041	.000042	a	586
.000043	.000047	.000053	.000064	.000073	.000079	.000090	.000112	a	587
.000134	.000148	.000160	.000175	.000182	.000174	.000162	.000153	a	588
.000141	.000121	.000096	.000068	.000041	.000018	.000000	-.000012	a	589
-.000022	-.000033	-.000034	-.000053	-.000060	-.000068	-.000069	-.000078	a	590
-.000075	-.000069	-.000079	-.000083	-.000083	-.000079	.000003	.000020	a	591

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-.000056	-.000052	-.000066	-.000076	-.000098	-.000090	-.000094	-.000097	592
-.000097	-.000093	-.000085	-.000072	-.000058	-.000045	-.000024	-.000011	593
-.000059	-.000083	-.000115	-.000150	-.000185	-.000210	-.000241	-.000274	594
-.000207	-.000270	-.000320	-.000268	-.000243	-.000253	-.000210	-.000224	595
-.000205	-.000146	-.000168	-.000181	-.000125	-.000115	-.000093	-.000058	596
.000022	.000064	.000103	.000151	.000198	.000221	.000238	.000249	597
.000250	.000241	.000224	.000205	.000186	.000172	.000145	.000097	598
.000141	-.000137	-.000154	-.000184	-.000156	-.000207	-.000257	-.000306	599
-.000354	-.000397	-.000433	-.000465	-.000473	-.000520	-.000515	.000000	600

CONTROL TOWER

MIDLAND AUX BLDG SEISMIC ANALYSIS - 1S - 5% DEW SOIL CASE TAFT E-W

MASS PT 5 TIME HISTORY

-.000223	-.000573	-.000327	-.001342	5	1
-.002669	-.002721	-.002983	-.001745	5	2
-.000617	-.000823	-.000323	-.000671	5	3
.000933	.000940	.001989	.001969	5	4
.001196	.001264	.001907	.001556	5	5
-.000983	-.000961	-.001779	-.001779	5	6
-.001153	-.001253	-.000533	-.001552	5	7
.000174	.000322	.000347	.000524	5	8
.001236	.000778	.000716	.002771	5	9
-.002733	-.001799	-.002317	-.001794	5	10
-.001153	-.001511	-.000951	-.000979	5	11
-.000184	-.000284	-.000951	-.000755	5	12
-.001131	-.001294	-.002795	-.002035	-.001286	5	13
-.000128	-.001359	.001413	.000472	5	14
.001556	.001535	.000329	.000355	.002334	5	15
-.000927	-.000385	-.002733	-.000574	.001726	5	16
.001934	.002612	.000332	-.002038	-.000522	5	17
-.001771	-.001133	-.001330	-.001764	-.001971	5	18
-.000267	-.000553	-.000535	-.000434	-.000791	5	19
.000123	.000120	.000077	.000077	5	20
.000594	.001538	.000730	.000234	5	21
.000786	.001182	.001253	.001114	5	22
-.000241	-.000761	-.000546	-.000771	5	23
-.000595	-.000432	-.000521	-.000327	5	24
-.000477	-.000744	-.000337	-.000781	5	25
-.001254	-.000939	-.000337	-.000521	5	26
.002785	.002424	.000326	.000326	5	27
.000604	.000712	.000395	.000542	5	28
.000221	.000779	-.000384	-.000592	5	29
-.000738	-.000781	-.000335	-.000335	5	30
-.000413	-.000381	-.000336	-.000578	5	31
.000413	.000437	.001370	.000454	5	32
.001939	.002154	.000938	-.000249	5	33
.000359	.000389	-.000762	-.000559	5	34
-.000953	-.000532	.000270	.000271	5	35
.000642	.000934	.000729	5	36
.001972	.001847	.001593	.000592	5	37
.001342	.001731	.000481	.000837	-.000197	5	38
-.021104	-.021119	-.023775	-.025992	-.027703	5	39
-.030723	-.031153	-.029726	-.026395	-.023139	5	40
-.030281	.000114	.001993	.001557	.001752	5	41
.001975	.001432	.001278	.000772	5	42
.000377	.000751	.000359	5	43
.000339	.000377	.000396	.000568	.000453	5	44
.000554	.000741	.000784	.000841	5	45
-.000151	-.000617	-.002719	-.001454	5	46
-.000453	-.000141	-.000765	5	47
.000163	.000430	5	48
5	49
5	50
5	51

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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-.070763	-.058025	-.043287	5	112
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.047562	[illegible]	[illegible]	5	113
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.055554	[illegible]	5	114
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-.022947	[illegible]	[illegible]	5	115
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-.074554	[illegible]	[illegible]	5	116
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-.022945	[illegible]	[illegible]	5	117
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-.017733	[illegible]	[illegible]	5	125
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	126
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-.020196	[illegible]	[illegible]	5	137
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	146
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	147
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-.030901	[illegible]	[illegible]	5	148
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	149
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	150
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	151
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	152
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.001697	[illegible]	[illegible]	5	153
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-.002311	[illegible]	[illegible]	5	154
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-.020672	[illegible]	[illegible]	5	155
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	156
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	157
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-.013569	[illegible]	[illegible]	5	158
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.014756	[illegible]	[illegible]	5	159
[illegible]	.042250	.027040	.033429	.040877	.048236	.054582	.059117	5	160
[illegible]	.050412	.051975	.04[illegible]	.029427	.015435	.000999	-.012853	5	161
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-.052707	[illegible]	[illegible]	5	162
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	163
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.022514	[illegible]	[illegible]	5	164
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.075513	[illegible]	[illegible]	5	165
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	166
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	167
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	168
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	169
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	170
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	171

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[illegible]	[illegible]	[illegible]	[illegible]	-.000135	[illegible]	[illegible]	.000053	5	292
[illegible]	[illegible]	[illegible]	[illegible]	.000377	[illegible]	-.000424	.000424	5	293
[illegible]	[illegible]	[illegible]	[illegible]	.000273	[illegible]	[illegible]	.000223	5	294
[illegible]	[illegible]	[illegible]	[illegible]	.000112	[illegible]	[illegible]	[illegible]	5	295
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	296
[illegible]	[illegible]	[illegible]	[illegible]	.000115	[illegible]	[illegible]	.000147	5	297
[illegible]	[illegible]	[illegible]	[illegible]	-.000151	[illegible]	[illegible]	[illegible]	5	298
[illegible]	[illegible]	[illegible]	[illegible]	.000323	[illegible]	.000251	.000333	5	299
[illegible]	[illegible]	[illegible]	[illegible]	.000491	[illegible]	[illegible]	[illegible]	5	300

SJ703109

CONTROL TOWER

MIDLAND AUX BLDG SEISMIC ANALY OBE- EW 6% PERM SOIL CASE [illegible] TAFT EQ

MASS PT 5 TIME HISTORY

[illegible]	[illegible]	[illegible]	-.000557	-.000553	-.000573	-.000575	-.000553	5	1
[illegible]	[illegible]	[illegible]	[illegible]	-.002751	-.002817	-.002837	[illegible]	5	2
[illegible]	[illegible]	[illegible]	-.006514	-.006827	.006946	.006945	.006874	5	3
[illegible]	[illegible]	.011975	.011975	.011924	.011732	.011730	[illegible]	5	4
[illegible]	[illegible]	[illegible]	.015942	.015933	.015939	.015937	[illegible]	5	5
[illegible]	[illegible]	[illegible]	-.016811	-.016831	-.016874	-.016835	-.016832	5	6
[illegible]	[illegible]	[illegible]	[illegible]	-.018517	-.018744	-.018815	-.018745	5	7
[illegible]	[illegible]	[illegible]	[illegible]	-.016274	-.016451	-.016443	[illegible]	5	8
[illegible]	[illegible]	[illegible]	[illegible]	.019754	.019741	.019777	[illegible]	5	9
[illegible]	[illegible]	[illegible]	[illegible]	-.018577	-.018555	-.018449	[illegible]	5	10
[illegible]	[illegible]	[illegible]	[illegible]	-.019752	-.019734	-.019277	[illegible]	5	11
[illegible]	[illegible]	[illegible]	-.018532	-.018529	-.018723	-.018738	[illegible]	5	12
[illegible]	[illegible]	[illegible]	[illegible]	-.018533	-.018533	-.018779	[illegible]	5	13
[illegible]	[illegible]	[illegible]	[illegible]	-.019417	-.019479	-.019479	[illegible]	5	14
[illegible]	[illegible]	[illegible]	[illegible]	.018419	.018459	.018427	[illegible]	5	15
[illegible]	[illegible]	[illegible]	-.018752	-.018752	-.018755	-.018754	[illegible]	5	16
[illegible]	[illegible]	[illegible]	[illegible]	.018428	.018430	-.018842	[illegible]	5	17
[illegible]	[illegible]	[illegible]	[illegible]	-.018642	-.018671	-.018737	[illegible]	5	18
[illegible]	[illegible]	[illegible]	[illegible]	-.018778	-.018778	-.018854	[illegible]	5	19
[illegible]	[illegible]	[illegible]	[illegible]	.018485	.018542	.018582	[illegible]	5	20
[illegible]	[illegible]	[illegible]	[illegible]	.018523	.018555	.018512	[illegible]	5	21
[illegible]	[illegible]	[illegible]	[illegible]	.018476	.018496	.018540	[illegible]	5	22
[illegible]	[illegible]	[illegible]	[illegible]	-.018579	-.018735	-.018749	[illegible]	5	23
[illegible]	[illegible]	[illegible]	[illegible]	-.018778	-.018812	-.018762	[illegible]	5	24
[illegible]	[illegible]	[illegible]	[illegible]	-.018776	-.018926	-.018963	[illegible]	5	25
[illegible]	[illegible]	[illegible]	-.011751	-.018152	-.018437	-.018869	[illegible]	5	26
[illegible]	[illegible]	[illegible]	[illegible]	-.018254	-.018437	-.018824	[illegible]	5	27
[illegible]	[illegible]	[illegible]	[illegible]	.018524	.018564	.018804	[illegible]	5	28
[illegible]	[illegible]	[illegible]	[illegible]	.018719	.018932	.018745	[illegible]	5	29
[illegible]	[illegible]	[illegible]	[illegible]	.018547	.018796	.018715	[illegible]	5	30
[illegible]	[illegible]	[illegible]	[illegible]	-.011143	-.018498	-.018537	[illegible]	5	31
[illegible]	[illegible]	[illegible]	[illegible]	-.018465	-.018933	-.018712	[illegible]	5	32
[illegible]	[illegible]	[illegible]	[illegible]	-.018228	-.018966	-.018538	[illegible]	5	33
[illegible]	[illegible]	[illegible]	[illegible]	.018259	.018567	.018414	[illegible]	5	34
[illegible]	[illegible]	[illegible]	[illegible]	.018439	.018715	.018505	[illegible]	5	35
[illegible]	[illegible]	[illegible]	[illegible]	-.018497	-.018631	-.018745	[illegible]	5	36
[illegible]	[illegible]	[illegible]	[illegible]	-.018557	-.018734	-.018836	[illegible]	5	37
[illegible]	[illegible]	[illegible]	[illegible]	-.018513	-.018724	[illegible]	[illegible]	5	38
[illegible]	[illegible]	[illegible]	[illegible]	.018637	.018436	[illegible]	[illegible]	5	39
[illegible]	[illegible]	[illegible]	[illegible]	.019745	.019154	.016541	[illegible]	5	40
[illegible]	[illegible]	[illegible]	[illegible]	-.018613	-.018708	-.020196	-.022655	5	41
[illegible]	[illegible]	[illegible]	[illegible]	-.018819	-.018778	-.018779	[illegible]	5	42
[illegible]	[illegible]	[illegible]	[illegible]	-.018233	-.018538	.018024	[illegible]	5	43
[illegible]	[illegible]	[illegible]	[illegible]	.018139	.018134	.018122	[illegible]	5	44
[illegible]	[illegible]	[illegible]	[illegible]	.018042	.018027	.018017	[illegible]	5	45
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	46
[illegible]	[illegible]	[illegible]	[illegible]	-.018134	-.018093	-.018339	[illegible]	5	47
[illegible]	[illegible]	[illegible]	[illegible]	-.018432	-.018521	-.018618	-.018454	5	48
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-.018193	[illegible]	5	49
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	50
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	[illegible]

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	-.055721	-.066931	-.067159	-.056610	-.041545	-.055112	-.046823	5	112
		-.019031	-.004503	.005374	.016458	.028183	.075785	5	113
		.044733	.043021	.046672	.047894	.046517	.042156	5	114
		.024497	.023139	.014055	.013233	.002772	-.004117	5	115
		-.032057	-.033456	-.033506	-.045596	-.051005	-.057582	5	116
		-.057323	-.057323	-.057959	-.053974	-.048797	-.043797	5	117
		.021379	.021397	.026255	.028350	.027551	.027551	5	118
		.028694	.028213	.028513	.027377	.027502	.027502	5	119
		.023437	.024159	.026452	.025091	.022504	.022504	5	120
		-.024262	-.024262	-.024994	-.046968	-.051294	-.051294	5	121
		-.033221	-.033667	-.043773	-.036599	-.032969	-.032969	5	122
		-.023994	-.013215	-.014971	-.011937	-.009155	-.009155	5	123
		.023127	.023127	.025181	.026859	.028593	.028593	5	124
		.012774	.012004	.010433	.009227	.005239	.005239	5	125
		-.033745	-.015809	-.023719	-.025296	-.029431	-.029431	5	126
		-.041774	-.042744	-.042149	-.039222	-.035713	-.035713	5	127
		-.013225	-.005562	.004711	.014155	.024554	.024554	5	128
		.038521	.037859	.034143	.029191	.023994	.023994	5	129
		.033674	.026577	.024715	.023277	.019529	.019529	5	130
		-.041734	-.045715	-.049965	-.051727	-.051319	-.051319	5	131
		-.052577	-.053013	-.053013	-.036514	-.026802	-.026802	5	132
		-.027834	-.013667	.005513	.014136	.025607	.025607	5	133
		.027149	.032023	.035419	.036737	.037921	.037921	5	134
		.034791	.036791	.038131	.038937	.039355	.039355	5	135
		-.017721	-.027934	-.034564	-.034564	5	136		
		-.053564	-.053477	-.053953	-.054182	-.054182	5	137	
		-.033564	-.033033	-.022940	-.014224	-.014224	5	138	
		.021314	.029466	.030462	.032135	.032135	5	139	
		.044701	.042055	.037346	.032038	.032038	5	140	
		.034134	.031025	-.002243	-.026027	-.026027	5	141	
		-.051727	-.041172	-.030774	-.023097	-.023097	5	142	
		-.013447	-.018501	-.026231	-.031177	-.031177	5	143	
		-.013907	-.017914	-.017073	-.015157	-.015157	5	144	
		-.024796	-.009162	-.015774	-.015774	5	145		
		-.041691	-.042819	-.042894	-.041037	-.041037	5	146	
		-.031931	-.031131	-.031702	-.026349	-.026349	5	147	
		-.033931	-.033741	-.032279	-.032583	-.032583	5	148	
		-.033351	-.032401	-.031152	-.029154	-.029154	5	149	
		.034017	.034732	.035773	.037636	.037636	5	150	
		.031827	.031826	.031782	.031582	.031582	5	151	
		.021134	-.000718	-.002254	-.000792	-.000792	5	152	
.005527	.006833	.006181	.006072	.004718	.002808	.000625	5	153	
-.005949	-.005872	-.005515	-.005531	-.005562	-.006798	-.007045	5	154	
	-.017427	-.018364	-.015599	-.015469	5	155			
	-.003321	-.003952	-.001284	.002832	.003773	.003773	5	156	
	.017777	.017725	.017541	.013455	.013429	.013429	5	157	
	-.013043	-.014933	-.015139	-.015475	-.01122	-.01122	5	158	
	.016257	.018675	.017640	.021423	.019429	.019429	5	159	
.019752	.024410	.028861	.032544	.033251	.043732	.043732	5	160	
.047461	.044604	.037515	.029530	.016957	.003997	.003997	5	161	
-.033089	-.037745	-.043191	-.047339	-.049039	-.049469	-.049469	5	162	
-.043568	-.043568	-.046122	-.047527	-.049903	-.047529	-.047529	5	163	
	-.031637	-.021796	-.005792	.005213	.023291	.023291	5	164	
	.070151	.070333	.073435	.070313	.058943	.058943	5	165	
	.032447	.018332	.003095	-.003245	-.013129	-.013129	5	166	
	-.049211	-.055967	-.058778	-.062157	-.062157	5	167		
	-.034207	-.034174	-.042343	-.047549	-.039564	-.039564	5	168	
	-.013739	-.003842	.008336	.014229	.014709	.016783	.016783	5	169
		.036437	.034284	.041320	.045375	.045375	5	170	
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CONTROL TOWER

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						-.031665	.000739	5	113
						-.008859	-.002139	5	114
						-.001794	-.000737	5	115
						-.023635	-.003579	5	116
						.015957	.024798	5	117
						.016283	.015126	5	118
						.014295	.013962	5	119
						.003478	.000651	5	120
						.005066	.005257	5	121
						-.008174	-.005598	5	122
						-.015776	-.017542	5	123
						-.000737	-.000375	5	124
						-.004547	-.007341	5	125
						-.019243	-.018134	5	126
						-.003832	-.003214	5	127
						.036154	.034566	5	128
						.018032	.015243	5	129
						-.020764	-.026571	5	130
						-.017456	-.014286	5	131
						.000721	.001545	5	132
						.001678	.002202	5	133
						.018197	.016791	5	134
						.004549	.005615	5	135
						.001165	-.001677	5	136
						-.006777	-.006237	5	137
						-.005914	-.005583	5	138
						.010145	.010324	5	139
						-.003042	-.001122	5	140
						.021142	.018545	5	141
						.001211	-.001732	5	142
						-.012978	-.012367	5	143
						-.003652	.002275	5	144
						.013768	.013517	5	145
						.004471	-.001197	5	146
						-.010692	-.007726	5	147
						.015917	.015837	5	148
						-.002413	-.000855	5	149
						.001586	.002104	5	150
						-.000342	.000167	5	151
						.005662	.005722	5	152
						.005202	.002832	5	153
						-.013569	-.012094	5	154
						-.002117	-.000795	5	155
						.013359	.014444	5	156
						-.017552	-.015534	5	157
						.016700	.012318	5	158
						.009565	.025215	5	159
						.012462	.004990	5	160
						-.017951	-.014971	5	161
						-.008004	-.012057	5	162
						-.010177	-.005789	5	163
						.022216	.015624	5	164
						-.006493	-.006529	5	165
						-.015863	-.011119	5	166
						-.007584	-.005593	5	167
						.011172	-.003587	5	168
						-.010405	-.006015	5	169
						.022978	.022414	5	170
						.016950	.005561	5	171

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								5	172
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RAILROAD BAY

MIDLAND AUX BLDG SEISMIC ANALYSIS - NS - 6% DAMP SOIL CASE TAFT EQ

MASS PT 4 TIME HISTORY

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	1
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.21 [illegible]	.[illegible]52	.[illegible]52	.[illegible]96	.[illegible]23	.[illegible]52	.015477	.[illegible]45	4	34
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-.000691	-.000572	-.000797	-.001028	-.001151	-.001315	-.001446	-.001453	4	232
-.000977	-.001463	-.001821	-.002149	-.002432	-.002669	-.002809	-.002844	4	233
.002403	.002512	.002457	.002583	.002747	.002874	.002972	.002944	4	234
.002791	.002795	.002785	.002872	.002922	.002871	.002823	.002751	4	235
.002558	.002452	.002329	.002223	.002123	.002091	.002094	.002079	4	236
.002077	.002077	.002063	.002024	-.002180	-.002365	-.002482	-.002614	4	237
-.002776	-.002721	-.002714	-.002694	-.002642	-.002679	-.002650	-.002650	4	238
-.002664	-.002667	-.002671	-.002695	-.002657	-.002641	-.002684	-.002684	4	239
-.002536	-.002535	-.002542	-.002556	-.002631	-.002677	-.002727	-.002727	4	240
-.002429	-.002466	-.002543	-.002587	-.002647	-.002693	-.002715	-.002715	4	241
-.002714	-.002737	-.002826	-.002920	-.003110	-.003270	-.003291	-.003291	4	242
.002917	.002946	.002993	.003072	.003216	.003473	.003532	.003532	4	243
.003478	.003479	.003523	.003529	.003534	.003497	-.003297	-.003297	4	244
-.002739	-.002692	-.002805	-.002812	-.002836	-.002837	-.002892	-.002892	4	245
-.002664	-.002775	-.002834	-.002875	-.002722	-.002857	-.002859	-.002859	4	246
.002661	.002805	.002849	.002933	.003056	.003077	.003046	.003046	4	247
.002858	.002879	.002948	.003047	.003044	.003025	.002988	.002988	4	248
-.002746	-.002815	-.002882	-.002981	-.003017	-.003050	-.003054	-.003054	4	249
-.002829	-.002873	-.002968	-.003031	-.003076	-.003125	-.003148	-.003148	4	250
-.002762	-.002751	-.002805	-.002921	-.003053	-.003037	-.003153	-.003153	4	251
.002882	.002889	.002976	.003042	.003175	.003196	.003183	.003183	4	252
.003041	.003006	-.002955	-.002917	-.002977	-.003093	-.003181	-.003181	4	253
-.002915	-.002892	-.002952	-.003041	-.003079	-.003094	-.003115	-.003115	4	254
-.002867	-.002867	-.002964	-.003032	-.003072	-.003074	.003029	.003029	4	255
.003045	.003017	.003076	.003092	.003084	.003081	.003051	.003051	4	256
.003032	.003037	.003045	.003017	.003024	.003083	.003052	.003052	4	257
.003041	.003024	.003079	.003096	.003095	.003096	.003053	.003053	4	258
.003037	.003032	-.003055	-.003078	-.003043	-.003052	-.003051	-.003051	4	259
-.003031	-.003040	-.003054	-.003078	-.003083	-.003054	-.003042	-.003042	4	260
-.003054	-.003074	-.003061	-.003068	-.003077	-.003042	-.003093	-.003093	4	261
-.003034	-.003052	-.003045	-.003087	-.003087	-.003023	-.003032	-.003032	4	262
-.003035	-.003044	-.003088	.003129	.003083	.003056	.003055	.003055	4	263
.003037	.003026	.003079	.003098	.003089	.003035	.003051	.003051	4	264
.003034	.003037	.003084	.003087	-.003033	-.003077	-.003047	-.003047	4	265
-.003054	-.003071	-.003084	-.003054	-.003051	-.003073	-.003079	-.003079	4	266
-.003035	.003049	.003059	.003036	.003031	.003079	.003030	.003030	4	267
.003033	.003053	.003062	.003034	.003059	.003014	.003008	.003008	4	268
.003032	.003027	.003054	.003034	.003030	.003057	-.003011	-.003011	4	269
-.003033	-.003036	-.003058	-.003071	-.003041	-.003059	-.003046	-.003046	4	270
-.003032	-.003038	-.003078	-.003096	-.003096	-.003019	-.003043	-.003043	4	271
.003029	.003019	.003083	.003051	.003035	.003018	.003039	.003039	4	272
.003032	.003023	.003051	.003072	.003059	.003072	.003025	-.003027	4	273
-.003027	-.003032	-.003074	-.003041	-.003075	-.003088	-.003076	-.003076	4	274
-.003032	-.003044	-.003068	-.003092	-.003070	-.003085	-.003019	-.003019	4	275
.003035	.003037	.003048	.003033	.003032	.003034	.003038	.003038	4	276
.003037	.003012	-.003019	-.003056	-.003073	-.003091	-.003046	-.003062	4	277
-.003035	-.003049	-.003059	-.003024	-.003048	-.003079	-.003024	-.003035	4	278
-.003036	-.003042	.003013	.003025	.003051	.003030	.003047	.003047	4	279
.003045	.003011	.003060	.003017	.003033	.003061	.003039	.003031	4	280
.003059	.003020	.003002	.003017	-.003035	-.003065	-.003083	-.003096	4	281
-.003052	-.003069	-.003082	-.003029	-.003046	-.003034	-.003070	-.003045	4	282
-.003042	-.003058	-.003036	-.003015	-.003072	-.003034	-.003062	-.003048	4	283
-.003046	-.003047	-.003046	-.003061	-.003060	-.003071	-.003011	-.003007	4	284
-.003038	-.003035	-.003072	-.003014	-.003035	-.003073	.003036	.003015	4	285
.003047	.003015	.003043	.003053	.003059	.003054	.003055	.003029	4	286
.003044	.003021	.003036	.003071	.003047	.003094	.003044	.003015	4	287
.003041	.003045	.003018	.003024	.003034	.003038	.003018	.003021	4	288
.003042	.003068	.003004	.003036	.003023	.003019	.003035	.003027	4	289
.003032	.003015	.003003	-.003014	-.003041	-.003065	-.003031	-.003002	4	290
-.003028	-.003058	-.003046	-.003053	-.003065	-.003014	-.003043	-.003037	4	291

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-.000338	-.000250	-.000192	-.000103	-.000038	.000021	.000085	4	292
-.000248	.000304	.000359	.000387	.000417	.000450	.000485	4	293
.000395	.000396	.000371	.000303	.000254	.000342	.000284	4	294
.000315	.000246	.000154	.000106	.000019	-.000083	-.000135	4	295
-.000437	-.000474	-.000472	-.000492	-.000461	-.000419	-.000351	4	296
-.000128	-.000082	.000143	.000141	.000210	.000201	.000125	4	297
-.000066	-.000049	-.000203	-.000233	-.000234	-.000287	-.000555	4	298
-.000402	-.000269	-.000063	.000071	.000135	.000259	.000529	4	299
.000585	.000548	.000509	.000367	.000202	.000029	.000000	4	300

S/703127

RAILROAD BAY

[illegible]LAND AUX BLDG SEISMIC ANALY OBE- 60 [illegible]S SOIL CASE MOD TAFT 69

[illegible]ASS PT 4 TIME HISTORY

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REVISED 12-11-76

RAILROAD BAY

MIDLAND ADX BLDG SEISMIC ANALYSE- VV - 4" PENN SOIL CASE MOD TAFT EQ

MASS PT 4 TIME HISTORY

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-.013891	-.009592	-.007166	-.005273	-.006140	-.006596	-.006596	4	71
-.015435	-.020050	-.019602	-.018263	-.019701	-.015447	-.015447	4	72
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3XC 7-25-79

BECHTEL ARB
TWX 5161 7/13/79

Confirmation Copy

ATTN: J/F. NEWGEN

BEBC- 3103
SUBJECT: CPCO/MIDLAND PLANT JOB 7220
UNIT 2 TRANSFORMER FOUNDATION
FILE: 0274, (C-2620, C-1700, [redacted] C-76-PR)

REFERENCE: AS-BUILT TOP OF CONCRETE ELEVATIONS TELECOPIED TO PROJECT ENGINEERING ON 7/12/79 (REM C-2287)

THE AS-BUILT TOP OF CONCRETE ELEVATIONS ON THE SOUTH SIDE OF THE UNIT 2 TRANSFORMER FOUNDATION IS APPROXIMATELY 1-1/2 INCHES LOWER THAN THE DESIGN ELEVATION IN ACCORDANCE WITH THE REFERECE. THIS VARIATION IN ELEVATION IS NOT ACCEPTABLE FOR THE ISOPHASE BUS CONNECTION AND THEREFORE NEEDS CORRECTION. PROJECT ENGINEERING RECOMMENDS THAT THE FOUNDATION BE GROUTED UNIFORMLY TO 634'-7". 1 INCH ABOVE THE DESIGN ELEVATION BEFORE ERECTING THE TRANSFORMER. IMMEDIATELY AFTER ERECTING THE TRANSFORMER, THE FOUNDATION SHALL BE MONITORED FOR SETTLEMENT ON A WEEKLY BASIS UNTIL OTHERWISE ADVISED BY PROJECT ENGINEERING DESIGN DRAWING C-121 WILL BE REVISED TO REFLECT THE CHANGE IN THE FOUNDATION ELEVATION. THE ISOPHASE ADAPTER SHALL NOT BE CONNECTED.

RL CASTLEBERRY
ANN ARBOR/7PE2118/7220-001/ER

BECHTEL MIDL

S:703140

C-2645

Bechtel Associates Professional Corporation

Inter-office Memorandum

To	R. L. Castleberry	Date	3 July 1979
Subject	Midland Units 1 & 2-Job 7220-001 Meeting Notes	From	S. S. Afifi
		Of	Geotechnical Services
Copies to	1320, 3130	At	Ann Arbor 10 D 5 7220-79-112

Enclosed are meeting notes from the meeting of March 20, 1979 concerning settlement of the diesel generator building and other associated problems at the Midland site.

S. S. Afifi

RG/nm
Attachments

ATTENDEES:

BECHTEL	CONSUMERS POWER	CONSULTANTS
S. S. Afifi	T. Cooke	J. Dunnicliff
J. Allen	D. Horn	A. Hendron, Jr.
S. L. Blue	G. Keeley	R. B. Peck
A. Boos	D. Sibbald	
H. H. Burke	T. Thiruvengadam	
P. K. Chen		
J. Davie		
B. Dhar		
W. R. Ferris		
D. R. Gle		
P. A. Martinez		
J. Milandin		
G. Richardson		
M. Rothwell		
E. Rumbaugh		
[redacted]		
J. O. Wanzeck		

8703170

MEETING NOTES

DATE: March 20, 1979

LOCATION: Ann Arbor Office (7B3)

SUBJECT: Settlement of the Diesel Generator Building and other associated problems at the Midland site.

ATTENDEES: See list attached

DISCUSSION: The meeting was opened by P. A. Martinez. The discussions will focus on the effectiveness of the proposed fix.

Diesel Generator Building

John Davie presented the results of the available settlement and soil boring information for the Diesel Generator Building. Thirty-two soil borings and thirteen cone penetrometer borings had been completed. The combined variation in settlement with depth for 14 instrument clusters showed a break at elevation 615' with more settlement above this elevation. The variation of settlement, piezometric level, and surcharge height vs. time was also presented. Dr. Hendron suggested that average data should not be used and the curves should be separated.

An observed slow down in settlement under the 10 ft. surcharge was noted after 2 weeks. It was decided that an additional 10 ft. surcharge would be added now. The fill would be brought up uniformly with a maximum differential of 5 ft. No acceptance criteria as to a maximum surcharge height could be given at this time. The final surcharge height will depend on the shape of the stress-deformation curve. Dr. Hendron expressed concern over the effects of surcharge on the service water pipes and requested a lesser surcharge slope in this area. Dr. Peck stated that the reservoir level would probably not make much difference in the measurements, but they should try to keep the reservoir at about the same level as now.

Liquefaction - Diesel Generator Building

Sand was encountered in about 30% of the area beneath the Diesel Generator Building with slightly more sand in the northwest corner, because of the utilities and condensate line in that area. The Seedsimplified method of analysis (based on standard penetration testing) was used. This analysis showed 19 out of 60 points evaluated have the potential for liquefaction. Dr. Peck suggested that based on the numbers we have, liquefaction may be a problem and it would be better to spend money on a fix. Various methods of stabilizing the sand were discussed but no conclusions were reached.

The calculated soil settlement due to ground shaking was also presented. Dr. Hendron stated that the methods of calculating settlement due to ground shaking were not reliable.

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Underground Utilities - Diesel Generator Building

The locations of all underground utilities (service water lines, diesel lines, borated water lines, and electrical channelized duct banks) were presented. Settlement of the underground utilities due to the surcharge and whether or not there would be contact beneath the lines was discussed. Borings will not help appreciably since there is no way of knowing if they are representative of the soil conditions beneath the pipes. It was concluded after discussion that more borings will be made along the pipelines and the pipes in the surcharged area would be profiled and evaluated based on the deformations observed.

Service Water Pump Structure

Locations, cross-sections, and elevations of the Service Water Pump Structure were presented by Bimal Dhar. Jim Wanzeck presented the results of the recent borings in the area. Soft areas were located which had SPT blowcounts of 2 and 3 blows/ft. and one area where the rods dropped 1 1/2 ft. under their self weight. A minimal amount of settlement has been observed although some stress cracks are present and one corner of a cantilever section is likely not supported. A detailed evaluation of the observed pattern of cracks was suggested. It was recommended that the cantilever section be underpinned and that the support be at the same level as the bottom floor. Dr. Peck recommended that caissons not be used for underpinning.

Auxiliary Building

Again the cross-sections and soil boring results were presented by Bimal Dhar and Jim Wanzeck respectively. Areas of low blow count were found in Unit 1 . The soil beneath the control tower was satisfactory but low blowcounts were found below the valve pits. Two additional borings will be done in the electrical penetration areas and one in the control tower.

Soil-Structure Interaction

To determine the appropriate soil parameters for soil-structure interaction, the soil around the Diesel Generator Building will be monitored as the surcharge is removed. Shear wave velocity measurements will be made in the tank farm area and at other locations. A preliminary low bound shear wave velocity of 500 ft./sec. should be used until the field testing can be completed.

U.S. Testing Data Review

The field density test data has been computerized to assist in the evaluation. The specification requires an average of 1 proctor and gradation for every 20 field density tests. From this data, the following observations were made:

a. 22 percent of all tests had over 105% compaction.
b. 51 percent of all tests have moisture contents which are outside of the zero air voids curve for the given dry density.
c. some proctors were used over a two year period.

From this data, apparently some of the field density tests passed because the wrong standard was used. Test pits will be used to verify the in situ dry density and moisture content.

S5703172

Summary

P. A. Martinez stated that Bechtel will have to show cause why construction can continue. The NRC will be sending approximately 25 questions in the near future. At this time, Bechtel will have 30 days to respond.

DENNY

D. R. Gle

DRG/nm

S.7703173

ATTENDEES:

BECHTEL

S. S. Afifi
J. Allen
S. L. Blue
A. Boos
H. H. Burke
P. K. Chen
J. Davie
B. Dhar
W. R. Ferris
D. R. Gle
P. A. Martinez
J. Milandin
G. Richardson
M. Rothwell
E. Rumbaugh
G. Tuveson
J. O. Wanzeck

CONSUMERS POWER

T. Cooke
D. Horn
G. Keeley
D. Sibbald
T. Thiruvengadam

CONSULTANTS

J. Dunnicliff
A. Hendron, Jr.
R. B. Peck

8703174

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

Dcc: S. Afifi
A. Almutti
B. Dhar
W. Ferris
R. Hermost
W. Jones
P. Martino
C. McConne
J. Newgen
G. Richard
J. Wanzeck
K. Wiedner
All w/att

July 3, 1979

BLC- 7830

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

Attention: Mr. R. C. Bauman

Subject: Consumers Power Company
Midland Plant - Job 7220
Meeting Notes No. 979
Settlement Problem of
Seismic Category I Facilities
And Structures
File: 0270, 0279, C-1700, C-264

Gentlemen:

Attached is a copy of meeting notes 979 for the meeting with Consumers in Ann Arbor regarding the planned remedial action for the settlement problem of Seismic Category I facilities and structures.

Very truly yours,

for R. L. Castleberry
Project Engineer

SL/db

Enclosure: Meeting Notes No. 979

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

8703175

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

MEETING NOTES NO. 979

MIDLAND PLANT UNITS 1 & 2

CONSUMERS POWER COMPANY

BECHTEL JOB 7220

DATE: May 11, 1979

PLACE: Ann Arbor, Michigan

SUBJECT: Soils Resolution Plan

FILE: 0279, C-2645

ATTENDEES:

Bechtel	CPCo
S. Afifi	T.C. Cooke
A. Almuti	D.E. Horn
B. Dhar	C.A. Hunt
W. Ferris	G.S. Keeley
R. Hermeston	D.B. Miller
W.G. Jones	T. Thiruvengadam
P.A. Martinez	
B.C. McConnel	
J. Newgen	
G.L. Richardson	
J.O. Wanzeck	
K. Wiedner	

PURPOSE: To inform CPCo of the planned remedial actions relating to Seismic Category I facilities and structures other than the diesel generator building, as well as a brief status report on the diesel generator surcharge (agenda attached)

ITEMS DISCUSSED:

1) Resumption of backfill operations

The NCRs affecting the backfill operations are being resolved on a priorty basis. The items discussed in the minutes of the May 4, 1979 meeting (attached,to J. Newgen's memorandum to P. Martinez, dated May 4, 1979, BCEM-460) are being resolved. The first priority area is the tank farm. The remaining priorities are being established by Bechtel construction.

8703176

2) Brief review of the diesel generator building settlement

The maximum settlement is approximately 7 inches with a minimum of 3-1/4 inches. The diesel generator building wall settlement history drawings were visually examined. The north and south walls show uniform settlement since December 15, 1978. There is no indication that the condensate lines are impeding the long-term building settlement.

An estimated date for surcharge removal can be made 4 to 6 weeks after establishing a settlement slope. The settlement rate is so small at the present time that more accurate survey methods are being developed. The new methods are anticipated to have an accuracy of $\pm$0.02 inch.

3) Planned remedial actions for structures

a) Service water structure

The northeast portion of the building will be supported by 100-ton piles driven to till. The piles will be designed to support vertical loads only. Horizontal forces will be resisted by the portion of the structure supported on natural soil.

b) Main feedwater isolation valve pits

The questionable soil will be removed and replaced with concrete. A temporary support will be provided and will span from the tendon access pit to the turbine building wall.

c) Auxiliary building electrical penetration room

The questionable soil will be removed and replaced with concrete for both Unit 1 and 2 penetration rooms. The extent of the excavation will be the only difference in the actions taken for each unit. Temporary support provisions are being designed for the Unit 1 electrical penetration room during dewatering. The actual need for the temporary support is still under investigation.

A perimeter dewatering system will be installed to allow excavation in a dry condition. The system will go from the Unit 1 reactor building south, around the turbine, administration, and diesel generator buildings, and then north to the Unit 1 reactor building.

d) Auxiliary building railroad bay

The loose sands susceptible to liquefaction will be chemically grouted. A grouting test program will be performed to develop required spacing, pressure, gel times, and the most effective type of chemical grout.

5) Tanks

a) Emergency diesel fuel oil tanks

There are no anticipated remedial actions. Two locations on each tank are being monitored for settlement. To date, there has been essentially no settlement observed.

b) Borated water tanks

There is no anticipated remedial action. There will be no surcharge placed. The tanks will be constructed, filled with water, and monitored for settlement. The monitoring will be continued until a long-term settlement trend has been determined. The borated water lines will be evaluated for settlement effects. The system turnover and startup requirements are being studied by the task force.

c) Condensate tanks

There is no anticipated remedial action. Connection details to the tank will permit settlement without impacting piping through the use of a metal bellows which will allow up to 6 inches of vertical movement, 1/2 inch of lateral movement, and 1-1/2 degrees of rotation. Due to the low number of loading cycles, the bellows are expected to last as long as the material. The lead time is expected to be 6 weeks.

6) Other structures

a) Service water valve pits

There is no anticipated remedial action. The valve pits serve no structural purpose other than protection for the service water valves from tornado missles and the surrounding soil and water. At present the valve pits are covered by the diesel generator building surcharge. The valve pits will be monitored as part of the FSAR site monitoring program.

8703178

b) Transformer foundations

1. Unit 1 transformer area

Surcharge will be placed over the transformer area and selected points will be monitored.

2. Unit 2 transformer area

There is no anticipated remedial action.

c) Guardhouse

The sand drain in the area has been investigated. The foundation design will not use piles but has been modified to reduce the soil pressure.

d) Retaining wall

There is no anticipated remedial action. The retaining walls will be monitored as part of the FSAR site monitoring program.

7) Underground utilities

a) Piping

1. Service water pipe

All profiling requested from Goldberg-Zoino-Dunnicliff & Associates (GZD) has been completed. Markers are being installed along the top of the line to allow the profiles to be measured in zones where the GZD device could not be used.

2. Borated water pipe

Markers are being installed along the top of the line to allow the profile to be measured.

3. Emergency diesel fuel oil pipes

The present design requires a sloped return to the oil tanks and engineering is investigating the need for this requirement. The diesel oil lines will be surveyed in the future.

S.703179

4) Condensate water pipes

All profiling requested from GZD has been completed. Engineering is investigating the area immediately below the diesel generator building. This investigation will account for the data from the profiles, borros anchors, settlement plates, building settlements, and condensate line settlement.

b) Electrical duct banks

A formal plan is being coordinated between engineering and construction to include functional monitoring, continuity checking, and a review of existing pulling history.

8) Cost, schedule and contracts

a) Cost - see Attachment 1

b) Schedule - see Attachment 2

for B.C. McConnel

CBM/js
5/25/1

AGENDA

Midland Units 1 and 2
Consumers Power Company
Bechtel Job 7220

DATE: Friday, May 11, 1979

TIME: 9:30 a.m.

PLACE: Bechtel Ann Arbor Offices

SUBJECT: SOILS RESOLUTION PLAN

ATTENDEES:

Consumers Power Company	Bechtel
G. S. Keeley	A. Boos/J. Betts
R. Wheeler	K. Wiedner
D. Sibbald	W. Ferris
D. Horn	S. Afifi/J. Wanzeck
T. C. Cooke	J. Hink
C. Hunt	G. Tuveson
T. Thiruvengadam	A. Almuti
	G. Richardson
	W. Jones
	P. Martinez

DISCUSSION ITEMS:

(1) Introduction.

(2) Review of diesel generator building settlements.
- (A) Records
- (B) Condensate liner (hang up or not)
- (C) Schedule for surcharge removal

(3) Planned fixes for structures and contracts
- (A) Service water pump structure
- (B) Isolation valve pits
- (C) Electrical penetration rooms
- (D) Railroad bay

(4) Tanks
- (A) Diesel fuel
- (B) Borated water
- (C) Condensate
- (D) Other tanks

(5) Other structures
- (A) Service water valve pit
- (B) Transformer foundation
- (C) Guardhouse
- (D) Retaining walls

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over . . .

(6) Underground facilities
    (A) Piping
    (B) Duct banks

(7) Cost & Schedule and Contracts
    (A) Piling
    (B) Underpinning
    (C) Grouting
    (D) Dewatering

M/pp

S3703132

JOB 7220
MIDLAND UNITS 1 & 2

ATTACHMENT 1

ORDER-OF-MAGNITUDE COST ESTIMATE FOR CORRECTIVE ACTIONS

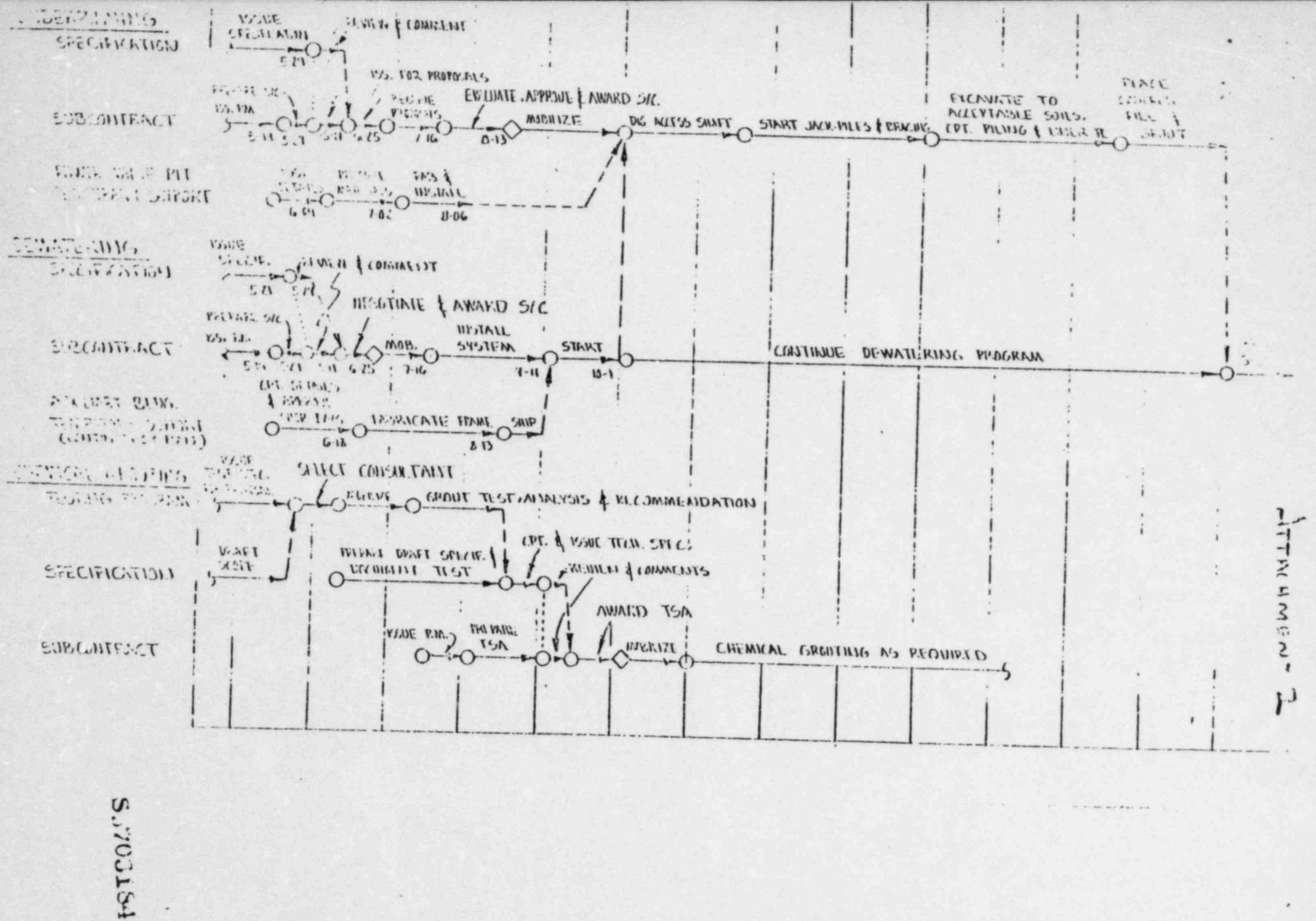
	S/C	FIELD	ENG & HO	TOTAL
1. Bearing piles for the Service Water Pump Structure, including a pile bearing test.	$ 100,000	$ 300,000	$ 100,000	$ 500,000
2. Underpinning of Electrical Penetration Rooms and the Main Feedwater Isolation Valve Pits, including pit temporary supports.	$ 3,250,000	$ 300,000	$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

Costs not indicated on this sheet:

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

S.703183

AAO - 5/11/79


SPECIFICATION
SUBCONTRACT
EVALUATE, APPROVE & AWARD S/C.
MOBILIZE
DG MISS SHAFT
START JACK-PILES & EXCAV.
EXCAVATE TO ACCEPTABLE SOILS, CPT. PILING & UNDER R
PLACE
SPECIFICATION
NEGOTIATE & AWARD S/C
SUBCONTRACT
MOB.
INSTALL SYSTEM
START
CONTINUE DEWATERING PROGRAM
FABRICATE FRAME
SHIP
SELECT CONSULTANT
GROUT TEST, ANALYSIS & RECOMMENDATION
SPECIFICATION
AWARD TSA
SUBCONTRACT
MOBILIZE
CHEMICAL GROUTING AS REQUIRED

PSTC0784

bcc: S. L. Blue
K. Wiedner
~~D. Castlebe~~
1230, 2140

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

3 July 1979

A. J. Hendron, Jr.
28 Golf Drive
Mahomet, Illinois 61853

Dear Dr. Hendron:

Attached please find a preliminary settlement calculation during earthquake of Midland Units 1 & 2 for your review and comments.

P. K. Chen for
S. S. Afifi
Asst. Chief Soils Eng.

PKC/nm
Attachment

JOB 7220

	COPY	INIT.
PROJ. ENG'R.	2	
ASST. P. E. T		
ASST. P. E. T		
ASST. P. E. P	1	
ASST. P. E. P		
MECH.		
ELECT.		
CS		
CIVIL	3	
P.D.		
ARCH.		
Q.E.		
C.TR...		
PROJ. ...		
PROC. ...		
FIELD ...		
CONST. ...		
FSAR		
ADMIN.		
FILE NO.	C.C.70...	

KC [redacted]
KC 7-24-79
S.703186

CALCULATION SHEET

CALC. NO. ____ REV. NO. ____

ORIGINATOR R. K. Chan DATE 7/2/79 CHECKED ____ DATE ____

PROJECT Midland units 1 & 2 JOB NO. 7220-001

SUBJECT Settlement During Earthquakes SHEET NO. ____

Reference: Settlement of Dry Sands During Earthquakes ASCE, By H. B. Seed, M. Silver April, 1972 Vol. 72. No. SM4

Problem: Based on the present remedial schemes a permanent dewatering system will be installed at the Midland site to eliminate the liquefaction potential for all the possible loose sands pockets/layers in the fill. The question remains to be answered is how much settlement will be induced during earthquakes.

Design Criteria: All the borings made in the vicinity of D/G building.

Assumption: Because of permanent dewatering system to be installed at the site, the fill sands will be either dry or moist.

S.703187

CALCULATION SHEET

BECHTEL

ORIGINATOR D. K. Chen DATE 7/2/79 CALC. NO. _____ REV. NO. _____

PROJECT Midland units 1 & 2 CHECKED _____ DATE _____

SUBJECT Settlement During Earthquake JOB NO. 7220-001

SHEET NO. _____

Analysis:

1). Assume Rigid body motion (conservative)

$$(\tau_{max}) = \gamma h \, A_{max}/g$$

$$= 134 \times L \times 0.12 = 16.08 L' \text{ psf}$$

2). Shear Modulus

Reference: Soil Moduli and damping factors for dynamic response analysis (Seed & Idriss EERC 70-10 12/70)

$$G = 1000 K_2 (\bar{\sigma}_m')^{1/2} \text{ psf}$$

See Table 3, of the paper

$K_2 = 34'$ for Loose moist sand

$$\bar{\sigma}_m' = \tfrac{1}{3}(\sigma_1' + \sigma_2' + \sigma_3')$$

If K_0 assumes to be 0.5

$$\bar{\sigma}_m' = \tfrac{2}{3}\sigma_1' = \tfrac{2}{3}\gamma h.$$

Also, see Figure 5, $K_2 = 34$ only equals to $D_r \approx 30\%$ SB703150

CALCULATION SHEET

CALC.# _____ REV. NO. _____

ORIGINATOR D. K. Chan DATE _____ CHECKED _____ DATE _____

PROJECT Midland units 1 & 2 JOB NO. _____

SUBJECT Settlement During Earthquakes SHEET NO. _____

$\therefore$ Shear Strain = τ/G (K_2 only changes slightly for shear strains 10^{-2} to 10^{-4})

$$= \frac{16.08h}{1000 \times 34 \times \sqrt{(\frac{2}{3} \times 134 \times h)}}$$

$$= 0.05 \times 10^{-3} \times h^{1/2}$$

$$\sim 5 \times h^{1/2} \times 10^{-3} \%$$

The induced shear strain only cause a very slight change in K_2; thus; an iteration procedure to obtain K_2 value compatible with shear strain is unnecessary.

3). Assume upper 20 ft all sand (El. 634 – 614). with $(D_r)_{avg} \simeq 45\%$

The reason to assume $(D_r)_{avg} \simeq 45\%$, because this is the lowest relative density performed by Silver.

	γ	ε_c (see figure 7 of silver p.p. (30 cycle – use conservative)
$h = 5$	$11 \times 10^{-3}\%$	0.13%
$h = 10$	$15.8 \times 10^{-3}\%$	0.2%
$h = 15$	$19.4 \times 10^{-3}\%$	0.25%
$h = 20$	$22.4 \times 10^{-3}\%$	0.3%

Avg. 0.22%

S5703183

AAD-520-6/75

CALCULATION SHEET

BECHTEL

CALC. NO. _____ REV. NO. _____

ORIGINATOR D. K. Chan DATE _____ CHECKED _____ DATE _____

PROJECT Mt. Vernon Unit 1 & 2 JOB NO. _____

SUBJECT Settlement During Earthquake SHEET NO. _____

$\therefore$ Settlement $= 20 \times 12 \times 0.0022$

$= 0.528$ "

Conclusion : The settlement is negligible.

CALCULATION SHEET

CALC. NO. _____ REV. NO. _____

ORIGINATOR D. K. Chan DATE _____ CHECKED _____ DATE _____

PROJECT Midland units 1 & 2 JOB NO. _____

SUBJECT Settlement During Earthquake SHEET NO. _____

$\therefore$ Shear Strain $= \gamma/G$ (K_2 only changes slightly b. shear strains 10^{-2} to 10^{-1}

$= 16.08h / 1000 \times 34 \times \sqrt{(\frac{2}{3} \times 134 \times h)}$

$= 0.05 \times 10^{-3} \times h^{1/2}$ /

$\sim 5 \times h^{1/2} \times 10^{-3}$ % /

The indeed shear strain only cause a very slight change in K_2; thus; an iteration procedure to obtain K_2 value compatible with shear strain is unnecessary.

3). Assume upper 20 ft all sand (El. 634 – 614) with $(D_r)_{avg} \approx 45\%$

The reason to assume $(D_r)_{avg} \approx 45\%$, because this is the lowest relative density performed by Silver.

	γ	ε_c (see figure 7 of silver's p.p.)
$h = 5$	11×10^{-3} % /	0.13 % / (30 cycle – u. consecutive)
$h = 10$	15.8×10^{-3} % /	0.2 % /
$h = 15$	19.4×10^{-3} % /	0.25 % /
$h = 20$	22.4×10^{-3} % /	0.3 % /

S.7703131

Gould
Peck
Loughney
Washington, DC

28 June 1979

Re: Midland Units 1 and 2

The following comments are made by the consultants with respect to items of the agenda discussed today. The ~~items~~ numbers of the headings corresponding to the agenda items

JOB 7220			
	ACT.	INFO	COPY / INIT.
PROJ. ENGR.			
ASST. P. E. T			
ASST. P. E. T			
ASST. P. E. P		1	MOR
ASST. P. E. F			
MECH.			
ELECT.			
CS			
CIVIL		3	
P.D.			
ARCH.			
C.E.			
C.TR./ENGR. PL.			
PROJ. MGR.			
PROC. MGR.			
FIELD			
CONST. CTRL'D.			
FSAR			
ADMIN.			
FILE NO.	0670.2		

XC 7-16-79

cc: T. E. Johnson
J. C. Hinz
B. Dhar
R. L. Rinford
K. Wiedner
P. A. Martinez
R. L. Castleberry
P. K. Chen.

[redacted]

S3703192

~~Permanent Dewatering System Preliminary~~

An exterior deepwell dewatering system can be used to dewater the plant site, with a riprap dewatering system being used to remove the crown of the ground water within the dewatered area.

Sufficient redundancy can be provided to assure that the ground water will remain within the desired levels in the event of a disruption or failure of any part of the system.

It is anticipated that ~~of~~ the dewatering system has been operational for over six months that the system could be down from 1 to 2 weeks without the ground water rising above critical level.

The nature of the site, existing soil and backfilled soil is such that after the initial dewatering of the site, the quantity of flow entering into the dewatered area would be ~~about~~ less than ~~500~~ gpm.

As determined during the initial dewatering installation the spacing of the dewatering wells ~~would~~ be adapted to compensate for any unforseen soil conditions encountered and/or any sources of recharge from the backfill placed around pipe lines extending to the pond and/or any source of ~~water~~ recharge water from leaky

S.703133

operational pipes located at critical points

Any equipment used to mopup the water within the exterior dewatering system would be left in place.

The required observation wells would be installed with the necessary controls at the proper locations to ascertain that the ~~desired~~ desired dewatered condition are being obtained. The observation system would be O, and since of the built-in conservatism, the dewatering system would not

~~Daily~~ frequent monitoring of the ground water levels and the operating deepwells would be scheduled.

Repair, or replacement of non functioning pumps would be done when sufficient pumps are down.

Scheduled cleaning of the well screens would be performed about every 3 to 6 month period

Assuming a perimeter of 3000 feet the rough estimated cost of an exterior deepwell system complete with the ~~no~~ necessary discharge, electrical controls and wiring and standby generators would be about $1,200,000. This assumes 250-300 deepwells.

To this should be added the cost of the interior mopup system, the observation wells and their controls, (probably $20,000) and the yearly maintenance cost.

The estimated yearly ~~re~~maintenance cost for treading the wells and repairing and or replacing the deepwell pumps is about $35,000.

To the above the cost of the monitoring should be added

~~Chief Engineer~~ SS703194

2) Liquefaction Potential

Liquefaction analyses have been conducted by Bechtel, on the basis of Standard Penetration Tests, of the soils under the Diesel Generator Building and various portions of the Auxiliary Building. These analyses have shown that the soils are not dense but do have a Factor of Safety against liquefaction of at least 1.5 for an SSE with a maximum ground acceleration of 0.1 g. Nevertheless, due to the erratic nature of the backfill, there is the possibility that some localized liquefying soils

S#703199

SSE for 0.12 g and if the SSE was in a higher level, to 0.20 g, then liquefaction of the sand backfill would be a problem. General area dewatering is necessary to eliminate the liquefaction potential. The goal would be to lower the piezometric levels from the present ones to somewhere near the top of the tilt. Dewatering is a more positive fix than chemical grouting because it can be positively monitored by piezometers whereas it may not be possible to positively prove the beneficial effects of grouting.

S3703190

Even though liquefaction of loose sands is eliminated by densifying, the seismic shakedown will result in some residual settlement after an earthquake. The magnitude of these settlements should be estimated by Seed, and should account for the effect of crippling stresses on the free water surface.

S5703137

~~Memo Re:~~ Agenda Item # 5

Support of Auxiliary Building

Date: 28 June 1979 Denver Holiday Inn Airport

By: ~~M. T. Davisson~~ C. H. Gould

(approximate)

Information furnished to consultants is listed below

1. Containment analyzed as though free of other ~~structures~~
2. Auxiliary " " " " " " " "
3. Turbine " " " " " " " "
4. Peak surge amplitude of ~~aa~~ auxiliary structure at c
   is 0.38 in. for 0.12 g.
5. Auxiliary wing figure OK on uncracked section
   but steel stress is 40 ksi on ~~aaa~~ cracked sect
6. 1500 K at E & W ends of wings relieves overstre
7. 3000 K " " " " " " restores origina
   ~~aaa~~ zero deflection
8. Horizontal force in each wing is 1250 K

Methods of fix considered by consultants are:

S: 7/03/79
and replace with ones co

A. Remove ~~replace~~ unsuitable material under valve pits and wings and permanently surface K line of Turbine building on rock piles. ~~Temp~~ support of wings with cribbing at E & W ends

up to 3000 kips each.

B. Permanent support by caissons of E & W ends of wings with 3000 kips each end. Remove unsuitable material under valve pit and replace with mass concrete. Support K-line of Turbine Bldg with jack piles as required. Options are:

(1) Tie auxiliary building to Turbine mat for lateral seismic resistance

(2) Tie auxiliary building to valve pit and the concrete fill beneath it. Option is

(a) Also tie valve pit to buttress access shafts for additional lateral resistance.

Construction procedures for jacked caissons have been thoroughly reviewed ~~by us~~ in prior meetings. However, concept B above calls for permanent Category I caissons; jack piles are not recommended. ~~The following items are Category I jacked caissons~~ to jacked caissons:

1. Steel casing is ignored for permanent load carrying.

2. Concrete is now Q

3. Till is the supporting material.

4. Design pressure on till is twice that under the ~~commitment~~ PSAR commitment. This is offset by following advantages:

   a. Proof load test to 1.5 times working load greatly exceeds the 1.12 (per more 1.20) times working load in a seismic event. Analysis shows bearing ~~capacity~~ has adequate factor of safety exceeding 2.5.

   b. Procedure calls for regarding piles - assure proper load sharing, as with temporary caissons.

We feel that solution B(1) above represents sound engineering. However, if NRC requirements dictate solution B(2) involves taking category I to category

~~Gentlemen~~ The consultants request the answers to the following:

1. State deflection configuration of auxiliary wing under full cantilever treatment, cracked and uncracked.

2. Seismic analysis of auxiliary building with deflection configuration, acceleration at each floor level, edge forces due to rocking, horizontal forces to be resisted and locations.

3. Analysis of auxiliary wing stresses and deflections with 1500K and 3000K e at E and W ends.

~~4. Available Model History and Specifications~~

M.T. Darisson
C.H. Gould
A.J. Hendron, Jr
R. Loughney
R.B. Peck

3. Diesel Generator Building

Removal of Surcharge. The longer the full surcharge can remain on the area, the more reliable will be the prediction of the clay-seated portion of the long-term settlement. In this reason, we would prefer to maintain constant conditions as long as ~~possible~~ practicable. We realize, however, that practical considerations do not permit an indefinite delay in surcharge removal. If a suitable means for making reliable temperature corrections to the readings of the piezo settlement gages, ~~and be investigated~~, we believe that removal could, if necessary, begin ~~by~~ in August. ¶ To this end, we suggest the fabrication and use of possibly four dummy gages, each consisting of a pair of rods in ~~the~~ a casing of the same type as that in the actual gages. One rod of each pair would be of identical size and material to that in the ~~not~~ actual gages, and the other of invar of the same dimensions. ~~The~~ Each assembly would terminate in a block of concrete placed on top of the fill ~~placed to~~ inside the building, adjacent to an active gage. The locations would be selected to

(over)

SS703202

provide a range in length of dummy gages corresponding to the maximum range of the actual gages in the building.

In addition, all readings should be interpreted carefully and corrected for thermal effects. To the extent possible, readings should be made under constant conditions, as in the early morning.

Loose sands beneath the building will not compromise the static bearing capacity or lead to settlement under static loads applied after surcharge removal. Some settlement must be expected due to vibration of the diesel engines; this should preferably be induced by operating the machines before general dewatering of the area, whereupon the settlement will be correspondingly reduced during use of the machines in the future. Earthquake-induced settlements are discussed under Liquefaction Potential.

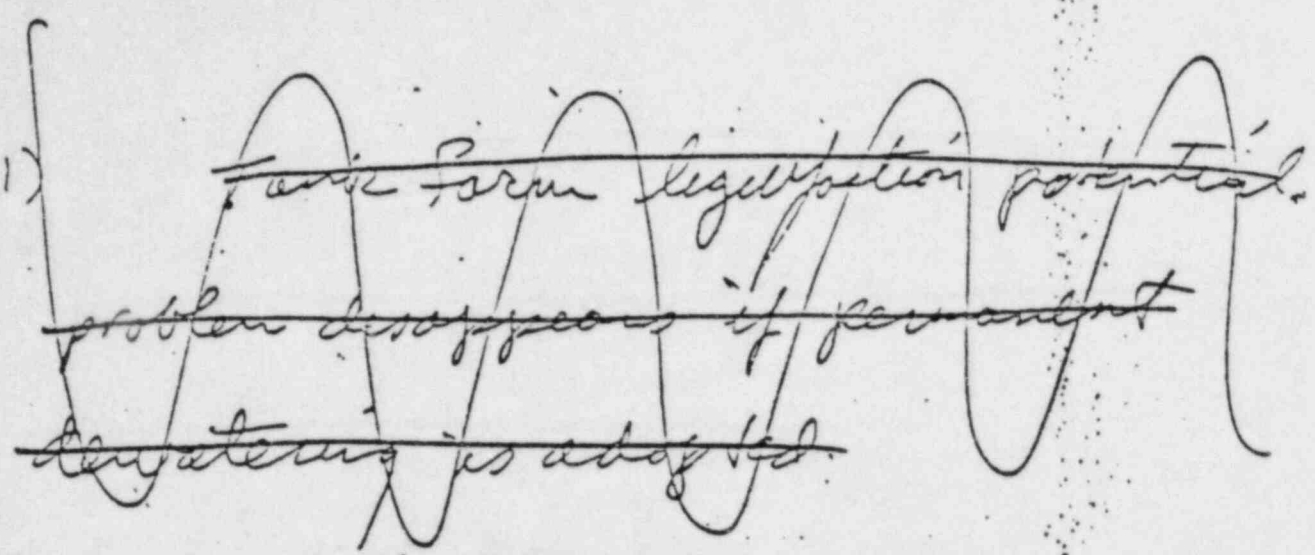
S370320

5) Need for Removal of Soft Sandy Under Diesel Generator Structure

If general pavement lantering is adopted, there is no need to excavate the loose sandy soil the diesel generator building. Their structure stiffness and bearing capacity is fully adequate for the structural dynamic bearing pressure. The connection of pipe and the building equipment within the building must be capable of taking the differential settling for the fact that the sandy soil the north side of the Diesel generator building will undergo more seismic subsidence settlement than

S.570.3264

side of the structure supported on colum
backfill is not likely to settle signifi
under the seismic loading.



(-1) ~~Take form liquefaction potential.~~
~~problem disappears if foundation~~
~~dewatering is adopted.~~

7. Service Water Structure

(-2) Service water structure underpinning with driven piles and a cortel is a positive solution. Even if liquifaction occurs, the piles maintain their buckling load as a minimum. The analysis of the structure should treat ~~the~~ piles in the normal manner; if the buckling load is ~~the~~ lower bound, the analysis should treat the piles as applying an upward load to the structure. The horizontal forces that earthquake will be taken on the base of the

equal to the buckling load

S.T.G.S.2(6)

Bechtel Power Corporation

Interoffice Memorandum

L. A. Dreisbach

Job 7220 Midland Project
Q-Listed Backfill Placement
0-2381

File No.

Date June 28, 1979

From J. F. Newgen

Of Construction

At Midland, MI Ext

W. L. Barclay w/a
J. P. Betts w/a
J. O. Wanzeck w/a
R. L. Castleberry w/a

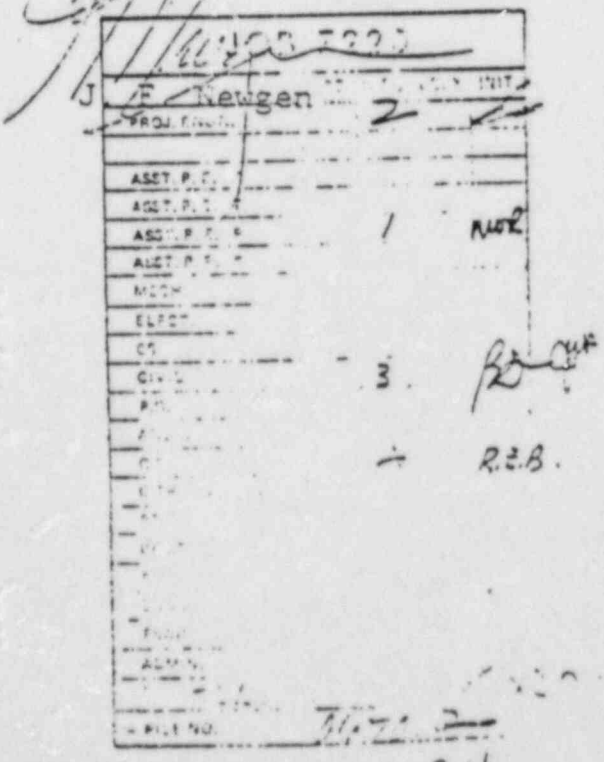
References: 1) D. E. Horn letter to L. A. Dreisbach dated May 25, 1979 (181FQA79)

2) J. O. Wanzeck IOM to R. L. Castleberry dated June 4, 1979

This memo is written to provide a complete response to reference 1) (copy attached). After reviewing reference 2) (copy attached), we conclude that it gives a total and factual response to Don Horn's letter. As such, we consider the matter closed and see no need to include it as item 14 to the other 13 action items related to resumption of Q-listed backfill placement.

JFN/AJB/jrh

Attachments



S3703203

xc C-211
xc -
xc- C-54.1.2

Consumers Power Company

Midland Project: P.O. Box 1963, Midland, Michigan 48640 - Area Code 517 631-0951

May 25, 1979

Mr L A Dreisbach
Bechtel Power Corp
PO Box 2167
Midland, MI 48640

MIDLAND PROJECT - FURTHER CORRECTIVE ACTION
REQUIRED PRIOR TO Q-LISTED BACKFILL PLACEMENT
File: 16.0 Serial: 181FQA79

It has come to our attention that on April 18, 1979 field density/moisture test 3432 in the Oily Waste Area had results of in-place dry density 133.3 and moisture content of 12%. Plotting these results on the Compaction Test (Proctor Curve) shows the results fall to the right of the zero air voids curve. The importance of understanding this anomaly cannot be too strongly stated based on the past settlement problems for which no clear cut base cause has ever been ascertained.

This problem must be understood and resolved prior to Q-listed backfill placement beginning in addition to the 13 action items attached to letter BCCC-3995 to TCCook from JFNewgen dated May 4, 1979. Please consider this problem as action item 14.

W R Bird
Section Head - QA Engineering, Midland

WRB/DEH

CC SAfifi
TCCooke
JLCorley
GSKeeley
MMarguglio
PAMartinez
JMiliandin
DBMiller
JFNewgen
CLRichardson
JWanneck
KWiedner

S.7703203

Bechtel Associates Professional Corporation

Inter-office Memorandum

M. L. Castleberry

Midland Unit 1 & 3
Q Listed Back Fill Placement

C. L. Blue
[redacted]
W. Wiedner
P. A. Martinez
J. D. Smith

Date June 4, 1979

From J. O. Wanzeck

Of Geotechnical Services

At Ann Arbor, MI

7220-79-88

RECEIVED
JUN 5 1979
BECHTEL POWER CORP
JOB 7220
FILE 21609 Q 0770

REFERENCE: CPCo Memo to L. A. Dreisbach, May 25, 1979

This item was taken care of in the field with J. O. Wanzeck and D. Sibbald of CPCo, we instructed the testing lab that more attention should be given to tests that look like they may be over the zero Air voids.

This sample also failed in moisture and was duly noted on the sheet as a failing test.

Three more tests and a boring that has been taken in the center of the area in questions were reviewed and the writer allowed with CPCo. concurrence the backfill to be placed.

It also should be noted that this is in a non Q area and the writer along with D. Sibbald of CPCo were well aware of the anomaly before any letter was written.

J. O. Wanzeck

JOW/nm
Attachment

8703210

C-2645

Bechtel Associates Professional Corporation

Inter-office Memorandum

To	Distribution	Date	June 5, 1979
Subject	Meeting Notes Midland Units 1 & 2-Job 7220-101	From	S. S. Afifi
		Of	Geotechnical Services
Copies to	S. L. Blue 1320, 3130	At	Ann Arbor 10 D 5 7220-79-94

Attached are meeting notes held on May 10, 1979 for review and comments. Please send comments by June 12, 1979.

S. S. Afifi

AM./nr
Attachments

Distribution:
A. Almuti
B. Dhar
A. Jones
T. Johnson
K. Wiedner
[redacted]
A. J. Hendron
M. T. Davisson
Chuck Gould
B. Wheeler
T. Thiruvengudam
C. Hunt

8703255

Meeting Notes

Midland Plant Units 1 and 2

Consumers Power Company

Bechtel Job 7220-101

DATE: May 10, 1979, 1:00 p.m. to 4:30 p.m.

PLACE: Ann Arbor, Michigan, Conference Room 9B3A&B

SUBJECT: Meeting to discuss Diesel Generator Building surcharge, exploration program, corrective measures, limits of material removal for underground structures, Q listed piles (installation, design, testing) and movement of structure during dewatering and underpinning.

ATTENDEES:

Bechtel	Consultant	CPCo.
S. Afifi	A. J. Hendron	Bob Wheeler
A. Almuti	M. T. Davisson	T. Thiruvengudam
B. Dhar	Chuck Gould	C. Hunt
J. Davie		
P. K. Chen		
J. O. Wanzeck		
A. Mohan		
A. Jones		
Ted Johnson*		
Karl Wiedner		
G. Tuveson		

*Part time

PURPOSE: The meeting was held at the Bechtel's Ann Arbor office to discuss the following items:

Item 1. Diesel Generator Building Surcharge

(a) Review of settlement and other related data.

(b) Accuracy of measurements.

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(c) Requirement of additional surcharge and removal of existing surcharge.

(d) Liquefaction potential.

Item 2. Exploration Program for;

(a) Auxiliary Building

(b) Service Water Pump Structure

(c) Underground Utilities

Item 3. Corrective Measures for;

(a) Auxiliary Building Control Tower

(b) Auxiliary Building Wings & Feedwater Valve Pile

(c) Auxiliary Building Railroad Bay

(d) Service Water Pump Structure

(e) Diesel Generator Building (grouting)

(f) Underground Utilities (*piping and duct banks)

Item 4. Limits of Material Removal during Underpinning Operation

Item 5. Q Listed Piles for Service Water Pump Structure

(a) Installation Procedure for Piles

(b) Design of Piles

(c) Testing of Piles

Item 6. Possible Movement of Structures During Dewatering and Underpinning

ITEMS DISCUSSED:

A summary of main items discussed and the agreements reached during the meeting are presented below.

S.705257

Item 1. Diesel Generator Building Surcharge

John Davie presented summaries of the diesel generator building surcharge, settlement and piezometer data. Particularly, the data included plots of rate of surcharge loading, rate of settlement at various points of building and piezometer levels response to surcharge loading vs. time. The Borros Anchors reading versus depth at different times and corresponding to surcharge loading levels were presented. This data was sent to Dr. Hendron and Dr. Peck in advance before the meeting.

Maximum settlement to date, at SE corner was about 0.59' and minimum settlement at NW corner was about 0.25'. However, there appears to be some minor fluctuations in the measurements. These fluctuations were caused by limited accuracy of the surveying instrument presently used. It appeared that most of the settlement measurements are stable, i.e., settlement readings has not changed during the last one week. Mainly an average reading from 33 settlement markers indicated that the settlement remained zero during the last one week.

It was agreed that no additional surcharge is required. Settlement and piezometer measurments should continue under the present level of surcharge loading for approximately six more weeks to arrive at a future definite date for surcharge removal.

Question concerning accuracy of heave (rebound) measurements during and after removal of the surcharge load was discussed. If was agreed that the heave measurements should be relatively precise. Presently proposed Sondex, instrument for measuring heave, appears to be less accurate. Further check into the accuracy of sondex need to be discussed with John Dunnicliff of

S.5703253

GZD & Assoc., Inc. It was also suggested that a few extensometer may be used.

Liquefaction potential of sand, under the foundation of various structure, in gereral, was discussed by P. K. Chen. Based on this discussion it was decided to use a factor of safety of 1.5 in evaluating liquefaction potential. It was agreed where sand fill with liquefaction potential exist will be treated by grouting. The following steps will be taken:

(a) The depth and area extent of sand below the diesel generator building will be studied based on the data derived from borings and the construction records.

(b) Liquefaction potential will be evaluated for the fill sand under the auxiliary building and diesel generator building. The blow count required for a factor of safety of 1.5 will be computed at different depths accounting for the surcharge from the building where applicable. These computed blow count in turn will be compared with the appropriate record of blow count based on the exploration program.

(c) Fill sands will be grouted when the calcualted factor of safety is less than 1.5 unless it is evident that they are in isolated pockets. The grouting pattern will be based on blowcount from the borings and will extend all around applicable borings until it is established that the surrounding soil is not groutable (clay). Extended beyond the perimeter of the building.

It was agreed that crosshole shear wave velocity measurements will be made in the diesle generator building area before grouting but after removal of the surcharge. Measurements will also be made in the tank farm area and other locations as required by project engineering.

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Item 2. Exploration Program

Jim Wanzeck reported that the exploration program is essentially complete. This exploration program included all areas including Class I utilities and structures. At the present time no additional borings are planned. Installation of Sondex for the measurement of rebound (heave) were planned for next week.

Further it was reported by Jim Wanzeck that a pump test at the west side of the Unit 1 electrical penetration room is planned to assist in the determination of dewatering requirements. The test will be performed and results forwarded to Dr. M. T. Davisson, Dr. A. J. Hendron, Jr., R. W. Loughney, and Dr. R. B. Peck. However, during the meeting the consultants consultants recommended that general dewatering be implemented as originally recommended by R. W. Loughney.

Item 3. Corrective Measures

Required corrective measures for various structures were discussed by A. Almuti. During the discussion with consultant followig steps were suggested:

1. It was recommended by Dr. T. M. Davisson that pilp piles should be used below the service water structures. The piles will be 14" in diameter with 3/8" wall thickness. They will be top driven with a hammer having a minimum energy of 24,000 ft. lb. The expected design pile load capacity will be 100 tons.
2. ACI specification 543 for concrete placement into the piles will be used.
3. Conservative estimate of blow counts for driving piles will be used.

SB7033240

4. Wave equation analysis will be performed.

Item 4. Limits of Material Removal

It was agreed the unsuitable soil under the auxiliary building wings be removed and replaced by concrete. The details of procedure for the replacement of unsuitable soil were discussed. Some concern relative to the deflection of cantilevered wings during the replacement operation were mentioned. No resolution was reached relative to the exact procedure to be used. With respect to the limits of material removal, was proposed that Dr. R. D. Wood be asked to help develop a procedure to determine the limits of accepatable material.

Item 5. Movement of Structures During Dewatering and Underpinning

Opinions relative to the movement of the structure during dewatering and underpinning were divided. Dr. Hendron, was of the opinion that sand movement will not be significant because effective stress changes are relatively small.

After some more discussion, all parties agreed that a back-up plan must be developed and should be ready for implimentation in case of anticipated settlements occur during dewatering operation. It was also suggested that jetting of dewatering wells will not be permitted within 50 feet of Class I structure.

Underpinning operations relative to various structures were discussed. The aspect of possible movement of the structures during underpinning was not addressed.

8703241

SUMMARY OF MEETING MINUTES
"RESUMPTION OF Q-LISTED BACKFILL PLACEMENT"
MIDLAND UNITS 1 & 2
APRIL 24, 1979

CPCo ITEM NO.	ACTION(S) TAKEN TO DATE	PLANNED ACTION(S) TO BE TAKEN BY (DATE)	IS COMPLETION OF PLANNED ACTION A RESTRAINT TO STARTING Q-LISTED BACKFILL PLACEMENT	PARTY RESPONSIBLE FOR PLANNED ACTION(S)
1. Identify all conflicts within FSAR, within the FSAR, or between the PSAR and the FSAR, and correct these inconsistencies via official changes to the appropriate documents.	Project Engineering and Geo Tech have revised FSAR Section 2.5.4 to correct inconsistencies pertinent to soils placement.	Project Engineering and Geo Tech will perform a review of other subsections of FSAR section 2.5 pertaining to backfill operations to eliminate inconsistencies, etc. (May 6, 1979)	Yes (As it applies to completion of review and changes to specification not processing of FSAR amendment.)	P.E. and Geo Tech
		Project Engineering and Geo Tech will perform a review of the Dames & Moore Soil Report and the	Yes (As it applies to completion of review and changes to specification not processing of FSAR amendment.)	P.E. and Geo Tech

SW703242

CPCo ITEM NO.	ACTION(S) TAKEN TO DATE	PLANNED ACTION(S) TO BE TAKEN BY (DATE)	Is COMPLETION OF PLANNED ACTION A RESTRAINT TO STARTING Q-LISTED BACKFILL PLACEMENT	PARTY RESPONSIBLE FOR PLANNED ACTION(S)
		"PSAR Committment List" pertaining to backfill placement to assure specs and FSAR are in conformance or are modified.		
		The review of "inactive" FSAR sections committed to in Appendix I, Section 1, Item C-3 (page 1-6) of the response to the NRC's 22 questions will identify and correct descrepancies in FSAR sections other than 2.5 which discuss backfill placement (Sept. 1979)	No	P.E. Geo Tech Construction
		Discuss and implement (as required) CPCo-PMO comments on FSAR Section 2.5.	Based on a preliminary review of the CPCo-PMO comments, the only restraint to resumption of backfill work is a revision to Spec. C-210 allowing the use of imported sands for Zone 2 Random Fill (May 6, 1979)	P.E. Geo Tech CPCo-PMO
2. Identify any inconsistencies between the PSAR/ FSAR and the		CPCo-QA will prepare their comments on Specifications C-210 and C-211 for discussion in conjunction with the CPCo-PMO comments listed in 1) above. (May 13, 1979)	Yes (As it applies to revising specification not processing of FSAR amendment.)	P.E. Geo Tech CPCo-QA

S.570.224.1

CPCo ITEM NO.	ACTION(S) TAKEN TO DATE	PLANNED ACTION(S) TO BE TAKEN BY (DATE)	IS COMPLETION OF PLANNED ACTION A RESTRAINT TO STARTING Q-LISTED BACKFILL PLACEMENT	PARTY RESPONSIBLE FOR PLANNED ACTION(S)
, detailed specifications or drawings, and correct these inconsistencies via official changes to the appropriate documents.				
3. Identify any inconsistencies omissions ithin the specications and rrect these inconsistencies via official Specification Change Notices.	——SAME AS ITEM # 2 ABOVE——			
4. Re-evaluate the appropriateness of the continued use of "random fill" in Zone 2 areas.		Specification C-210 and C-211 will be revised to redefine random fill with special emphasis on soils supporting structure (May 6, 1979)	Yes	P.E. Geo Tech
5. Provide a flow diagram of the steps which are needed for the quality control and assurance		A combined flow chart will be prepared illustrating the backfill process and the responsibilities of Bechtel Field Engineering, Bechtel Quality Control,	Yes	Construction

CPCo ITEM NO.	ACTION(S) TAKEN TO DATE	PLANNED ACTION(S) TO BE TAKEN BY (DATE)	PLANNED ACTION A RESTRAINT TO STARTING Q-LISTED BACKFILL PLACEMENT	PARTY RESPONSIBLE FOR PLANNED ACTION(S)
of soils work and assure that for each step there is a designation as to the specific organization primarily responsible for the action; a designation of the specific procedure to be used; and a designation of the specific acceptance criteria for the step.		and U. S. Testing. (May 6, 1979)		
6. Assure that all "clarifications" and "interpretations" are resolved via official Specification Change Notices.		EDPI 4.4.9.1 will be revised. (May 4, 1979)	No	P.E.
7. Establish a single individual at the site to be responsible for each of the following: directing the construction aspects of the soils	The following positions have been established a) Soils Field Engineer b) Geo Tech Soils Engineer (Assigned to Job 7220) c) Soils Q.C. Field Engineer			

S 670245

CPCo ITEM NO.	ACTION(S) TAKEN TO DATE	PLANNED ACTION(S) TO BE TAKEN BY (DATE)	PLANNED ACTION A RESTRAINT TO STARTING Q-LISTED BACKFILL PLACEMENT	PARTY RESPONSIBLE FOR PLANNED ACTION(S)
	work; directing the design aspects; and directing the quality control aspects.	Their responsibilities are defined in the flow chart described in 5) above.		
8.	Institute 100 percent inspectionof each lift placement with a corresponding Inspection Record documentation of the specific characteristics inspected in each case.	Bechtel Q.C. will work with CPCo-QA to finalize the revised QCIR for backfill placement. (CPCo-QA has a draft of the revised QCIR which calls for Surveillance (5) of backfill work by a fulltime Q.C. Soils Engineer with generation of daily reports) May 6, 1979	Yes	Bechtel Q.C. CPCo-QA
9.	Re-evaluate the capability of the equipment being used in relation to the maximum allowable lift thickness and the compaction requirements.	Project Engineering has received the procedure for test pad placement from Geo Tech. Project Engineering will forward said procedure to Construction for initiation of pad placement by 4/27/79. (April 27, 1979)	Yes	P.E. Construction
10.	Re-evaluate the appropriateness of the continued use of the nuclear densometer, with	The use of the nuclear densometer has been discontinued for inspection of record use.		

CPCo ITEM NO.	ACTION(S) TAKEN TO DATE	PLANNED ACTION(S) TO BE TAKEN BY (DATE)	PLANNED ACTION A RESTRAINT TO STARTING Q-LISTED BACKFILL PLACEMENT	PARTY RESPONSIBLE FOR PLANNED ACTION(S)
its measurement accuracy being questionable relative to the moisture content specification limits of "plus or minus two percent of optimum".				
11. Re-evaulate the AR's, specifications and procedures relative their adequacy in specifying the points in the process at which the measurements or tests are to be made, the frequencies of these measurements or tests, and the conditions under which new laboratory standards must be acquired.		Geo Tech will review specification C-210 and C-211 requirements as related to adequacy of specified process and testing controls (May 6, 1979)	Yes	Geo Tech
		An audit will be performed on U.S. Testing by Bechtel to determine the adequacy of their soils testing procedures (April 26, 1979)	Yes (Results of audit will have to be evaluated.)	P.E. Geo Tech Bechtel QA
12. Assure that there is a method, on a three dimensional and volumetric basis, or identifying	SAME AS ITEM # 8 ABOVE			

CPCo ITEM NO.	ACTION(S) TAKEN TO DATE	PLANNED ACTION(S) TO BE TAKEN BY (DATE)	PLANNED ACTION A RESTRAINT TO STARTING Q-LISTED BACKFILL PLACEMENT	PARTY RESPONSIBLE FOR PLANNED ACTION(S)
the specific lifts which are inspected and tested.				
11. Assure that each nonconformance report (regardless of the type of report) is dispositioned.		For each Q-listed area where backfill is to be placed all Discrepancy Reports and NCR's (Bechtel and CPCo) will be fully dispositioned and closed out prior to placement of backfill.	Yes (As it relates to areas on an individual basis where backfill work is to be performed.) Note: This is an existing quality program requirement.	P.E. Construction, Behctel QC
		Additionally, P.E. will release areas for backfill which are listed in NCAR 24 as questionable areas on a case by case basis by memo or TWX.	Yes	P.E.

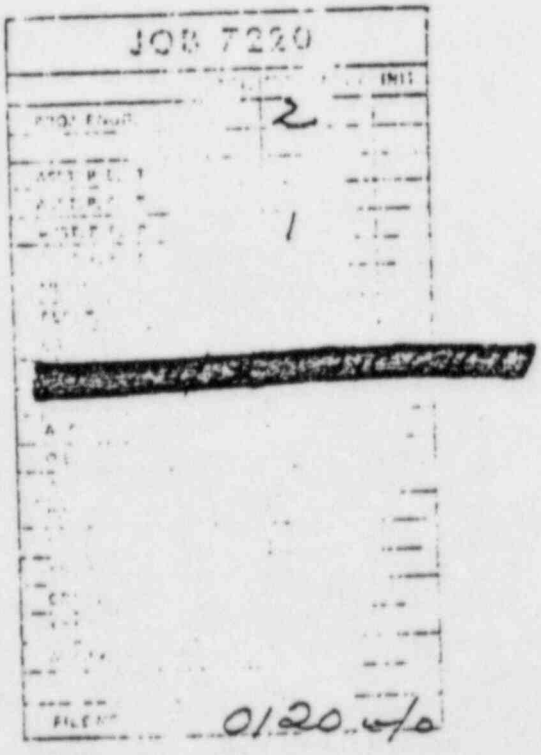
C-2645

Date: June 11, 1979

Company: Goldberg Zoino Dunnicliff & Ass.

P.O.:

Remarks: Field summaries



C-79 PL

SJ703243

FIELD SUMMARY

FILE No. A2190F
REPORT No. 8 SHEET No. 1
DATE 5-31-79 DAY Thu.

PROJECT Midland Nuclear Plant LOCATION Midland MI

OWNER Consumer Power CONTRACTOR Bechtel

WEATHER CONDITIONS Fair 45-65°

REMARKS See attachments

REPORT

1. Arrived on site at 0630 hours.

2. Equipment working:

   a) 1-Cat 225 backhoe
   b) 2-dump truck

3. Attachments:

   a) 2-attached sketches
   b) 1-checklist for F.D. tests
   c) 1-F.D. Summary sheet
   d) 1-Daily Sand Calibration

4. Work being accomplished:

   a) Mr. M. Petersen of Bechtel Inc.,directed the undersigned to Test Pit #2 located east of the 2 starter-transformer pads. He stated that the testing for this test pit would follow procedures prescribed by Mr. J. Wanseck,which were employed during excavation of TP#1. That is,2 field density tests will be performed at each of the first and second levels and one test at every 12" increment of depth there after to a depth of approximately 12' from the existing ground surface.

   b) The backhoe excavated a total of 7' ± this date from the existing ground surface (elevation 634' ±). Two field density tests (20 and 21) were performed 2' ± from the existing ground surface. Also 2 tests (#22 and 23) were performed 3' ± from the existing ground surface. For the remaining 4' ±,one test was performed at each level (#24,25,26 and 27) See attached sketch. The insitu dry unit weights are tabulated on the attached summary sheet. Field density test results will be completed pending results of laboratory proctor tests.

ON-JOB TIME _____
TRAVEL TIME _____
OFFICE TIME _____
TOTAL TIME _____

PREPARED BY

S.703250

REVIEWED BY

FIELD SUMMARY

FILE No. A2190F
REPORT No. 8 SHEET No. 2
DATE 5-31-79 DAY Thu.

PROJECT Midland Nuclear Plant LOCATION Midland MI

OWNER Consumer Power CONTRACTOR Bechtel

WEATHER CONDITIONS

REMARKS

REPORT

c) Six representative soil samples were obtained at each level for laboratory testing.

d) The elevations for the field density tests are being provided by Bechtel personnel and have an accuracy factor of 1" ±.*

e) The material excavated this date is predominately silty clay, trace Fine to coarse sand trace gravel with the last 2 levels being clayey glacial till.

4. Mr. John Sullivan, Associate and Director of Field Services for GZDA was on site this date to observe field and laboratory operations.

5. Left site at 1700 hours.

Dist: Mr. R.L. Castleberry

* Accuracy of survey determined by Mr. C. Wilson Chief of Survey, Bechtel Corporation.

ON-JOB TIME 10
TRAVEL TIME
OFFICE TIME
TOTAL TIME 10

J. Webber
PREPARED BY

D. W. Carrier
REVIEWED BY

CC: GREG J. NO DUNNIGLIFF & ASSOC., INC.

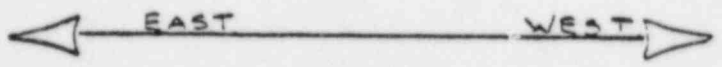
FIGURE 10-2

Goldberg, Zoino, Dunnicliff & Assoc., Inc.
Consultants in Geotechnical Engineering
Newton Upper Falls, Mass.

Project _____ Sheet _____ of _____
File No. _____ Date _____
By _____

TEST PIT 2

MIDLAND NUCLEAR POWER PLANT



EXISTING GROUND SURFACE ELEV.

634'±

NOTE: ELEVATIONS PROVIDED BY BECHTEL PERSONNEL. ACCURACY FACTOR IS ±1"

632'± FD 21 FD 20

631'± FD 23 FD 22

630'± FD 24

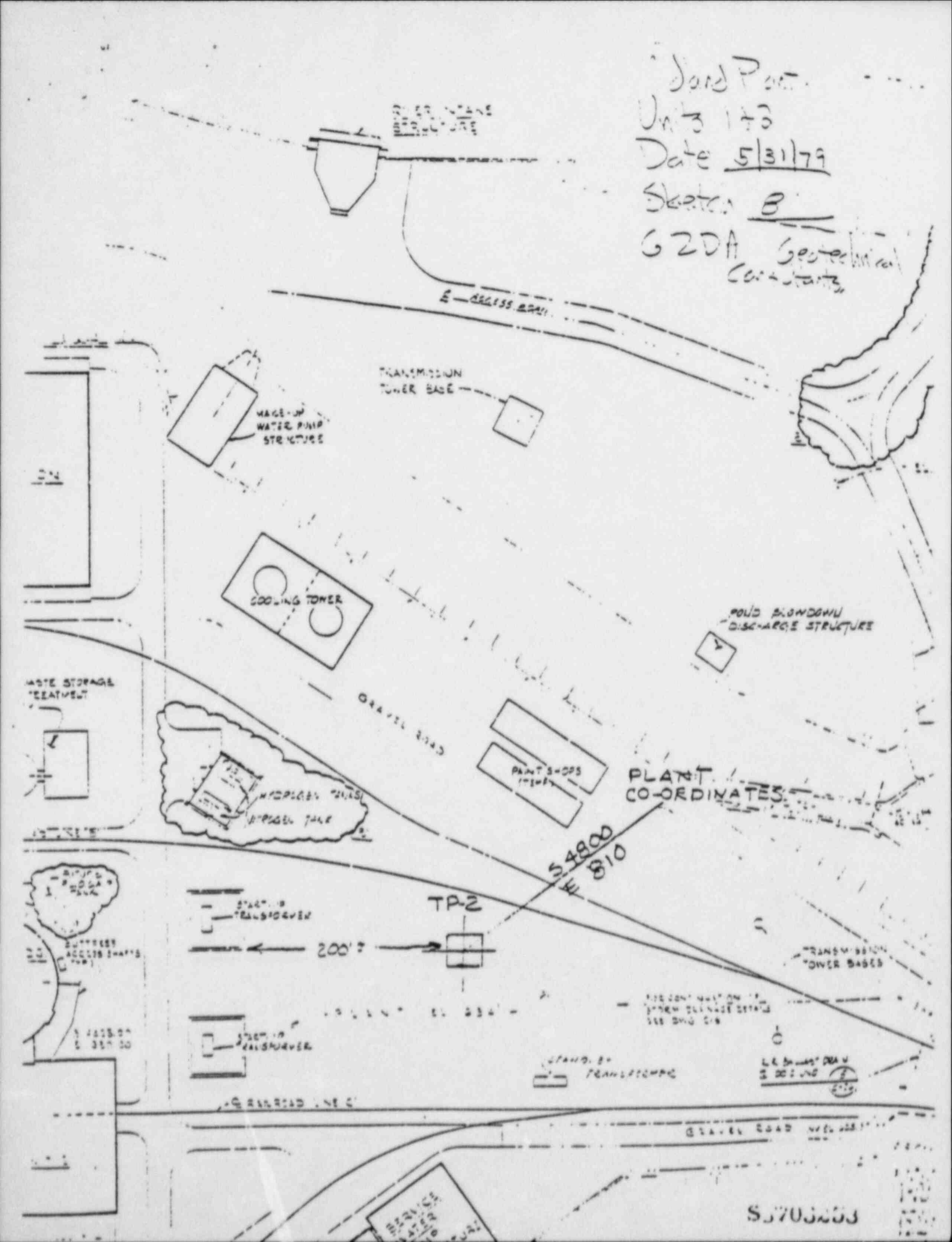
629'± FD 25

628'± FD 26

627'± FD 27

Bottom of Test Pit AS OF 5/31/79

S3703252


Job No.
Unit 1+2
Date 5/31/79
Sketch 8
GZDA Geotechnical Consultants
E—ACCESS ROAD
TRANSMISSION TOWER BASE
WATER PUMP STRUCTURE
COOLING TOWER
POND BLOWDOWN DISCHARGE STRUCTURE
WASTE STORAGE TREATMENT
GRAVEL ROAD
PLANT CO-ORDINATES
S 4800
810
TP-2
200'
TRANSMISSION TOWER BASES
RAILROAD LINE
S370J203

FIELD DENSITY TEST RESULTS

FILE No. A2190F
REPORT No. 8 SHEET No. 1
DATE 5-31-79

PROJECT Midland Nuclear Plant LOCATION Midland MI

OWNER Consumer Power CONTRACTOR Bechtel

WEATHER CONDITIONS Fair 45-65°

REMARKS

FD Test No.	Approx. Elev. (ft.)	Max. Dry Dns. corr for + 3/4" stone (pcf)	Optimum Moisture Content (%)	In-Place Dry Dns. (pcf)	Moisture Content (%)	Compaction (%)	Remarks
20	632' ± 1"			113.4	15.4		3
21	"			109.7	20.3		"
22	631' ± "			113.0	17.0		"
23	" "			108.5	19.9		"
24	630' ± "			116.4	15.8		"
25	629' ± "			116.6	17.4		"
26	628' ± "			128.7	11.3		"
27	627' ± "			124.8	9.9		"
7	627' ± 1"	133.0	8	122.1	15.5	91.8	1+2
10	626' ± "	133.2	"	123.7	11.1	92.9	"
11	625' ± "	128.9	9.5	132.6	9.9	102.9	"
12	624' ± "	127.0	10	121.6	13.2	95.7	"
13	623' ± "	131.6	8.5	115.8	15.4	87.9	"
14	622' ± "	129.0	"	114.2	13.2	88.5	"

1. Results of tests performed on 5-22-79.
2. Bechtel Modified Proctor.
3. Results to be reported when lab proctors completed.

J. Webber
PREPARED BY

DWC
REVIEWED BY

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS

FIGURE 10-4

8703230

SAND CALIBRATION RECORD

PROJECT Midland Nuclear Plant
FILE No. A2190E DATE 5-31-79
TESTED BY JCW
CHECKED BY DWC 5-31-79

	kilograms	lbs.
1. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs. (mold no. 1)	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.875	21.77
Weight of sand, in lbs.		7.11
Unit weight of sand, in pcf		94.5 pcf
2. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs.	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.875	21.77
Weight of sand, in lbs.		7.11
Unit weight of sand, in pcf		94.5 pcf
3. Weight of 0.075 cu. ft proctor mold (w/o collar) empty, in lbs.	6.649	14.66
Weight of 0.075 cu. ft proctor mold (w/o collar) full, in lbs.	9.871	21.77
Weight of sand, in lbs.		7.11
Unit weight of sand, in pcf		94.5 pcf
Average of 1, 2 & 3		94.5 pcf
		Unit weight of sand

NOTE:
Sand calibration required once per day and each time a new bag of sand is opened.

S.7003253

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS

FIGURE 10-3
SIDE 2 of 2

MIDLAND NUCLEAR POWER PROJECT
MICHIGAN

Project MIDLAND NUC
File No. 2190.5 Date 5/3/79
Individual being checked
James C Webber
Checker DWC

CHECK SHEET FOR FIELD DENSITY TESTS

1. Equipment: Check to see if all equipment is in proper working condition and not damaged.

	Yes	No
a. Does the sand cone valve turn freely?	✓	
b. Is sand cone in good condition (not bent, dented, out of round, etc.)?	✓	
c. Is balance operative and all weights available for use?	✓	
d. Is the kit complete?		
.075 cubic ft. mold (*)	✓	
Glass jar	✓	
Cone (*)	✓	
Base plate (*)	✓	
Ottawa sand (*)	✓	
Plastic jar with cover	✓	
Screw driver	✓	
2" Paint brush	✓	
Balance (*)	✓	
Weights (*)	✓	
#4 Sieve	✓	
3/4" Sieve	✓	
Field Unit Weight forms (Calculation sheets)	✓	
Plastic sample bags	✓	
Sample Tags	✓	
(*) Requires use of calibrated equipment		
e. Is only calibrated equipment being used? (see * above)	✓	

2. Procedures: Observe procedures employed for calibration of sand and spot check field density test procedure by obervsing performance of a minimum of one test daily.

a. Were ASTM D-1556/GZD procedures used in calibrating the Ottawa sand?	✓	
b. Were ASTM D-1556/GZD procedures used in performing field density test?	✓	
c. Is cone calibrated as per ASTM/GZD procedures?	✓	

8703250

3. Calculations: Check calculations of all field density tests and sand calibration.

a. Are all necessary data and calculations on the field unit weight sheet complete? (Soil sample description, Project Name, File No., Test No., Date, Tested by, Unit weight of calibrated sand, all blanks under sections titled Field Unit Weight of Soil and Water Content - Minus 3/4" fraction) Note that: Compaction Unit Weight, Results, Mathematical Rock Corrections and calculations at the page bottom will be completed after the appropriate laboratory tests have been performed (Compaction test and Specific gravity) ✓ 6/1/79 ____

b. Is the sand calibration record completed as per GZD specifications (once per day and each time new bag of sand is opened)? ✓ ____

c. Is the cone calibration record completed as per GZD specifications (minimum of once per week)? ✓ ____

d. Are all calculations correct (checked)? If yes, initial and date "checked by" spaces for Field Unit Weight form, Sand Calibration Record, and Cone Calibration Record. ✓ 6/1/79 ____

If any answer to the above questions is NO, request and obtain clarification and/or completion of the item or items in question from the technician whose work is being checked. Explain fully in the space provided below the nature of the discrepancy, its resolution, and pass these comments on to the project engineer.

Explanation: Checked 6/1/79 due to over drying of water content

This check list is to be attached to the daily field report.

S3703357

FIGURE 10-6
Page 2 of 2

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

bcc: T. Johnson
A. Almuti
S. Afifi
S. Blue
J. Newgen
E. Smith
L. Sokol
K. Wiedner
Com Log

April 27, 1979

R.W. Loughney
Loughney Dewatering Inc.
2280 Grand Ave.
Baldwin, New York 11510

Attention: Mr. R.W. Loughney

Subject: Consumers Power Company
Midland Plant - Job 7220
Dewatering Under Existing Structure
File: [redacted] C-2647, C-2648

Gentlemen:

We are transmitting a data package regarding the subsurface conditions beneath the auxiliary building and service water pump structure at the Midland nuclear power plant. Dewatering is required for underpinning or piling in the dry. Underpinning is proposed to be used under the auxiliary building penetration rooms (wings) and the adjacent valve pits. The procedure will entail creating an outside shaft to permit soil removal from underneath the structures and simultaneous placement of jack piles for temporary support. Soil replaced is estimated to be 15 feet underneath the foundation (to el ±594'). Piling will utilize a narrow shaft (about 6 to 7 feet deep) along the north end of the service water structure to permit installation of jack piles under the structure (bottom of shaft is about el 603').

We request that you evaluate these data with regard to dewatering feasibility and prepare a conceptual dewatering scheme and associated cost estimate for each of the two structures for budgeting purposes. Please respond to this request by May 4, 1979.

Listed below are some key items to consider in your evaluation.

1. The cutoff trench in the cooling pond dike does not exist in the dike adjacent to the diesel generator building and service water pump structure. Therefore, the surficial sand may provide a conduit between the cooling pond water and groundwater in the sand backfill beneath the structures where dewatering is required.

2. The integrity of existing structures must not be endangered by the removal of fines from foundation material during dewatering operations. Installation of well points by jetting should not be considered.

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3. Evaluate the feasibility and benefit of lowering the level of the cooling pond to aid in dewatering at the three structures.

4. Evaluate the benefit of dewatering a representative test pit to aid in the design of dewatering schemes.

The following is a list of the data contained in this package.

FSAR

Page 2.4-26:	Groundwater Movement
Page 2.4-28:	Potential Seepage Effects from Onsite Cooling Pond
Page 2.5-76:	Special Foundation Treatment
Table 2.4-7:	Generalized Subdivisions of Site Subsurface Materials Above Bedrock
Table 2.4-11:	Laboratory Permeability Test Summary
Figure 2.4-32:	Groundwater/Contours
Figure 2.4-36:	Design of Groundwater Quality Monitoring Wells
Figure 2.5-17:	Plant Area Boring Plan
Figure 2.5-20:	Generalized Subsurface Profile Section A
Figure 2.5-21:	Generalized Subsurface Profile Section B
Figure 2.5-22:	Generalized Subsurface Profile Section C
Figure 2.5-46:	Site with Plant Fill Area, Slurry Trench and Dike Section Locations
Figure 2.5-53:	Safety Section G
Figure 2.5-54:	Generalized Subsurface Dike Profile
Appendix 2A-267:	Log of Soil Boring 5

SB703861

re 7: Bechtel Borings, Dutch Cone Penetrations, and Test Pit Locations in Midland Plant Area 1978 and 1979

Cross-Section N-N', Auxiliary Building

Cross-Section P-P', Auxiliary Building

Cross-Section Q-Q', Radwaste Building

Subsurface Cross-Sections A-A' and B-B', Service Water and Circulating Water Structure

Subsurface Cross-Sections C-C', D-D', and E-E', Service Water and Circulating Water Structures

Cross-Section S-S', Service Water Building

Cross-Section T-T', Service Water Building

Cross-Section U-U', Service Water Building

Figure 8, Diesel Generator Building Boring Plan

Figure 25, Cross-Section F-F', Diesel Generator Building

Figure 27, Cross-Section H-H', Diesel Generator Building

Plan

on Arrangement

or and Auxiliary Building Plan at El 568'-0"

or and Auxiliary Building Plan at El 584'-0"

or and Auxiliary Building Plan at El 599'-0"

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Reactor and Auxiliary Building Plan at El 614'-0"

Turbine Building Plan at El 614'-0"

Reactor and Auxiliary Buildings Plan at El 634'-6"

Turbine Building Plan at El 634'-6"

Auxiliary Building, Section A

Reactor and Auxiliary Building, Section B

Auxiliary Building, Section E

Reactor Building, Sections C and D

Auxiliary Building, Section F

Turbine Building, Sections A, B, and C

Service Water Pump Structure Plan and Sections

Circulating Water Pump Structure

	AX-1 through AX-17	F-1
	OL-6	Q-8
RW-6	SW-1 through SW-5	SW-5A
SW-9	SW-12A	SWL-1 through SWL-8
	T-9 through T-12	TR-7

ata regarding grain size analyses and logs of new borings
to you upon their receipt.

Very truly yours,

R.L. Castleberry
Project Engineer

List of FSAR data, Drawings, Figures, and Boring logs

SW703863

C-2645

MIDLAND PLANT LICENSING POSITION

LICENSING ISSUE 44, REV A

DIESEL GENERATOR BUILDING SETTLEMENT

1.0 ISSUE

As a result of the Bechtel Foundation Data Survey Program (Specification C-76), it was determined that the diesel generator building has experienced settlement greater than expected. This resulted in issuance of Nonconformance Report 1482 dated August 21, 1978, and subsequent notification of the USNRC of a reportable occurrence in accordance with requirements of 10 CFR 50.55(e).

2.0 CURRENT NRC/ACRS POSITION

2.1 GENERIC

No applicable Advisory Committee on Reactor Safeguards (ACRS) generic item exists.

2.2 NRC

No applicable NRC task action plan exists.

2.3 RECENT DOCKETS

Questions regarding settlements of Category I structures have been asked on other dockets.

2.3.1 Farley 1 and 2

The NRC asked if the observed settlements of Category I structures were in good agreement with the estimate.

The applicant responded by presenting the observed and respective estimated settlements of buildings that had 95% of the dead load plus equipment load acting on their foundations. There was agreement between the two types of settlements.

2.3.2 North Anna Power Station, Unit 1 and 2

In the safety evaluation report related to operations, the NRC noted that an unexpected amount of settlement was experienced by the service water pumphouse and a corner of the service building. The applicant was to install a permanent dewatering system. The applicant also was to have a program to observe settlements.

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C-2645

The ACRS committee asked the applicant if the tilting of the pumphouse in a seismic accident would induce additional stresses in the piping. The applicant replied that the expansion joints were designed for the relative motion.

2.4 MIDLAND

Applicable questions received on this issue are Question 130.21 from the structural engineering branch; Questions 362.1, 362.2, 362.10, 362.12, 362.13, 362.14, 362.15, 362.16, and 362.17 from the geotechnical branch of the NRC; and Question 040.106 from the power systems branch. Based on these questions, the NRC requires the following.

a. Evaluation of the ability of Category I structures, located upon backfill, to withstand appropriate loading combinations

b. Comparison of stresses predicted due to settlement to those permitted by the ACI code

c. Results of quality control tests of fill under and adjacent to all Category I structures

d. Methods employed for removing sands having relative density less than 75% under Category I structures

e. Documentation of settlement of Category I structures

f. Program for further consolidation of the backfill material under diesel generator building

g. Program for reassessing the properties of the backfill and its effect on conduits in the diesel generator building area

h. Program for confirming dynamic characteristics of the fill

i. Program of measures undertaken to avoid excessive settlements of the unconstructed portion of the service water intake structure

j. Listing of changes and justification for the changes in compaction control specifications

k. Providing settlement values based on the fact that the building is founded on spread foundation versus a mat foundation assumed in the existing calculations

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1. Criteria and design methods to preclude adverse settlement of diesel generator fuel lines and fuel storage tanks

NRC Reports 50-329/78-12 and 50-330-12 of November 14, 1978, have addressed some conflicts in the specifications used. NRC Reports 50-329/78-20 and 50-330/78-20 of March 19, 1979, review field compaction requirements, calculations of settlement, and fill placement inspection.

In addition to the above, the NRC Inspection and Enforcement Division, as a result of their investigation of the settlement issue, sent CPCo a letter dated March 21, 1979, which contained 22 requests for additional information. These questions are to be responded within 30 days. The questions have been answered.

3.0 PREVIOUS LICENSING AGREEMENTS ON MIDLAND

PSAR Subsection 2.8.4.4 indicates the estimated settlement for the diesel generator building to be approximately 1/2 inch. FSAR Figure 2.5-48 documents the settlement evaluation for the whole plant and the estimated settlement for the diesel generator building to be of the order of 3.2 inches.

4.0 CURRENT MIDLAND DESIGN RELATIVE TO ISSUE

The diesel generator building has been designed as a Seismic Category I structure according to applicable codes and standards. The estimated settlement is shown in Figure 2.5-48 of the FSAR.

5.0 CURRENT ENGINEERING AND PROCUREMENT STATUS

Engineering and procurement is 95% complete. Three out of four diesel generators have been delivered. The control panels are yet to be delivered. However, because of the unexpected differential settlement, some engineering work is in progress. MCAR 24 documents the activity.

6.0 CURRENT CONSTRUCTION STATUS

The construction of civil work is about 60% complete, and mechanical and electrical is 15% complete.

7.0 CPCO OPTIONS

There are a number of options documented in MCAR 24, which could be used. However, the only option considered by CPCo and the Bechtel task committee on this issue is as follows.

7.1 OPTION 1

Preload and consolidate the soil under the building. This involves loading the entire building with surcharge of sand,

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thus accelerating the settlement. The settlement would be closely monitored. The surcharge would be kept until the building showed no further signs of settlement. At this point, the surcharge of sand would be removed.

This option has been recommended by soil consultants retained by Bechtel for the problem of settlement of the diesel generator building. MCAR 24 documents the current activities under this option.

8.0 COST AND SCHEDULE EXPOSURE

The estimated cost for the option is difficult to determine at this time. However, preliminary estimates are that it will cost between $2 million and $5 million.

The impact on schedule is not yet finalized.

S3703867

Question 362.11 (2.5)

The March 15, 1969, report by Dames & Moore for foundation investigation and preliminary exploration for borrow materials which is included in your PSAR provided final foundation design criteria, including:

> "d) Recommended foundation type and estimated total settlement 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 not exceed 3/4 inch." (Emphasis added)

The June 29, 1968, report by Dames & Moore on this same subject also states their understanding that the maximum allowable differential settlement between the radwaste building and the adjacent reactor containment building is 3/4 inch.

Provide documentation that this maximum differential settlement between buildings has not and will not be exceeded throughout plant life.

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Response

Allowable differential settlements referenced from Dames & Moore reports dated June 28, 1968, and March 15, 1969, refer to settlements between the reactor containments and the auxiliary building.

Settlement of these structures has not been monitored since the start of construction. Settlement benchmarks were installed at locations shown in Figure 2.5-48A. Available settlement data and estimated building loads for the reactor containments and the auxiliary building are shown in Figures 2.5-89 through 2.5-91. Applied loads were estimated from material quantities used in construction.

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Examination of measured settlements for these structures indicates that differential settlements are small and relatively uniform. An evaluation is being made to determine when interconnections were made to allow determination of the amount of differential settlement occurring since that date. This information will be provided by amendment in April 1979. Further settlement analyses considering ultimate building loads, loads from adjacent structures, and the construction sequence will be made to provide estimates of differential settlements. Settlement measurements will also be continued during and after application of final loads.

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Question 362.12 (2.5.4)

Describe your preloading program which is planned to further consolidate backfill material underneath the Diesel Generator Building. Include your schedule for these activities.

Response

The diesel generator building is founded on 25 feet of backfill material (el 603 to 628 feet) as described in FSAR Section 2.5. In July 1978, the settlement of the diesel generator building exceeded the anticipated values shown in FSAR Figure 2.5-48. Independent consultants, Dr. R. Peck of Albuquerque, New Mexico, and Dr. A. Hendron, Jr. of the University of Illinois, have been retained to evaluate the problem.

A preloading program recommended by Dr. Peck and Dr. Hendron was chosen to consolidate the soil under the diesel generator building. The preload program accelerates the soil consolidation process so that the major part of the settlement occurs when it can be evaluated. Additional recommendations made by the consultants include:

1. Raising the site groundwater table by filling the cooling pond to its maximum operating level

2. Completing the construction of the diesel generator building to maximize the soil pressure

The preloading program includes filling the interior of the diesel generator building and the surrounding area with uncompacted pit run granular materials. A system of soil instruments recommended by the consultants is installed to measure the effects of the preload. The types of soil instruments are recommended by Goldberg-Zoino-Dunnicliff & Associates, Inc. and installed under the direction of C.J. Dunnicliff.

The depth of preload recommended is 15 to 20 feet. The preload covers the interior of the diesel generator building and an area 20 feet outside the diesel generator east, west, and south walls. The preload on the north side is retained by temporary retaining forms because the turbine building is located on the north side of the diesel generator building. The material quantities and in situ densities are measured to estimate applied loads. The preload sequence is dictated by the turbine building wall reinforcement and the requirement to gather data from the soil instrumentation. The preload sequence includes an initial hold at a 10 foot depth to obtain any soil data followed by 5 foot lifts to obtain additional data.

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Activities performed prior to placement of preload material are as follows:

1. Isolation of the structure from settlement restraints

2. Reinforcement of the turbine building basement wall

3. Baseline survey of selected underground utilities

4. Installation of the soil instrumentation system

Each of the above activities is discussed in detail in the following paragraphs.

1. The restraints preventing the diesel generator building from settling with the fill material are four electrical duct banks. The duct banks extend vertically through the footing and plant fill down to undisturbed material at el 593'-0". As a result, the duct banks transferred appreciable building weight to the natural soil and prevented the structure from following the settlements associated with the fill material. The area near the duct bank was excavated to expose the extent of support. The duct banks are chipped back to below the footing for a height of 12 inches and to a size less than the opening in the footing. The ducts are wrapped with resilient material to a size 2 inches larger than the duct. The excavated area under the footings is backfilled with lean concrete. 18

2. Because of the close proximity of the turbine building, temporary reinforcement of the basement wall is required to support the additional lateral earth pressure from the preload. The reinforcement consists of a system of tie rods to the diesel generator building, shimming to existing structures, adding structural steel bracing, buttresses, and composite concrete reinforcement inside of the turbine building.

3. Selected utilities are profiled using a pressure registering device to provide a base survey to compare with a profile to be taken after removal of preload. The profiling device and profile measurements are made by Goldberg-Zoino-Dunnicliff & Associates, Inc. under the guidance of C.J. Dunnicliff.

   The soil instrumentation installed consists of piezometers, settlement platforms, and Borros anchors at selected locations and elevations within and around the diesel generator building. The soil instrumentation is monitored at frequencies appropriate to the rate of settlement and dissipation of pore water pressure. The instruments are expected to be monitored at daily

intervals during preload placement and for one more week thereafter and at weekly intervals during static conditions.

The schedule to complete the activities described is as follows:

The soil boring program, placement of the soil instrumentation, and removing settlement restraints have been completed.

The turbine building reinforcements, the pond filling, and construction of the structure are in progress now.

The placement of the first 10 feet of preload directly north and south of the building plus within will be completed in March 1979. The preload is estimated to be removed within 6 months.

When the diesel generator building settlement evaluation is completed, the results will be included in the FSAR. It is presently estimated that the details of the preload evaluation will be included in the July 1979 amendment of the FSAR.

Question 362.13 (2.5.4)

Provide your program for reassessing the properties of the backfill materials after completion of the preloading program of request 362-12. This program should differentiate between:

1. Areas affected by the vertical conduits in the Diesel Generator Building area, and

2. Areas not affected by the conduits.

Also, provide your program for confirming the dynamic characteristics of the fill materials used in seismic analyses of supported structures. Include your schedule for this program.

Response

Backfill material properties in the diesel building area will be assessed based on the settlement, pore water pressure, and rebound results obtained from the preloading program described in the response to FSAR Question 362.12. Preloading will involve loading the foundation soils in excess of the final building loads.

With respect to the areas being affected by vertical conduits, they have been separated from the building as discussed in the response to FSAR Question 362.12. Where possible, results of monitoring the building and instrumentation will be reviewed to evaluate the effects, if any, of the vertical conduits.

Compressibility of the backfill materials will be estimated from settlements of the building and underlying soils measured during preloading. Measurements will be made on the building, and Borros anchor settlement rods and settlement plates will be installed at selected locations and elevations throughout the backfill. Post-preload ultimate settlements and time settlement behavior will be estimated from load settlement responses obtained during preloading, taking into account the final building loads being lower than those experienced during preloading. Shear strength of the backfill materials will be assessed considering both frictional and cohesive strength properties. To aid in this assessment, laboratory consolidated, undrained triaxial tests accounting for stress history effects will be conducted on samples taken before preloading. The consolidation stage of these tests will be designed to simulate field conditions experienced through removal of the preload.

Dynamic characteristics of the backfill materials will be reassessed from moduli obtained from rebound measurements because stress behavior of the soils measured during rebound will be at strain levels comparable to those experienced during dynamic loading.

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Estimations of post-preload settlements will be made based on settlement versus time behavior obtained during preloading. A sequence of the preload program is discussed in the response to FSAR Question 362.12. 18

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Question 362.14 (2.5.4.10.3)

In the light of the large settlements of the plant area fill that has occurred and the fact that the unconstructed portion of the service water intake structure is intended to be founded in the plant area fill, what measures will be taken to avoid the possibility of excessive settlements of this structure?

Response

A review of measured settlements after application of 95% of the building loads shows that settlements of the service water intake structure have been small and relatively uniform. Settlement benchmark locations and measured settlements are provided in the answer to NRC Question 362.11. Settlement measurements will be continued.

A review of field records will be made to determine the types of backfill, its configuration, and properties indicated by density tests to further evaluate the possibility of future settlements. This information will be submitted by amendment in June 1979.

8703874

Question 362.15 (2.5.4.5)

Provide a detailed list of changes that have occurred in the compaction control specifications. Begin with what is specified in the PSAR and proceed to those specifications that are applicable at present, giving the dates and justification for all changes. Include in the listing any changes in types of fill material required for different areas, methods of compaction control, required degree of compaction, allowable moisture content variations, and lift thickness.

Response

Earthwork operations began in June 1969. Technical Specification 7220-C-10 was initiated in April 1969. This specification was primarily used for excavation of plant structures and for constructing cooling pond dikes. The earthwork operations were discontinued during the latter part of 1970 because the project was shut down.

The project was reactivated in 1973. Technical Specification 7220-C-210 was initiated and Technical Specification 7220-C-10 was superseded to cover earthwork for plant area fill as well as cooling pond dikes. Technical Specification 7220-C-211 was originated to cover the structural backfill which is to be performed in areas not accessible to motorized rollers. Several changes to these specifications were made at various stages of the project. The changes in the specifications with justifications are listed in Tables Q&R 2.5-1, 2.5-2, and 2.5-3. 18

A comparison between PSAR (Dames & Moore recommendations) and the specification applicable at present (7220-C-210) has been made and is included in Table Q&R 2.5-4. Earthwork in areas not accessible to motorized rollers and criteria for structural backfill is not discussed in the PSAR.

Tables Q&R 2.5-1 through 2.5-4 address the areas such as foundation preparation, materials, freeze protection, lift thickness, moisture control, compaction, slopes, and supervision. Editorial, administrative, and other changes not pertaining to earthwork are not addressed.

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Question 362.16 (2.5.4)

Provide a copy of the Midland settlement study by P.K. Chen entitled "Settlement Evaluation for Plant Area."

Response

The Midland settlement study entitled Settlement Evaluation for Plant Areas is a Bechtel engineering calculation. A summary of this settlement study, including the parameters used to establish the analytical model, the methods of analysis, and a discussion of the results, is provided in FSAR Subsection 2.5.4.10.3. If additional information or detail is required, a meeting can be scheduled and the full calculation made available for review and discussion.

A revised settlement analysis is in progress and will consider the following as-built conditions:

1. The foundation elevation and type for diesel generator building

2. The compressibility coefficient ($Cc/1+e_o$) of the plant area fill based on borings, laboratory tests, and monitoring results of the diesel generator building

3. Final reactor containment building loads

The revised analysis is scheduled for completion in July 1979.

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Question 362.17 (2.5.4.10.3)

It is our understanding that the estimated settlement values for the diesel generator building shown in Figure 2.5-48 are based on the building having a mat foundation. If this is so, provide settlement calculations and ultimate settlement values based on the design foundation configuration as presented in section 3.8.5.1.3 of the FSAR. 18

Response

The estimated ultimate settlement values indicated on Table 2.5-48 were based originally on the diesel generator building having a mat foundation with a uniform intensity of 3 ksf. A comparison of the induced vertical stresses versus depth between a mat foundation with a uniform load intensity of 3 ksf and the present design of the diesel generator building at various locations has been made. Differences in estimated settlements resulting from the two foundation conditions are small and within the accuracy limits of the analysis. 19

Because of the variable soil conditions under the diesel generator building, the predicted ultimate settlement will be based on the measured values which will be obtained from the ongoing monitoring program. It is presently estimated that the predicted ultimate settlement values will be provided by amendment in July 1979. 18 19

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TABLE Q&R 2.5-1

CHANGES IN COMPACTION CONTROL SPECIFICATION,
TECHNICAL SPECIFICATION C-10

Rev No.	Date	Description or Purpose of Issue	Change or Changes Made	Justification, Remarks
0	4/17/69	Issued for bids		
1	5/2/69	Issued Addendum 1	Section 1.1.3 in Section 1.1, Work Included, was modified to include a definition of work limits.	Clarification
			Section 11.2.1 in Section 11.2, Excavation, was expanded to include any excavation required for the Miller Road Culvert.	Scope change
			Section 12.5.6 in Section 12.5, Backfill, was modified to specify 5 feet of surcharge with slurry backfill material over the backfilled slurry trench instead of 2 feet of Zone 1 material and 6 passes of 50 ton rubbertired roller.	Alternate means of providing surcharge
			Section 13.1 was modified to include that the foundation should be scarified and moisture conditioned as required. It also specifies that an alternative roller can be used if approved by the contractor. Additional passes may be required.	To provide bond between embankment and original ground surface. Alternate roller approved by contractor was allowed to facilitate construction. Improved subgrade preparation.
			Section 14.1.2, Suitability of Materials, identifies the responsibility of the subcontractor to conform to the specified material requirements by making tests as required. The results are to be approved by the contractor.	Assurance to meet the requirements of specifications

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TABLE Q&R 2.5-1 (continued)

Rev	Date	Description or Purpose of Issue	Change or Changes Made	Justification, Remarks
			Section 14.4.1 clarifies the responsibility of the subcontractor to make tests on the materials to be used in the construction of embankments.	To emphasize that the materials used in the embankment should meet the specification requirements
			The gradation requirements for Zone 1 material was revised. The requirement that not more than 60% passing a #200 sieve was dropped.	The PSAR[1] indicates that the materials available onsite are acceptable for fill. Some onsite borrow materials had fines in excess of 60% passing sieve #200.
2	2/18/69	Addendum 2 was added. Issued for construction	The intent of this addendum was to raise the top of the dike elevation to 632' and the excavation to elevation 615'. Various paragraphs throughout the specifications were modified to reflect these changes	Reflect design changes
3	7/18/69	Addendum 3 was added	This addendum dealt exclusively with Section 10.0, Sealing Wells. It was expanded to include exploratory holes and specified pressure grouting for both wells and exploratory holes.	To delineate requirements for sealing wells and exploratory holes
4	8/28/69	Addendum 4 was added	Section 4.2, List of Drawings, was modified by adding Drawings C-119, Cooling Pond-Dike Sections, Sh 3 and C-120, Channel Excavation.	The scope change included additional sections for cooling pond dike and added channel excavation to dredge and widen the Tittabawassee River.
			The specification was revised to include Zones 1A and 4A. The gradation, lift thickness, and compaction requirements were all specified.	To allow the use of onsite excavated material for dike construction[1]
5		Addendum 5 was originated. However, it was not issued for construction		Project was shut down.

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TABLE Q&R 2.5-2

CHANGES IN COMPACTION CONTROL SPECIFICATION,
TECHNICAL SPECIFICATION C-210

Rev.	Date	Description or Purpose of Issue	Change or Changes Made	Justification and Remarks
A	1/12/73	Issued for client review and approval		
0	3/29/73	Issued for bids		Incorporated client comments and comments from other disciplines.
1	4/25/73	Revised to incorporate changes	Section 11.3: "Prior to placement of new fill, the outer slope will be excavated to a minimum depth of 2 feet" was changed to read "... a maximum depth of 2 feet."	Revised design criteria.
1	4/25/73	Revised	Section 14.1.1: The ASTM designation for the cement to be used in the grout was changed to ASTM C-150, Type 11A, from ASTM C-175, Type 11A.	ASTM C-175 was discontinued and replaced by ASTM C-150.
			Section 17.2.1: Coarse aggregate for concrete conforming to MDSHSS was changed from Type 6A to Type 6AA.	Physical requirements for Type 6AA materials are more stringent.
2	7/27/73	Issued for subcontract	Various paragraphs were modified to reflect the lowering of the bottom elevation of the cooling pond from elevation 615' to 614'.	To allow for additional borrow material.
			Section 12.4.4: Density of soil in place was modified by the sentence, "A nuclear density device may be used provided that the results are compatible with those obtained by the specified procedure."	To provide alternate means for testing the in place materials.
3	7/10/74	Revised to incorporate changes	Section 8.2.1 was modified by the addition of the following clause, "...nor lower than el 612'..."	To allow for additional borrow material.

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TABLE Q&R 2.5-2 (continued)

Rev.	Date	Description or Purpose of Issue	Change or Changes Made	Justification, and Remarks
			Section 12.5.5 was modified to include instructions for the placing of 4Z material.	Crushed stone material 4Z was added to be used for baffle dike.
			Modifications to Table 12-1 are as follows:	
			1) For Zone 1, impervious fill, the requirement that not more than 60% fines passing a #200 sieve was deleted.	The PSAR indicates that the materials available onsite are acceptable for fill. Some onsite borrow material had fines in excess of 60% passing sieve #200.
			2) The description of Zone 4 material was changed from a "clean gravel graded as specified" to "crushed stone." The gradation requirements were also revised.	Improved riprap bedding material over originally specified Zone 4 material. 18
			3) The gradation requirements for Zone 5A, Riprap, originally specified that 50% (by weight) of the material shall have particle sizes of 10 inches (#100) or larger. This was reduced to 40% (by weight).	The riprap stocked in a quarry was tested and the graduation was close to that specified in the specifications. Therefore, the material was acceptable.
4	6/4/75	Revised to incorporate changes	In Section 12.4.4 the hole size of soil with little or no gravel was changed from a 6 inch diameter, 9 inch depth, cylindrical hole to that specified in ASTM D 1556.	Clarification of testing procedures.
5	7/8/77	Revised to incorporate changes	ASTM designation C-136 was added to Section 12.4.3	This change was made to include additional testing capabilities.

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TABLE Q&R 2.5-2 (continued)

Rev.	Date	Description or Purpose of Issue	Change or Changes Made	Justification, and Remarks
			Section 12.5: Placement of materials in areas inaccessible to motorized rollers was deleted.	Scope of work in areas inaccessible to motorized rollers was to be performed under a separate specification, C-211.
			Section 12.6 was modified from +2% of optimum moisture content to -2% and not more than +5% of of the optimum in areas away from plant area for Zone 2 material.	Materials in the borrow areas were wet. Materials with moisture content not more than +5% of optimum were allowed to be placed in the construction laydown area due to schedule requirements.
			Section 13.7.2 was added.	This change was added to accommodate the compaction requirements for cohesionless soil. NOTE: For compaction requirements of cohesive soils, see Table Q&R 2.5-4.
			Section 16 was increased in scope to include document control, nonconformance, corrective actions, and internal audits.	Reevaluation of quality program position on subcontractors.
6	4/25/78	Revised	Sections 12.4.2 and 12.4.4 were modified by adding the provision that if a nuclear density device is used it should be used in accordance with ASTM D 3017, using manufacturers instructions.	Added ASTM standards for using a nuclear device for testing materials.

18

8703982

TABLE Q&R 2.5-3

CHANGES IN COMPACTION CONTROL SPECIFICATION,
TECHNICAL SPECIFICATION C-211

Rev	Date	Description or Purpose of Issue	Change(s) Made	Justification, Remarks
0	4/25/74	Issued for construction		
1	1/15/75	Revised to incorporate changes	The grain size gradation was originally determined by ASTM D 422-1963. This was changed to ASTM C 136-1971 and ASTM C 117-1969 as required (see Section 5.1).	The ASTM standard specified, ASTM D 422, was inappropriate for this application. 18
2	6/4/75	Revised to incorporate changes	Section 5.1 was revised to show that the material within 3 feet of any plant area structure should be considered structural backfill. Outside this 3 foot limit, other materials were allowed.	In areas 3 feet away from the outside walls of the plant structure, the structural backfill was unnecessary and other materials were allowed.

S3703883

TABLE Q&R 2.5-3 (continued)

Rev	Date	Description or Purpose of Issue	Change(s) Made	Justification, Remarks	
2	6/4/75 (continued)		Section 5.4, Compaction Equipment, was revised to allow the use of other than operator-held, vibratory power transfers. The use of this equipment within 3 feet of any structure would have to be reviewed by project engineering.	Compaction equipment was to be selected based on the demonstrated ability to accomplish the required compaction. Use of compaction equipment other than operator-held equipment within 3 feet of structural walls should be reviewed by project engineering to evaluate the effect of these rollers on the structural walls.	18
			Added Section 5.5.2, stating that cohesive soil, used as structural backfill, should be compacted to not less than 95% maximum density as determined by modified proctor method ASTM D 1557, Method D.	The compaction requirement for materials other than structural backfill was introduced.	

SB703884

TABLE Q&R 2.5-3 (continued)

Rev	Date	Description or Purpose of Issue	Change(s) Made	Justification, Remarks
3	11/8/76	Revised	Section 5.1.4 was added allowing the top 2 feet of backfill to be Zone 1, where excavation was 6 feet or more. It also specified that Zone 4 material could be used for the top 6 inches, if necessary.	To accommodate vehicular traffic adjacent to structures and to divert surface water runoff from the structural backfill areas.
			Section 5.5.2 was modified to allow use of the Bechtel modified proctor test in determining the maximum dry density and optimum moisture content.	Compaction criteria for cohesive soils were revised to be consistent with Specification C-210. For compaction criteria of cohesive soils under Specification C-210, see Table Q&R 2.5-2.
4	9/21/77	Revised	Section 5.1.1 was revised to show that the grain size gradation should be determined by ASTM D 422, instead of ASTM C 136-1971 and C 117-1969.	To conform with Bechtel standards.
5	10/23/78	Revised	Sections 5.6.1 and 5.6.2 were revised to delete references to ASTM designations C 136-1971 and C 117-1969.	To reflect changes made in Revision 4.

8703885

TABLE Q&R 2.5-4

COMPARISON OF COMPACTION CONTROL SPECIFICATIONS IN PSAR WITH PRESENTLY APPLICABLE TECHNICAL SPECIFICATION C-210

	Specification C-210		PSAR-Dames & Moores Final Report 3/15/69		
Item	Section	Description/Requirement	Section	Description/Recommendation	Remarks
1. Subgrade preparation	10.0	Foundation Preparation: Foundations shall be cut to firm undisturbed material and free of loose materials. Foundation shall be approved before placing fill material. Prior to placing fill material on the foundation, the surface shall be scarified, moisture conditioned as required, and rolled with four passes of a 50 ton rubber tired roller or other approved rollers.	Page 13	Following stripping and excavation, the exposed surfaces shall be thoroughly proof rolled with two passes of a 20 yd^3 loaded scraper under the supervision of a qualified soils engineer. Zones of loose or soft soils delineated by proof rolling should be compacted or removed and replaced with controlled compacted fill	18
2. Materials	12.3, Table 12-1	Various zones of materials were used to construct the embankment and identified in Table 12-1.	Page 14	Onsite excavated soils are considered suitable fill material. As sandy soils are more readily compacted with small equipment sand fill was recommended in areas of limited access.	For areas not accessible to motorized rollers and adjacent to plant structures, structural backfill in accordance with Specification C-211 was used.

8703886

TABLE 2.5-4 (continued

Item	Specification C-210 Section	Specification C-210 Description/Requirement	PSAR-Dames & Moores Final Report 3/15/69 Section	PSAR-Dames & Moores Final Report 3/15/69 Description/Recommendation	Remarks
3. Freeze protection (for excavation and embankment construction)	8.0, 12.5, 12.10, 13.8	No embankment shall be placed on a frozen surface nor shall any ice or frozen earth be incorporated into the embankment. Embankment construction requiring moisture conditioning shall be suspended if the ambient air temperature is 32F and falling. Precautions shall be taken to protect partially completed embankment during winter. Required reconditioning shall be performed resulting from lack of winter protection.	Page 14	If excavations are to be kept open during winter, at least 3-1/2 feet of natural soils or similar cover should remain in place over the final subgrade or overlying the mud mat. No compacted soils shall be allowed to freeze. Frozen soils are to be removed or recompacted prior to resumption of earthwork.	No freeze protection is covered under Specification C-210 for excavations. 18
4. Lift thickness for construction of embankments	12.5, 13.5	For Zones 1, 2 and 3, the lift thickness shall be determined based on the evaluation of compaction equipment. Maximum uncompacted lift thickness is limited to 12 inches.	Page 15	All fill and backfill material should be placed in nearly horizontal lifts approximately 6 to 8 inches in loose thickness.	Test pads were prepared to qualify the density achieved by testing 12 inch thick layers for several types of rollers.

S270587

TABLE 2.5-4 (continued

Item	Specification C-210 Section	Specification C-210 Description/Requirement	PSAR-Dames & Moores Final Report 3/15/69 Section	PSAR-Dames & Moores Final Report 3/15/69 Description/Recommendation	Remarks
5. Moisture control	12.6, 13.6	Insofar as practicable, Zones 1, 1A, and 2, which require moisture control shall be moisture conditioned in the borrow areas. The water content during compaction shall be ±2% of the optimum moisture content. The wet limit for Zone 2 shall be that moisture content at which the tires of the specified rubber tired rollers rut the surface of fill by more than 6 inches.	Page 15	All fill and backfill materials should be placed at or near the optimum moisture content.	The optimum moisture content was determined per ASTM D 1557 modified to obtain 20,000 ft-lb of energy per ft^3 of soil.
6. Compaction	12.8, 13.7	Zone 1: 50 ton[1], 4 passes[2] Zone 1A: 50 ton[1], 4 passes[2] Zone 2: 50 ton[1], 4 passes[2] Zone 3: 50 ton[1], 4 passes[2] (or vibratory roller) Zone 4: Construction equipment routed over the zone or additional rolling as directed by contractor Zone 4A: 50 ton[1] (as directed by the contractor) Zone 5: Not required Zone 5A: Not required Zone 6: Not required	Page 16	Recommended Minimum Compaction Criteria Purpose of Fill: Support of structures; Sand Soils % Relative Density[3]: 85; Clay Soils % of Max. Density[4]: 100 Adjacent to structures: 75; 95 Area fill (not supporting or adjacent to structures): 70; 90	Compaction was done in accordance with ASTM D 1557 modified to obtain 20,000 ft-lb energy per ft^3 of soil.

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SU703888

TABLE 2.5-4 (continued

Item	Specification C-210 Section	Specification C-210 Description/Requirement	PSAR-Dames & Moores Final Report 3/15/69 Section	PSAR-Dames & Moores Final Report 3/15/69 Description/Recommendation	Remarks
		A pass shall consist of the entire coverage of the area with at least one trip of the equipment specified. To effect complete coverage of the area being rolled, each trip of the roller shall overlap the adjacent trip by not less than 2 feet. Dumping, spreading, sprinkling, disking, or harrowing and compacting may be performed at the same time at different points along the section where there is sufficient area to permit these operations to proceed simultaneously.			18
		Additional Rolling - As determined by the contractor, if the desired compaction of any portion of embankment is not obtained by the minimum passes specified, additional passes shall be made over the surface area of such designated portions of the embankment until the desired degree of compaction has been attained. However, where lift thickness is greater than specified, or moisture content at time of rolling is improper or specified rolling has not been performed, such rolling shall be by and at the expense of the subcontractor.			

8907030389

TABLE 2.5-4 (continued

Item	Specification C-210 Section	Specification C-210 Description/Requirement	PSAR-Dames & Moores Final Report 3/15/69 Section	PSAR-Dames & Moores Final Report 3/15/69 Description/Recommendation	Remarks
		Fill Not Accessible to Specified Rollers General - Unless otherwise specified, all embankment fill not accessible to roller compaction shall be compacted by power or hand tampers, or by rolling or other approved means to the same degree required for like materials compacted by roller. Fill containing both sides of a wall, pipe, or structure shall be kept at approximately the same elevation and compacted equally on the sides until placement has reached the required elevation. Compaction Requirements for Plant Area Fill Cohesive Soils - All cohesive backfill in the plant area and the berm shall be compacted to not less than 95% of maximum density as determined by ASTM D 1557, Method D. Cohesionless Soils - All cohesionless backfill in the plant area and the berm shall be compacted to not less than 80% of relative density as determined by ASTM D 2049, with the exception that Zones 4, 4A, 4Z, 5, 5A, and 6 materials need no special compactive effort other than as described in Section 12.8.1.			18

8703390

TABLE 2.5-4 (continued

Item	Specification C-210 Section	Specification C-210 Description/Requirement	PSAR-Dames & Moores Final Report 3/15/69 Section	PSAR-Dames & Moores Final Report 3/15/69 Description/Recommendation	Remarks
7. Slopes	2.5	During construction of the embankment, the slope should not exceed 3 horizontal to 1 vertical to have a differential elevation of 20 feet maximum.	Page 15	For cohesive soils, the recommended slope is 2:1, and for cohesionless soils a slope of 4:1 or flatter is recommended.	
		The design drawings indicate a minimum of 3:1 slopes or flatter for permanent embankments.		Temporary excavations in dewatered sand fills are to be 1-1/2:1 or flatter. Compacted clay fills may be cut vertically up to 10 feet in height.	
8. Supervision	-	All earthwork operations were subject to approval by the contractor.	Page 16	Filling operations should be performed under the continual supervision of a qualified soils engineer who would perform in place density tests in the compacted fill to verify that all materials are placed and compacted in accordance with the recommended criteria.	A qualified soils engineer supervised the earthwork operations at various stages but not on a continuous basis.

18

(1) Rubber tired roller
(2) Minimum number of passes per lift
(3) Maximum and minimum density of sand soils should be determined in accordance with ASTM Test Designation D-2049-64T.
(4) Maximum dry density and optimum moisture content should be determined in accordance with ASTM Test Designation D-698, modified to require 20,000 ft-lb of compactive energy per ft^3 of soil.

8703391

Question 130.21 (3.8,2.5)

Provide an evaluation of the ability of those seismic Category I structures which are located upon backfill and which are experiencing settlement in excess of that predicted to withstand appropriate loading combinations, including SSE, throughout plant life. Describe how stresses associated with differential settlement of the structural foundations and any corrective preloading activities have been or will be factored into these evaluations. Also provide a comparison of the stresses predicted due to settlement to those allowable stresses permitted by the ACI Code. 17

Response

The diesel generator building is the only seismic Category I structure located on plant fill which is experiencing settlement in excess of the values predicted in FSAR Figure 2.5-48. The structure is a heavily reinforced concrete structure which is described in FSAR Section 3.8.

A preload program is in progress to consolidate the underlying foundation material. This program has been described in the response to FSAR Question 362.12. The settlement survey program described in FSAR Subsection 2.5.4.13 has been expanded to provide additional information on how the structure is reacting to the soil settlement. The settlement survey program for the building was expanded from 3 survey points to 12 survey points and the recording increment was decreased from 60 to 7 days. The additional data are to be used to evaluate the effects the settlement has on the structure. 18

The FSAR does not contain load combinations which address stresses due to differential settlement. We are presently researching sources for appropriate load combinations to be used. This criteria will be presented in the April 1979 amendment. Furthermore, the stress evaluation is dependent upon the settlement data from the preload program. The stress evaluation will be provided along with the results of the preload program in the July 1979 amendment.

QUALITY ASSURANCE PROGRAM
MANAGEMENT CORRECTIVE ACTION REPORT
MCAR-1

REPORT NO. 24

JOB NO. 7220 Q NO. 1.40 DATE 9/7/78

I *DESCRIPTION (Including references):

The Bechtel "Foundation Data Survey Program" has indicated that the settlement of the Diesel Generator Building has been greater than expected. This has been documented in NCR-1482 dated (8/21/78). A preliminary evaluation of soil boring data from an investigation being conducted by Project Engineering indicated that the magnitude of the investigative tests and analysis of test results makes this item reportable under 10CFR50.55 e, 1, iii.

*RECOMMENDED ACTION (Optional)

1. Determine the amount of settlement of the Diesel Generator Building (DGB) and increase the frequency of foundation survey measurements to find if the settlement is or will be excessive.
2. Determine the cause of the settlement.
3. If the settlement is or will be excessive, determine what actions are required to correct the condition and preclude recurrence.

REFERRED TO [X] ENGINEERING [ ] CONSTRUCTION [ ] QA MANAGEMENT [ ] _____

ISSUED BY L. A. Dreisbach 9/7/78
Project QA Engineer Date

II REPORTABLE DISCREPANCY

[ ] NO [X] YES

NOTIFIED CLIENT 9/7/78
Project Manager Date 9/7/78

III CAUSE

CORRECTIVE ACTION TAKEN

RECEIVED SEP 8 1978 BECHTEL A.A. 7220

MECH.	
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CS	
CIVIL	4
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PROJ. MGR.	
PROC. MGR.	
FIELD	
CONST. COORD.	
FSAR	
ADMIN.	
FILE NO.	0.5.5 4

AUTHORIZED BY _____ Date

DISTRIBUTION:
Project Manager
Construction Manager
Engineering Manager
Project Engineer
Proj. Supt. / Proj. Const. Mgr. or P & I Procurement Mgr.
Chief Field QC Engineer or Procurement Insp. Mgr.
QA Supervisor
Client

J.B. Violette
S.I. Heisler
L.A. Dreisbach
J. Amaral (Gaithersburg)
J.E. Bashore (Norwalk)

FORMAL REPORT TO CLIENT _____ Date
(If Section II Applies)

CORRECTIVE ACTION IMPLEMENTED

S.703893

VERIFIED BY _____
Project QA Engineer Date

*Describe in space provided and attach reference document

Results of density and compaction tests made in the test pits are presented in Figure 33, with the percent compaction referenced to ASTM D 1557 (56,000 ft-lbs).

Laboratory soil tests have been performed by Goldberg-Zoino-Dunnicliff & Associates, Inc. These results include data on moisture content, unit weight, plasticity, gradations, strength, consolidation, compaction, mineralogy, and cation exchange capactiy. Graphical summaries of the diesel generator building soil plasticity, water content, dry unit weight, total unit weight, and shear strength are presented in Figures 34 through 39.

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

a. Plasticity characteristics from nonplastic to low plasticity (Figure 34)

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

c. Dry unit weights between 96 and 130 pcf, averaging about 120 pcf (Figure 36)

d. Total unit weights between 112 and 143 pcf, averaging about 133 pcf (Figure 37)

e. Shear strengths based on unconfined compression test results on the samples obtained ranged from approximately 100 to 3,646 psf (Figure 38)

f. A shear strength to moisture content relationship as shown in Figure 39

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

4. NRC Inspection Report

In response to the conflicts addressed in NRC Inspection Reports 50-329/78-12 and 50-330/78-12 dated November 14, 1978, FSAR Change Notice 1065 has been initiated to address Items a, b, c, and d listed in Section 4 of Activities in Progress for Interim Report 3. Further evaluations of the additional items are continuing and will be addressed in subsequent reports.

5. Evaluation of Underground Pipe for Preload Pressure

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

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

Activities in Progress

1. Strengthening of the Turbine Building Wall

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

2. Preload Operation

Preloading of the diesel generator building is continuing. As of February 2, 1979, the granular fill material for the preload has been placed to the elevations shown in Figure 41.

3. Cutting of the Condensate Pipelines

The two 20-inch condensate lines and two 6-inch condensate lines shown in Figures 9 and 10 have been cut outside the turbine building wall to prevent potential overstressing of the pipes during preload. Continued surveillance will be provided on the cut pipelines and further evaluation will be provided in subsequent reports.

4. Evaluation of Field Records

Field density test records prepared by the testing subcontractor are being evaluated.

5. Summary of Plant Fill Under Seismic Category I Structures

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

a) Tank Farm

Field studies in the tank farm area show generally stiff to very stiff clay backfill with some soft zones and occasional medium to very dense sand backfill over natural soils. Current plans involve filling the tanks and measuring structure settlements. Loading duration will be determined based on predictions of future settlements. No surcharge in addition to tank loading is planned, but settlement measurements will be continued after completion of preloading.

b) Diesel Generator Building

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

c) Diesel Fuel Tanks

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

d) Retaining Walls Adjacent to the Service Water Pumphouse

Borings in the retaining wall areas indicate that this wall may be supported by stiff to very stiff clay backfill over natural soils. The wall will continue to be monitored to allow further evaluation.

e) Service Water Building Area on Plant Fill

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

f) Service Water Pipes

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

6. Cooling Pond Fill

Since November 8, 1978, the cooling pond has been filled from el 621.9 to its current level of 625.8. Additional filling to the maximum level of 627.0 will be accomplished after the spring river-flows begin.

Affect on Project Schedule

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

Submitted by: R C Mark

Reviewed by: B Ohr

Approved by: [illegible]

Concurrence by: Karl Wieduwilt

RM/pd
2/6/4

SB1C00S1

FILE: LG-6.44.1

00582

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Bechtel Power Corporation

777 East Eisenhower Pkwy.
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CONST COORD				
ADMIN				

FILE NO 0270, 0670.2

RS-033-01

February 14, 1980

BLC-8827

Mr. G. S. Keeley
Project Manager
Consumers Power Company
1945 West Parnall Road
Jackson, Michigan 49201

Midland Units 1 and 2
Consumers Power Company
Bechtel Job 7220
50.54(f) JANUARY STATUS REPORT
File: 50.54(f)

Dear Mr. Keeley:

Attached is the January Status Report. The following is a summary of the attached report:

	Questions 1-22	Question 23
Actions due prior to 1/31/80	74	40
Reported complete, verified by QA	10	20
Reported complete, not verified	21	8
Due, but not complete	5	12
Insufficient documentation for January's Status Report	38	N/A

The February Status Report will be submitted by March 7, 1980.

Very truly yours,

John A. Rutgers
Project Manager

JAR/MKW/kb
Attachment
Response: No
Chron Use: 01 M1 Action
02 Closes 4775
03 Open action for Q6, due A0307

cc: W. R. Bird (CPCo-Jax)
L. A. Dreisbach (Bechtel-Mid)
L. H. Curtis (Bechtel-AA)
R. L. Rixford (Bechtel-AA)
J. Milandin (Bechtel-AA)
A. J. Boos (Bechtel-Mid)
S. L. Blue (Bechtel-AA)
R. A. Simanek (Bechtel-AA)
L. E. Davis (Bechtel-Mid)

SB100109

005821

STATUS OF 50.54(f) QUESTIONS 1-23
ACTION ITEMS FOR JANUARY 1980

Status Codes:

1) Complete, verified
2) Complete, not yet verified
3) Due, but not complete
4) Insufficient evidence of documentation to establish or verify status

Questions 1-22 Action Item numbers are the same as were used by the Diesel Generator Building Task Group and are identified on this status report.

Question 23 Action Item numbering is the same as in the Response to Question 23 submitted to Consumers Power via BLC-8460, J. A. Rutgers to G. S. Keeley, dated November 14, 1979.

STATUS OF 50.54(f) QUESTIONS 1-22

ACTION ITEMS
JANUARY 1980

005821

QUES. & ACTION ITEM	DESCRIPTION AND REFERENCE	ACTION COMPLETION DATE DUE	STATUS
Ques. 1			
1	Perform a final review and update of the PSAR commitment list. (Pg. 1-3, Item 1)	1-1-80	(3) This was completed BLC-8641 dtd 12-31-
2	Review sections of the FSAR determined to be inactive (Pg. 1-4, Item 2)	1-1-80	3
3	Review EDP 4.22 (Pg. 1-4, Item 3)	6-29-79	2
4	Audit action items 1-3 (Pg. 1-4, Item 4)		3
5	Review specifications not included in the specificity study initially (Pgs. 1-4 & 1-5, Item 2)	6-29-79	2
6	Complete review of the Dames and Moore Report (Pgs. I-6, Item C.1.b)	6-29-79	1
7	Complete review of pertinent portions of the FSAR Sections 2.5 and 3.8 (Pg. I-6, Item C.3)	6-29-79	2
8	Correct settlement calculations and update FSAR (Pg. I-6, Item C-4.a)	11-1-79	2
9	Schedule audits of the geo-tech section on a six months basis (Pg. I-7, Item C.4.c)	7-27-79 (first audit)	1
10	Review drawing for possible effect of vertical duct bank restrictions (Pg. I-7, Item C.5.b)	6-1-79	2
11	Complete actions in response to DRVCL audit (Pg. I-7/8, Item D.1)	5-18-79	2

00582

QUES. & ACTION ITEM	DESCRIPTION AND REFERENCE	ACTION COMPLETION DATE DUE	STATUS
12	Revise EDP 4.49 to incorporate clarifications & instructions for use of SCN (Pg. I-8, Item D.2.d)	5-1-79	1
13	Schedule audits of each design discipline calculations on a yearly basis (Page I-8/9, Item D.4)	6-27-79	1
14	Re-evaluate construction equipment used for compaction (Page I-11, Item C.1)	Prior to resuming soils work	2
15	Assign field soils engineer and soils engineer from the design section (Page I-11, Item C.2.a)	Prior to resuming soils work	2
16	Review const. specs and procedures to identify equip. requiring qualifications (Pg. I-11, Item D.1)	6-29-79	1
17	Review Field Procedure FPG-3.000 to assure clarity and completeness (Pg. I-11, Item D.2)	5-31-79	2
18	Revise PQCI C-1.02 to provide inspection rather than surveillance and to record inspections (Pg. I-16, Items C.1.a and C.1.b and Pg. I-17, Item C.3.b)	Prior to resuming soils work	2
19	Complete indepth review of soil test results (Pg. I-17, Item C.3.a)	7-31-79	1
20	Perform indepth audit of U.S. Testing (Pg. I-18, Items C.4.b and D.3.c)	5-31-79	1
21	Review all active QCI's for surveillance callouts and modify where necessary (Pg. I-18, Item D.1)	6-29-79	3

STATUS OF 50.54(f) QUESTIONS 1-22
ACTION ITEMS
JANUARY 1980

005821

QUES. & ACTION ITEMS	DESCRIPTION AND REFERENCE	ACTION COMPLETION DATE DUE	STATUS
22	Evaluate documentation callouts on QCIs (Pg. I-18)	6-29-79	3
23	Incorporate scientific sampling plans for inspection Pg. I-20, Item D.5.f)	10-19-79 (QCI for receipt by 5-15-79)	1
24	Complete indepth review of the Bechtel Trend Program (Pg. I-22, Item D.1.a)	6-1-79	1
25	Conduct QA Training (Pg. I-22, Item D.1.b)	6-1-79	1

SB1C0113

QUES. & ACTION ITEMS	DESCRIPTION AND REFERENCE	ACTION COMPLETION DATE DUE	STATUS
Ques. 2 1	This action item is not identified at this time. This item will be identified and its status noted in future reports.		4
Ques. 3 1	Clarify response to FSAR Question 362.12 (Pg. a)	5-79 FSAR Amend.	2
Ques. 4 1	Provide criteria for permissible residual settlement (Pg. a)	8-79	4
2	Provide details of treatment of loose sands (Pg. b)	8-79	4
3	Take dynamic moduli measurements upon removal of preloads for D.C.B. and other buildings (Pg. c)	10-79	4
4	Use data (c) to evaluate the seismic respo-se of these structures (Pg. d)	11-79	4
5	Prepare additional response to NCR for items 4a and 4b (Pg. e)	8-79	4
Ques. 5 1	This action item is not identified at this time. This item will be identified and its status noted in future reports.		4
Ques. 6 1	Establish procedure & criteria for filling borated water storage tanks with water to demonstrate satisfactory subsoil condition (Pg. a)	9-1-79	4
2	Deleted (Pg. b)		4
3	Deleted (Pg. c)		4

005821

STATUS OF 50.54(f) QUESTIONS 1-22
ACTION ITEMS
JANUARY 1980

QUES & ACTION ITEMS	DESCRIPTION AND REFERENCE	ACTION COMPLETION DATE DUE	STATUS
Ques. 6 4	Evaluate settlement of diesel fuel oil tanks - provide precise corrective measures if required (Pg. d)	9-1-79	4
Ques. 7 1	Perform continuity check on duct banks after completion of preload program (Pg. a)	11-79	4
2	(Included in a) (Pg. b)		4
3	(Included in a) (Pg. c)		4
Ques. 8 1	Establish a requirement to realign diesel generators if manufacturer's tolerances for pitch and roll are exceeded (Pg. a)	9-15-79	4
Ques. 9 1	This action item is not identified at this time. This item will be identified and its status noted in future reports.		4
Ques. 10 1	This action item is not identified at this time. This item will be identified and its status noted in future reports.		4
Ques. 11 1	This action item is not identified at this time. This item will be identified and its status noted in future reports.		4

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QUES. & ACTION ITEMS	DESCRIPTION AND REFERENCE	ACTION COMPLETION DATE DUE	STATUS
Ques. 12 1	Complete one additional boring in middle of diesel fuel oil tanks area (Pg. a)	Open	2
2	Complete three additional borings in the auxiliary building control tower area (Pg. b)	Open	2
3	Complete table 12-1 for soils investigation and planned remedial measures. Respond to NRC. (Pg. c)	5-79	2
Ques. 13 1	Complete seismic reanalysis of D.G.B. to account for current lack of compaction (Pg. a)	10-79	4
2	Review D.G.B. design and Cat. 1 equipment, piping and elec. systems to the enveloped seismic responses (Pg. b)	12-79	4

QUES. & ACTION ITEMS	DESCRIPTION AND REFERENCE	ACTION COMPLETION DATE DUE	STATUS
Ques. 13 3	Service water pump structure -Conduct a seismic reanalysis to account for revised soil - structure interaction.	10-79	4
	-Review structural design and Cat. 1 equipment, piping and elec. systems and incorporate the seismic responses of the reanalysis (Pg. c)	12-79	4
4	Auxiliary Building -If significant change of foundation properties results, conduct a seismic reanalysis. -Review structural design and cat. 1 equip, piping, and elec. systems and incorporate the seismic response of the reanalysis. (Pg. d)	12-79	4
5	Underground Utilities - Investigate the change in differential displacement separately for buildings founded on fill pending results of seismic reanalysis (Pg. e)	12-79	4
Ques. 14 1	Review estimated settlement values for borated water storage tanks upon completion of load test program (Pg. a)	After Tank Completion	4
2	For flexible buildings - analyze for differential settlement based on stiffness at the time of distortion. Evaluate forces due to arching and combine with loads from Question 15 (Pg. b)	12-79	4
3	Examine auxiliary building, feedwater isolation valve pits and borated water storage tank ring foundations for cracks - map significant cracks. (Pg. c)	6-79	2

QUES. & ACTION ITEMS	DESCRIPTION AND REFERENCE	ACTION COMPLETION DATE DUE	STATUS
Ques. 14 4	Analyze building effected by differential settlement for observed differential settlement plus predicted differential settlement (Pg. d)	8-79	4
5	Prepare additional response to the NRC to provide analysis and evaluation (Pg. e)	8-79	4
Ques. 15 1	For Seismic Category I structures evaluate differential settlements in accordance with ACI 318-71 (Pg. a)	12-79	4
2	Expand the Midland structural design criteria for Class I structures to include the differential settlement effects. (Pg. b)	12-79	4
3	Prepare additional response to the NRC (Pg. c)	12-79	4
Ques. 16 1	Perform soils borings in the areas of buried pipes. (Pg. a)	8-79	2
Ques. 17 1	Complete evaluation of impact of the failure of non-seismic Category I piping on safety-related structures, foundations and/or equipment. (Pg. a)	6-29-79	2
2	If future profiles show any extreme conditions, analyze the piping system and make necessary repairs. (Pg. b)	9-1-79	4
3	Prepare additional response to the NRC (Pg. c)	6-29-79	2
Ques. 18 1	Perform re-examination of stresses in seismic Cat. I piping connecting between buildings as part of normal iteration of design.	12-79	4

QUES. & ACTION ITEMS	DESCRIPTION AND REFERENCE	ACTION COMPLETION DATE DUE	STATUS
	Consider stresses induced by differential settlement after connecting pipe and anticipated future settlement.		
Ques. 19 1	Profile pipes in vicinity of D.G.B. after removal of preload-evaluate as described in Response 17. (Pg. a)	9-15-79	4
2	Take additional gap measurements between embedded sleeves and pipes when surcharge is removed. Coordinate this information with the profile data. (Pg. b)	9-15-79	4
3	Perform a complete evaluation of safety related piping after completion of the preload program. (Pg. c)	12-79	4
Ques. 20 1	Analytically check affected pump and nozzle loadings. If necessary disassemble flange joints and evaluate separation. (Pg. a)	6-29-79	2
2	Verify piping support loads for systems subjected to settlement induced loads. (Pg. b)	6-29-79	2
3	Prepare additional response to the NRC. (Pg. c)	6-29-79	2
Ques. 21 1	This action item is not identified at this time. This item will be identified and its status noted in future reports.		4
Ques. 22 1	This action item is not identified at this time. This item will be identified and its status noted in future reports.		4

STATUS OF 50.54(f) QUESTION 1-22, CODE 3 ACTION ITEMS
JANUARY 1980

0058211

es. & tion em	Description and Reference	Scheduled Completion	Status
es. 1 1	Perform a final review and update of the PSAR commitment list (Completed – BLC – 8641 dated 12-31-79	01/01/80 No!	This review is being conducted as part of the FSAR re-review discussed in the Response to Question 23, Part (2). (See Question 23 Action Item 44)
es. 1 2	Review sections of the FSAR determined to be inactive.	01/01/80	This review included in FSAR re-review. (See Question 23, Action Item 44)
es. 1 4	Audit action items 1-3	No due date	This audit further described in Response to Question 23, Part (2), Section 5.0. Audit team currently being established and checklists developed. Audit expected to be completed by March 28, 1980.
es. 1 21	Review all active QCI's for surveillance callouts and modify where necessary.	06/29/79	This review and evaluation has been conducted as described under Question 23 Action Item 19.
es. 1 22	Evaluate documentation callouts on QCI's.	06/29/79	Same as Action Item 21, above.

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STATUS OF 50.54(f) QUESTION 23
ACTION ITEMS FOR JANUARY 1980

Code 1: Action Item 2
Action Item 3
Action Item 4
Action Item 5
Action Item 6
Action Item 7
Action Item 8
Action Item 9
Action Item 10
Action Item 12
Action Item 13
Action Item 15
Action Item 16
Action Item 17
Action Item 18
Action Item 20
Action Item 23
Action Item 24
Action Item 27
Action Item 36

Code 2: Action Item 1
Action Item 11
Action Item 14
Action Item 19
Action Item 22
Action Item 29
Action Item 38
Action Item 40

Code 3: Not complete items will appear on the following attachment.

STATUS OF 50.54(f) QUESTION 23, CODE 3, ACTION ITEMS
JANUARY 1980

005821

tion tem	Description and Reference	Scheduled Completion	Status
19	Quality Control Instructions will be evaluated to ensure that the documentation characteristics which are to be inspected (i.e., review callouts are clearly specified.	No due date	Quality Control instructions have been evaluated, revised, and are being reviewed by Consumers Power Quality Assurance.
21	A review of interoffice memoranda, memoranda, telexes, TWXs, and other correspondence relating to specifications for construction and selected procurements of Q-listed items will be initiated. The purpose of the review will be to identify any clarifications which might reasonably have been interpreted as modifying a specification requirement and for which the specification itself was not formally changed. An evaluation will be made to determine the effect on the technical acceptability, safety implications of the potential specification modification, and any work that has been or may be affected. Review and acceptance criteria for the specifications will be defined by November 30, 1979.	11/30/79	Has been reviewed. Comments being resolved. Resolution expected to be complete 3/14/80.
25	Quality Assurance will issue a Nuclear Quality Assurance Manual amendment to clarify the requirement that procedures include measures for qualifying equipment under specified conditions.	12/14/79	NQAM revision is in progress. Reforecast date is 3/14/80.
26	In view of Action Item 6, Geotechnical Services will revise Procedure FP-6437 by December 31, 1979, to require that calculations be annotated to reflect current design status.	12/31/79	H&CF/SFHO has reviewed procedure FP-6437. Revision has not been made. Revised MED 4.37, has been sent to H&CF to serve as an example of the changes needed.

SB100122

STATUS OF 50.54(f) QUESTION 23, CODE 3, ACTION ITEMS
JANUARY 1980

Action Item	Description and Reference	Scheduled Completion	Status
28	Civil/Structural Design Criteria 7220-C-501 will be modified to contain the requirements that a duct bank penetration shall be designed to eliminate the possibility of the non-specific size duct interacting with the structures.	12/31/79	IOM from the civil discipline group supervisor to the civil group leaders was issued 12/31/79 to notify the group leaders of the need to revise the civil design criteria. This revision has not been done.
30	Engineering and Construction will revise or prepare procedures governing the placement and compaction of soils and implementing the requirements of the Nuclear Quality Assurance Manual as stated in Action Item 25.	12/31/79	This action is delayed pending determination of the revised NQAM requirements of Action Item 25 and is reforecast for 3/14/80.
31	Design documents, instructions, and procedures for those activities requiring inprocess controls will be reviewed to assess the adequacy of existing procedural controls and technical direction. Engineering review is scheduled for completion by December 31, 1979.	12/31/79	No action taken to date. Reforecast date not available at this time.
32	Guidelines for surveillance of testing operations will be developed and included in Field Instructions for the onsite Soils Engineer. Engineering/Geotechnical Services will develop the guidelines by November 30, 1979.	12/31/79	Guidelines sent for Action Item 22. Field Instructions being developed. Reforecast completion 2/22/80.
33	The Quality Assurance audit and monitoring program will be revised to emphasize and increase attention to the need for evaluating policy and procedural adequacy and assessment of product quality. A specialized audit training program will be developed and implemented to ensure guidance for this revised approach.	12/31/79	The quality assurance monitoring program is currently being revised to emphasize and increase attention to the assessment of product quality. A training session was held 12/6/79 to provide guidance for the revised approach. A revised list of potential monitoring subjects has been generated. The remainder of the action is reforecast for 3/14/80.

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STATUS OF 50.54(f) QUESTION 23, CODE 3, ACTION ITEMS
JANUARY 1980

005821

tion tem	Description and Reference	Scheduled Completion	Status
34	Control Document SF/PSP G-6.1 will be revised to provide requirements for inspection planning specificity and for the utilization of scientific sampling rather than percentage sampling.	01/24/80	Draft revision to SF/PSP G-6.1 being reviewed by Bechtel and Consumers Power Quality Assurance.
35	SF/PSP G-3.2, "Control of Nonconforming Items," is in the process of being revised to provide an improved definition of implementing requirements for identifying repetitive nonconforming conditions.	01/24/80	Draft revision to SF/PSP G-3.2 being reviewed by Bechtel and Consumers Power Quality Assurance. Forecast issue date 02/29/80.
37	Consistent with the intent of Action Item Numbers 35 and 36, Quality Assurance will review nonconformance reports which are open, or will become open between this time and January 23, 1980. This review will be to identify any repetitive nonconforming conditions pertaining to product type or activity, or pertaining to nonconformance cause.	01/24/80	In accordance with Question 23 Action Item 36 the Quality Assurance Trend procedure has been revised and applied to all nonconformances which have become open between November 1979 and the date the revised Trend procedure was implemented. Bechtel QA is currently evaluating the scope and method of reviewing nonconformance reports which were still open as of November 1979.
39	Engineering and Construction will revise or prepare procedures governing the placement and compaction of soils and implementing the requirements of the Nuclear Quality Assurance Manual as stated in Action Item 25.	01/31/80	Field Engineering has prepared a revision to FIC 1.100 anticipating the results of QA and Project Engineering completion of Action Items 25 and 30, respectivly.
44	FSAR sections are being rereviewed as discussed in the Response to Question 23, Part (2).	07/80	FSAR rereview in progress, status will be provided in February Status Report.
45	U.S. Testing will be required to demonstrate to the cognizant Engineering Representative that testing procedures, equipment, and personnel used for quality verification testing (for other than NDE and soils) were, and are, capable of providing accurate test results in accordance with the requirements of applicable design documents.	05/01/80	Engineering is contacting cognizant engineering experts to arrange for review of testing procedures equipment and personnel.

SB1C0121

MIDLAND JOB 7220

COMM. CON L LOG NO. N/A

ROUTING	A	I	C	INITIAL
J. Clements				
W. Skelley		1		
B. Burdick		2		
L. Conen				
J. Joy				
W. Cox		3		
J. Gunning				
M. Leisure				
L. Hultquist				
P. Lunk				
A. Seymour				

FILE: LG-6.44

RESPONSE REQUIRED: YES _____ NO ✓

DUE DATE: _____

REPLY: Partial/Complete

SB:00336

IDENTIFY: _____

Consumers
Power
Company

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

RECEIVED
SEP 24 1979
BECHTEL
A.A. 7220

JOB 7220			
	ACT.	INFO. COPY	INIT
PROJ. ENGR.	2		
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ELECT.			
CS			
CIVIL		JK	9/24
P.D.			
ARCH.			
O.E.			
C.TRACTOR FIELD			
PROJ. MGR.			
PROC. MGR.			
FIELD			
CONST. COORD.			
[redacted]		JK	9/24
ADMIN.			
T. Jones Cy Ch. d		JK	9/24
FILE NO.	0271		

September 20, 1979

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

MIDLAND PROJECT
SEISMIC DESIGN INPUT
FILE: 0485.16, 0505.802 SERIAL: 7615
UFI: 71*01, 71*01*11
RESPONSE REQUIRED

On September 10, 1979 Bechtel presented the tentative results of the effect of increasing the Midland Plant SSE from 0.12g to 0.20g. During this presentation, Bechtel explained that the proposed fixes for the settlement issue were being designed for a SSE acceleration of 0.12g. Specifically the following structures were involved:

1. Caissons for the auxiliary building wings
2. Concrete below the feedwater isolation valve pits
3. Piles for the service water pump structure, if found necessary
4. Corbels on the service water pump structure

Consumers Power Company has reviewed this situation and due to the potential impact of the NRC requiring the Midland Plant to show that it can survive an SSE of .2g these structures should be designed to withstand an SSE of 0.2g rather than 0.12g. Bechtel should proceed with the design of these structures using an SSE of 0.2g.

In addition, should the need for additional new structures requiring a revision in seismic design input be required, Bechtel should advise CPCo so that a similar evaluation can be made.

Bechtel should place top priority in terms of manpower and schedule towards completion of the general seismic issues and specifically the preliminary study discussed in the meeting referenced above.

A preliminary report of this study as agreed in the meeting should be provided to CPCo by October 1, 1979. Further action items will be established after CPCo review of this report.

J J Zabritski

SB100337

For: R C Bauman
Project Engineer

Due: 4-13-79 7220

UNITED STATES NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

MAR 22 1979

ACT. UNDER CONT. NO.	
PROJ. ENGR.	2
ASST. P.E. T	3
ASST. P.E. T	1
ASST. P.E. T	
MECH.	
ELECT.	2
CS	
CIVIL	
P.D.	
ARCH.	
G.E.	
C.TR. ENGR. PL.	
PROJ. MGR.	
PROC. MGT.	
FIELD	
CONST. CONTR.	
FSAR	
ADMIN.	
JHinds	
FILE NO. 0505.2	0670.2

MR 4-6-79
GSK (2)
JBWM/WRB (IC
MGK
JDS (Low Lt.
MEG (Ltr
(IL+G)
VXC 4-6-79
VXC 4-6-79
VXC 4-6-79

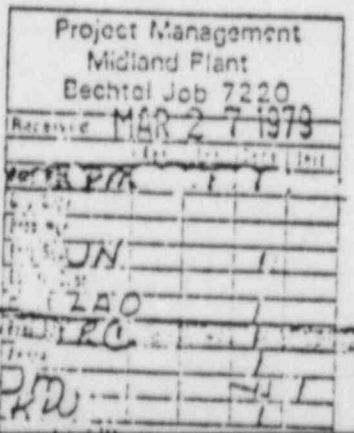
Docket No. 50-329
Docket No. 50-330

Consumers Power Company
ATTN: Mr. Stephen H. Howell
Vice President
1945 West Parnall Road
Jackson, MI 49201

Gentlemen:

This refers to the investigation conducted by Messrs. G. A. Phillip, E. G. Gallagher and G. F. Maxwell of this office on December 11-13, 18-20, 1978, and January 4-5, 9-11 and 22-25, 1979, of activities at the Midland Nuclear Plant, Units 1 and 2, authorized by NRC Construction Permits No. CPPR-81 and No. CPPR-82. The investigation related to the settlement of the diesel generator building at Midland and the adequacy of the plant area fill. The preliminary results of this investigation were discussed with Consumers Power Company and Bechtel Corporation representatives in our office on February 23 and March 5, 1979. The report on the matters discussed during those meetings were included with my letter to you dated March 15, 1979. That letter also set forth the principal matters of our concern as a result of this investigation.

Enclosed is a copy of the report of this investigation. In accordance with Section 2.790 of the NRC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations, a copy of this letter and the enclosed investigation report will be placed in the NRC's Public Document Room, except as follows. If this report contains information that you or your contractors believe to be proprietary, you must apply in writing to this office within twenty days of your receipt of this notice, to withhold such information from public disclosure. The application must include a full statement of the reasons for which the information is considered proprietary, and should be prepared so that proprietary information identified in the application is contained in an enclosure to the application.



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The results of this investigation continue to be under review by the NRC staff. Upon completion of this review you will be advised of any enforcement action to be taken by the Commission.

Should you have any questions concerning this investigation, we would be pleased to discuss them with you.

Sincerely,

James G. Keppler
Director

Enclosure: IE Investigation
Reports No. 50-329/78-20
and No. 50-330/78-20

cc w/encl:
Central Files
Reproduction Unit NRC 20b
PDR
Local PDR
NSIC
TIC
Ronald Callen, Michigan Public
Service Commission
Dr. Wayne E. North
Myron M. Cherry, Chicago

SB100384

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

REGION III

Report No. 050-329/78-20; 050-330/78-20

Subject: Consumers Power Company
Midland Nuclear Power Plant, Units 1 and 2
Midland, Michigan

Settlement of the Diesel Generator Building

Period of Investigation: December 11-13, 18-20, 1978 and January 4-5, 9-11, 22-25, February 23, March 5, 1979

Investigators: G. A. Phillip — 3-19-79

E. J. Gallagher — 3-19-79

G. F. Maxwell — 3-19-79

Reviewed By: D. W. Hayes, Chief
Engineering Support Section 1 — 3/19/79

G. Fiorelli, Chief
Reactor Construction and
Engineering Support Branch — 3/19/79

C. E. Norelius
Assistant to the Director — 3/19/79

29pp.

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REASON FOR INVESTIGATION

On September 7, 1978, the licensee notified Region III, by telephone, that the settlement of the Diesel Generator Building and foundations experienced constituted a matter reportable under the requirements of 10 CFR 50.55(e). Written interim reports were subsequently submitted by the licensee by letters dated September 29 and November 7, 1978. An investigation was initiated to obtain information concerning the circumstances of this occurrence to determine whether: a breakdown in the Quality Assurance program had occurred; the occurrence had been properly reported; and, whether the FSAR statements were consistent with the design and construction of the plant.

SCOPE

This investigation was performed to obtain information relating to design and construction activities affecting the Diesel Generator Building foundations and the activities involved in the identification and reporting of unusual settlement of the building. The investigation consisted of an examination of pertinent records and procedures and interviews with personnel at the Midland site, the Consumers Power Company offices in Jackson, Michigan, and the Bechtel Power Corporation offices in Ann Arbor, Michigan.

SUMMARY OF FACTS

By letter dated September 29, 1978, the licensee submitted a report as required by 10 CFR 50.55(e) concerning an unusal degree of settlement of the Diesel Generator Building (DGB). This report confirmed information provided during earlier telephone conversations on or about August 22, 1978, with the NRC Resident Inspector and on September 7, 1978, with the Region III office. This report was an interim report and was followed by periodic interim reports providing additional information concerning actions being taken to resolve the problem. Further testing and monitoring programs and an evaluation of the resulting data have been undertaken by the licensee to determine the cause of the settlement and the adequacy of the corrective action being taken. The results of these efforts will be submitted in a final report to the NRC.

Information obtained during this investigation indicates: (1) A lack of control and supervision of plant fill activities contributed to the inadequate compaction of foundation material; (2) corrective action regarding nonconformances related to plant fill was insufficient or

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inadequate as evidenced by the repeated deviations from specification requirements; (3) certain design bases and construction specifications related to foundation type, material properties and compaction requirements were not followed; (4) there was a lack of clear direction and support between the contractors engineering office and construction site as well as within the contractors engineering office; and, (5) the FSAR contains inconsistent, incorrect and unsupported statements with respect to foundation type, soil properties and settlement values.

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DETAILS

Persons Contacted

During this investigation approximately 50 individuals were contacted. Twelve CPCo personnel which included corporate engineering and quality assurance personnel as well as site management, quality assurance and quality control personnel. Thirty-two Bechtel personnel were contacted. These largely consisted of site engineering, quality assurance, quality control, survey and labor supervisors and personnel in project engineering, quality assurance and Geotech at the Ann Arbor, Michigan office. Three individuals employed by U.S. Testing Company were also interviewed.

Introduction

On August 22, 1978, the licensee informed the NRC Resident Inspector at the Midland site that unusual settlement of the Diesel Generator Building (DGB) had been detected through the established Foundation Data Survey Program. While the licensee regarded the matter as serious it was not considered to be reportable under the provisions of 10 CFR 50.55(e) until further data was obtained.

Following the acquisition of additional data from further surveys and a core boring program which was initiated on August 25, 1978, the licensee concluded the matter was reportable and so telephonically notified Region III on September 7, 1978. The notification was followed up by a series of interim reports the first of which was submitted to Region III by letter dated September 29, 1978. Subsequent interim reports were transmitted by letters dated November 7, 1978 and January 5, 1979.

An inspection was conducted by Region III during the period October 24-27, 1978, to review the data then available; to observe the current condition of the structure; and, to review current activities. Information regarding the inspection is contained in NRC Inspection Report No. 50-329/78-12; 50-330/78-12.

On December 3-4, 1978, a meeting with NRR and Region III representatives was held at the Midland site to review the status of the problem, to discuss open items identified in the aforementioned inspection report and possible corrective actions.

Identification and Reporting of Diesel Generator Building Settlement

Surveys to establish a baseline elevation for the DGB were completed by Bechtel on May 9, 1978. As a result of these surveys, the Chief of Survey Parties noted what he considered to be unusual settlement. He

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indicated that from his experience he would have expected about 1/8" settlement. The July 22 data showed a differential settlement between various locations ranging from 1/4" to a maximum of 1 5/8". He promptly instructed his survey personnel to resurvey to determine whether the data was accurate. The resurvey confirmed the accuracy of the survey data. The Chief of Survey Parties reported the survey results to the Bechtel lead civil field engineer.

The lead civil field engineer said that in July 1978 the settlement of a pedestal in the DGB was noted from surveys and about a week later a 1" discrepancy was noted when scribes on the DGB were being moved up. He said that at that time he was uncertain as to whether actual settlement had occurred, the survey was in error or the apparent discrepancy was a construction error. He instructed the Chief of Survey Parties to check his survey results and to perform surveys more frequently than the 60-day intervals required by the survey program as a means of determining whether actual settlement had occurred and whether settlement continued.

The Field Project Engineer was also informed of the apparent settlement and concurred with the lead civil field engineer's actions. He said he had toured the building at that time and he saw no visible indications of stress which could be expected when unusual settlement occurs.

The lead civil field engineer said the DGB was monitored for about a month. He compared the amount of settlement being experienced with the settlement values reflected in Figure 2.5-48 of the FSAR and did not consider it reportable until those values were exceeded. When the settlement did exceed those values as indicated by survey data obtained on about August 18, 1978, he prepared a nonconformance report with the assistance of QC personnel.

The July 22 survey data was transmitted by the site to the Bechtel Project Engineering office in Ann Arbor by a routine transmittal memo dated July 26, 1978. The data was received at Ann Arbor, processed through document control on August 9, 1978, and was routinely routed to the Civil Engineering Group Supervisor. He stated he did not review the data but placed a route slip on it indicating those members of his group who should review it.

The engineer in the Civil Group, who had established the survey program and who was responsible for assuring it was being carried out, stated he reviewed the data and did not regard it as unusual. For that reason he did not bring the matter to anyone's attention but merely routed it to other personnel in the civil group. The engineer responsible for the DGB said he did not see the data before the settlement problem was identified by the field in a nonconformance report.

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With the issuance of the nonconformance report, No. 1482, on August 18, 1978, CPCo was also informed of this condition. On or about August 21, 1978, the NRC Resident Inspector was orally informed of the matter by CPCo. It was indicated at that time that although CPCo regarded the matter as serious, they did not consider it to be reportable under 10 CFR 50.55(e).

Construction on the DGB was placed on hold on August 23, 1978 and a test boring program was initiated on August 25, 1978. After preliminary evaluation of soil boring data, a Management Corrective Action Report (MCAR), No. 24, was issued by Bechtel on September 7, 1978. The MCAR stated that based on a preliminary evaluation of the data, the matter was reportable under 10 CFR 50.55(e), 1, iii and Region III was so notified by telephone on that date.

The telephone notification was subsequently followed up by a letter dated September 29, 1978, from CPCo enclosing a copy of MCAR 24 and Interim Report 1 prepared by Bechtel.

On the basis of the above, it is concluded that in this instance the licensee complied with the reporting requirements of 10 CFR 50.55(e).

Review of PSAR/FSAR Commitments on Compacted Fill Material

In a previous NRC Inspection Report, No. 329/78-12; 330/78-12, an apparent inconsistency was identified between FSAR Table 2.5-14 (Summary of Foundations Supporting Seismic Category I and II Structures), Table 2.5-9 (Minimum Compaction Criteria) and the site construction drawing C-45 (Class I Fill Material Areas) regarding the type of foundation material to be used for plant area fill. Table 2.5-14 identifies the supporting soil materials for the Auxiliary Building D, E, F, and G, Radwaste Building, Diesel Generator Building and Borated Water Storage Tanks to be "controlled compacted cohesive fill." Table 2.5-9 also indicates the soil type for "support of structures" to be clay. Contrary to these FSAR commitments, drawing C-45 indicates Zone 2 (random fill) material, defined in Table 2.5-10 as "any material free of humus, organic or other deleterious material," is to be used with "no restrictions on gradation." Boring samples substantiated that Zone 2 (random fill) material was in fact used.

During this investigation a review of documentation showed that the commitment to use cohesive soils was also made in response to PSAR question 5.1.11 and submitted in PSAR Amendment 6, dated December 12, 1969, which states, "Soils above Elevation 605 will be cohesive soils in an engineered backfill." This response also indicated that certain class I components such as, emergency diesel generators, borated water storage tanks and associated piping and electrical conduit would be founded on this material.

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CPCo quality assurance issued a nonconformance report QF-66, dated October 10, 1975, which stated that contrary to the PSAR statement (quoted above) Specification C-211 being implemented at the site required cohesionless (sand) material to be used within 3 feet of the walls of the plant area structures. The corrective action taken was for Bechtel to issue SAR Change Notice No. 0097 which stated, "The FSAR will clarify the use of cohesive and cohesionless soils for support of Class 1 structures." As noted above, the FSAR tables 2.5-14 and 2.5-9 once again stated that cohesive (clay) material was used for support of structures while the construction drawing continued to permit the use of random fill material.

This investigation included efforts to ascertain whether procedures were established and implemented for the preparation, control and review of the technical criteria set forth in the safety analysis report (SAR). This included the role of both Bechtel and CPCo in the review of the SAR. Bechtel had established control of the SAR in procedure MED 4.22 (Preparation and Control of Safety Analysis Report Revision 1, dated June 20, 1974). The SAR preparation and review flow chart requires the Engineering Group Supervisor (EGS) to review the originator's draft for technical accuracy and compliance with the standard format guide. Records indicated that Section 2.5.4 was originated by the Bechtel Geotech group on January 3, 1977. It was reviewed and approved for technical accuracy by an engineer in the civil project group on April 29, 1977. No technical inaccuracies were noted in the documentation. The Civil EGS advised that he did not personally review Section 2.5.4.

The designated engineer stated that in his review of the section he was primarily concerned with the Auxiliary Building not the Diesel Generator Building. He said the review of FSAR material was performed by members of a group set up for this purpose. Not all of the content was checked since they relied to some extent on the originator. The author of Section 2.5.4 said he was not aware that changes regarding fill material had occurred since the preparation of the PSAR. It was ascertained that Field Engineering did not review the FSAR prior to its submittal.

A partial review of the FSAR revealed that although Figure 2.5-48 indicates anticipated settlement of the Diesel Generator Building during the life of the plant to be on the order of 3 inches. Section 3.8.5.5 (Structural Acceptance Criteria) contains the following statement: "Settlements on shallow spread footings founded on compacted fills are estimated to be on the order of 1/2" or less."

Section 3.8 was prepared by Project Engineering. Geotech, who prepared Section 2.5, said they were unaware of the presence of the statement regarding 1/2" settlement in Section 3.8. The originator of Section 3.8

said that the above statement was taken from the Dames and Moore report submitted as part of the PSAR. Since the PSAR did not show any change in this regard, he assumed the statement was valid for inclusion in the FSAR. He said there was no other basis to support this statement.

CPCo also has an established procedure for the review and final approval of the SAR by procedure MFPM-13 dated June 23, 1976. Section 5.6 states that "CPCo shall approve all final draft sections of the FSAR prior to final printing." Discussion with the responsible licensee representatives for review of Section 2.5.4 indicated that a limited amount of cross-reference verification of technical content of the FSAR is performed by CPCo.

The CPCo Project Engineer in Jackson stated that the review of drawings and specifications was an owner's preference kind of thing. No attempt was made to review all drawings and specifications since they did not have the manpower or expertise for that type of review. The staff engineers of the various disciplines were asked to indicate the drawings and specifications they wanted to review.

Regarding the review of the FSAR, he said that he had prepared a memorandum to the staff engineers stating the procedure that would be followed in performing the review. An examination of this memo, dated July 28, 1976, showed that prime reviewers would perform a technical review, resolve comments made by other reviewers and perform the CPCo licensing review to assure compliance with required FSAR format and content.

As portions of the FSAR were received from Bechtel, CPCo sent comments to Bechtel. Following this review, meetings between Bechtel and CPCo were held to clearup any unresolved matters before each section was released for printing. A review of the files at CPCo relating to Section 2.5 and 3.8 showed that no comments were made concerning the above inconsistent and incorrect content. The apparent inconsistent and incorrect statements were not identified during the review of the FSAR prior to submittal and the review procedures did not provide any mechanism to identify apparent inconsistencies between sections of the FSAR.

Based on the above, measures did not assure that design basis included in design drawings and specifications were translated into the license application which resulted as an inconsistency between the design drawings and the FSAR. This is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion III as identified in Appendix A. (329/78-20-01; 330/78-20-01)

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Effect of Ground Water in Plant Area Fill

Final plant grade will be established at elevation 634. The normal ground water was assumed to be at ground surface prior to construction, approximately elevation 603. The surface of the water in the cooling water pond will be at a maximum of approximately elevation 627.

The Dames and Moore report on Foundation Investigation submitted with PSAR Amendment No. 1, dated February 3, 1969, stated that, "The effect of raising the water level to elevation 625 in the reservoirs will cause the normal ground water level in the general plant area to eventually rise to approximately elevation 625. However, a drainage system will be provided to maintain the ground water level in the plant fill at elevation 603."

A supplement to Dames and Moore report was submitted in PSAR Amendment No. 3, dated August 13, 1969, which changed the above planning of a drainage system to control the ground water. The supplement states, "The underdrainage system considered in the initial report has been eliminated; consequently it is assumed that the ground water level in the plant area will rise concurrently to approximately elevation 625."

A Bechtel soils consultant theorized in a December 4, 1978, site meeting that if soils beneath the diesel generator building had been compacted too dry of optimum, changes in moisture after placement could cause the soils to settle significantly. Therefore, the total effect of the ground water being permitted to saturate the plant fill material is undetermined at this time. An evaluation of this condition is under review by the licensee. This item is considered unresolved. (329/78-20-02; 330/78-20-02)

Review of Compaction Requirements for Plant Area Fill

During the investigation a review of the history of the compaction requirements was performed in order to determine whether the compaction of the plant fill was implemented in compliance with the commitments in the PSAR and in site construction specifications.

PSAR, Amendment 1, dated February 3, 1969, presented the Dames and Moore report "Foundation Investigation and Preliminary Exploration for Borrow Materials." The recommended minimum compaction criteria for support of critical structures is stated on page 15. It indicates 95% of maximum density for "cohesive soils" as determined by ASTM D-1557-66T and 100% for "granular soils."

PSAR, Amendment 3, dated August 13, 1969, included a supplement to the Dames and Moore report entitled, "Foundation Investigation and Preliminary

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Exploration for Borrow Materials." Page 16 of this report lists the recommended minimum compaction criteria for sand soils and cohesive soils. For the fill material for supporting structures the minimum compaction is 85% relative density for sand and 100% of maximum density for clay as determined by ASTM D-698 modified to require 20,000 ft-lbs. of compactive energy (equivalent to 95% of ASTM D-1557, Method D which provides 56,000 ft-lbs of compactive energy). Subsequent to the filing of Amendment 3, no amendments were made to the PSAR to indicate that the recommendations contained in the Dames and Moore report would not be followed or would be further modified.

Bechtel Specification C-210, Section 13.0 (Plant Area Backfill and Berm Backfill) indicates the compaction requirements for cohesive soil (13.7.1) to be "not less than 95% of maximum density as determined by ASTM D-1557, Method D" and for cohesionless soils (sand) (13.7.2) to be compacted "to not less than 80% relative density as determined by ASTM D-2049."

A comparison of the PSAR commitments to the specification requirements shows that the compaction commitments for cohesive soil (clay) were translated into the construction specification i.e. 95% of maximum density using ASTM D-1557, Method D (compactive energy of 56,000 ft-lbs). However, the compaction commitment in the PSAR for cohesionless soil (sand) was not the same as in the construction specification, i.e. 85% relative density versus the 80% relative density, translated in the construction specification.

The compaction requirements actually implemented were as follows:

a. Cohesive soil (clay): 95% of maximum density as determined by the "Bechtel Modified Test," a compactive energy of 20,000 ft-lbs was used instead of 56,000 ft-lbs of compactive energy as committed to in the PSAR and required by the construction specification C-210, Section 13.7.1.

b. Cohesionless soil (sand): 80% relative density as determined by ASTM D-2049 was used instead of 85% as committed to in the PSAR. However, this is consistent with construction specification C-210, Section 13.7.2.

The compaction requirements implemented during construction of the plant area fill between elevations 603 and 634 were, therefore, less than the commitments made in the PSAR for cohesive and cohesionless fill material. In additon, the cohesive (clay) material was also compacted to less than that required by the Bechtel specification. (Specification C-210, Section 13.7).

A review of Specification C-210 (specification controlling earthwork contract) beginning with Revision 2, dated July 27, 1973, which was issued for subcontract showed that it contained conflicting sections relating to the plant area backfill compaction requirements.

Section 13.7, Compaction Requirements, from revision 2 to the latest revision of specification C-210 consistently specified that the backfill in the plant area shall be compacted to 95% of maximum density as determined by ASTM 1557, Method D.

Section 13.4, Testing Plant Area Backfill, of specification C-210 contained the statement that tests would be performed as set forth in Section 12.4.5, Laboratory Maximum Density and Optimum Moisture Content, which in turn specified a lesser standard, 20,000 foot-pounds per cubic foot, which is commonly referred to as the Bechtel Modified Proctor Density Test (BMP). This is contrary to the requirements of Section 13.7. Section 12 of the specification applies to Dike and Railroad Embankment Construction.

It was also noted that this control inconsistency was reflected in the applicable Midland QA Inspection Criteria, SC-1.10, Item 2.3(d) Compaction which states "Backfill material for the specified zones has been compacted to the required density as determined by Bechtel Modified Proctor Method" and yet references C-210, Section 13.7 as the inspection criteria.

The inconsistency in control is further indicated in Specification C-208 which defined the testing contract requirements of subgrade materials, Section 9.1 (Testing) required compaction tests to be in accordance with ASTM D-1557 and only when directed was the BMP compaction criteria to be used. It was determined contrary to this U.S. Testing was only orally advised that the BMP was the standard to be applied to the tests they performed of plant area fill.

Through interviews and an examination of internal documents it was ascertained that because of these inconsistencies, the question of the applicable compaction standard for cohesive materials in the plant area was a recurring one.

The following is a summary of the documentation regarding the confusion of the compaction requirements for plant area fill:

1. Letter 7220-C-210-77 dated June 10, 1974, (subcontracts to Field Engineering) states "there has been some confusion as to the interpretation of the following item: 13.7 Compaction Requirement: all backfill in the plant area and berm shall be compacted to not less than 95% of maximum density as determined by modified Proctor method

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(ASTM 1557, Method D), with the exception that Zones 4, 4A, 5, 5A, and 6 Materials need no special compactive effort other than as described in Section 12.8.1 (emphasis included in specification). Quality Control questioned whether the exception stated above applies only to Zones 4, 4A, 5, 5A, and 6 or did construction have to abide by Section 12.8.1 for Zones 1 and 2. Section 12.8.1 clearly requires Zone 2 material to be placed with a 50 ton rubber tired roller with a minimum of four roller passes per lift. QC's interpretation was that the field needed "to obtain 95% of maximum density by the modified Proctor method (ASTM 1557, Method D), with no restrictions as to the method used to obtain these results."

2. Letter 7220-C-210-23, dated June 24, 1974, (field Engineering to construction) responded to Item 1 above. It states, "We have reviewed your June 10, 1974, IOM concerning compactive effort required on Zones 1 and 2 in the plant and berm backfill areas. We agree with your interpretation; i.e. a 95% of maximum density is the acceptance criteria, and the number of roller passes listed in Paragraph 12.8.1 does not apply to plant and berm backfill. We feel the specification is now clear and no FCR is required."

3. Letter BCBE-370, dated July 25, 1974, (field construction to project engineering) lists outstanding items requiring Project Engineering's action. This includes the question, "Is the 95% compaction required in the plant area to be 95% of Bechtel Modified or 95% of ASTM-1557, Method D."

4. Letter BEBC-456, dated August 1, 1974, (Project Engineering to Field Construction) states that Geotech is addressing the question posed in BCBE-370 (Item 3 above).

5. Memorandum from Geotech to Bechtel Field, dated September 18, 1974, responds to the question raised in BCBE-370 (Item 3 above). It states, "It is our opinion that all the compaction requirements that are needed for Zone II material in the plant fill is as stated in 13.7 with the exception that Zones 4, 4A, 5, 5A, and 6 materials need no special compactive effort other than described in Section 12.8.1." Geotech reiterates the specification requirement of 95% of ASTM 1557, Method D. This was confirmed with the Geotech personnel.

6. Telecon dated September 9, 1974, from R. Grote (Field Engineering) to Rixford (Project Engineering) states, "I made an analogy (an exaggeration admittedly but applicable) that if the compaction could be acheived with a herd of mules walking over the fill it would be acceptable as long as it got the required 95% compaction. Rixford agreed."

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7. Telecon Consumers to Bechtel Engineering dated September 19, 1974, expressed Consumers Power Company concern about what they felt was a lack of control of compaction in the plant area fill. CPCo addressed the added responsibility this lack of control places on the inspector. Bechtel told CPCo that it "was the inspector's job to make sure we got proper placement, compaction, etc."

8. Telecon dated September 18, 1974, by Bechtel Field Engineering to Bechtel Project Engineering discussed compaction requirements for specification C-210. It stated, "Compaction acceptance is based on meeting an 'end product' requirement, i.e. 95% of maximum density only. No method of achieving this 'end product' is specified or is required. Rixford fully agrees with the above."

9. Telecon dated October 7, 1977, from Bechtel Field Engineering to Bechtel Project Engineering states, "QA has asked for clarification of subject specification (C-210), Section 13 for plant area and berm backfill. Section 13.4 for testing of materials refers to Section 12.4 and therefore, requires the Bechtel Modified Proctor Density Test for Compaction of cohesive backfill. Section 13.7 for compaction of the same materials refers to testing in accordance with ASTM D-1557, Method D Proctor, without specific reference to Bechtel Modification." Bechtel Engineering responded to this question as follows: "This apparent conflict is clarified by Specification C-208, Section 9.1.a, direction to the testing subcontractor, which calls for ASTM D 1557 test for these materials and also allows Bechtel Field (the contractor) to call for the Bechtel Modification of that test. Either method is therefore acceptable to project engineering."

10. Telecon dated October 7, 1977, from Bechtel QA to Bechtel Project Engineering questions, "Is the intent of Paragraph 13.7 of Specification C-210 that the test be run to the 'Bechtel' modified proctor test as is indicated in the FSAR Paragraph 2.5.4.5.3 and in response to NCR 88." Engineering's response was "yes."

Various interviews were held with Bechtel construction field engineers, U. S. Testing personnel and Bechtel Ann Arbor Geotech and Project Engineering personnel to ascertain their understanding of the compaction requirements. Four predominant versions of the understood compaction requirements were stated by various individuals within the Bechtel organization. They are as follows:

a. Specification C-210 required the contractor to perform compaction to the ASTM 1557, Method D, however, the testing requirements would be performed to the less stringent "Bechtel Modified Test Method."

b. The required compaction and testing was always understood to be based on the "Bechtel Modified Test Method."

c. The required compaction and testing was always understood to be based on the standard ASTM 1557, Method D requirements.

d. A tacit understanding had been established to use the Bechtel Modified Method, but to exceed this requirement by enough to also satisfy the requirement of ASTM 1557, Method D.

It is apparent from the above four distinctly different understandings of the compaction requirements, that the apparent confusion was not resolved. A member of the Bechtel QA staff in Ann Arbor who had previously been a QA Engineer at the Midland site said that QA audits of QC inspection criteria did not identify the above inconsistencies.

This failure to accomplish activities affecting the quality of the plant area fill in accordance with procedures is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion V as identified in Appendix A. (329/78-20-03; 330/78-20-03)

Review of Moisture Control Requirements for Plant Area Fill

Specification C-210, Section 13.6 (Moisture Control) requires moisture control of the plant area fill material to conform to Section 12.6. The moisture control requirement in Section 12.6.1 states, in part, "Zone 1, 1A and 2 material which require moisture control, shall be moisture conditioned in the borrow areas," and that "water content during compaction shall not be more than two percentage points below optimum moisture content and shall not be more than two percentage points above optimum moisture content."

Contrary to the above, Bechtel QA identified in SD-40 dated July 22, 1977, that "the field does not take moisture control tests prior to and during placement of the backfill, but rather rely on the moisture results taken from the in-place soil density tests."

The following is a summary of the documentation that followed the identification of the above deviation from specification C-210.

1. Letter BCBE-1533R (dated August 15, 1977) field to project engineering states, "it was found that densities meeting specification requirements could be attained, irrespective of the use of moisture tests," and that "moisture tests were not used to control backfill moisture." The field requested "that project engineering agree to acceptance of backfill materials installed in the past, along with the records thereof, irrespective of the use of the moisture tests."

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2. Letter BEBC-1859 (dated September 30, 1977) responsed to the fields request in BCBE-1533R. Engineering states, "It should be noted that it is ideal to control the moisture of backfill material at the borrow areas by conditioning" and that "the procedure used to take moisture content tests after compaction would not have direct impact on the quality of work." Engineering then agreed with the field request that "backfill placed prior to modification of testing methods to be accepted as is."

3. Telecon October 10, 1977, (Bechtel QA Site to Bechtel Engineering, Ann Arbor) indicated that, "there are no moisture requirements at the time of density testing, only density requirement. The moisture requirement is prior to compaction."

4. Telecon October 13, 1977, (Bechtel Engineering to Bechtel QA Site) changed what was indicated in the telecon on October 10, 1977, (Item 3 above). Engineering then stated, "The moisture requirement (± 2% of optimum) is mandatory and must be implemented at the time of placement and testing." This is contrary to what was stated on October 10, 1977.

5. Letter BCBE-1669R (dated November 18, 1977) once again is a field request to Bechtel engineering requesting, "written clarification of the 2% tolerance on backfill moisture content during compaction."

6. Letter BEBC-1998 (dated December 15, 1977) provides engineering's response to BCBE-1669R requesting clarification of the moisture requirement. Engineering stated, "The moisture content of the soil should be within 2% of optimum during placement and compaction. However, this property of the soil is not necessarily a measure of its adequacy after compaction."

7. Letter 0-1631 (dated December 21, 1977) closes QA Action Request SD-40 (dated July 22, 1977) which first identified the moisture control deficiency.

8. Telecon (dated April 7, 1978) from Field Engineering and Quality Control to Project Engineering once again requests them "to clarify BEBC-1998" (December 15, 1977), Item 6 above. Two situations were presented to engineering as follows: (a) The moisture sample taken from the borrow area at the start of the shift is acceptable, however, the moisture test taken in conjunction with the density test fails while compaction was attained; and (b) The moisture sample taken from the borrow area at the start of the shift fails and the material is conditioned to meet moisture content required.

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however, the moisture test later fails at the time the passing compaction test is taken. Engineering responded, "the above two situations are acceptable as is." This response is contrary to the direction previously given in telecon dated October 13, 1977 (see Item 4 above).

9. Letter GLR-249 (April 16, 1978) is a Bechtel Site QA request to Project Engineering to resolve the moisture content situation and "to provide clear direction for the control of moisture content." QA recommends "one possible solution would be to delete the requirement to control the moisture content and rely on the compaction requirement only for completion of soils work."

10. Letter BEBC-2286 (June 1, 1978) was Project Engineering's response to GLR-249 (Item 9 above). It states, "moisture content is not necessarily a measure of a soil's adequacy to act as a foundation or backfill material," and that "soil with the specified density following compaction would not be rejected on the basis that its moisture content was not controlled in the borrow area."

Based on the reviews of documentation, moisture control had not been implemented as the specification required. In addition, the matter had not been resolved for the period of time from the issuance of QA Action Request SD-40 on July 22, 1977, until June, 1978, during which time soils safety-related work continued.

According to the licensee, although moisture control was not strictly followed in accordance with specification requirements, final density tests were used as a basis for acceptance of soil placement.

As pointed out to the licensee, moisture control is a required control point to assure attainment of percent compaction specified in specification C-210.

This failure to assure that conditions adverse to quality are promptly identified and corrected to preclude repetition is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion XVI as identified in Appendix A. (329/78-20-04; 330/78-20-04)

Review of Subgrade Preparation for Plant Area Fill

The Dames and Moore report on foundation investigation submitted with PSAR Amendment 3, dated August 13, 1969, states, "the clay soils are susceptible to loss of strength due to frost action, disturbance and/or the presence of water. If the construction schedule requires that foundation excavation be left open during the winter, it is recommended that excavation operations be performed such that at least

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3 1/2 feet of natural soil or similar cover remain in place over the final subgrade or overlying the mud mat. This layer of protective material is necessary to prevent the softening and disturbance of subgrade soils due to frost action." The license indicated that instructions for winter protection of foundation excavations were transmitted by sketch C-271.

The Dames and Moore report also stated, "If filling and backfilling operations are discontinued during periods of cold weather, it is recommended that all frozen soils be removed or recompacted prior to the resumption of operations."

After review of the applicable sections of specification C-210 (i.e. Sections 12.5.1, 12.10, 10.1 and 11) the inspector has determined that the Bechtel specification did not provide specific instructions for removal or recompaction of frozen/thawed soils upon resumption of work after the winter period to preclude the effects of frost action on the compacted subgrade materials.

This failure to assure that regulatory commitments as specified in the license application are translated into specification, drawings or instructions is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion III. (329/78-20-05; 330/78-20-05)

Review of Nonconformance Reports Identified for Plant Area Fill

The following examples of nonconformance and audit reports regarding the plant area fill were reviewed relative to the cause of the nonconformance and the engineering evaluation and corrective action:

	No.	Nonconforming Condition	Engineering Evaluation
(1)	CPCo QF-29 (10/14/74)	Failure to perform inspection and testing of structural backfill (sand) delivered to jobsite 29 of 30 day in Aug. and Sept. 74. Bechtel QC not informed of deliveries.	"Use as is" based on samples taken from stock pile.
(2)	CPCo QF-52 (8/7/75)	Moisture control out of tolerance of specification C-210, Section 13.6.	Accepted in place material with low moisture.
(3)	CPCo QF-68 (10/17/75)	Compaction test had been calculated using incorrect maximum lab density. Test recorded as passing was actually a failure.	Failing tests were cleared by subsequent passing tests.

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(4)	Bechtel NCR 421 (5/5/76)	Material placed did not meet moisture requirements.	Engineering stated that this ramp area is temporary and would be removed. This was removed based on note added to NCR 421 on 3/18/77.

Note: In the vicinity of this ramp a Geotech engineer determined the material to be "soft" and directed a test pit to be dug for investigation in September 1978 after the D. G. Bldg. settlement was identified.

(5)	CPCo QF-120 (9/21/76)	Lift thickness exceeded maximum of 4" in areas not accessible to roller equipment. Insufficient monitoring of placing crews. Laborer foreman not familiar with requirements.	Material was removed and recompacted.
(6)	CPCo QF-130 (10/18/76)	Inspection plan C-210-4, Rev. 0, permits 12" lift thickness for areas inaccessible to rollers caused by "misinterpretation of specification requirements. Spec. permitted 4" lift thickness.	Corrected inspection plan requirements.
(7)	CPCo QF-147 (2/2/77)	Failure to perform inspection and testing of structural backfill (sand) on 12/1/76, 12/14/76 and 1/11/77 (same as QF-29 dated 10/14/74) material lacked gradation test requirements.	Engineering accepted the material in place "use as is."
(8)	CPCo QF-172 (7/8/77)	Moisture control out-of-tolerance and compaction criteria not met.	Engineering accepted materials.
(9)	CPCo QF-174 (7/15/77)	Gradation requirements for Zone 1 materials not met.	Engineering accepted materials.

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(10)	CPCo QF-199 (11/4/77)	Moisture content not met; compaction requirements for cohesive and cohesionless soil not met. Materials had been accepted using incorrect testing data.	Issued Bechtel NCR's No. 1004 and 1005; No. 1004 still open; No. 1005 "accepted as is."
(11)	CPC. QF-203 (11/22/77)	Gradation requirement not met yet materials accepted.	Engineering "accepted as is."
(12)	CPCo Audit F-77-21 (5/77 & 6/77)	Moisture content requirements not met; test frequency not met.	Bechtel QC to inform foreman directing soils work of requirements.
(13)	CPCo Audit F-77-32 (10/3/77)	Compaction requirement for both cohesive and cohesionless materials not met; moisture requirements not met; tests had been accepted yet failed requirements.	Project Engineering to justify the materials these failing tests represent. NCR QF-195 still open.
(14)	Bechtel NCR 686 (2/1/77)	Same deficiency as NCR 698.	Accepted, "use as is."
(15)	Bechtel NCR 698 (2/9/77)	Structural backfill (sand) was delivered without acceptance tests on Oct. 26, 29, Nov. 12, 1976 and Jan. 11, 12, 1977.	Engineering accepted "use as is."
(16)	Bechtel NCR 1005 (10/26/77)	Moisture content requirements not met.	"Accepted as is" based on density test only.

Based on a review of the above nonconformance and audit reports corrective action regarding nonconformances related to plant fill was insufficient or inadequate as evidenced by the repeated deviations from specification requirements.

This failure to assure that the cause of conditions adverse to quality are identified and that adequate corrective action be taken to preclude

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repetition is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion XVI as identified in Appendix A. (329/78-20-06; 330/78-20-06)

Review of Calculations of Settlement for Plant Area

A review of the settlement calculations for the structures in the plant area was performed during a visit to the Bechtel, Ann Arbor Engineering office. Specific attention was given to structures founded on plant area "compacted fill." The following specific findings were made:

1. FSAR, Section 3.8.4.1.2 (Diesel Generator Building) indicates the foundation of the DGB to be continuous footings with independent pedestals for each of the Diesel Generators. Contrary to the structural arrangement described in the FSAR, the settlement calculations for the DGB were performed on the premise that the building and equipment loads would be uniformly distributed to the foundation material by a 154' x 70' foundation mat. The settlement calculations were performed between August 1976 and October 1976 by Bechtel Geotech Division.

   Discussion with the Geotech Engineer who performed the settlement calculations indicated that he had not been informed of the design change of the foundation until late August 1978 when the excessive settlements of the DGB and pedestal became apparent.

2. FSAR Figure 2.5-47 indicates the load intensity for the DGB to be 4 KSF (4000 lbs. per sq. ft.); however, the settlement calculations reviewed indicate a uniform load of 3 KSF (3000 PSF). This appears to be a conflict between the FSAR and settlement calculations.

3. The settlement calculations for the borated water storage tanks were performed assuming a 54' diameter circular foundation mat with an assumed uniform load of 2500 PSF. Instead, the tanks are supported on a continuous circular spread footing and compacted structural backfill as detailed on the construction drawings. The Geotech engineer was also not made aware of the revised foundation detail.

FSAR Figure 2.5-48 (Estimated Ultimate Settlements) indicates the anticipated ultimate settlement for Unit 1 and 2 plant structures. The values indicated for the Diesel Generator Building and Borated Water Storage Tanks are the values developed assuming uniformly distributed loads founded on mat foundations as was indicated in the settlement calculations reviewed even though the actual design and construction utilizes spread footings. The FSAR does not indicate the foundation

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type assumed in the settlement calculations and therefore the values in the FSAR figure appear to represent the settlements estimated for the as-constructed spread footing foundation.

4. During a review of the settlement calculations, it was observed that the compression index (C_c) for the compacted fill between elevations 603 and 634 in the plant area was assumed to be 0.001 (estimate based on experience). FSAR Section 2.5.4.10.3.3 (Soil Parameters) indicates the soil compressibility parameters used in the settlement calculation are presented in Table 2.5-16. This table indicates that for the plant fill elevations 603 to 634, the compression index used was 0.003. Contrary to the FSAR value, 0.001 was used in the settlement calculations reviewed. This value is directly used to determine the estimated ultimate settlement of structure supported by plant fill material.

Based on the above examples, measures did not assure that specific design bases, included in design documents, were translated into the license application resulting in inconsistencies between design documents and the FSAR. This is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion III as identified in Appendix A. (329/78-20-07; 330/78-20-07)

Discussions with CPCo personnel responsible for the technical review and format indicated that a comparison between the design documents and FSAR had not been performed. Likewise, Bechtel personnel indicated that a detailed comparison for the technical accuracy of design documents to the FSAR statements had not been performed; instead reliance was placed on the originator's input.

According to the Civil Engineering Group Supervisor, a mat foundation was considered for the DGB only during the conceptual stage. All drawings generated show a spread footing foundation. The supervisor stated that the Geotech engineer apparently based his calculations on the conceptual stage information. He went on to say that an individual in Geotech was responsible for checking the calculations and the first thing he is supposed to do is determine that the basis for the calculations is correct. He said that apparently this was not done.

Review of Settlement of Administration Building Footings

During the investigation, it was disclosed that the Administration Building at the Midland Site had experienced excessive settlement of the foundation footings. Although the Administration Building is a non-safety-related structure, it is supported by plant area fill material compacted and tested to the same requirements as material

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supporting safety-related structures and therefore pertinent to the current settlements being experienced by the Diesel Generator Building. The following are the events relating to the settlement of the Administration Building footings.

During the end of August, 1977, a Bechtel field engineer observed a gap between a slab and the grade beam of the Administration Building. On August 23, 1977, a survey was taken of the settlement. The results indicated that the footings supporting the grade beam had experienced settlement ranging from 1.32" (north side) to 3.48" (south side). This settlement took place between July 1977, and the end of August 1977. The footings were supported by "random fill" (Zone 2 material).

The concrete footings on the order of 7' 6" by 7' 6" by 1' 9" deep were removed along with the grade beam. The random fill material was also removed. According to U. S. Testing personnel, it was observed during excavation of the fill material that there were voids of 1/4" to 2" or 3" within the fill and these were associated with large lumps of unbroken clay measuring up to 3 feet in diameter.

The Civil Field Engineer assigned responsibility for plant fill work said that, although he was no soils expert, it was his opinion that the problem was caused by the presence of pockets of water due to drainage from the steam tunnel. The Lead Civil Field Engineer also indicated a drainage problem caused the Administration Building footings settlement. They were, however, unclear as to how the water pockets were formed, i.e. whether they were formed as the fill was being placed or how they could develop after the fill was compacted.

The excavated fill was replaced with concrete and the design of individual footings was changed to a continuous spread footing design for support of the building.

As a result of the settlement of the Administration Building footings a total of seven borings were taken of which five were in the Administration Building area, one in the Evaporator Building area and one south of the Diesel Generator Building. In the Administration Building area the foundation material was found to be "soft" with "spongy characteristics." The two other borings did not indicate unusual material properties in that the blow counts were reasonable. These borings were taken in September 1977.

The licensee indicated that reports from Bechtel concluded that the primary cause of the settlement in the Administration Building area was insufficient compaction of the fill. Bechtel also concluded that "deviations from specific compaction requirements was the result of

SB100406

repeated erroneous selection of compaction standard," i.e. the incorrect optimum moisture-density curve was used for the soil material being compacted. In effect, the moisture-density curve was erroneously assumed to represent the soil being used and therefore soil was compacted to less than maximum density.

Bechtel personnel, including the Civil Group Supervisor, Project Engineering, the Field Project Engineer, the Lead Civil Field Engineer, and the Chief Civil QC Inspector, all stated that the Administration Building footing settlement was regarded as a localized problem. The question as to the adequacy of the entire plant area fill did not arise even though the following similarities existed between the Administration Building area and rest of plant fill; (a) same soil specification applied, (2) same material (random fill) was used and (3) same control procedures and selection of laboratory compaction standards was used. The Diesel Generator Building area required even more fill than other safety-related structures since its base is located at a higher elevation than the others.

Review of Interface Between Diesel Generator Building Foundation and Electrical Duct Banks

A review of the design interface between the electrical and civil sections of the Bechtel organization was performed to determine whether the design accounted for the interaction of the electrical duct banks and spread footings on the differential settlement of the northside of the DGB. It was determined that the electrical and civil groups made accommodations in the design to permit settlement of the spread footings around the electrical duct banks by including a styrofoam "bond breaker" around the duct banks. Both electrical and civil groups reviewed and approved electrical Drawing E-502 which includes the appropriate detail.

However, Bechtel Drawing C-45 which identifies Class I fill material areas permits the use of Zone 2 (random fill) which includes "any material free of humus, organic or other deleterious material." This, in effect, does not preclude the use of concrete around the electrical duct banks beneath the spread footings. Due to the difficulty in compacting, Bechtel elected to replace the soil material with concrete. Letter from project engineering to field construction, dated December 27, 1974, states, "lean concrete backfill is considered acceptable for replacement of Zone 1 and 2." The instruction is considered inadequate, in that, the concrete placed around the duct banks restricted the settlement on the north side of the DGB where electrical duct banks enter through the footing. This contributed to the excessive differential settlement in the North-South direction across the building.

SB100407

This failure to prescribe adequate instructions for activities affecting the quality of safety-related structures is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion V as identified in Appendix A. (329/78-20-07; 330/78-20-07)

Review of Soils Placement and Inspection Activities for Plant Area Fill

A subcontractor, Canonie Construction Company, South Haven, Michigan, performed the major portion of the earthwork at the Midland site. Although Canonie was primarily engaged to construct the cooling pond dike, they also performed most of the plant area fill work. Bechtel, however, also performed plant fill work prior to and after Canonie left the site in mid-October 1977. The last Canonie daily QA/QC fill placement report is dated October 16, 1977.

According to Canonie QA/QC records the first fill in the DGB area was placed in late October and early November 1975. No further fill was placed in the area until July 1976. After that time, fill work in the area was interspersed with soils work in other areas.

While it would be difficult to identify the soil work performed by Bechtel versus that performed by Canonie, records reviewed indicated that most of the Bechtel work was done during the latter part of 1976 and continued through 1977 and 1978. Although most of the Bechtel work related to placing sand around piping and ducts after they were laid and placing sand adjacent to walls, some motorized work compacting clay fill was also done by Bechtel.

Regarding the plant fill work performed by Bechtel, CPCo Audit Report No. F-77-21 dated June 10, 1977, identified a number of deficiencies which recommended the corrective action to be as follows: (1) "the foremen directing the soils work should be instructed as to the required moisture content limits" and (2) "the foreman directing the soils work should be instructed as to the correct test frequency requirements." Interviews with two such Bechtel foremen confirmed the fact that they were directing soil operations. They indicated they received their instruction regarding lift thicknesses and testing requirements verbally from field engineering through a general foreman.

Bechtel design criteria C-501 (Page 8) and PSAR Amendment No. 3 (Dames and Moore Report, Page 16) states that, "Filling operations should be performed under the continuous technical supervision of a qualified soils engineer who would perform in-place density tests in the compacted fill to verify that all materials are placed and compacted in accordance with the recommended criteria."

SB100408

Based on the above, the soils activities were not accomplished under the continuous technical supervision in accordance with Bechtel design criteria. This failure to provide a qualified soils engineer to perform technical supervision for activities affecting quality as required by specifications and the PSAR is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion V. (329/78-20-08; 330/78-20-08)

The foremen indicated that Bechtel Field Engineers and QC inspectors were rarely in the areas where soils activities were going on. The foremen decided when and where tests were taken. The locations of tests were approximated by pacing or visually estimating distances from columns or building walls. Lift thicknesses were determined visually, usually without the use of grade stakes.

Soils testing services are provided by U. S. Testing Company based on the requirements of Specification C-208. The two U. S. Testing technicians who said they performed an estimated 90% of the soil testing during the years 1975-77 indicated that they rarely saw a Bechtel field engineer or QC inspector in the areas where plant fill activities were going on. One technician said he could recall only one occasion when a QC inspector was present when he took an in-place density test. The other technician estimated he had contact with a QC inspector in the field about once a month. A Bechtel QC inspector, however, was assigned to the testing laboratory on a full-time basis.

U.S. Testing personnel stated that erroneous test locations were a chronic problem regarding the Bechtel placed fill. The location of a test was usually given at the time of the test by a labor foreman or a laborer if the foreman wasn't there. Sometimes, however, a foreman was not familiar with the area in which he was working and the location was not provided until sometime after the test. It became necessary on occasion to withhold test results as a means of getting the test location. Test elevations were approximated sequentially.

The technicians further advised that rarely did a Bechtel QC inspector request a test. Normally, labor foremen requested them. On occasion a technician passing through an area would be asked by a foreman if a test should be taken. Upon completion of in-place tests, the results were usually communicated to the foreman directing the work. Test failures were also reported by telephone to QC or Field Engineering. A weekly report of test was provided to Bechtel QC and Field Engineering who reviewed any test failures and resolved them.

U. S. Testing personnel advised that they were requested to take tests of clay fill while it was raining and in order to do so, plastic was held over them to protect their equipment while the test was made. Even though it was raining, the fill placement work was not stopped on

SB100409

some occasions. A Bechtel foreman confirmed that density tests were on occasion taken while it was raining. While this is not contrary to the specification instructions, it is contrary to standard practice.

U. S. Testing personnel indicated that when moisture was added, the procedure did not include blending the material which resulted in mushy seams. It is commonly accepted good parctice to disc the fill after spraying it with water to add needed moisture. A Bechtel foreman stated that if moisture was needed they compacted 6" then sprinkled it and then added another 6".

The field engineer who was assigned responsibility for plant fill work stated he did not spend full time on soils work since he also had responsibility for two structures, the steam tunnel and general yard work. He said he tried to get out to the area where fill work was being done once a day. Some times he did and sometimes he did not. He indicated it was his impression that the QC Inspector responsible for the soils work on the day shift visited those work areas once or twice a week. He confirmed that only oral instructions were furnished to the foremen whom he felt were conscientious. The main problem he experienced with the foreman was maintaining proper lift thickness.

The QC inspector who was primarily responsible for the plant fill work is no longer employed by Bechtel. The QC inspector who was responsible for the plant fill work on the night shift stated that he tried to devote about one hour a night to the plant fill activities. He indicated that during 1976-1977 there was much emphasis being placed on cadwelding and rebar work and it was necessary to spend the majority of his time on those activities. He maintained that he did have fairly frequent contacts with the technicians who performed the in-place density tests, particularly when test failures occurred. He indicated it was his impression that the labor foremen were directing fill placement adequately.

Review of Inspection Procedures

The following procedures which are relative to backfill operations at Midland Units 1 and 2 between August 1974 through December 1977 were reviewed.

a. Bechtel Master Project QC Instruction for Compacted Backfill - C-1.02 was issued for construction October 18, 1976, and it is presently the current instruction which is used by Bechtel QC (when Bechtel is the inspection agency, providing first level inspections during backfill operations). Further, this instruction was used by Bechtel QC when monitoring the activities of

SB100410

other inspection agencies (Canonie) when such agencies were performing the first level inspections of backfill operations during the time periods of October 18, 1976, until June 28, 1977.

b. Bechtel Quality Control Master Inspection plan for Plant Foundation Excavation and Cooling Pond Dikes (Plant Area Backfill and Berm Backfill) - Procedure No. C-210-4 was the instruction utilized by Bechtel QC when monitoring the activities of other inspection agencies that were providing the first level inspections of backfill operations (this instruction was utilized during time periods prior to October 18, 1976).

c. Bechtel Quality Control Master Inspection Plan for Structural Backfill Placement - No. C-211-1 is an instruction utilized by Bechtel QC when performing first level inspection of backfill activities prior to October 18, 1976.

Bechtel Procedure C-1.02, listed above, was written as a replacement for both Procedures C-210-4 and C-211-1. The inspection activities which were delineated in Procedures C-210-4 and C-211-1 were compared with those described in Procedure C-1.02. The following are some of those activities which were compared:

	Activities/Task Description	Inspection Code for-- C-210-4	C-211-1	C-1.02
Backfill Material				
(*) 1.	Free of brush, roots, sod, snow, ice or frozen soil.		I	S(V)
(*) 2.	Material moisture conditioned to required moisture content.	S	I	S(V)
3.	Structural backfill used with 3" of plant structure, shall be cohesionless and free-draining.		I	
(*) 4.	Material not placed upon frozen surface.		I	S(V)
5.	Foundation approved prior to backfill placement.	H	H	R/H
6.	Prior to start of work, area free of debris, trash and unsuitable material.			I(V)

SB100411

Compaction Requirements

	1.	Cohesionless material compacted not less than 80% relative density.	S	S	S(V)
(*)	2.	Cohesive material compacted to not less than 95% max. density.	W	S	S(V)
(*)	3.	Zones 1, 1A, 2 and 3 material in uncompacted lifts not exceeding 12"; areas not accessible to roller equipment the material placed in uncompacted lifts no exceeding 4".	W	I	S(V)

Material Testing

1.	Verify testing and test results are as per engineering requirements.				
	a.	Materials	S	S	S(V)
	b.	Moisture	S	S	S(V)
	c.	Compaction	S	S	S(V)
2.	Review lab test report verifying:				
	a.	Proper test method.	R	R	R
	b.	Proper test frequency.	R	R	R
	c.	Technical adequacy.	R	R	R

I - Inspection point
H - Hold point
W - Witness point
S - Surveillance (V) - visual
R - Review records

Those activities identified by an (*) asterisk indicate inspection requirements which have been relaxed from the original procedural requirements.

It is considered that the relaxation of actions relating to the confirmation that soils placement activities were conducted according to

SB:00412

specifications contributed to inadequate compaction of foundation and fill material and the increase incidence of deviations from specifications regarding lift thickness, moisture control and frequency of testing.

This failure to provide adequate inspection of activities affecting quality is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion X. (392/78-20-09; 330/78-20-09)

Exit Meetings

Members of the NRC staff met with Consumers Power Company and Bechtel Corporation at the NRC Region III office on February 23, 1979 to present the scope, purpose, and preliminary findings of the investigation. That meeting was subsequently followed by a second meeting held on March 5, 1979, during which Consumers Power Company responded to the preliminary investigation findings. The documents used during these meetings were transmitted to Consumers Power Company by NRC letter dated March 15, 1979.

SB:00413

1. Steel casing is ignored for permanent load carrying.

2. Concrete is now Q

3. Till is the supporting material.

4. Design pressure on till is twice that under the ~~conditions~~ PSAR commitment. This is offset by following advantages:

   a. Proof load test to 1.5 times working load greatly exceeds the 1.12 (perhaps more 1.20) times working load in a seismic event. Analysis shows bearing ~~pressure~~ has adequate factor of safety exceeding 2.5.

   b. Procedure calls for regacking piles to assure proper load sharing, as with temporary caissons.

We feel that solution B(1) above represents sound engineering. However, if NRC requirements dictate solution B(2) involves ~~up~~ing category I to category I

(7)

~~Enclosed~~ The consultants request the answers to the following:

1. Static deflection configuration of auxiliary wings under full cantilever + dead wt, cracked and uncracked.

2. Seismic analysis of auxiliary building with deflection configuration, acceleration at each floor level, edge forces due to rocking, horizontal forces to be resisted and locations.

3. Analysis of auxiliary wing stresses and deflections with 1500K and 3000K ea at E and W ends.

~~4. Is available Flood History analysis~~

M.T. Davisson
C.H. Gould
A.J. Hendron, Jr
R. Loughney
R.B. Peck

SB100355

3. Diesel Generator Building

Removal of Surcharge. The longer the full surcharge can remain on the area, the more reliable will be the prediction of the clay-seated portion of the long-term settlement. For this reason, we would prefer to maintain constant conditions as long as ~~possible~~ practicable. We realize, however, that practical considerations do not permit an indefinite delay in surcharge removal. If a suitable means for making reliable temperature corrections to the readings of the piezo settlement gages, and be investigated we believe that removal could, if necessary, begin ~~by~~ in August. ¶ To this end, we suggest the fabrication and use of possibly four dummy gages, each consisting of a pair of rods in a ~~tube~~ casing of the same type as that in the actual gages. One rod of each pair would be of identical size and material to that in the ~~each~~ actual gages, and the other of invar of the same dimensions. Each ~~The~~ assembly would terminate in a block of concrete placed on top of the fill ~~adjacent to~~ inside the building, adjacent to an active gage. The locations would be selected to

(over)

SB100356

provide a range in length of dummy gages corresponding to the maximum range of the active gages in the building.

In addition, ~~no doubt~~ all readings should be interpreted carefully and corrected for thermal effects. To the extent possible, readings should be made under constant conditions, as in the early morning.

Loose sands beneath the building will not compromise the static bearing capacity or lead to settlement under static loads applied after surcharge removal. Some settlement must be expected due to vibration of the ~~gas~~ diesel engines; this should preferably be induced by operating the machines before general dewatering of the area, whereupon the settlement will be correspondingly reduced during use of the machines in the future. Earthquake-induced settlements are discussed under Liquefaction Potential.

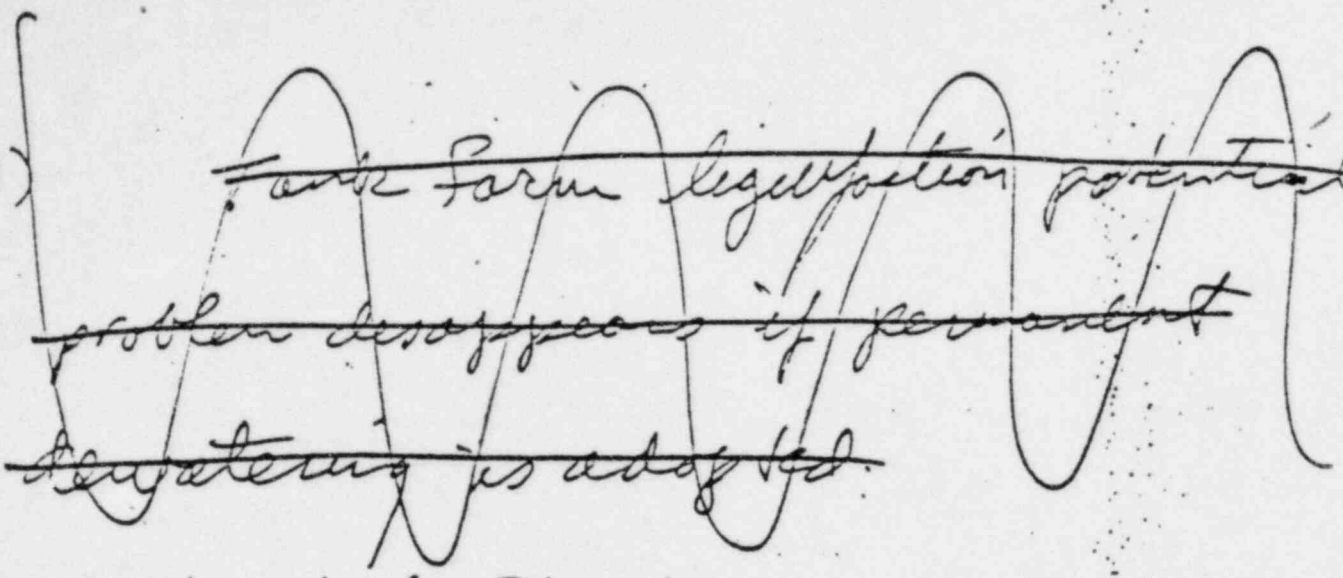
SR100957

5) Need for Removal of Soft Sands Under Diesel Generator Structure

If general, permanent lowering is adopted, there is no need to excavate the loose sands under the diesel generator building. Their static stiffness and bearing capacity is fully adequate for the static and dynamic bearing pressures. The connections of pipes and the building equipment within the building must be capable of taking the differential settlements arising from the fact that the sands on the north side of the Diesel generator building will undergo more seismic shakedown settlement than the south

SR100958

side of the structure supported on colonial backfill is not likely to settle significantly under the seismic loading.



(-1) ~~Table Form liquefaction potential problem description if permanent dewatering is adopted~~

7. Service Water Structure

(-2) Service water structure underpinning with driven piles and a cortel is a positive solution. Even if liquifaction occurs, the piles maintain their buckeling load as a mereimum. The analysis of the structure should treat ~~the~~ piles in the normal manner; if the buckling load is ~~the~~ lower bound, the analysis should treat the piles as applying an upward load equal to the buckling load to the structure. The horizontal forces due earthquake will be taken on the base of the

SR10/13/80

main portion of the structure.

SR:00361

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

bcc: A. Almuti
S. Afifi
~~T. Johnson~~
W. Jones
J.F. Newgen
L. Sokol
K. Wiedner
Com Log

TELECOPY
CONFIDENTIAL

BLC- 7675

Consumers Power Company
3500 E. Miller Road
Post Office Box 1963
Midland, Michigan 48640

June 5, 1979

Attention: Mr. T.C.Cooke
Project Superintendent

Subject: Consumers Power Company
Midland Plant - Job 7220
Additional Consultants
File: 0270, C-2645, C-88,
C-91, C-94, C-95
Reference: BLC-7545 dated 5/3/79

Gentlemen:

This letter is to inform you of our proposed course of action to dewater, underpin, pile drive, and pressure grout in and around areas where insufficiently compacted backfill material is placed. The information in this letter is consistent with the outcome of the meeting held in Ann Arbor on May 11, 1979.

Dewatering (7220-C-88) - The specification for dewatering the plant area where excavation is to take place is presently being coordinated within Bechtel. Upon completion, it will be issued for bids. We seek your direction on this subcontract to be negotiated sole source with Loughney Dewatering Inc. of 2280 Grand Avenue, Baldwin, New York, based on short lead time available and satisfactory experience on previous work. The estimated order-of-magnitude cost for this subcontract is $500,000.

Underpinning (7220-C-95) - The specification for underpinning under the auxiliary building electrical penetration area and excavation under the feedwater valve pits is presently being written. Upon completion, it will be issued for bids. Our proposed bidders for this subcontract are as follows:

Spencer, White & Prentice
P.O. Box 1785
South Hackensack, NJ 07606

Mergentime Corporation
Bartles Corner Road
Box 662
Flemington, NJ 08822

8810090962

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FILE	7220-1

The estimated order-of-magnitude cost for this subcontract is $3,250,000.

Chemical Grouting (7220-C-91) - The specification for pressure grouting under the railroad bay and the northwest corner of the diesel generator building is presently being reviewed. Upon completion, it will be issued for bids. Our proposed bidders for this subcontract are as follows:

Hayward Baker
1845 Mayfield Road
Odenton, MD 21113

Chem Grout Inc
P.O. Box 1140
LaGrange Park, IL 60525

The estimated order-of-magnitude cost for this work including equipment, materials, and labor is $1,500,000.

Pile Driving (7220-C-94) - The specification for pile driving to support the service water pump structure placed on the fill is presently being reviewed. It is proposed that the piling work, including the test pile, be an add-on item to the piling subcontract which is to be issued for the pipe bridge to Dow Chemical Co. The order-of-magnitude estimated cost of this subcontract item is $100,000.

All of the companies that we have recommended to bid are competent in performing the work in their respective areas. In addition, the schedule of the corrective actions makes it very desirable to limit the number of bidders to those known to be qualified for this work. We will send copies of the specification to you for review and comments concurrent with issuance of the specification for bids. If you have any comments, they will be resolved prior to award of the contract.

We request your approval and comments on the proposed bidders on or before June 8, 1979.

Very truly yours,

R.L. Castleberry
Project Engineer

JGH/js
5/14/5

cc: D.B. Miller
R. C. Baumin

Bechtel Associates Professional Corporation

Inter-office Memorandum

To R. L. Castleberry

Date June 5, 1979

Subject Midland Units 1 & 2
Job No. 7220-001
Diesel Generator Instrumentation

From J. O. Wanzeck

Of Geotechnical Services

At Ann Arbor 10 D 5
7220-79-92

Copies to S. L. Blue
S. S. Afifi w/a
K. Wiedner w/o
[redacted]
P. A. Martinez w/o
1320, 3410

Attached you will find a copy of Soil and Rock Instrumentation letter describing instrumentation now being placed in the diesel generation building.

J. O. Wanzeck

JOW/nm
Attachments

CIVIL ENG NUCLEAR POWER
ANN ARBOR

	IN	OUT	DATE
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FILE 7220-1			

8111070454

SOIL & ROCK INSTRUMENTATION

GEOTECHNICAL INSTRUMENTATION DIVISION OF
GOLDBERG • ZOINO • DUNNICLIFF & ASSOCIATES, INC.

May 31, 1979
File No. D2220-C

Bechtel Associates Professional Corporation,
P.O. Box 1000,
Ann Arbor, Michigan 48106

Attention: Dr. Sherif Afifi

Re: Midland Units 1 & 2
Diesel Generator Building
Instrumentation

Gentlemen:

The following will elaborate on paragraph 7 of Dr. Afifi's May 22, 1979 letter to Dr. M. T. Davisson and Dr. A. J. Hendron, Jr. Future settlement or rebound of the Diesel Generator Building will be monitored as follows:

1. Before Removal of Surcharge

1.1 All Borros anchors that now pass through the mezzanine floor, together with the five settlement rods on each generator pedestal will be converted such that future readings can be made with a mechanical dial indicator height gage. The conversion will consist of reducing the "stick up" rod lengths above the floor as necessary, attaching a flat metal reference surface to the floor alongside each rod and a reference surface on each rod itself. A portable mechanical dial indicator height gage will be used to determine the elevation difference between each pair of reference surfaces. These measurements will give the settlement of the mezzanine floor relative to each anchor or pedestal (i.e. not absolute settlement). Anticipated accuracy is better than 0.01 inches.

1.2 A study of optical survey settlement readings on the deepest Borros anchors (Nos. 12, 17, 42, 44, 49, 52 and 59) within the building area indicates total anchor settlements ranging from 0.01 ft to 0.11 ft, and it is clear that these anchors cannot be used as benchmarks to convert the above relative settlement readings to absolute values.

30 TOWER RD. • NEWTON UPPER FALLS • MASS. 02164 • 617-965-3700

8001090965

1.3 Four additional Borros anchors are being installed, with anchors at Elev. 535 ft. Two are located outside the building, alongside the south wall near the east and west corners. A reference bracket will be attached to the building wall at each location, through which the riser rod will pass. The remaining two anchors are located within the building, one in the east bay, one in the west bay, with reference surfaces as for the converted Borros anchors described above. These new anchors will serve two purposes when "stick up" readings are taken with the portable dial height gage. First, they will provide at four locations, a direct measurement of absolute building settlement, (assuming that Elev. 535 ft is below the seat of settlement). Accuracy will be better than 0.01 inches. Second, for the anchors and pedestal rods nearby each new anchor, they will provide a means of converting the above relative settlements to absolute settlements.

1.4 It has been agreed with Bechtel survey personnel (Chuck Wilson) that future optical survey readings on all Borros anchors, settlement platforms and pedestal rods will be made using either the new deep east bay anchor or the new deep west bay anchor as benchmark, with the benchmark designated as Elev. 100. Care will be taken to maximize accuracy of these readings, data will be reported to 0.001 ft, and it was agreed by Bechtel survey personnel that accuracy would be better than 0.01 ft. Survey readings will be made three times each week. Note the need for keeping track of any lengths cut off rods as in paragraph 1.1 above. We recommended consideration of first order levelling procedures with a micrometer for reading, but were informed that with presently available equipment and personnel this was impracticable.

1.5 When taking each set of optical settlement data, Bechtel will also shoot from the presently used benchmark on to the two new Borros anchors within the building area, as a check (but probably no better than 0.01 ft accuracy) on the validity of using these two anchors as benchmarks. As often as possible Bechtel will also shoot from the presently used benchmark on to the two new Borros anchors outside the south wall.

2. During Removal of Surcharge

2.1 Existing Borros anchors will not provide accurate data, either using optical survey or the dial height gage, as riser and alignments will change as surcharge is removed around them.

2.2 Five "Condex" systems will be installed, one near each corner outside the building and one at the northeast corner of the pedestal in the east bay. The Sondex system consists of a corrugated plastic tube with wire rings wrapped around the tube at 5 ft intervals, and

will be installed in borings to Elev. 535 ft. A probe containing an electrical coil is lowered down the tube on the end of a survey tape, an electrical cable connecting the coil to a power source and indicator at the surface. Through the principle of induction the indicator is used to determine proximity between coil and each wire in turn, and depths to each wire noted on the survey tape, hence vertical movement data is obtained from successive readings. Accuracy will be maximized by using a winding mechanism and dial indicator at the surface, referenced either to a bracket on the outside of the building or to the mezzanine floor and, assuming that Elev. 535 ft is below the seat of rebound, is expected to be 0.02 inches. Care will have to be taken to avoid damaging the Sondex tubes during surcharge removal and to attach the tubes to the building as surcharge is removed from around them.

2.3 It is possible that the four newly installed deep Borros anchors with the dial height gage will also provide useful rebound data, provided that lengths of rod exposed during surcharge removal are attached to the building.

3. After Removal of Surcharge

3.1 The dial height gage reading system will be re-established at the lower floor level on selected Borros anchors. Details will have to be worked out with Bechtel personnel to ensure compatibility with permanent building features.

3.2 The four Sondex systems on the outside of the building (perhaps also the fifth) can also be used if reference arrangements are lowered to near final grade.

Would you please distribute copies of this letter to Bechtel personnel in the field and to others as necessary.

Very truly yours.

C. John Dunnicliff

CJD:mc

C. John Dunnicliff
Geotechnical Instrumentation Consultant

cc: Mr. James Wanzeck, Bechtel, Ann Arbor
Mr. Yves Kraus, SRI, Midland

NONCONFORMANCE REPORT

1. PROJECT NAME: Midland Units 1 & 2	JOB NO.: 7220		19. NO. 1182	20. PAGE 1 OF 2
2. UNIT(S): Common	3. DRAWING/PART NO.: N/A	REV: N/A	4. ITEM DESCRIPTION: Building Settlement	5. ITEM LOCATION: Diesel Gen. Bldg.
6. P.O. OR SPEC NO.: N/A	7. SERIAL NO.: N/A	8. REPLACEMENT PART P/N: N/A REV: N/A SER NO: N/A	9. SOURCE: Construction	10. CONTRACTOR/SUPPLIER: N/A
11. INSPECTION CRITERIA ( ) DWG ( ) SPEC (X) OTHER	IR NO. N/A NO. Survey	12. ASME AUTHORIZED INSPECTION REQ'D ( ) YES (X) NO	13. SKETCH ATTACHED (X) YES ( ) NO	14. Discovered During ( )Rec'g (X)Const ( )Test	15. Equip Furnished By ( )Client ( )Eng (X)FLD

16. NONCONFORMING CONDITION: The attached sketch identifies settlement of the Diesel Generator Foundations and Structure. In addition the mud mat between the E/Wall and Generator has spalled and has been displaced. "Q"-List #1.40. Hold for Engineering Disposition. 4 Hold Tags Applied.

17. REPORTED BY: [signature] DATE: 8-21-78

18. VALIDATED BY: [signature] for W.L.B DATE: 8-21-78

21. ROUTING: (X) TO FIELD ENGINEERING ( ) TO OTHERS (SPECIFY)

22. ( ) Field Engineering Disposition (X) Field Engineering Recommended Disposition to Project Engineering

PROJECT ENGINEERING TO EVALUATE AND SPECIFY ALL TESTING AND OTHER INVESTIGATION REQUIREMENTS TO RESOLVE THIS NONCONFORMANCE.

[signature]

23. PROJECT ENGINEERING DISPOSITION

24. DISPOSITION CONCURRENCE

rework	reject	repair	use as is

PROJECT FIELD ENGINEER DATE

PROJECT ENGINEER DATE

PROJ CONSTR QC ENGINEER DATE

AUTHORIZED INSPECTOR DATE

25. DISPOSITION RESULTS

26. QC ACCEPTANCE

QC ENGINEER DATE

AUTHORIZED INSPECTOR DATE

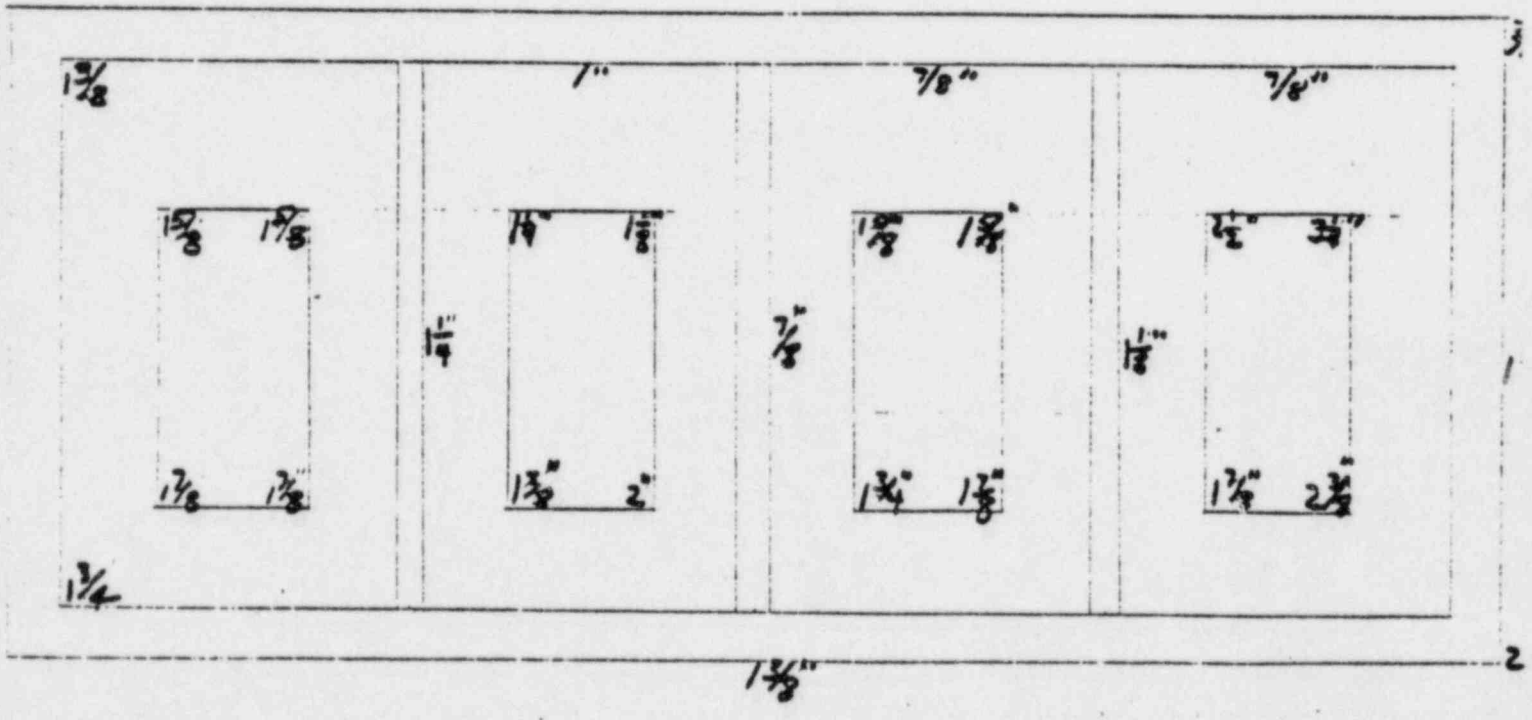
SP-3117

DATE

DESIGN BY CFH DATE 8-21-78 CHECKED BY ____ SHEET NO. 1

PROJECT JOB NO.

SUBJECT CALCULATION NO. FILE NO.



Note: figures shown are total settlements from theoretical plant elevation

SB108318

BECHTEL ANN ARBOR

MEMO FROM G. L. RICHARDSON 10/17 DATE

TO: Len Draisbach

I am running this by Maloney before I issue as final form. Any comments you have would be appreciated

SB108319

Soils Records
Review
G. Richardson
Draft 3-13-78

LIST OF ATTACHMENTS

NO 1. Soil Placement Requirements - A flow chart of pertinent requirement for placing soil which was used to determine types of documents to sample.

NO 2. Review Record - Record of Quality Control and Subcontractor Records reviewed

NO 3. QA Audits - record of QA Audits reviewed and results of audits

NO 4 Structural Backfill - list of QC records reviewed for receipt of structural Backfill

NO 5. Compaction Tests - Summary of compaction Tests prepared by QC and reviewed during this check

SB10F325

Soils Records Review
G. Richardson
Draft 3-13-78

SOILS PLACEMENT REQUIREMENTS - DIESEL GENERATOR BUILDING

Material excavated from designated borrow areas and placed as embankments (fills) as indicated on Plot Plot Drawing and Specifications
- Spec 7220-C-210
- Dwgs 7220-C-44, 45

↓

Subcontractor responsible for excavation, placement and compaction per Spec C-210

↓

Conduct QA manual
- Lift thickness checks Acc. - Daily (17.1.1) = 12" Max. loose lift
- Daily report (17.1.2)

Structural Backfill Material placed by Bechtel - Spec 7220-C-210 →
- Material from offsite source - stockpiled on site

→ Receipt Inspected by Quality Control. Tested at receipt by UST

Quality Control Surveillance of Subcontractor operations
- Foundation Preparation
- Hold point - Approval of NE required (Spec C-210 para 17.5.1)
- Hold point FIP C-210-9 (N)
- " " QCI C-1.02 (R/H)
- " " QCI SC-1.10 (N)
- Area Field Engineer assigned to provide Technical support To Subcontractors and supervision
- Subcontract Administration Engineer assigned to 7220-C-210 To administer the subcontract. Daily Reports produced by Subcontract Adm.

→ Testing performed by Test Lab
- Spec 7220-C-208 →
- Spec 7220-C-210
- Spec 7220-C-211

↓

Compaction Requirements
- Cohesive Soils - 95% of Maximum Density
- Cohesionless Soils - 80% Relative Density

QA Audit Surveillance of:
- Placement operations
- Compaction QA program
- Testing Operations
- UST QA program
- Records
- Quality Control

↓

Client Audits / Surveillance

Note: Flow chart based on Specifications 7220-C-208, 7220-C-210; 7220-C-211; Drawings 7220-C-44 and 7220-C-45; Quality Control and Quality Assurance procedures.

SB[illegible]126

Attachment 2
DRAFT G. Rutherford's
10/23/78

REVIEW RECORD

Elev	Approximate Placement Period	Quality Control Number	Record Issued	Record Closed		Subcontractor Records Due By	Subcontractor Rework Thickness	
597-608	6/76 - 9/76	FHPC 210-1-58	6-16-76	10-22-76		6-29-76	—	
		FHPC 210-1-53	10-28-75	1-2-76		7-23-76	—	
	10/75 - 11/75	FHPC-210-1-51	8-20-75	1-22-76		11-13-75	OK	
						11-12-75	—	
						11-11-75	OK	
						10-31-75	—	
						10-29-75	—	
Ramp	7/76 - 8/76	FHPC-210-1-62	7-7-76	11-29-76		7/23/76	No Reports in File	QA Audit indicates reports as of 7-19-76, 8-20-76, 8-27-76, 9-1-76
607-633	7/77 - 12/77	FHPC-210-1-58	6-16-76	10-22-76	Time of area included	6-22-77	OK	
		FHPC-210-1-62	7-7-76	11-29-76	Area	6-23-77	OK	
	3/78 - 8/78	QC IR C-1002-76	9-20-78	7-12-78		6-28-77	OK	
		75	9-21-78	7-13-78				
		74	9-19-78	6-26-78		6-30-77	OK	
		72	9-5-78	7-26-78				
		71	3-27-78	6-26-78		7-11-77	OK	
		70	3-20-78	7-1-76				
		69	2-18-78	5-3-78		7-22-77	OK	
		68	2-21-78	6-26-78				
		67	2-7-78	5-5-78		7-28-77	OK	Plans cover both work by Bechtel and by Earthwork Subcontractor
		66	1-5-78	7-17-78				
		65	12-22-77	7-17-78		9-30-77	OK	
		64	12-19-77	7-21-78				
		63	12-13-77	7-13-78		10-3-77	OK	
		62	11-30-77	12-21-77				
		61	11-11-77	12-21-77		10-9-77	OK	
		59	10-31-77	12-21-77				
		56	10-25-77	12-21-77				
		53	10-10-77	12-13-77				
		51	10-3-77	12-13-77				
		48	9-26-77	10-13-77				
		47	9-19-77	10-25-77				
		44	9-12-77	10-17-77				
		42	9-13-77	10-6-77				
		40	9-13-77	10-6-77				
		36	8-15-77	10-5-77				
		35	8-9-77	9-9-77				
		33	8-1-77	8-15-77				
		31	7-22-77	8-13-77				
		29	7-18-77	8-13-77				
		24	7-11-77	10-8-77				
		23	7-5-77	8-13-77				
		8	5-18-77	6-13-77				
		QC IR SC-1.10-1	6/21-28/77		QC Plans Covering Subcontractor Surveillance.			
		" SC-1.10-2	6/29-7/6/77					
		" SC-1.10-13	10/27-28/77					

SB10E327

BECHTEL

Attachment 4

Soil ... Review

Receipt of Structural ...

Spec 7220-C-211

Items ...

MRR AEO-2211 dated 2-14-77

- QCIR R-1.00-745 dated 2-10-77
  " R-1.00-786 " 2-11-77

- User Tests (Excavation) 0518, 0519, ..., ..., ...
- Bechtel NCR 700

MRR AEO-3217 dated 5-15-78

- QCIR R-1.00-1233 dated 5-10-78
  R-1.00-1243 " 5-11-78
  R-1.00-1245 " 5-12-78
  R-1.00-1256 " 5-13-78
  R-1.00-1277 " 5-16-78

MRR AEO-3509 dated 6-17-78

- QCIR R-1.00-1382 dated 6-1-78
  R-1.00-1393 " 6-5-78
  R-1.00-1411 " 6-7-78
  R-1.00-1414 " 6-10-78
  R-1.00-1431 " 6-12-78

- User Tests 0513, 0526

SB108328

BECHTEL

Job 7220

COMPACTION TESTS

1. Each Test on the attached Summary was [illegible] checked on the records produced by the [illegible] on form "Compaction Fill Density Test Reports" [illegible]

2. The following failing tests were [illegible] shown on the records by passing tests [illegible] other areas.

Failing Test No	Retest or [illegible]
MD - 665	MD-666
MD - 756	MD-793
MD - 758	MD-761
MD - 759	MD-762
MD - 1253	MD-1292
MD 1285	MD-1298
MD - 1286	MD-1300
MD - 1564	MD-1611
MD - 1358	MD-1401
MD - 1311	NCR 1404
MD - 1795	MD-1796
MD - 1761	MD-1762
MD - 1648	MD-1647
MD - 1584	MD 1503
MD - 1587	MD-1556
MD - 1892	MD-1514

SB1CF329

to _____

WEEKLY COMPACTED FILL DENSITY TEST REPORT

Spec. No. _____

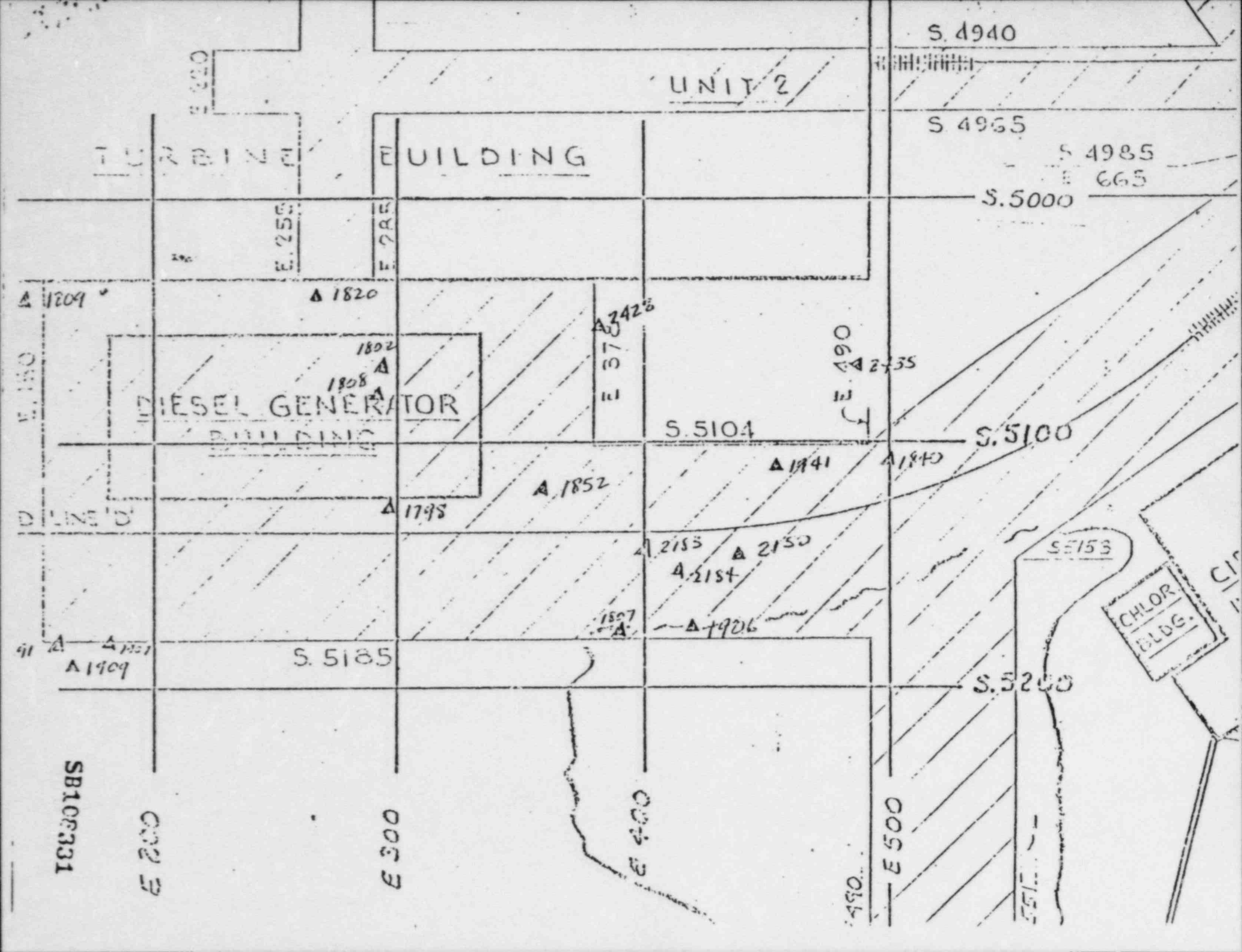
Lab. Insp. _____

Tested Week of _____

Sheet _____ of _____

Date Taken	Test No. MD	Unified No. Classification BMP/RD	OMC	Zone	Location	Elev. of Test	Depth Below Final Grade (ft.)	In Place Wet Density (lb/c.f.)	Water Content (%)	In Place Dry Density (lb/c.f.)	Max. Lab. Dry Density (lb/c.f.)	Percent compaction	Remarks
1/6/77	2435.	55	N/A	2	40's of Q Line @ 12.0 Line	627		118.8	5.8	112.3	MAX 109.7 / MIN 93.2	110.7	RD ✓
1/7/77	2428.	"	"	"	50' E of E/Wall 20's of Tie-B	624		117.9	7.2	110.0	" "	101.3	✓
1/7/77	2150.	"	"	"	5' W of 11.0 115's of Q	625		124.6	9.1	114.2	" "	118.2	✓
1/10/77	1909.	269	10.0	1	S 5190 - E 169	630		141.5	11.4	127.0	127.3	99.8	✓
1/6/77	1941.	55	N/A	2	S 5110 E 465	628		116.4	5.7	110.1	MAX 109.7 / MIN 93.2	101.7	RD ✓
1/9/77	1905.	"	"	"	130's of Q 80' W of 12	620		115.2	7.2	107.5	" "	99.5	✓
1/10/77	1907.	397	9.0	1	S 5187 E 185	628		147.0	10.9	132.5	131.6	100.7	✓
1/11/77	1891.	263	9.1	1	S 5187 E 155	621		144.0	9.3	131.7	131.0	100.5	✓
1/5/77	2184.	277	13.4	1	S 5165 E 420	630.5		145.0	13.1	128.2	121.0	106.0	✓
1/6/77	2183.	"	"	"	S 5150 E 400	629		143.0	12.9	126.7	121.0	106.0	✓
1/12/77	1852.	269	10.0	1	S 5112 E 359	629		139.5	11.8	125.0	127.3	98.0	✓
1/9/77	1840.	"	"	"	S 5107 E 520	632		143.0	11.5	128.2	127.3	100.7	✓
1/3/77	1820.	270	11.1	1	S 5042 E 265	626.5		134.5	11.2	121.0	124.6	97.1	✓
1/2/77	1809.	269	10.0	1	S 5190 E 140	627		142.5	10.5	129.0	127.3	101.3	✓
1/2/77	1808.	"	"	"	S 5074 E 270	628		143.0	10.4	129.5	127.3	101.7	✓
1/2/77	1807.	271	10.1	1	S 5182 E 390	631		140.0	10.5	126.7	126.6	100.1	✓
1/1/77	1802.	269	10.0	1	S 5070 E 290	627		140.5	11.5	126.0	127.3	99.0	✓
[illegible]	796.	"	"	"	S 5122 E 295	627		144.0	9.6	131.0	127.3	103.0	✓

SB10-330


S.4940
UNIT 2
S.4965
S.4985
665
S.5000
TURBINE BUILDING
E.250
E.285
E.280
1809
1820
1802
1808
DIESEL GENERATOR BUILDING
S.5104
S.5100
1841
1840
1852
1795
2155
2150
2154
1907
1906
1909
S.5185
S.5200
SE153
CHLOR. BLDG.
SB106331
E 200
E 300
E 400
E 500

Date [illegible]

WEEKLY COMPACTED FILL DENSITY TEST REPORT

Lab. Insp. _____

Tested Week of _____

Sheet _____ of _____

Date Taken	Test No.	Unified No. Classification BMP RD	CMC	ZONE	Location	Elev. of Test	Depth Below Final Grade (ft.)	In Place Wet Density (lb/c.f.)	Water Content (%)	In Place Dry Density (lb/c.f.)	Max. Lab. Dry Density (lb/c.f.)	Percent compaction	Remarks
7/30/77	1791.	269	10.0	1	S 5135 E 175	623	-	139.0	10.8	125.5	127.3	98.6	✓
7/29/77	1779.	"	"	"	S 5060 E 245	625		147.0	11.8	131.5	127.3	103.3	✓
7/28/77	1778.	"	"	"	S 5105 E 280	624		141.5	10.5	128.0	127.3	100.5	✓
7/25/77	1772.	262	11.8	1	S 5128 E 160	620		139.5	12.0	124.5	123.9	100.1	✓
7/29/77	1765.	269	10.0	1	S 5162 E 145	619		143.0	10.9	129.0	127.3	101.3	✓
7/27/77	1763.	260	10.2	1	S 5145 E 170	616		136.5	8.8	125.5	129.8	96.7	✓
7/27/77	1760.	"	"	"	S 5112 E 437	629.5		148.5	9.2	136.0	129.8	104.8	✓
7/26/77	1741.	270	11.1	1	S 5034 E 270	627		141.0	12.2	125.7	124.6	100.9	✓
7/23/77	1739.	"	"		S 5180 E 410	629		140.5	12.0	125.5	124.6	100.7	✓
7/23/77	1726.	274	10.9	1	S 5188 E 432	628.5		137.5	11.0	123.0	124.8	98.6	✓
7/22/77	1719.	270	11.1	1	S 5175 E 375	626.5		142.0	11.4	127.5	124.6	102.3	✓
7/22/77	1718.	278	15.2	1	S 5182 E 308	624		146.0	14.5	127.5	117.0	109.0	✓
7/21/77	1704.	270	11.1	1	S 5200 E 308	623		135.0	12.3	120.2	124.6	96.5	✓
7/11/77	1644.	269	10.0	1	S 5050 E 207	618		138.5	11.5	124.2	127.3	97.6	✓
7/11/77	1643.	"	"	"	S 5087 E 150	615		141.5	10.5	128.0	127.3	100.5	✓
7/1/77	1595.	262	11.8	1	S 5100 E 320	625		131.0	10.1	119.0	123.9	96.0	✓
7/1/77	1593	269	10.0	1	S 5125 E 370	626		135.5	11.5	121.5	127.3	95.4	✓
		"	"	"	S 514[illegible] E 350	623.5		140.[illegible]	10.2	127.0	127.3	99.8	✓

SB1 06233

S.4940
S 4965
S 4985
E 665
S.5000
S.5100
S5155
S.5200
E500
E400
E300
E200
S.5104
S.5185
UNIT 2
BUILDING
TURBINE
DIESEL GENERATOR
BUILDING
1760
A
1726
A
1718
A
1644
A
1774
A
1741
A
1773
A
1503
A
512
A
1741
A
1743
A
1743
A
1772
A
1741
A
1743
A
1743
A
1743

cc: _____

WEEKLY COMPACTED FILL DENSITY TEST REPORT

Lab. Insp. _____

Tested Week of _____

Sheet _____ of _____

Date Taken	Test No.	Unified No. Classification RD	OMC	Zone	Location	Elev. of Test	Depth Below Final Grade (ft.)	In Place Wet Density (lb/c.f.)	Water Content (%)	In Place Dry Density (lb/c.f.)	Max. Lab. Dry Density (lb/c.f.)	Percent compaction	Remarks
	MD												
2/77	1303.	55	N/A	2	32'S of Q Line 20'W of 6.0	610	-	118.0	8.7	108.6	MAX 109.1 / MIN 90.2	95.3	✓
2/77	1302.	"		"	32' S of Q Line 28'W of 6.0 Line	606		118.2	9.5	107.9	" "	92.3	✓
1/77	1301.	"		"	30'S of Q Line 4' W of 6.0	606		122.4	11.7	109.6	" "	99.6	✓
28/77	1297.	"		"	27' S of Q Line 31' E of 6.0	612		114.8	6.1	108.2	" "	93.6	✓
28/77	1296	"		"	25' S of Q Line 35' E of 6.0	610		114.8	6.4	107.9	" "	92.5	✓
26/77	1294.	"		"	40' S of Q Line 2' of 6.0	608		122.2	4.7	116.7	" "	121.7	✓
26/77	1288.	274	10.9	1	198' W of 12.0 14' S of Q Line	616		142.5	9.9	129.7	129.8	103.9	Clears 1285
21/77	1285.	"	"	"	146' W of 12.0 14' S of Q Line	616		142.25	13.2	125.7	124.8	100.7	Fail / Retest
19/77	1281.	55		2	5' W of 8.0 30' S of Q Line	611		117.5	5.9	111.0	109.7 / 90.2	105.0	✓
19/77	1280.	"		"	5' W of 8.0 30' S of Q Line	613		117.8	5.9	111.2	" "	106.2	✓
18/77	1279.	"		"	5' W of 8.0 30' S of Q Line	609		115.2	6.0	108.7	" "	95.7	✓
11/77	1268.	"		"	15' S of Q Line on 8.0	611		120.1	6.8	112.5	" "	111.5	✓
11/77	1267.	"		"	15' S of Q Line on 9.0 Line	611		118.0	6.9	110.4	" "	102.9	✓
8/77	1259	"		"	30' S of Q Line on 8.0	608		115.1	6.1	108.5	" "	94.9	✓
7/77	1251.	"		"	14' S of Q Line on 9.0 Line	609		115.4	5.1	109.8	" "	100.9	✓
16/75	1074.	251	9.2	2	22' W of 12 52' S of Q Line	608		145.0	10.1	131.8	130.6	101.0	✓
24/76	751.	255	14.4	2	55' S of Q Line 22' E of 2.0	608		135.5	16.3	116.5	117.4	99.0	✓
				"	55' E of 2.0			135.0	16.4	116.0	"	99.0	✓

SB10f334

S.4910
S.4965
S.4985
665
S.5000
S.5100
S.5153
S.5200
E500
490
UNIT 2
BUILDING
S.5104
E400
E300
S.5185
TURBINE
DIESEL GENERATOR
BUILDING
E200
SB108335

WEEKLY COMPACTED FILL DENSITY TEST REPORT

Lab. Insp. _____

Tested Week of _____

Sheet _____ of _____

Date Taken	Test No. MP	Unified No. Classification BHP	LO	RHL	ZONE	Location	Elev. of Test	Depth Below Final Grade (ft.)	In Place Wet Density (lb/c.f.)	Water Content (%)	In Place Dry Density (lb/c.f.)	Max. Lab. Dry Density (lb/c.f.)	Percent compaction	Remarks
22/77	1570.	269	70.0	1	S516.5 E334	622	-	140.5	9.8	128.0	127.3	100.5	✓	
22/77	1569.	"		"	S5162 E265	622		135.5	9.1	124.2	127.3	97.6	✓	
23/77	1563.	271	10.1	1	S5142 E223	620		131.5	8.9	120.7	126.6	95.3	✓	
23/77	1560.	262	11.8	1	S5165 E245	621		131.5	10.0	119.5	123.9	96.4	✓	
22/77	1551.	269	10.0	1	S5155 E350	613.5		133.0	9.7	121.2	127.3	95.1	✓	
22/77	1550.	"		"	S5170 E345	617		138.5	9.7	126.2	127.3	99.1	✓	
22/77	1547.	277	13.4	2	S5175 E430	625.5		137.0	13.0	121.2	121.0	100.2	✓	
2/77	1461.	55	n/a	2	39' S of Q line 6' E of 6.0	617		122.6	5.5	115.9	MAX 104.1 / MIN 90.2	124.7	LD	
2/77	1414.	278	15.2	1	57' S of Q-line 30' W of 9.0	622		141.5	13.2	125.0	117.0	106.8	✓	
1/5/77	1354.	55	n/a	2	40' S of Q-line & of 8.0	620.		118.5	9.1	108.6	MAX 104.1 / MIN 90.2	95.5	LD	
1/5/77	1353.	"		"	3' W of 7.0 40' S of Q line	618		110.3	4.8	105.2	" "	80.5	✓	
1/4/77	1343.	"		"	50' S of Q line on 8.0 line	612		111.0	5.6	105.1	" "	79.8	80%✓	
1/3/77	1311.	"		"	35' S of Q line 25' W of 6.0	613		109.8	7.4	102.2	" "	66.1	NCR(1004) ✓	
1/3/77	1310.	"		"	32' of Q line 19' E of 6.0 line	613		120.5	5.8	113.9	" "	117.1	LD	
1/3/77	1309.	"		"	35' S of Q line 25' W of 6.0	610		113.0	7.1	105.5	" "	81.6	✓	
1/3/77	1308.	"		"	35' S of Q line 10' E of 6.0	611		115.6	6.9	108.3	" "	92.8	✓	
1/3/77	1307.	"		"	24' W of 6.0 37' S of Q line	611		122.3	6.8	114.5	" "	119.7	✓	
					6' E of 6.0				7.8	113.1	" "	115.9	✓	

SB108336

S.4940
S.4965
S.4985
E 665
S.5000
S.5100
S.5153
S.5200
E500
E400
E300
E200
S.5104
S.5135
UNIT 2
BUILDING
DIESEL GENERATOR
1308
1307
1311
1306
1563
1567
1562
1570
1551
1550
1547
1354
1414
1343
1353
SB108337

Date _____

WEEKLY COMPACTED FILL DENSITY TEST REPORT

Lab. Insp. _____

Tested Week of _____

Sheet _____ of _____

Date Taken	Test No. MD	Unified No. Classification BMP RD	OHC	Zone	Location	Elev. of Test	Depth Below Final Grade (ft.)	In Place Wet Density (lb/c.f.)	Water Content (%)	In Place Dry Density (lb/c.f.)	Max. Lab. Dry Density (lb/c.f.) Rough/Final	Percent compaction	Remarks
7/12/76	677.	41	N/A	1	45'W of 6.0 10'S of Q Line	607		113.6	6.6	106.6	105.7/59.6	91.0	✓
7/12/76	676.	"		"	61'W of 6.0 15'S of Q line	605		123.7	7.8	114.7	" "	125.0	✓
7/9/76	675.	"		"	75'W of 6.0 12'S. of Q Line	602		119.5	8.0	110.6	" "	108.0	✓
7/8/76	671.	"		"	36'W of 6.0 18'S of Q Line	607		121.6	8.8	111.8	" "	113.0	✓
7/7/76	667.	"		"	18'W of 5.6 Line 4'S of Q Line	606		118.7	8.0	109.9	" "	105.0	✓
7/1/76	644.	43	N/A	2	18'W of 6.0 Line 5'S. of Q Line	604		122.8	10.2	111.4	110.5/90.8	104.0	✓
7/1/76	643.	"	"	"	31'W of 6.0 3'S of Q Line	602		119.4	9.4	109.1	" "	94.0	✓
6/23/76	641.	"	"	"	39'W of 6.0 5'S of Q Line	600		114.9	7.5	106.9	" "	85.0	✓
6/9/76	592.	"	"	"	15'W of 5.3 Line 2'S of Q Line	599		115.4	7.3	107.5	" "	87.0	ORIGINAL GROUND RE
6/9/76	590.	30	N/A	2	15'W of 5.3 Line 2'S of Q Line	597*		128.7	20.8	106.5	108.5/91.5	90.0*	Dyn. C44 Rev. Note #1

SB10e23S

S 4940

S 4965

S 4985
E 665

S 5000

S 5100

S 5153

S 5185

E 500

E 400

E 300

E 200

UNIT 2

BUILDING

TURBINE

DIESEL GENERATOR BUILDING

SB108339

BECHTEL CORPORATION

WEEKLY COMPACTED FILL DENSITY TEST REPORT

Spec. No. _____

Date _____

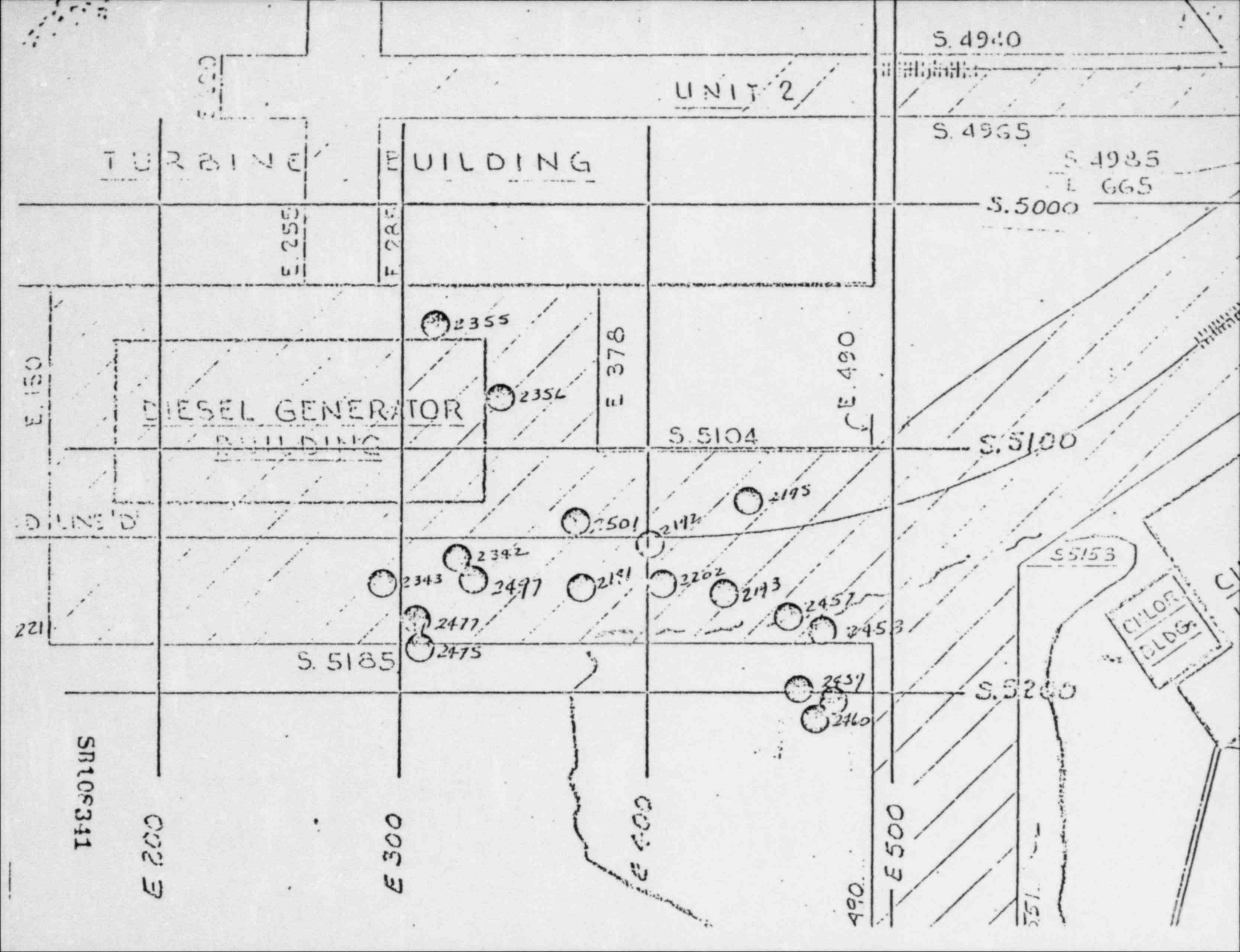
Lab. Insp. _____

Tested Week of _____

Sheet _____ of _____

Date Taken	Test No. MD	Unified No. Classification BPM/OMC/ZONE	Location	Elev. of Test	Depth Below Final Grade (ft.)	In Place Wet Density (lb/c.f.)	Water Content (%)	In Place Dry Density (lb/c.f.)	Max. Lab. Dry Density (lb/c.f.)	Percent compaction	Remarks
4/12/78	2501	264 8.2 1	40'E of D.G, 100'S of TT	633	-	144.0	13.2	127.2	131.7	96.6	
4/12/78	2497	264 8.2 1	40'S of D.G- 175'S of Q	632	-	146.0	12.7	129.5	131.7	98.3	
3/31/78	2477	55 N/A 2	10'E of 3 Line 175'S of Q	652	-	116.4	3.0	113.0	109.7 OMC / 90.2 min.	113.5	RD
3/31/78	2475	55 " 2	12'E of 3 Line 150'S of Q	630		119.5	7.6	111.1	104.7 MAX / 90.2 min.	105.8	
12/21/77	2460	" " "	200'S of Q Line 20'W of 11.0	630		124.7	8.9	114.5	" "	119.4	✓
12/21/77	2459	" " "	170'S of Q Line 33'W of 11.0	631		120.4	6.4	113.2	" "	114.3	✓
12/23/77	2458	- " -	12'W of 11.0 150'S of Q	626		115.5	5.3	109.7	" "	100.0	✓
12/23/77	2451	" " "	3'E of 10.0 145'S of Q	629		117.6	7.9	109.0	" "	97.3	✓
10/27/77	2356	" " "	22'S of N/Wall 2'E of E/Wall	632.5		120.0	7.2	111.9	" "	109.1	✓
10/27/77	2355	" " "	14'W of E/Wall 2'N of N/Wall	631.5		123.3	6.8	115.4	" "	112.8	✓
10/26/77	2343	271 10.1 1	S 5163 - E-280	632		134.0	10.8	122.7	126.6	96.9	✓
10/24/77	2342	255 14.4 1	S 5155 - E-324	630		138.0	12.2	123.0	117.4	104.8	✓
10/24/77	2211	271 13.4 1	S 5175 - E 129	631		139.5	12.3	124.2	121.0	102.6	✓
10/21/77	2202	270 11.1 1	S 5151 E 407	633		140.5	12.2	125.2	124.-	100.5	✓
10/21/77	2195	" " "	S 5130 E 442	631		145.5	12.4	129.5	124.6	103.9	✓
10/21/77	2193	271 13.4 1	S 5166 E 427	633		144.0	13.1	126.7	121.0	104.7	✓
10/20/77	2192	270 11.1 1	S 5145 - E 400	633		144.0	12.9	127.5	124.6	102.3	✓
10/20/77	2191	" " "	S 5163-E 372	631		141.0	12.4	125.7	124.6	101.1	

SH 10 OF 340


S. 4940
UNIT 2
S. 4965
S. 4985
L 665
S. 5000
TURBINE BUILDING
E. 255
E 285
E 378
E 460
E. 150
DIESEL GENERATOR BUILDING
S. 5104
S. 5100
2355
2356
2501
2342
2343
2497
2141
2202
2143
2451
2453
2477
2475
S. 5185
S. 5153
CI'LOR BLDG.
2457
2460
S. 5200
SR109341
E 200
E 300
E 400
E 500
490
351
221

Bechtel Power Corporation

Inter-office Memorandum

To J. Hilandin

Subject Soils Placement Records
Midland Job 7220

Copies to S HARSLEY
L. Dreisbach
W. Barclay
J. Newgen
P. Martinez
E. RUMBAUGH
R CASTLEBERRY
D WAHL

Date October 13, 1978

From G. L. Richardson

Of Quality Assurance Staff

At Ann Arbor

In accordance with your request, I have reviewed Midland jobsite records related to the placement of backfill materials in the area of the Diesel Generator Building to assure that the project requirements were properly implemented during the work operations.

The attached report summarizes the information reviewed. No areas of improper implementation or program noncompliances were noted during this review.

G. L. Richardson

GLR/le
GLR-78-10

attachment

SB108388

DRAFT 10/13/78
G. L. Richardson

REPORT OF REVIEW OF SOILS PLACEMENT/INSPECTION RECORDS RELATED TO EMBANKMENT IN THE AREA OF THE DIESEL GENERATOR BUILDING

I. PURPOSE:

To provide assurance that records for installation of plant fill and structural backfill are complete and provide evidence the work was accomplished in accordance with the program requirements.

II. CONTROLLING DOCUMENTS:

Technical Specifications 7220-C-210 and 7220-C-211

Project Drawings - Specifically 7220-C-44 and C-45

Cononie's QA Manual (Earthwork Subcontractors)

Quality Control Inspection Plan C-210-4

Quality Control Instructions C-1.02 & SC-1.10

Note. Revisions to these documents vary through 1975 - 1977.

III. METHOD OF VERIFICATION:

Program requirements were determined from the controlling documents. Attachment 1 summarizes the pertinent requirements for placement by the subcontractor or Bechtel, Inspection and Testing. Using these requirements, quality documents were reviewed to assure that necessary inspections and tests were carried out during the time of placement in the area of the Diesel Generator Building. Attachments list the actual documents reviewed. The results of this review is summerized in the following paragraphs.

IV. SUMMARY OF RESULTS:

1. The approximate dates of backfill operations in the area of the Diesel Generator Building was determined from a summary of testing prepared by Quality Control (attached). This s[illegible]

SB10C389

list the test results for this area and also provides plots of the location of the tests. Based on this data the material was placed during the periods of:

October - November, 1975 - limited work in area

June - September, 1976 - most work was building ramp south of turbin building

July - December, 1977 - Majority of fill placed during this period.

April - July, 1978 - Bechtel placement*

A review of the subcontractors daily report confirmed that these dates are appropriate.

*Earthwork Subcontractor (Cononie) operations ended about 11/10/77.

2. Quality Control files were reviewed to assure that Quality Control Inspection Plans or inspection records were prepared to cover the scope of work and were properly implemented. Forty-two (42) FIP's and QCIR's were reviewed. This review indicates that QCIR's/FIP's were prepared to cover the work as it was in progress. These plans/records were properly scoped, prepared and completed which indicates the required surveillances and inspections were properly signed off on the records checked.

3. The Earthwork Subcontractors QA Program requires their QC Engineer to produce certain records which include daily reports and lift thickness checks. All of the records for 1975, 1976 [illegible] 1977 were quickly reviewed to assure their availability. 18 of the records were reviewed for proper implementation and completion and found satisfactory. The lift thickness checks on these records indicate lifts less then the maximum (12") allowed by the specification. It was noted that one lift thickness [illegible]

SB108390

for 1976 are not in the QC files. Quality Control has identified this item and has requested subcontracts administration to obtain the missing documentation. Quality Assurance conducted an audit on 9/17/76 (25-11-2) which include a review of lift thickness checks. Five lift thickness check records were reviewed for 7-14-76, 8-11-76, 8-20-76, 8-27-76 and 8-31-76 and found acceptable. This verifies the lift thickness checks were being taken and recorded.

4. Test Records for the Diesel Genrator were checked by review of the tests summarized by Quality Control. (Copies attached) These tests results summarized were compared with the test "Compaction Fill Density Test Reports" (QC File C-210.3) produced by U. S. Testing and found to be accurate. The test results (percent compaction and relative density) reviewed complied with the requirements of the technical specification. The frequency of testing for the area within the limits of S 5036 to S 5185 and E 150 to E 490 is in the approximate area of one field density test for each 300 cubic yard placed. This figure is lower than the required frequency of one test for each 500 cubic yards placed. The figure is based on an assumed placement depth of 30 feet and 157 density tests takne.

5. Twelve (12) QC Receiving records were reviewed for structural backfilling along with seven (7) user gradation tests and found acceptable.

6. Quality Assurance audits were reviewed for the period of construction. Eleven (11) audits were conducted covering the areas of Test Laboratory Operations, In-process Soils Placement and implementation of the Earthwork Subcontractors QA Program.

SB108391

V. CONCLUSIONS

The records reviewed indicate the backfill materials placed by Cononie and Bechtel were placed on approved foundations, in a manner consistent with the project requirements, and compacted to the densities required by the project documents. This is evidenced by the completed records produced by:

1. Cononie Quality Control Engineer
2. Bechtel Quality Control
3. U. S. Testing Laboratory
4. Bechtel Quality Assurance

The records included in this review also indicate the quality programs approved for use by Cononie and Bechtel were properly implemented as related to the backfill operations in the area of the Diesel Generator Building.

SB108392

Soils Records
Review
G. Richardson
Draft 3-13-75

LIST OF ATTACHMENTS

NO 1. Soil Placement Requirements - A flow chart of pertinent requirement for placing soil which was used to determine types of documents to sample.

NO 2. Review Record - Record of Quality Control and Subcontractor Records reviewed

NO. 3 QA Audits - record of QA Audits reviewed and results of audits

NO. 4 Structural Backfill - list of QC records reviewed for receipt of structural Backfill

NO 5. Compaction Tests - Summary of compaction Tests prepared by QC and reviewed during this check

SB108393

Consumers Power Company

File under: U.S.I. 7220-C-208

Midland Project: P.O. Box 1963, Midland, Michigan 48640 · Area Code 517 631-0951

September 8, 1977

Mr. J. F. Newgen
Bechtel Power Corporation
P.O. Box 2167
Midland, MI 48640

MIDLAND PROJECT ~~GWO 7020~~ — ADMINISTRATION BUILDING/GRADE BEAM FAILURE
File: 0130 Serial: 2538

On August 25 we became aware of the situation regarding settlement of the subject beam. Inasmuch as this particular item could fall under the provisions of Article 9 of the Bechtel Power/Consumers Power Company contract regarding repair of defective work at contractor's expense, we are requesting that you advise us as to the reasons for this failure and set up a separate account for costs incurred for removal and repair of same (engineering and construction).

We would anticipate that your response to this office would include some discussion as to why the incident should or should not come under the provisions of Article 9 of the contract.

L. C. Cooke
Project Superintendent

LC/pp

SR139082

I DESCRIPTION OF CONDITION

By routine survey check of August 23, 1977, the top surface at column line H_T on the north end of the subject grade beam was found to be 3½" below its design elevation. The south end of the beam at its tie into the steam tunnel wall was at its design elevation, however, there was approximately ½" separation between the beam and the wall. The beam was not structurally cracked. Soil conditions at the time of the failure were per the attached Figure 1A. There was no visible evidence of soil heaving, cracking, sluffing, or water flow at any point on the 3:1 slope to the north of the subject beam, nor was there any visible soil disturbance on either side of the beam looking from the top. The foundation layout for the Administration Building is shown in Figure 2. As built elevations of the subject beam are given in Table 1.

To confirm that the beam was not incorrectly surveyed when constructed, the beam was surveyed again the week of August 29. Additional settlement was noted and the beam was found to be approximately ½" out of plumb, leaning to the west at column line H_T.

No settlement was found from surveys of all other Administration Building footings and the steam tunnel walls.

SR158083

II INITIAL EVALUATION OF FAILURE

After evaluation of the conditions by both the Field and Project Engineering, it was determined that the 0.4 line foundation could not be economically stabilized and salvaged.

Bechtel Letter

To: T.C. Cooke

Subject: Report On Failure of the Administration Building Grade Beam at 0.4 Line

P.A. Bechtel ← SFHO

bcc P.A. Martinez
R. Hermeston
R.L. Castleberry
F.E. Meyer
F.G. Teague / J.P. Betts
R.B. Ward / J.S. Dean
?

all located in A²

SB158085

Reference: T.C. Cooke letter to J.F. Newgen CCBC-11[illegible] dated 9/8/77 (Serial 2538)

SB158084

This letter is written in response to the referenced letter and provides a report on the cause of the subject failure which you requested.

For simplicity we have divided the report into four main sections. ~~Each of which represents a~~ Our comments regarding the applic-

Since conditions
~~Because~~ the cause of the failure was not apparent from the ~~facts~~ at the time of discovery, it was determined that additional testing and observations would be required during removal of the beam to, hopefully, determine the cause of failure and the best method of replacement.

III RESULTS OF TESTING

A) Original Material Testing

Attachment #1 includes the reports of the in place density tests taken during placement of the Zone 1 (clay) material under the footings in June 1977 (See Figures 1A & 1B for location of this material). This material was taken from a field stockpile which included material taken from many excavations into the dike and different areas of the fill as well as other approved sources. Differences in grain size, texture and other structural properties of this material account for the fact that the Bechtel modified Proctor tests taken in different locations of the stock pile range in optimum dry density from 117 ~~PCF~~ to 132.9 ~~PCF~~. The Proctor or maximum dry density value used to compare with field densities was selected by the testing technician using bottled samples of each recent Proctor in the lab for visual comparison to the field density sample. New Proctor tests were run by the test lab whenever a new or questionable material was encountered. A new Proctor test was also run for a minimum of every 10,000 yards of compacted fill placed. As new tests were taken, old Proctor samples were disposed of.

A review of the results of all tests taken in the fill under the 0.4 line footing indicate that the material was properly compacted to 95% of optimum density. Several tests in the area failed originally, however, all failing lifts were re-conditioned and re-compacted and all were re-tested and found acceptable, prior to continuing removal.

B) Material Testing and Observations During Footing Removal

During footing removal (September 1977) there were several rains and almost continuous surface water.

The removal program called for removal of all Zone 2 (sand) and the Zone 1 materials placed in June of 1977 (see figures 1A & 1B). Slope protection using plastic mats and de-watering was continuously maintained during excavation to protect the adjacent Zone 1 material (placed prior to 1977) and the remaining Administration Building footings supported by that fill. Surveys run during and after the footing removal on adjacent footings and steam tunnel walls indicated no settlement or disturbance of those structures.

The Zone 2 material, which is a free draining sand material, did not show visual evidence of disturbance or movement throughtout its depth. The mud mat under the footings, for the few which could be cleaned prior to break-up and removal, did not show structural cracking.

The Zone 1 (clay) material placed in June 1977 below footing to elevation 614' was tested at each footing location at varying elevations by taking field density test and corresponding moisture tests. The material was moist, soft, and easily penetrated by hand probing up to 2 feet with a 3/4 " rod. Field density and moisture tests in accordance with ASTM D-1556 during material removal were compared to the current Procter maximum density, optimum moisture information (which was probably not appropriate as the fill was placed 3 to 4 months before the tests). The fill was found to fail specification requirements in either moisture or density or both. Compaction was judged to be around 92-94%. The moisture was found to be in the 15% to 22% range. A Bechtel

modified Procter curve was then run on a sample of this material (see Attachment #2). Using this Procter as the standard, the in place density of this material (average = 117 PCF) averaged 90% of the optimum compaction density. Of the 15 tests taken, 4 showed density below the above average compaction and one test was below 83% of the optimum compaction density using the actual Proctor as the standard of comparison.

Six unconfined compression tests (ASTM D-2166-66) were run between elevation 614' and Elevation 622' in the removed Zone 1 material during footing removal (See Table 2). The minimum unconfined bearing strength was noted to be 550 PSF ft. The allowable bearing capacity of the soil was found to be in the range of 788 PSF to 1792 PSF.

Test borings were taken at two locations (column line 0.4 and L_N and 0.4 and H_T) after footing removal and prior to removal of the Zone 1 material below the footing at elevation 622'. The boring machine utilized a 2" split Shelby Tube. Sampling and testing were conducted in accordance with instructions provided by a Bechtel Geotech from the Area Representative. Testing included standard penetration tests, unconfined compression tests and Procter Tests. Boring logs are given in Figures 3 through 7. Unconfined compression strengths are included in Table #2. The low bearing capacity of Zone 1 material placed in June of 1977 was confirmed both by penetration tests and unconfined compression tests on this material.

SB158088

Results of the density testing done on the boring samples are given in Figures 8, 9 and 10. These tests confirm the in place compaction tests taken during footing removal. The borings extended into the original glacial till at approximate elevation 580' (±). The results of penetration

tests in the dike material below elevation 614.5) indicated that material was sound and suitable for foundation. Further Proctor and field density testing of the material below elevation 614' indicated densities and moistures acceptable and in accordance with specification requirements.

IV. ANALYSIS

It is evident that the low bearing capacity of the Zone 1 material placed in June 1977 between elevation 614' and 622' is the cause of this failure. If the allowable bearing capacity of the soil is assumed to be about 1000 PSF, the overburden of 12 feet of sand on the footings would overstress this material (12 feet at 120 PCF = 1440 PSF).

The cause of the reduced bearing capacity of this material cannot be exclusively established. However, the material's high moisture content contributed to the reduced bearing capacity. When compacted to 95% of the optimum density this material is relatively impermeable to water. The material had a higher maximum density than the maximum density selected by the testing technicians for comparison of in place densities, which resulted in an average actual compaction of 90% rather than the required 95%. Although the reduced in place density cannot be directly correlated to this settlement by calculations, it did contribute in some measure to increased water permeability and the reduced bearing capacity. As an illustration of the effect of reduced percent compaction on the strength of soil, data of California bearing ratio tests previously made on three identical samples of Midland soil compacted at different levels of compactive effort are presented in Figure 11.

SB158039

Considering the unusually wet conditions after this material was placed and the possibility that ground water seepage was introduced into the material in question, it is also possible that the slope to the north of these footings softened and failed. As indicated previously in this report, there was no

visable evidence of such failure, and the 3:1 slope should have been gradual enough to sustain the fill; however, under conditions of reduced internal soil strength, this condition might have contributed to the problem. Vibration introduced by compaction equipment used to place the Zone #2 (sand) above the questionable material also contributed to the problem.

In summary, although no single factor was found to be the definitive cause, the low bearing capacity of the material directly below the footings resulted in the failure. As borings and tests on the surrounding materials indicated they were suitable for foundation, removal of the questionable material was determined to be the appropriate solution to the problem.

To further assure that existing footings in the administration building were not disturbed by the removal and replacement of the 0.4 line footings, a load test of the footings on column lines Pa and Nk was conducted in accordance with ASTM D1194-72. The full design load was applied and maintained for 24 hours on each footing. Results of the tests (Attachment 3) were reported to Project Engineering and were found acceptable.

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)
Pa	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_P	633.93	0.28
H_T	633.92	0.29

SB158031

MIDLAND UNITS 1 & 2

ADMINISTRATION BUILDING EXCAVATION

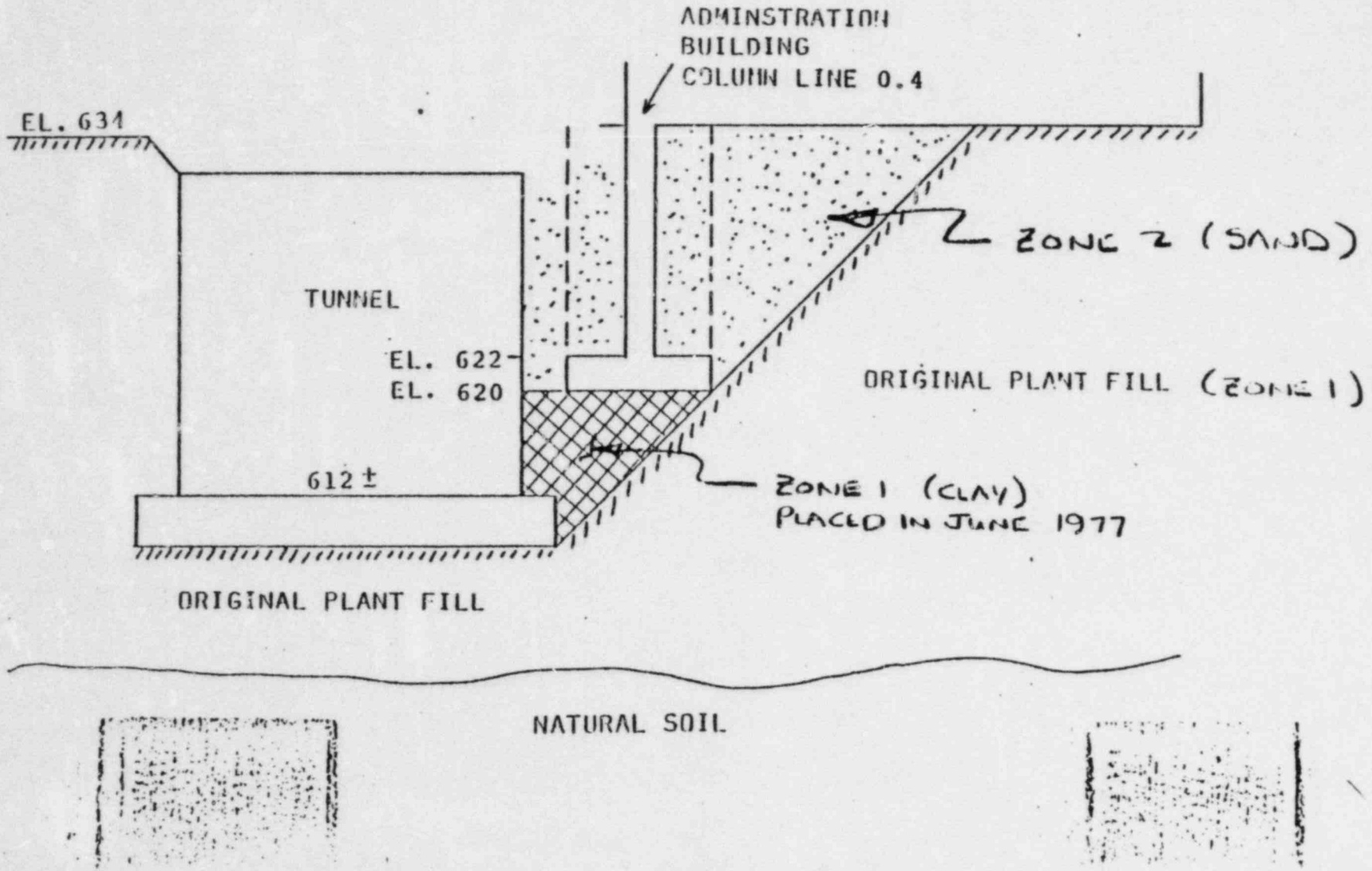
UNCONFINED COMPRESSION TESTS

Sample No.	Sample Location	Sample Elevation	*Unconfined Compression Strength Lbs Per Sq Ft	**Allowable Bearing Value Lbs Per Sq Ft	Percent Strain	Rema
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	914	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	2423	20.0	

ST - Shelby Tube Sample * ASST/ASTM D 2166-66(72) **1/2 x 5.14 x 1/2 x Unconfined Com

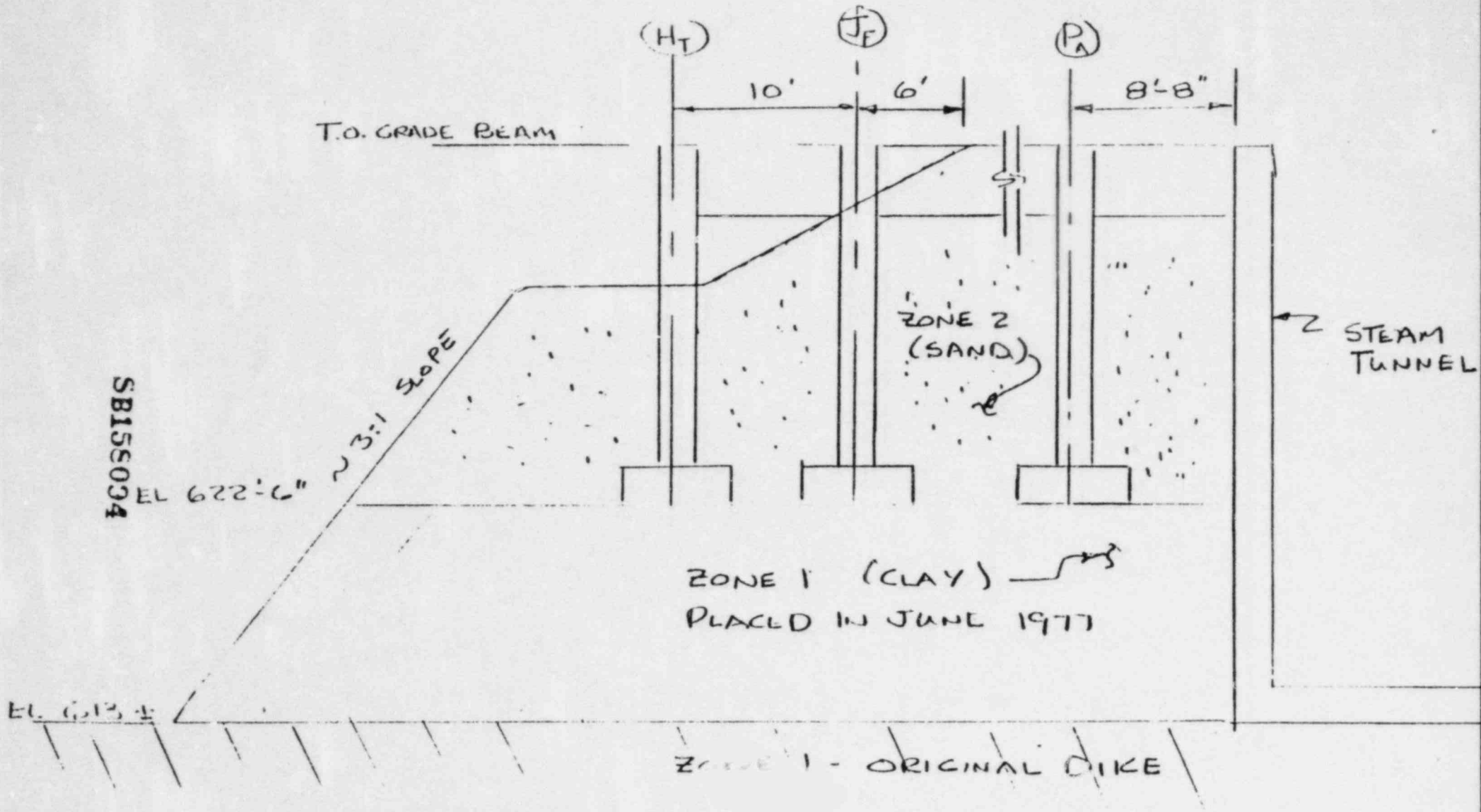
SB155092

Figure 1A



SB15S093

FIGURE 15.



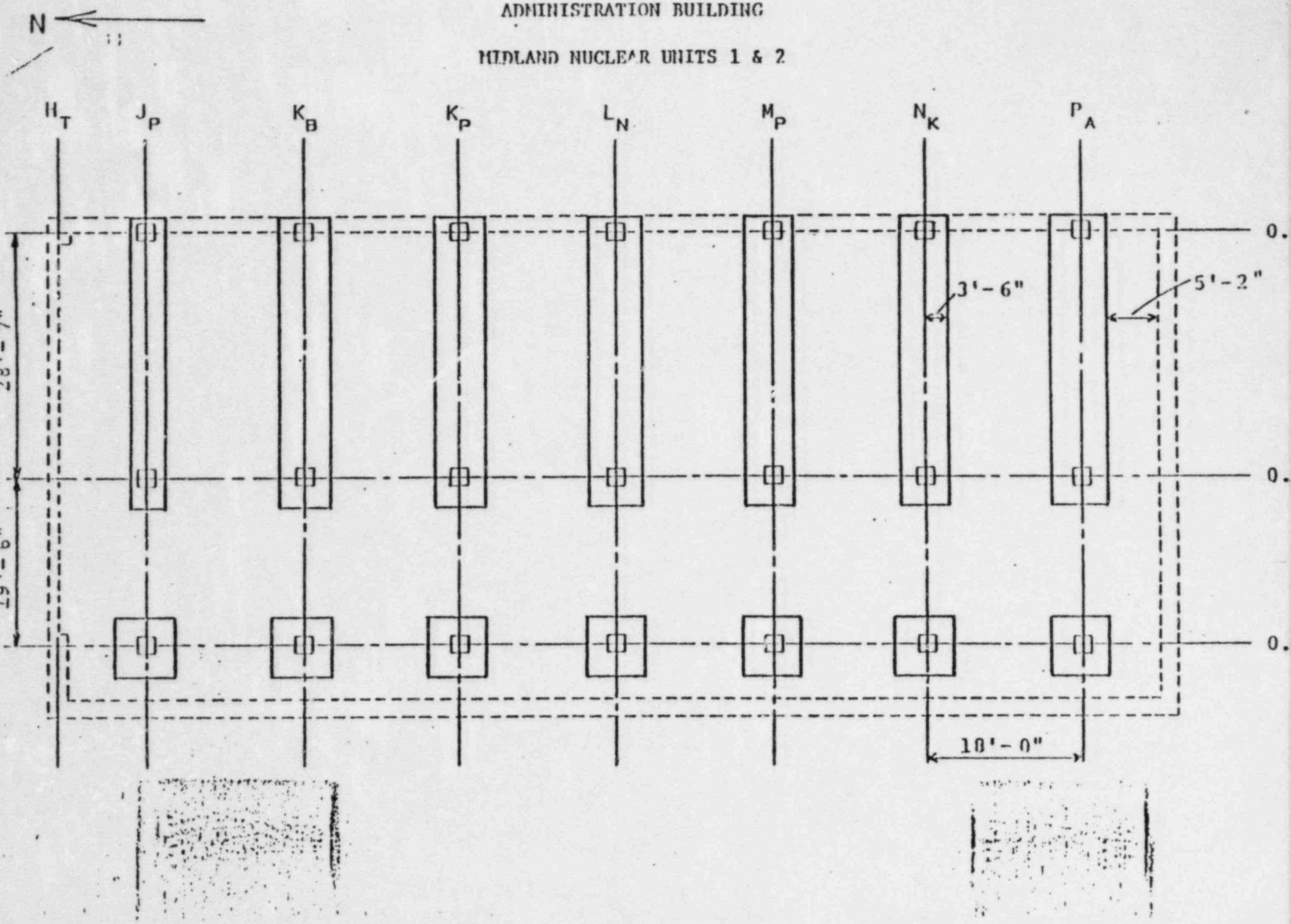
SECTION @ 0.4 LINE - LOOKING LAST
NIS
ADMINISTRATION BUILDING

Figure 2

FOUNDATION LOCATION PLAN

ADMINISTRATION BUILDING

MIDLAND NUCLEAR UNITS 1 & 2



8805050S

BORING L.G

MIDLAND NUCLEAR PLANT | 7220 | 1 of 1 | LN

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

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

CORE RECOVERY (FT./%)	CORE HOSES	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./LENGTH	LOGGED BY:
140#/18"	NONE	JERRY B. GIVENS

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE/LENGTH CORE RUN	SAMPLE RECOVERY/CORE RECOVERY	SAMPLE BLOWS/" / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	2ND 6"	3RD 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							622					
							620				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-CIRCULATIA WATER BELOW 8.5'
2'ST	2'	1.5'	—	—	—	—	619.5	2.5		1	2'-2.5' GREY GRAVELLY CLAY (CL)	
2'ST	2'	0.9'	—	—	—	—		4.5		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		3	7'-25.5' BROWNISH GREY (FILL)	
2'SS	1.5'	1.2'	37	13	17	20		9.5		4		
2'ST	2'	0'	—	—	—	—		12		5	12' LARGE COBBLE (? BENT TUBE)	SLIGHT WATER SEEPAGE AT 2.5'
2'SS	1.5'	0.5'	25	10	14	14		14.5		6	14.5' INCREASE IN SAND CONTENT	
2'ST	2'	1.0'	—	—	—	—		17		7	15.5' 1" STONE	USED DEWITT GLAZING COMPOUND AND MASKING TAPE TO SEAL TUBES
2'SS	1.5'	0.9'	31	17	16	15		19		8		SAVED 33 SAMPLES IN JARS
2'ST	2'	1.7'	—	—	—	—		22		9	22' STONE	
2'SS	1.5'	0.5'	19	6	9	10		22.5		10	22'-27.5' STIFF TO MEDIUM STIFF	#1 Qp = 4.5+ TSF
							594.5	25.5		11	22.5' DECREASE IN SAND CONTENT	#2 Qp = 4.5+ TSF
2'ST	2'	0'	—	—	—	—		27.5		12	25.5'-27.5' MEDIUM PLASTICITY	#3 Qp = 4.5+ TSF
2'SS	1.5'	0.2'	10	4	5	5	591.0	28			27.5'-31' SAND SEAM ? LOOSE? (POOR RECOVERY AREA - TUBE PUSHED EASILY) (FILL)	#4 Qp = 4.5+ TSF
2'ST	2'	1.3'	—	—	—	—	589.0	30.5			31'-33' SANDY CLAY, GREY, STIFF TO MEDIUM STIFF (CL) (FILL)	#5 NO Qp - TUBE BENT BADLY
2'SS	1.5'	0.2'	20	2	9	11		32			33'-37' SILTY SAND, THIN W LITTLE MOSTLY MEDIUM COLOR, FINE TO MEDIUM GRAINED, MEDIUM DENSE (SP/SM) (FILL)	#6 Qp = 2.25 TSF
2'SS	2.5'	2.0'	100+	22	100/.1'	—	585.0	37.5			37'-43.5' SILTY SAND, GREY, FINE TO MEDIUM GRAINED, VERY DENSE, MOIST (SP/SM)	#7 NO Qp - TIP OF TUBE BENT
2'SS	2.5'	2.0'	100+	77	100/.2'	—		40.5			36.5'-43.5' FINE GRAINED	#8 Qp = 4.5 TSF
2'SS	2.5'	0.2'	100+	100	—	—	578.5	43				#9 Qp = 2.75, 4+ TSF
								43.5			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 - #15 NO Qp (SAND)
												WATER LEVEL 5.9' AFTER CASING PULLED
												HOLE BACKFILLED WITH SOIL AT COMPLETION

SB158036

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

SITE: ADMINISTRATION BLDG.

HOLE NO.: LN

9/27/77

9/28/77

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
MILLSTONE NUCLEAR PLANT	7220	1 of 1	LNA

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

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9/22/77	9/22/77	SINGLETON (ABEL DRIL.)	CME-550	5"	—	—	5'

CORE RECOVERY (FT/%)	CORE BOXES	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

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE/LENGTH CORE RUN	SAMPLE RECOVERY/CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	2ND 6"	3RD 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							622					5" AUGER TO 5'; TOOK BULK SAMPL FOR COMPACT. TEST FROM 2.5'-5' AND COMBINED IT WITH BULK SAMPLE FRO HOLE LNB
											0'-2.5' SAND BACKFILL	
BULK	2.5'	2.5'	—	—	—	—	619.5	2.5			2.5'-5' COMPACTED CLAY	
							617	5			TOTAL DEPTH = 5' EL. BOTTOM = 617	HOLE BACKFILL WITH SOIL AFTER COMPLE
												REFER TO BORING LOG "LN" FOR MOR INFO. CONCERN SOIL PROFILE

SB158037

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

SITE	HOLE NO.
ADMINISTRATION BLDG.	LNA

BORING LOG

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

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

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

CORE RECOVERY (FT./%)	CORE BOXES	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

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	2ND 6"	3RD 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							622					
											0'-2.5' SAND BACKFILL	5" AUGER TO 5'; TOOK BUL. SAMPLE FOR COMPACTION TEST FROM 2.5'-5' AND COMBINED IT WITH BULK SAMPLE FROM HOLE LNA
BULK	2.5'	2.5'	—	—	—	—	619.5	2.5/5			2.5'-5' COMPACTED CLAY	
							617				TOTAL DEPTH = 5' EL. BOTTOM = 617	HOLE BACKFILL WITH SOIL AFTER COMPLE
												REFER TO BORING LOG "LN" FOR MOR INFO. CONCERN ING SOIL PROFILE

SB155038

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

SITE	HOLE NO.
ADMINISTRATION BLDG.	LNB

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
MIDLAND NUCLEAR PLANT	7220	1 of 1	H_T

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

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

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

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

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE/LENGTH CORE RUN	SAMPLE RECOVERY/CORE RECOVERY	SAMPLE BLOWS "N"/PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	2ND 6"	3RD 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							631				0'-11.5' SILTY SAND, TAN (BACKFILL) (SP/SM)	5' AUGER TO 6.5' SET CASN. DRILLED W/ 4" TRI-CONE ROLL. BIT USING RE-CIRCULATING FLUID
2"SS	1.5'	0.7'	8	2	3	5	619.5	11.5		1	11.5'-16' SANDY CLAY, GREYISH 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		13.5		2		#2 Qp = 0.8 TSF
2"SS	1.5'	0.9'	25	7	12	13	615	16		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		18.5	FILL	4		#4 Qp = 4.5+ TSF
2"SS	1.5'	0.5'	18	10	12	6		23.5		5	23.5 INCREASE IN SAND CONTENT	#5 Qp = 3 TSF
2"SS	1.5'	0.9'	22	8	10	12	602.5	28.5		6	28.5'-47' SANDY CLAY, TANNISH BROWN, VERY STIFF, MEDIUM PLASTICITY MOIST (CL) PELLET OF COAL STREAKING THROUGH	#6 Qp = 3.25 TSF (CLAY)
2"SS	1.5'	1.0'	30	10	15	15		33.5		7	28.5'-33.5 SEAM OF GREY SILTY FINE TO MEDIUM SAND 33.5-38.5 GREYISH BROWN, SEAMS OF SAND	#7 Qp (NONE, TOO SANDY)
2"SS	1.5'	1.0'	10	2	5	5		38.5		8	38.5-47 STIFF	#8 Qp = 1.75 TSF (BREAKING UP, SANDY)
2"SS	1.5'	0.2'	15	5	6	9	584	43.5		9		#9 No Qp (TOO LITTLE REC.)
2"SS	1.5'	1.5'	111	18	40	71	581	48.5		10	47-50' FINE SILTY SAND, GREY, VERY DENSE, TRACE ORGANICS, CLAYEY SILT LENSES, SLIGHT MOISTURE (SM)	#10 No Qp (SAND)
											TOTAL DEPTH = 50' EL. BOTTOM = 581'	WATER LEVEL AT 9' WHILE DRILLING, RISE TO 7.1' AFTER DRILLING COMPLETED AND CASING REMOVED. HOLE BACKFILL W/ SOIL AFTER COMPLETION

SB158039

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

SITE: ADMINISTRATION BLDG.

HOLE NO.: H_T

13C10-1

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
MIDLAND NUCLEAR PLANT	7220	1 of 1	HTA

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
ADMINISTRATION BLDG.	1.0' NORTH OF HOLE "HT"	90°	—

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9/23/77	9/28/77	SINGLETON/ABEL DRILL	CME-550	5"	—	—	14.5

CORE RECOVERY (FT./%)	CORE BOXES	CASING	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
—	—	1	—	631	(SEE HOLE "HT")	—

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

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE/ LENGTH CORE RUN	SAMPLE RECOVERY/ CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	PENETRATION BLOWS 2ND 6"	PENETRATION BLOWS 3RD 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							631					
											0'-11.5' SAND BACKFILL	5" AUGER TO 14.5', TOOK BULK SAMPLE FOR COMPACT. TEST FROM 11.5'-14.5'
BULK	3'	3'	—	—	—	—	619.5	11.5/14.5			11.5'-14.5' COMPACTED CLAY	HOLE BACKFILL WITH SOIL AFTER COMPL
							616.5				TOTAL DEPTH = 14.5' EL. BOTTOM = 616.5	REFER TO BORING LOG "HT" FOR MORE INFO. CONCERNING SOIL PROFILE

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

SITE	HOLE NO.
ADMINISTRATION BLDG.	HTA

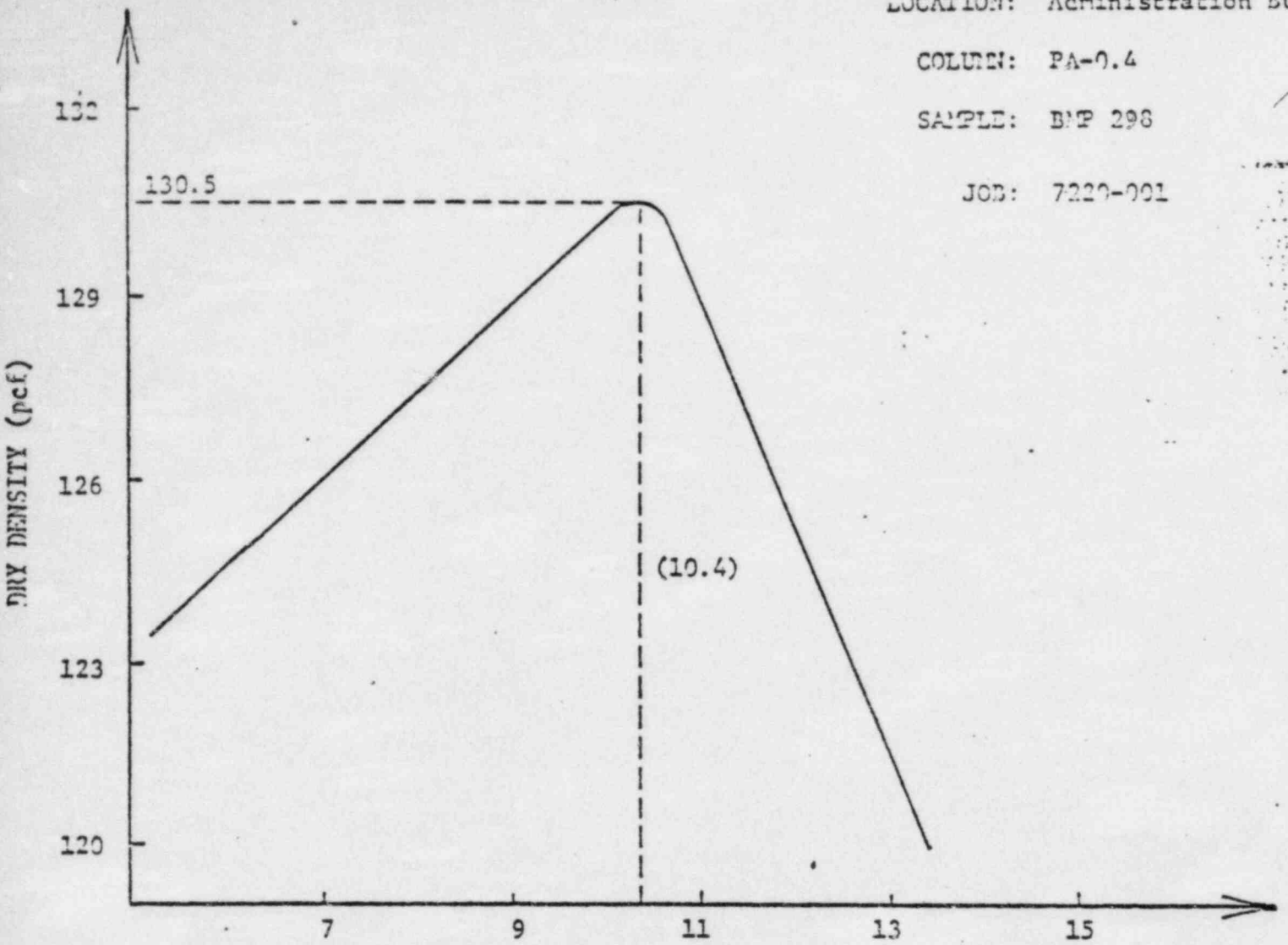
SB158100

LOCATION: Administration Build

COLUMN: PA-0.4

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	90.0
			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	91.0
BMP 273	117.0	15.2	108.5	19.5	92.7	83.1

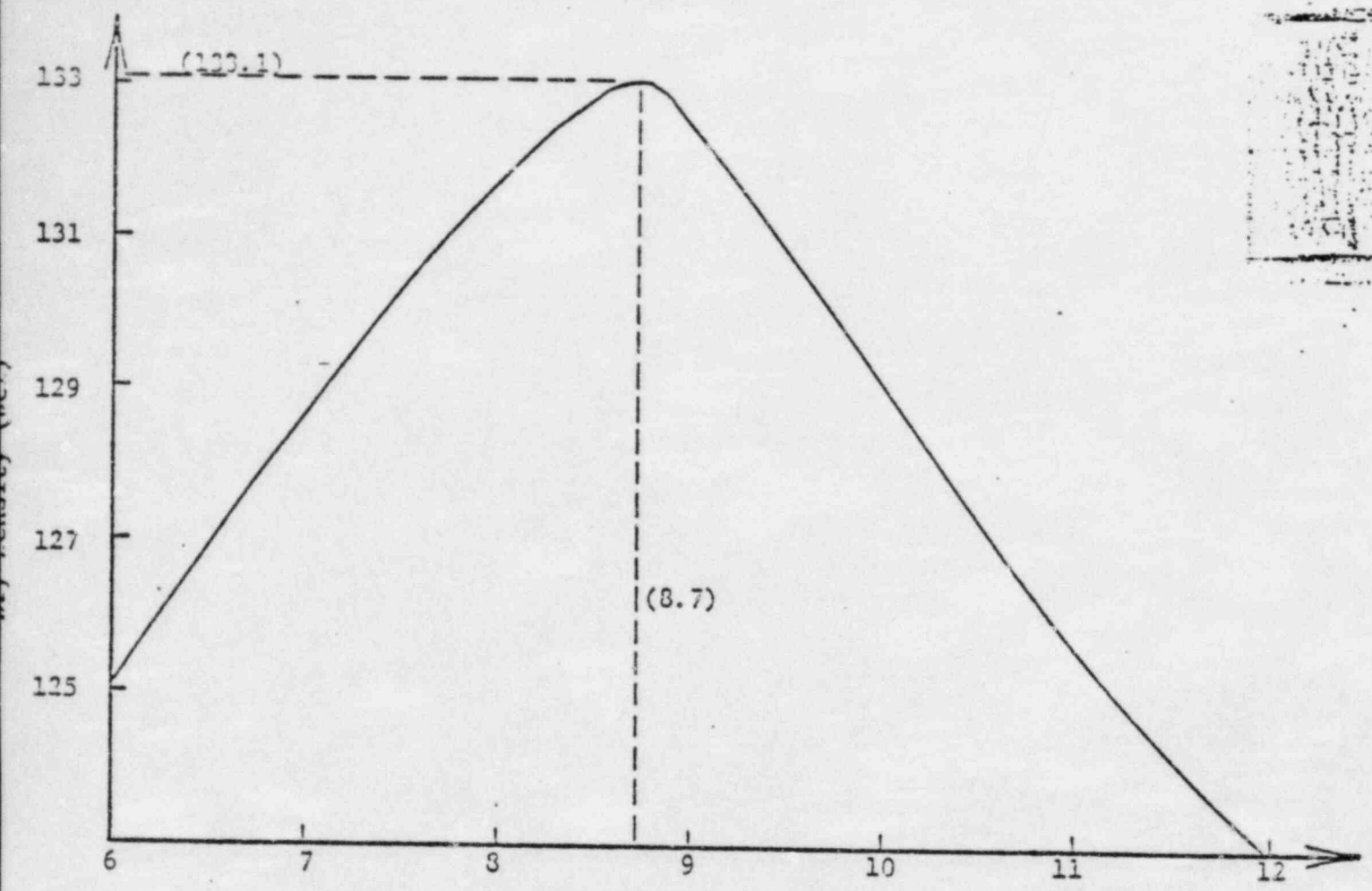
$\gamma_{d(max)}$ = Maximum dry density as determined for a particular compaction test

Wo = Corresponding optimum water content

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

Wof = Corresponding field moisture content

SB158101



MOISTURE CONTENT %

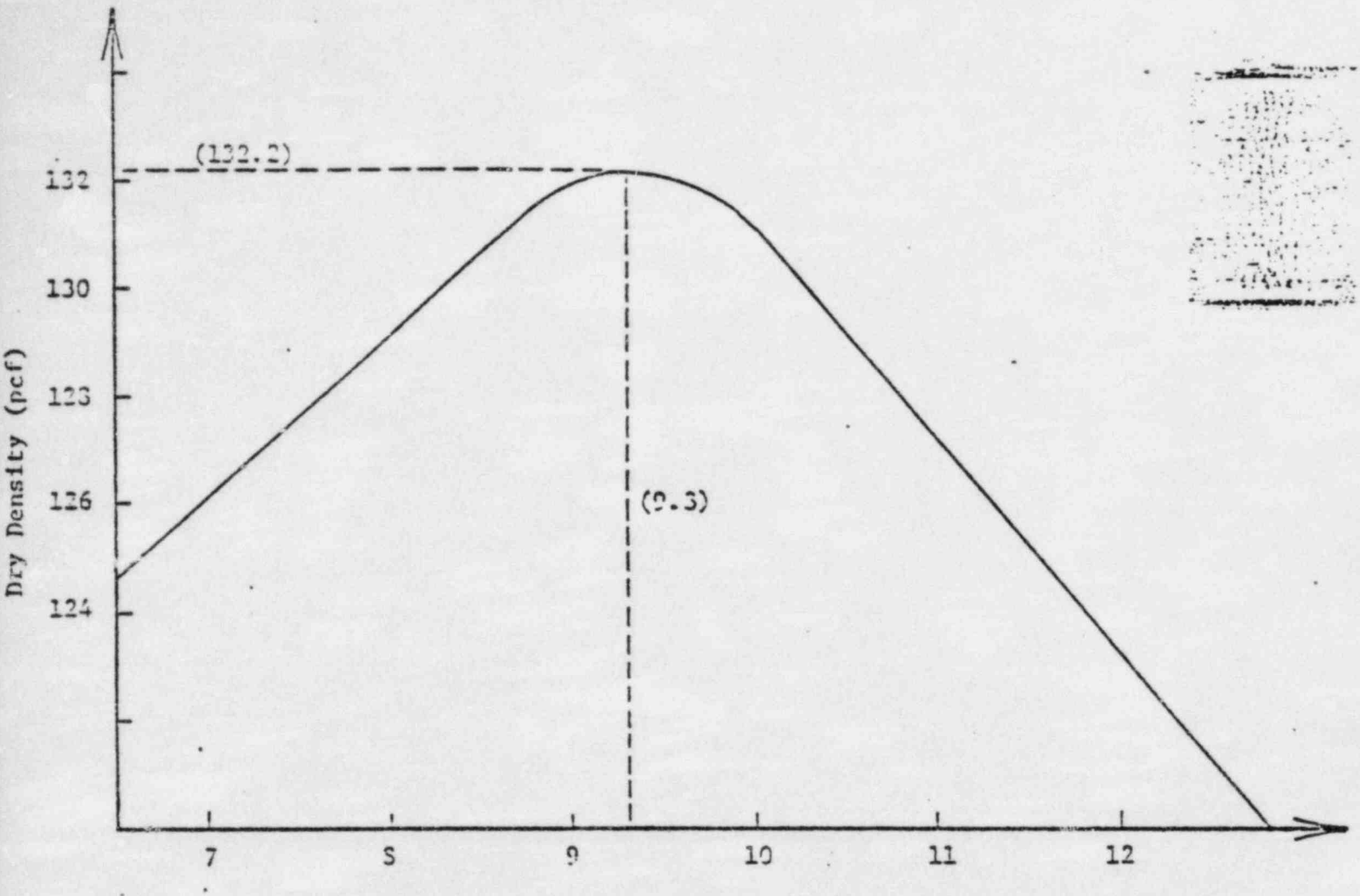
LOCATION: Administration Building

COLUMN: LN-0.4

SAMPLE: BHP-299

JOB: 7220-001

SB158102



MOISTURE CONTENT %

LOCATION: ADMINISTRATION BUILDING

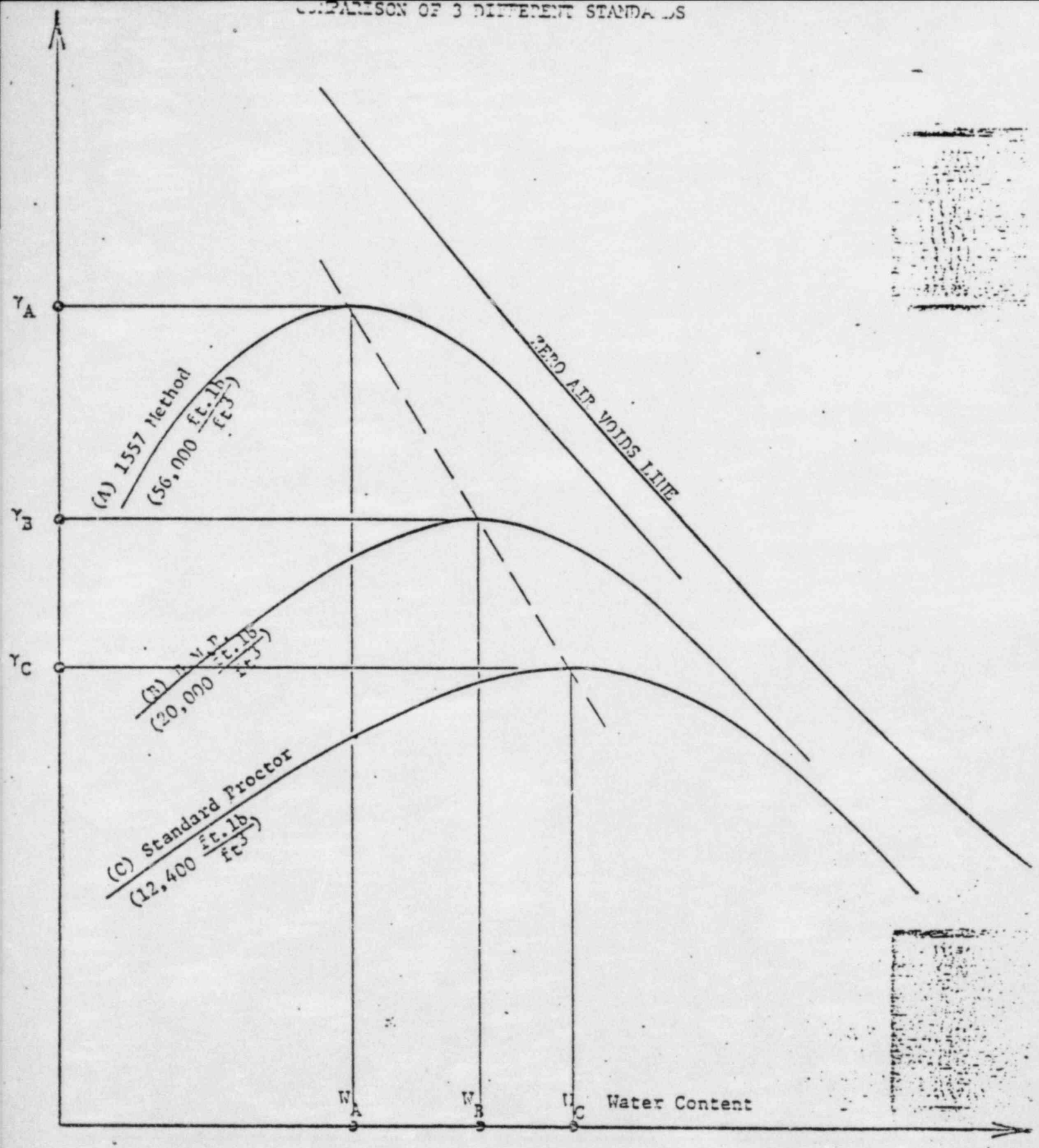
COLUMN: ET-0.4

SAMPLE: BNP-300

JOB: 7220-001

SB15S103

COMPARISON OF 3 DIFFERENT STANDARDS



	Optimum Water Content	Maximum Dry Density	Load at 0.1" Penetration
A	12.7(%)	124.5(pcf)	94.5 (psi)
B	14.0(%)	117.0(pcf)	57.2 (psi)
C	15.0(%)	112.8(pcf)	5 (psi)

SB158104

COMPACTED FILL DENSITY TEST REPORT

Admin. Bldg. Tests Highlighted.

1 of 15

QC ACCEPTANCE

CONTROL NO. FI

1 PROJECT NO 7220

2 DATE 6-27-77

PAGE 1 OF

SB158105

4 SPEC NO 7220-C-208 5 DRAWING NO Plot Plan 6 TESTED WEEK OF 6/19/77 TO 6/

7 DATE TAKEN	8 TEST NO	9 TESTED BY	10 LOCATION	11 ELEV. OF TEST	12 DEPTH BELOW FINAL GRADE (FT)	13 IN PLACE WET DENSITY (LB/CU FT)	14 MOISTURE CONTENT (%)	15 IN PLACE DRY DENSITY (LB/CU FT)	16 SOIL CLASSIFICATION	17 MAX. LAB. DRY DENSITY (LB/CU FT)	18 PERCENT COMPACTION	19 REMARKS
					—							
					—							
					—							
					—							
					—							
6/17	1467			639	—	132.5	13.4	130.0	371 5.2 1	117.0	113.6	Pass
					—							
					—							
					—							
					—							
					—							
					—							
					—							
					—							
					—							
			See Page 2									
6/19	1471	BS		600	—	143.5	2.3	124.5	369 9.5 1	130.1	91.5	Pass
"	1473	"	33'E of 12.0	614	—	132.5	2.9	131.7	369 10.0 1	127.3	95.6	Pass

20 PREPARED BY (Signature) [signature] 6/19/77 DATE 6/19/77 21. RESPONSIBLE ENGINEER [signature] DATE 7/5/77

CONTROL NO.

1 PROJECT NO 7220 2 DATE 6-27-77 PAGE 2 OF

1 SPEC NO 7220-C-308 5 DRAWING NO Plan No. 6 TESTED WEEK OF 6/27 to 6/2

DATE TAKEN	8. TEST NO	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT)	13. IN PLACE WET DENSITY (LB/C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB/C.F.)	16. SOIL CLASSIFICATION	17. MAX LAB DRY DENSITY (LB/C.F.)	18. PERCENT COMPACTION	19. REMARKS
6/21	1271	BS	1+00 Rt	621	—	114.6	5.2	108.9	55 W/P 2	109.2	96 %	Pass
6/21	1272	BS	1+00 Lt	621	—	113.2	5.6	107.2	55 W/P 2	109.2	98.2 %	Pass
6/21	1273	BS	2+50 Rt	619	—	114.1	6.0	107.6	55 W/P 2	109.2	98.6 %	Pass
6/21	1274	BS	2+50 Lt	619	—	113.0	6.2	106.4	55 W/P 2	109.2	97.5 %	Pass
6/21	1275	BS	4+00 Rt	620	—	113.8	5.8	107.5	55 W/P 2	109.2	98.5 %	Pass
6/21	1276	BS	4+00 Lt	620	—	112.9	6.1	106.4	55 W/P 2	109.2	97.5 %	Pass
6/21	1277	BS	5+50 Rt	619	—	113.5	6.0	107.1	55 W/P 2	109.2	98.1 %	Pass
6/21	1278	BS	5+50 Lt	619	—	113.0	6.2	106.4	55 W/P 2	109.2	97.5 %	Pass
6/21	1279	BS	7+00 Rt	618	—	113.4	6.0	106.9	55 W/P 2	109.2	97.9 %	Pass
6/21	1280	BS	7+00 Lt	618	—	112.8	6.3	106.1	55 W/P 2	109.2	97.2 %	Pass
6/21	1281	BS	8+50 Rt	617	—	113.1	6.1	106.6	55 W/P 2	109.2	97.7 %	Pass
6/21	1282	BS	8+50 Lt	617	—	112.5	6.4	105.7	55 W/P 2	109.2	96.8 %	Pass
6/21	1283	BS	10+00 Rt	616	—	112.9	6.2	106.3	55 W/P 2	109.2	97.4 %	Pass
6/21	1284	BS	10+00 Lt	616	—	112.3	6.5	105.5	55 W/P 2	109.2	96.6 %	Pass
6/21	1285	BS	11+50 Rt	615	—	112.7	6.3	106.0	55 W/P 2	109.2	97.1 %	Pass
6/21	1286	BS	11+50 Lt	615	—	112.1	6.6	105.1	55 W/P 2	109.2	96.3 %	Pass
6/21	1287	BS	13+00 Rt	614	—	112.5	6.4	105.7	55 W/P 2	109.2	96.8 %	Pass
6/21	1288	BS	13+00 Lt	614	—	111.9	6.7	104.9	55 W/P 2	109.2	96.1 %	Pass
6/21	1289	BS	14+50 Rt	613	—	112.3	6.5	105.5	55 W/P 2	109.2	96.6 %	Pass
6/21	1290	BS	14+50 Lt	613	—	111.7	6.8	104.6	55 W/P 2	109.2	95.8 %	Pass
6/21	1291	BS	16+00 Rt	612	—	112.1	6.6	105.1	55 W/P 2	109.2	96.3 %	Pass
6/21	1292	BS	16+00 Lt	612	—	111.5	6.9	104.3	55 W/P 2	109.2	95.5 %	Pass
6/21	1293	BS	17+50 Rt	611	—	111.9	6.7	104.9	55 W/P 2	109.2	96.1 %	Pass
6/21	1294	BS	17+50 Lt	611	—	111.3	7.0	104.0	55 W/P 2	109.2	95.2 %	Pass
6/21	1295	BS	19+00 Rt	610	—	111.7	6.8	104.6	55 W/P 2	109.2	95.8 %	Pass
6/21	1296	BS	19+00 Lt	610	—	111.1	7.1	103.7	55 W/P 2	109.2	95.0 %	Pass
6/21	1297	BS	20+50 Rt	609	—	111.5	6.9	104.3	55 W/P 2	109.2	95.5 %	Pass
6/21	1298	BS	20+50 Lt	609	—	110.9	7.2	103.4	55 W/P 2	109.2	94.7 %	Pass
6/21	1299	BS	22+00 Rt	608	—	111.3	7.0	104.0	55 W/P 2	109.2	95.2 %	Pass
6/21	1300	BS	22+00 Lt	608	—	110.7	7.3	103.2	55 W/P 2	109.2	94.5 %	Pass
6/21	1301	BS	23+50 Rt	607	—	111.1	7.1	103.7	55 W/P 2	109.2	95.0 %	Pass
6/21	1302	BS	23+50 Lt	607	—	110.5	7.4	102.9	55 W/P 2	109.2	94.2 %	Pass
6/21	1303	BS	25+00 Rt	606	—	110.9	7.2	103.4	55 W/P 2	109.2	94.7 %	Pass
6/21	1304	BS	25+00 Lt	606	—	110.3	7.5	102.6	55 W/P 2	109.2	93.9 %	Pass
6/21	1305	BS	26+50 Rt	605	—	110.7	7.3	103.2	55 W/P 2	109.2	94.5 %	Pass
6/21	1306	BS	26+50 Lt	605	—	110.1	7.6	102.3	55 W/P 2	109.2	93.7 %	Pass
6/21	1307	BS	28+00 Rt	604	—	110.5	7.4	102.9	55 W/P 2	109.2	94.2 %	Pass
6/21	1308	BS	28+00 Lt	604	—	109.9	7.7	102.0	55 W/P 2	109.2	93.4 %	Pass
6/21	1309	BS	29+50 Rt	603	—	110.3	7.5	102.6	55 W/P 2	109.2	93.9 %	Pass
6/21	1310	BS	29+50 Lt	603	—	109.7	7.8	101.8	55 W/P 2	109.2	93.2 %	Pass
6/21	1311	BS	31+00 Rt	602	—	110.1	7.6	102.3	55 W/P 2	109.2	93.7 %	Pass
6/21	1312	BS	31+00 Lt	602	—	109.5	7.9	101.5	55 W/P 2	109.2	92.9 %	Pass
6/21	1313	BS	32+50 Rt	601	—	109.9	7.7	102.0	55 W/P 2	109.2	93.4 %	Pass
6/21	1314	BS	32+50 Lt	601	—	109.3	8.0	101.2	55 W/P 2	109.2	92.7 %	Pass
6/21	1315	BS	34+00 Rt	600	—	109.7	7.8	101.8	55 W/P 2	109.2	93.2 %	Pass
6/21	1316	BS	34+00 Lt	600	—	109.1	8.1	101.0	55 W/P 2	109.2	92.5 %	Pass
6/21	1317	BS	35+50 Rt	599	—	109.5	7.9	101.5	55 W/P 2	109.2	92.9 %	Pass
6/21	1318	BS	35+50 Lt	599	—	108.9	8.2	100.7	55 W/P 2	109.2	92.2 %	Pass
6/21	1319	BS	37+00 Rt	598	—	109.3	8.0	101.2	55 W/P 2	109.2	92.7 %	Pass
6/21	1320	BS	37+00 Lt	598	—	108.7	8.3	100.4	55 W/P 2	109.2	91.9 %	Pass
6/21	1321	BS	38+50 Rt	597	—	109.1	8.1	101.0	55 W/P 2	109.2	92.5 %	Pass
6/21	1322	BS	38+50 Lt	597	—	108.5	8.4	100.1	55 W/P 2	109.2	91.7 %	Pass
6/21	1323	BS	40+00 Rt	596	—	108.9	8.2	100.7	55 W/P 2	109.2	92.2 %	Pass
6/21	1324	BS	40+00 Lt	596	—	108.3	8.5	99.8	55 W/P 2	109.2	91.4 %	Pass
6/21	1325	BS	41+50 Rt	595	—	108.7	8.3	100.4	55 W/P 2	109.2	91.9 %	Pass
6/21	1326	BS	41+50 Lt	595	—	108.1	8.6	99.6	55 W/P 2	109.2	91.2 %	Pass
6/21	1327	BS	43+00 Rt	594	—	108.5	8.4	100.1	55 W/P 2	109.2	91.7 %	Pass
6/21	1328	BS	43+00 Lt	594	—	107.9	8.7	99.3	55 W/P 2	109.2	90.9 %	Pass
6/21	1329	BS	44+50 Rt	593	—	108.3	8.5	99.8	55 W/P 2	109.2	91.4 %	Pass
6/21	1330	BS	44+50 Lt	593	—	107.7	8.8	99.0	55 W/P 2	109.2	90.7 %	Pass
6/21	1331	BS	46+00 Rt	592	—	108.1	8.6	99.6	55 W/P 2	109.2	91.2 %	Pass
6/21	1332	BS	46+00 Lt	592	—	107.5	8.9	98.7	55 W/P 2	109.2	90.4 %	Pass
6/21	1333	BS	47+50 Rt	591	—	107.9	8.7	99.3	55 W/P 2	109.2	90.9 %	Pass
6/21	1334	BS	47+50 Lt	591	—	107.3	9.0	98.4	55 W/P 2	109.2	90.1 %	Pass
6/21	1335	BS	49+00 Rt	590	—	107.7	8.8	99.0	55 W/P 2	109.2	90.7 %	Pass
6/21	1336	BS	49+00 Lt	590	—	107.1	9.1	98.2	55 W/P 2	109.2	89.9 %	Pass
6/21	1337	BS	50+50 Rt	589	—	107.5	8.9	98.7	55 W/P 2	109.2	90.4 %	Pass
6/21	1338	BS	50+50 Lt	589	—	106.9	9.2	97.9	55 W/P 2	109.2	89.6 %	Pass
6/21	1339	BS	52+00 Rt	588	—	107.3	9.0	98.4	55 W/P 2	109.2	90.1 %	Pass
6/21	1340	BS	52+00 Lt	588	—	106.7	9.3	97.6	55 W/P 2	109.2	89.4 %	Pass
6/21	1341	BS	53+50 Rt	587	—	107.1	9.1	98.2	55 W/P 2	109.2	89.9 %	Pass
6/21	1342	BS	53+50 Lt	587	—	106.5	9.4	97.3	55 W/P 2	109.2	89.1 %	Pass
6/21	1343	BS	55+00 Rt	586	—	106.9	9.2	97.9	55 W/P 2	109.2	89.6 %	Pass
6/21	1344	BS	55+00 Lt	586	—	106.3	9.5	97.1	55 W/P 2	109.2	88.9 %	Pass
6/21	1345	BS	56+50 Rt	585	—	106.7	9.3	97.6	55 W/P 2	109.2	89.4 %	Pass
6/21	1346	BS	56+50 Lt	585	—	106.1	9.6	96.8	55 W/P 2	109.2	88.6 %	Pass
6/21	1347	BS	58+00 Rt	584	—	106.5	9.4	97.3	55 W/P 2	109.2	89.1 %	Pass
6/21	1348	BS	58+00 Lt	584	—	105.9	9.7	96.5	55 W/P 2	109.2	88.4 %	Pass
6/21	1349	BS	59+50 Rt	583	—	106.3	9.5	97.1	55 W/P 2	109.2	88.9 %	Pass
6/21	1350	BS	59+50 Lt	583	—	105.7	9.8	96.3	55 W/P 2	109.2	88.2 %	Pass
6/21	1351	BS	61+00 Rt	582	—	106.1	9.6	96.8	55 W/P 2	109.2	88.6 %	Pass
6/21	1352	BS	61+00 Lt	582	—	105.5	9.9	96.0	55 W/P 2	109.2	87.9 %	Pass
6/21	1353	BS	62+50 Rt	581	—	105.9	9.7	96.5	55 W/P 2	109.2	88.4 %	Pass
6/21	1354	BS	62+50 Lt	581	—	105.3	10.0	95.7	55 W/P 2	109.2	87.6 %	Pass
6/21	1355	BS	64+00 Rt	580	—	105.7	9.8	96.3	55 W/P 2	109.2	88.2 %	Pass
6/21	1356	BS	64+00 Lt	580	—	105.1	10.1	95.4	55 W/P 2	109.2	87.4 %	Pass
6/21	1357	BS	65+50 Rt	579	—	105.5	9.9	96.0	55 W/P 2	109.2	87.9 %	Pass
6/21	1358	BS	65+50 Lt	579	—	104.9	10.2	95.2	55 W/P 2	109.2	87.2 %	Pass
6/21	1359	BS	67+00 Rt	578	—	105.3	10.0	95.7	55 W/P 2	109.2	87.6 %	Pass
6/21	1360	BS	67+00 Lt	578	—	104.7	10.3	94.9	55 W/P 2	109.2	86.9 %	Pass
6/21	1361	BS	68+50 Rt	577	—	105.1	10.1	95.4	55 W/P 2	109.2	87.4 %	Pass
6/21	1362	BS	68+50 Lt	577	—	104.5	10.4	94.6	55 W/P 2	109.2	86.6 %	Pass
6/21	1363	BS	70+00 Rt	576	—	104.9	10.2	95.2	55 W/P 2	109.2	87.2 %	Pass
6/21	1364	BS	70+00 Lt	576	—	104.3	10.5	94.4	55 W/P 2	109.2	86.4 %	Pass
6/21	1365	BS	71+50 Rt	575	—	104.7	10.3	94.9	55 W/P 2	109.2	86.9 %	Pass
6/21	1366	BS	71+50 Lt	575	—	104.1	10.6	94.1	55 W/P 2	109.2	86.2 %	Pass
6/21	1367	BS	73+00 Rt	574	—	104.5	10.4	94.6	55 W/P 2	109.2	86.6 %	Pass
6/21	1368	BS	73+00 Lt	574	—	103.9	10.7	93.9	55 W/P 2	109.2	85.9 %	Pass
6/21	1369	BS	74+50 Rt	573	—	104.3	10.5	94.4	55 W/P 2	109.2	86.4 %	Pass
6/21	1370	BS	74+50 Lt	573	—	103.7	10.8	93.6	55 W/P 2	109.2	85.7 %	Pass
6/21	1371	BS	76+00 Rt	572	—	104.1	10.6	94.1	55 W/P 2	109.2	86.2 %	Pass
6/21	1372	BS	76+00 Lt	572	—	103.5	10.9	93.3	55 W/P 2	109.2	85.4 %	Pass
6/21	1373	BS	77+50 Rt	571	—	103.9	10.7	93.9	55 W/P 2	109.2	85.9 %	Pass
6/21	1374	BS	77+50 Lt	571	—	103.3	11.0	93.1	55 W/P 2	109.2	85.2 %	Pass
6/21	1375	BS	79+00 Rt	570	—	103.7	10.8	93.6	55 W/P 2	109.2	85.7 %	Pass
6/21	1376	BS	79+00 Lt	570	—	103.1	11.1	92.8	55 W/P 2	109.2	84.9 %	Pass
6/21	1377	BS	80+50 Rt	569	—	103.5	10.9	93.3	55 W/P 2	109.2	85.4 %	Pass
6/21	1378	BS	80+50 Lt	569	—	102.9	11.2	92.5	55 W/P 2	109.2	84.7 %	Pass
6/21	1379	BS	82+00 Rt	568	—	103.3	11.0	93.1	55 W/P 2	109.2	85.2 %	Pass
6/21	1380	BS	82+00 Lt	568	—	102.7	11.3	92.3	55 W/P 2	109.2	84.5 %	Pass
6/21	1381	BS	83+50 Rt	567	—	103.1	11.1	92.8	55 W/P 2	109.2	84.9 %	Pass
6/21	1382	BS	83+50 Lt	567	—	102.5	11.4	92.0	55 W/P 2	109.2	84.2 %	Pass
6/21	1383	BS	85+00 Rt	566	—	102.9	11.2	92.5	55 W/P 2	109.2	84.7 %	Pass
6/21	1384	BS	85+00 Lt	566	—	102.3	11.5	91.8	55 W/P 2	109.2	84.0 %	Pass
6/21	1385	BS	86+50 Rt	565	—	102.7	11.3	92.3	55 W/P 2	109.2	84.5 %	Pass
6/21	1386	BS	86+50 Lt	565	—	102.1	11.6	91.5	55 W/P 2	109.2	83.8 %	Pass
6/21	1387	BS	88+00 Rt	564	—	102.5	11.4	92.0	55 W/P 2	109.2	84.2 %	Pass
6/21	1388	BS	88+00 Lt	564	—	101.9	11.7	91.2	55 W/P 2	109.2	83.5 %	Pass
6/21	1389	BS	89+50 Rt	563	—	102.3	11.5	91.8	55 W/P 2	109.2	84.0 %	Pass
6/21	1390	BS	89+50 Lt	563	—	101.7	11.8	91.0	55 W/P 2	109.2	83.3 %	Pass
6/21	1391	BS	91+00 Rt	562	—	102.1	11.6	91.5	55 W/P 2	109.2	83.8 %	Pass
6/21	1392	BS	91+00 Lt	562	—	101.5	11.9	90.7	55 W/P 2	109.2	83.1 %	Pass
6/21	1393	BS	92+50 Rt	561	—	101.9	11.7	91.2	55 W/P 2	109.2	83.5 %	Pass
6/21	1394	BS	92+50 Lt	561	—	101.3	12.0	90.4	55 W/P 2	109.2	82.8 %	Pass
6/21	1395	BS	94+00 Rt	560	—	101.7	11.8	91.0	55 W/P 2	109.2	83.3 %	Pass
6/21	1396	BS	94+00 Lt	560	—	101.1	12.1	90.2	55 W/P 2	109.2	82.6 %	Pass
6/21	1397	BS	95+50 Rt	559	—	101.5	11.9	90.7	55 W/P 2	109.2	83.1 %	Pass
6/21	1398	BS	95+50 Lt	559	—	100.9	12.2	89.9	55 W/P 2	109.2	82.3 %	Pass
6/21	1399	BS	97+00 Rt	558	—	101.3	12.0	90.4	55 W/P 2	109.2	82.8 %	Pass
6/21	1400	BS	97+00 Lt	558	—	100.7	12.3	89.7	55 W/P 2	109.2	82.1 %	Pass
6/21	1401	BS	98+50 Rt	557	—	101.1	12.1	90.2	55 W/P 2	109.2	82.6 %	Pass
6/21	1402	BS	98+50 Lt	557	—	100.5	12.4	89.4	55 W/P 2	109.2	81.8 %	Pass
6/21	1403	BS	100+00 Rt	556	—	100.9	12.2	89.9	55 W/P 2	109.2	82.3 %	Pass
6/21	1404	BS	100+00 Lt	556	—	100.3	12.5	89.2	55 W/P 2	109.2	81.7 %	Pass

SB15S106

20 PREPARED BY (Signature) R. Smith DATE 6/15/77 21. RESPONSIBLE ENGINEER M. F. Rehm DATE 7/1

FORM 1002 (1-74) 4-67 / 1 / 1 to Interim 6-27-77

SB158107 COMPACTED FILL DENSITY TEST REPORT 3 of 15

QC ACCEPTANCE

CONTROL NO. FI

1. PROJECT NO. 7220 2. DATE 6/27/77 PAGE 3 OF

1. SPEC NO. 7220 C-203 5. DRAWING NO. Plant Area 6. TESTED WEEK OF 6/19 to 6/1

7. DATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT)	13. IN PLACE WET DENSITY (LB/C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB/C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB DRY DENSITY (LB/C.F.)	18. PERCENT COMPACTION	19. REMARKS
6/24	1421	RS	S 5+02 E 11	620.5	—	141.0	11.0	127.0	270 11.1	124.6	101.9	Pass
"	1425	"	S 5+32 E 112	627.5	—	137.5	10.0	125.0	269 10.0	127.3	98.2	Pass
"	1426	"	S 5+32 E 92	620.5	—	133.0	12.0	118.8	277 13.4	121.0	98.2	Pass

20. PREPARED BY (Signature) R Orrell DATE 6/25/77 21. RESPONSIBLE ENGINEER [illegible] DATE 7/2/77

Passed 7-27-77

CONTROL NO.

1. PROJECT NO. 7223 2. DATE 6-27-77 PAGE 4 OF

4. SPEC. NO. 1220-C-208 5. DRAWING NO. Plant Area 6. TESTED WEEK OF 6/11/77 thru

7. DATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB/C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB/C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB/C.F.)	18. PERCENT COMPACTION	19. REMARKS
6/21	491	RS	[illegible]	619	—	128.5	14.5	112.2	278 15.2 1	117.0	95.9	Fill
"	1499	"	[illegible]	612	—	130.0	[illegible]	118.2	269 10.0 1	127.3	92.9	Fill
"	1500	"	240' S 66° E of 12.0	616	—	133.0	9.9	121.0	269 10.0 1	127.3	95.1	Fill Cle
"	1501	"	100' S 0° E of 12.0	624	—	136.0	10.4	123.2	262 11.8 1	123.9	99.4	Fill Cle
"	1502	"	251' S 0° E of 12.0	625	—	130.5	9.9	118.7	262 11.8 1	123.9	95.8	Fill
"	1503	"	[illegible]	622	—	143.0	10.8	129.0	269 10.0 1	127.3	101.3	Fill
"	1504	"	S 5265 E 72	628	—	134.0	10.7	121.0	270 11.1 1	124.6	97.1	Fill
6/21/77	1505	"	S 5282 E 100	625	—	125.5	9.9	114.2	277 13.4 1	121.0	94.4	Fill
"	1506	"	S 5322 E 56	626	—	136.5	8.3	126.0	269 10.0 1	127.3	99.0	Fill
"	1507	"	[illegible]	629	—	136.0	11.8	121.6	269 10.0 1	127.3	95.5	Fill
"	1508	"	[illegible]	621	—	139.0	10.3	126.0	269 10.0 1	127.3	99.0	Fill
"	1509	"	[illegible]	622	—	129.0	12.9	114.3	278 15.2 1	117.0	97.7	Fill
"	1510	"	S 5252 E 31	624	—	145.0	10.3	131.0	270 11.1 1	124.6	105.1	Fill
"	1511	"	S 5245 E 57	626	—	131.5	9.9	119.7	270 11.1 1	124.6	96.1	Fill
"	1512	"	S 5232 E 100	626	—	136.5	10.1	124.0	277 13.4 1	121.0	102.5	Fill
"	1513	"	S 5240 E 108	6255	—	137.5	10.3	124.7	269 10.0 1	127.3	98.0	Fill

20. PREPARED BY (Signature) R. Smith 6/25/77 DATE 6/25/77 21. RESPONSIBLE ENGINEER A.F. Graham DATE 7/1/77

9002 (3/71) 7/7 1 1.14 Above 6-27-77

SB158103

CONTROL NO. FILE

1. PROJECT NO. 7220 2. DATE 6-27-77 PAGE 5 OF 5

4. SPEC NO. 7220-S-258 5. DRAWING NO. Road Grade 6. TESTED WEEK OF 6/21 to 6/27

7. DATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX LAB DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS

SB158110

6 of 13

DATE

PAGE 1 OF

DATE

21. RESPONSIBLE ENGINEER

DATE

COMPACTED FILL DENSITY TEST REPORT

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8. ACCEPTANCE

CONTRACT NO.

1. PROJECT NO.

2. DATE

PAGE 1 OF

4. TO ID

5. DENSITY NO.

6. TESTED WEEK OF

7. TEST NO.	8. TEST TIME	9. TEST ID NO.	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINISH GRADE	13. DENSITY	14. MOISTURE CONTENT	15. DENSITY DRY BASIS	16. SOIL CLASS. & GR.	17. DRY DENSITY	18. PERCENT COMPACTION	19. REMARKS

SB158112

CONTROL NO.

1. PROJECT NO. 1126 2. DATE 6-20-11 PAGE 3 OF

4. TEST NO. 5. BORING NO. Pier 1209 6. TESTED WITH

7. DATE	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF T.P.	12. DEPTH BELOW T.P. (Feet)	13. WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT	15. DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS

20. TESTED BY (Signature) DATE 6/19/11 21. RESPONSIBLE ENGINEER DATE

CONTROL NO. CBT

1. PROJECT NO. 7220 2. DATE 6-22-22 PAGE 11 OF 12

5. CONTRACTOR 6. TESTED WEEK OF

3. TEST NO.	4. TEST NO.	LOCATION	10. ELEV. OF TEST	DEPTH BELOW FINISH GRADE (FT)	11. IN PLACE WET DENSITY (LB/C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB/C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB/C.F.)	18. PERCENT COMPACTION	19. REMARKS

SB158114

1. PROJECT NO. 1220 2. DATE 6/2/00 PAGE 1 OF 1

5. TESTED BY [illegible] 6. TESTED WEEK OF [illegible]

3. TEST NO.	4. TEST TIME	7. LOCATION	8. ELEV. OF TEST	9. DEPTH BELOW TOP OF FILL	10. REPLACE UNIT WT. (lbs/cu ft)	11. MOISTURE CONTENT (%)	12. REPLACE DRY DENSITY (lbs/cu ft)	13. SOIL CLASSIFICATION	14. MAX. LAB. DRY DENSITY (lbs/cu ft)	15. PERCENT COMPACTION	16. REMARKS
								Sup Opt			
[illegible]	[illegible]	[illegible]	185		129.5	7.6	119.8	277 134	121.0	99.1	[illegible]
[illegible]	"	[illegible]	114		129.0	10.2	117.0	277 134	121.0	96.7	[illegible]
[illegible]	[illegible]	[illegible]	340		126.0	12.2	113.3	278 152	111.0	96.6	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]								
[illegible]	[illegible]	[illegible]	345		124.0	9.8	113.5	278 152	111.0	100.1	[illegible]
[illegible]	"	[illegible]	411		130.0	11.3	113.7	277 134	121.0	94.0	[illegible]
[illegible]	"	[illegible]	462		127.0	11.1	114.2	277 134	121.0	94.4	[illegible]
[illegible]	"	[illegible]	482		131.5	11.1	117.7	277 134	121.0	97.3	[illegible]
[illegible]	"	[illegible]	491		130.0	12.6	117.7	277 134	121.0	96.1	[illegible]
[illegible]	"	[illegible]	494		135.5	14.2	118.7	278 152	117.0	101.5	[illegible]
[illegible]	"	[illegible]	[illegible]		128.0	9.9	116.5	278 152	117.0	99.4	[illegible]
[illegible]	"	[illegible]	[illegible]		127.0	11.1	[illegible]	277 134	121.0	91.3	[illegible]
[illegible]	"	[illegible]	[illegible]		111.0	5.5	105.2	278 152	117.0	89.6	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		124.0	9.8	112.9	[illegible]	117.0	96.0	[illegible]
[illegible]	[illegible]	[illegible]	28		138.0	16.6	118.0	278 152	117.0	101.7	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]								
[illegible]	[illegible]	[illegible]	[illegible]		141.0	14.1	123.4	278 152	121.0	101.9	[illegible]

[illegible] Signature (X) [illegible] DATE 6/13/00 21. RESPONSIBLE ENGINEER [illegible] DATE 6/22/00

SB158115

PAGE 2 OF 4

1. PROJECT NO. 7220 2. DATE 6-20-00

6. TESTED WEEK OF

3. TEST NO.	4. TEST TIME	5. LOCATION	7. ELEV. OF TEST	8. DEPTH OF TEST	9. IN-PLACE WET DENSITY (PCF)	10. MOISTURE CONTENT (%)	11. IN-PLACE DRY DENSITY (PCF)	12. SOIL CLASSIFICATION	13. MAX./MIN. LAB. DRY DENSITY (PCF)	14. PERCENT COMPACTION	15. REMARKS
								D OPT 70%			
1	1027	Sta 41+6	LB	-	119.7	6.6	108.9	55 N/A 2	109.1/103	98.5	Pass
				Clay 1							
2	1035	2' LT									
				Clay 1							
3	1311	20' RT	615	—	113.8	6.9	106.5	55 N/A 2	109.1/103.2	98.1	Pass
4	1314	"	611	—	122.1	5.3	116.5	55 N/A 2	109.1/103.2	107.0	Pass
				Clay 1							
5	1317	2' LT	605	—	119.6	6.8	112.0	55 N/A 2	109.1/103.2	102.5	Pass
				Clay 1							
6	1320	20' RT	620	—	122.2	8.4	112.7	55 N/A 2	109.1/103.2	103.4	Pass
				Clay 1							
7	1323	2' LT	606	—	121.5	8.2	112.4	55 N/A 2	109.1/103.2	110.5	Pass
				Clay 1							
8	1326	20' RT	610	—	121.3	8.0	110.5	55 N/A 2	109.1/103.2	103.4	Pass
9	1329	"				6.3	108.3	55 N/A 2	109.1/103.2	99.0	Pass
10	1332	"	610	—	113.2	4.1	108.1	55 N/A 2	109.1/103.2	98.1	Pass
11	1335	"	610	—	118.2	6.7	110.1	55 N/A 2	109.1/103.2	105.0	Pass

DATE 6-13-01 21. RESPONSIBLE ENGINEER DATE

SB158116

CONTROL NO. FILE NO.

1. PROJECT NO. 9220 2. DATE 6/2017 PAGE 3 OF 4

3. SOIL TYPE & SOURCE 4. LOCATION Port Area 5. TESTED WEEK OF 5/28/2017

7. TEST NO.	8. LAB NO.	9. LOCATION	10. ELEV. OR DEPTH	11. REPLACE WET DENSITY (LB/CF)	12. LOCATION MOISTURE (%)	13. REPLACE DRY DENSITY (LB/CF)	14. SOIL CLASSIFICATION			15. MAX. LAB. DRY DENSITY (LB/CF)	16. PERCENT COMPACTION	17. REMARKS
							Typ Class					
1704	1801	20'	6.0	145.0	9.2	132.8	221	13.4	1	121.0	101.8	FAIL
[redacted]												
	1802	20'	7.									
[redacted]												
				138.0	13.6	121.5	277	13.4	1	121.0	100.4	Pass
1706	1803	20'	6.0	139.5	11.0	125.7	221	13.4	1	121.0	103.9	FAIL
1707	1804	20'	5.0	138.6	11.1	124.7	277	13.4	1	121.0	95.6	FAIL
1708	1805	20'	4.0	140.0	11.6	125.5	277	13.4	1	121.0	103.7	Pass
1709	1806	20'	3.0	125.0	12.1	101.7	276	15.2	1	117.0	93.8	FAIL
1710	1807	20'	2.0	138.6	12.1	123.6	277	13.4	1	121.0	101.9	Pass
1711	1808	20'	1.0	134.0	14.0	117.5	276	15.2	1	117.0	100.4	Pass
1712	1809	20'	0.0	137.0	11.2	123.2	277	13.4	1	121.0	101.8	FAIL
1713	1810	20'	1.0	141.0	11.0	127.0	277	13.4	1	121.0	104.9	Pass
[redacted]												
1715	1901	20'	6.0	140.5	10.2	127.5	291	10.1	1	126.6	100.7	Pass
1716	1902	20'	6.0	140.0	10.2	125.4	277	13.4	1	121.0	96.2	FAIL

20. PREPARED BY (Engineer) RCH DATE 6/20/17 21. RESPONSIBLE ENGINEER [redacted] DATE 6/20/17

COMPACTED FILL DENSITY TEST REPORT

CONTRACT NO. FILE NO.

PAGE 4 OF 4

1. PROJECT NO. 1220 2. DATE 6-2-77

5. PROJECT NAME Pinole Valley

6. TESTED WITH OF

A. TEST NO.	B. TEST TIME	C. TEST LOCATION	D. ELEV. OR DEPTH OF TEST	E. MOISTURE CONTENT %	F. FIELD DRY DENSITY PCF	G. MOISTURE CONTENT %	H. FIELD DRY DENSITY PCF	I. SOIL CLASSIFICATION	J. LAB. DRY DENSITY PCF	K. RELATIVE COMPACTION	L. REMARKS
10	10:30										

[redacted]

SB1551117

PREPARED BY (Signature) DATE 6-13-77 21. RESPONSIBLE ENGINEER DATE

14 of 15

CONTROL NO.

1. PROJECT NO. 7220 2. DATE 6-13-77 PAGE 1 OF

4. SPEC NO. 7220-C-208 5. DRAWING NO. STRUCTURAL 6. TESTED WEEK OF 5-22-77 thru

7. DATE TAKEN	8. TEST NO.	9. TEST TAKEN BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS

SB158119 COMPACTED FILL DENSITY TEST REPORT 15 of 15

CONTROL NO. FILE

1. PROJECT NO. 7220 2. DATE 6-13-77 PAGE 1 OF 1

4. SPEC NO. 7220-C-208 5. DRAWING NO. Plot Plan 6. TESTED WEEK OF 5-22-77 thru

7. DATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
5-24				619	---	136.5	11.2	122.7	262 118 1	123.9	99.0	Pass
5-24				620	---	140	13.4	123.7	262 118 1	123.9	100.1	Pass
"	1350	"		622	---	135.5	12.0	121.0	262 118 1	123.9	97.7	Pass
	1351				---							
5-24	1352	"		622	---	131.0	12.8	116.2	278 15.2 1	117.0	100.3	Fail
	1353	"			---	Page 2						
5-24	1354	"		623	---	139.5	12.5	124.0	262 118 1	123.9	100.1	Pass
"	1355	"		619	---	124.0	11.5	111.2	262 118 1	123.9	89.7	Fail
5-24	1356	"		621	---	141.5	10.5	128.0	262 118 1	123.9	103.3	Pass
5-24	1357	"		624	---	131.0	14.2	114.7	278 15.2 1	117.0	98.0	Pass
"	[redacted]									1.3		
		"			---	121.0	10.0	110.0	278 15.2 1	117.0	94.0	Fail
5-24	1359	"		625	---	134.5	18.5	113.5	278 15.2 1	117.0	97.0	Fail
"	1360	"		622	---	131.5	17.3	111.2	278 15.2 1	117.0	100.2	Fail
"	1361	"		628	---	135.0	18.7	113.7	278 15.2 1	117.0	97.0	Fail

20. PREPARED BY (Signature) R. Smith DATE 6-8-77 21. RESPONSIBLE ENGINEER DATE

Source C-4-P#
Hammer weight 10#
Drop distance 18"
No. Layers 4
No. Blows 25

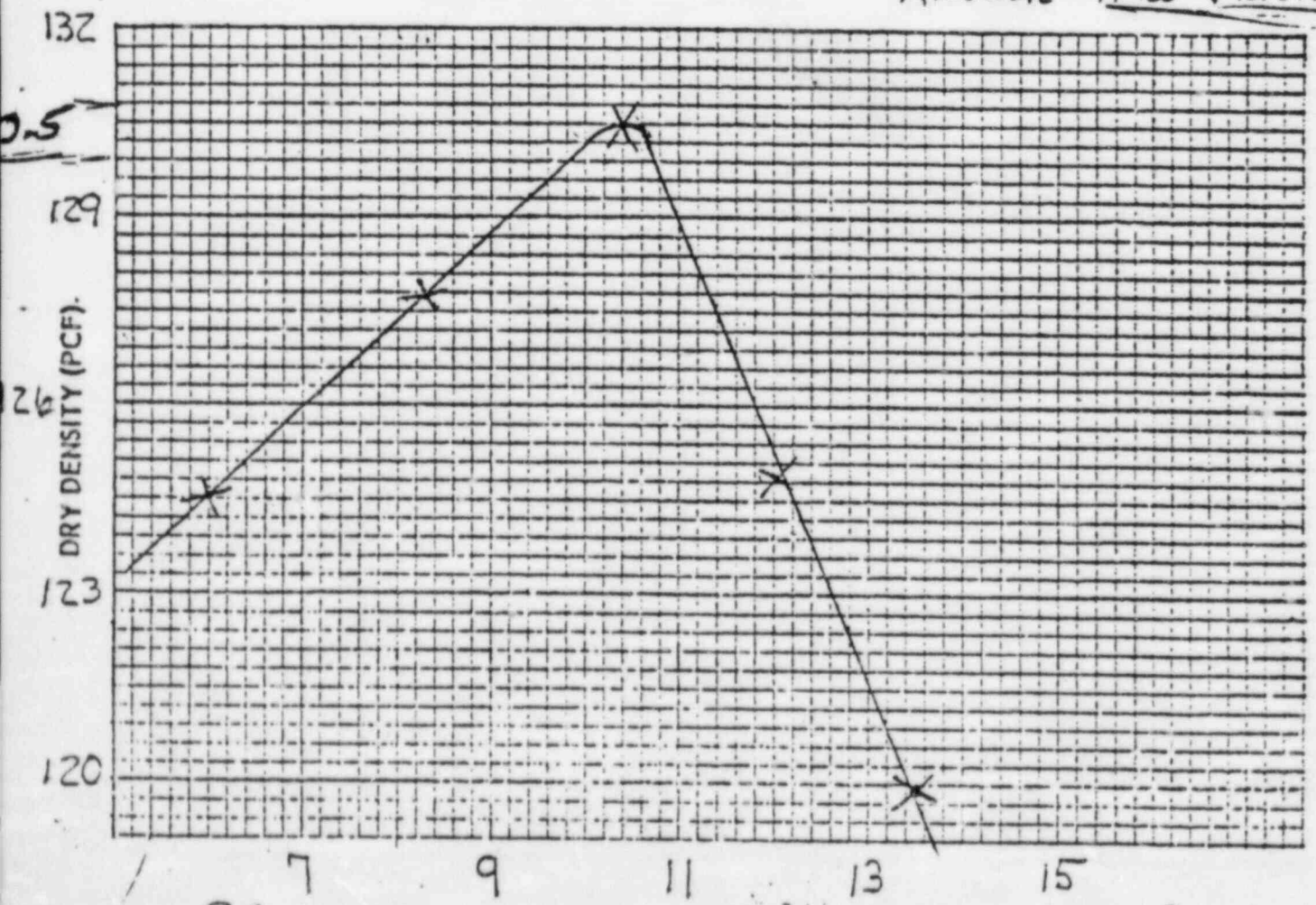
Date 9/23/77
Initials RS
Type of test AMP-298
Mold size 6"

(Admin. Bldg. Excav.)

ATTACHMENT # 2 -
PAGE 1 of 1

TEST DATA						
Mold No.	PM-1	PM-1	PM-1	PM-1	PM-1	
Wt. wet sample + Mold (gms)	11187	11305	11538	11394	11262	
Wt. of Mold (gms)	6633	6633	6633	6633	6633	
Wt. of wet sample (gms)	4554	4672	4905	4761	4629	
Vol. of sample (cc.)	2124	2124	2124	2124	2124	
Wet Unit Weight (lb. /cu.ft.)	133.8	137.3	144.1	139.9	136.0	
Can No.		57	14	71	70	
Wt. wet sample + Can (gm.)	225.8	190.3	205.0	216.1	223.6	
Wt. Dry sample + Can (gm.) cs 9/23/77 2168	~~+6+5~~	181.5	194.2	201.6	206.5	
Wt. water (gm.)	9.0	8.8	10.8	14.5	17.1	
Wt. can (gm.)	79.3	76.1	90.0	80.5	79.8	
Wt. dry sample (gm.)	137.5	105.4	104.2	121.1	126.7	
Moisture Content %	6.5	8.3	10.4	12.0	13.5	
Average Moisture Content %						
Dry Unit Weight (lb. /cu.ft.)	125.6	126.8	130.5	124.9	119.8	

ANSWER TRUE PROCTORS



J Jacks 9.28.77

CHECKED BY:

UST 5 425

SB158120

RESULTS

Bechtel Power Corporation

Midland Units 1 & 2

Job No. 7220

ADMINISTRATION BUILDING FOUNDATION LOAD TEST

Prepared by:

D. W. Billings

November 7, 1977

SB158121

ADMINISTRATION BUILDING FOUNDATION LOAD TEST

SCOPE

To load Administration Building strip footings which span between Column Lines 0.9 and 0.6 and located along Column Lines Kb through Pa. The loads to be used and applied simultaneously are 115 tons applied at Column Line 0.9 and 180 tons applied at Column Line 0.6.

PROCEDURE

1. Arrange cribbing, concrete weights, shims and jacks similar to attached Drawing FSK-LT1, Sheets 1 and 2. Load tests to begin at Column Line Pa, progressing north to Column Line Kb.

2. Record elevations of both piers on footing prior to jacking.

3. Apply load to piers at 0.6 and 0.9 simultaneously as follows:

   a. Column Line 0.9: Jack in increments of approximately 9.6 tons (450 psi*) at 15 minute intervals to total test load of approximately 115 tons (5600 psi*).
   b. Column Line 0.6: Jack in increments of approximately 15.0 tons (750 psi*) at 15 minute intervals to total test load of approximately 180 tons (8750 psi*).
   c. Record elevations of each pier after each load increment.
   d. Install jacking collars tight against blocks throughout test.

   * Incremental readings are rounded to nearest 50 psi.

4. Monitor loading of each footer as follows:

   a. Observe pressure indicators once an hour for four (4) hours after total load is applied and record readings. Record elevations of each pier and jack to required pressures only if readings have dropped.
   b. Observe and record pressure readings approximately nine (9) hours after total load is applied and jack to required pressures if readings have dropped. Record elevations of each pier.
   c. Observe and record final pressure readings approximately 24 hours after commencement of test. Record elevations of each pier prior to unloading. Release jacks and record elevations of each pier after load is removed.
   d. NOTE: Additional readings may be required at the request of the Engineer.

SB158122

CALCULATIONS

1. Determination of load/pressure relationship

Jack Type - Duff Norton Ram Pac, Model RC-100-H-5.7
Capacity - 100 tons
Working Pressure - 9695 psi (Gauge Reading)
Effective Ram Area - 20.63 Sq. In.

a. 180 ton test load at Column Line 0.6:

90 tons per jack

$$\frac{\text{Req'd Pressure (psi)}}{90 \text{ tons}} = \frac{9695 \text{ psi}}{100 \text{ tons}} \Rightarrow \text{Req'd Pressure} = \underline{\underline{8726 \text{ psi}}}$$

Incremental Loading:

3 hour duration at 15 minute intervals = 12 increments

$$\frac{180 \text{ tons}}{12} = 15 \text{ ton increments (7.5 tons per jack)}$$

$$\frac{\text{Req'd Pressure (psi)}}{7.5 \text{ Tons}} = \frac{9695 \text{ psi}}{100 \text{ Tons}} \Rightarrow \text{Req'd Pres./Increment} = \underline{\underline{727 \text{ psi}}}$$

b. 115 Ton test load at Column Line 0.9:

57.5 Tons per jack

$$\frac{\text{Req'd Pressure (psi)}}{57.5 \text{ Tons}} = \frac{9695 \text{ psi}}{100 \text{ Tons}} \Rightarrow \text{Req'd Pressure} = \underline{\underline{5575 \text{ psi}}}$$

Incremental Loading:

$$\frac{115 \text{ Tons}}{12} = 9.6 \text{ ton increments (4.8 tons per jack)}$$

$$\frac{\text{Req'd Pressure (psi)}}{4.8 \text{ Tons}} = \frac{9695 \text{ psi}}{100 \text{ Tons}} \Rightarrow \text{Req'd. Pres./Increment} = \underline{\underline{465 \text{ psi}}}$$

c. Bearing area required to distribute test load to soil surrounding footers:

Allowable Load = 3 kips/sq. ft.
Maximum Load = Approximately 200 Tons
Bearing Area Required = $\frac{400 \text{ kips}}{3 \text{ kips/sq. ft.}}$ = 133 Sq. Ft.

SB155123

RESULTS

Test results are tabulated on Attachment "A", Pages 1a & b through 6a & b.

ADMINISTRATION BUILDING FOUNDATION LOAD TEST

STRIP FOOTER AT COLUMN LINE Pa

Date of Test: 11/8/77

Monitored By: D. Billings
J. Kelleher
Survey: Smith,
Frimodig, Durham

Weather Conditions: Light Rain/Fog

Temperature at Time of Incremental Loading: 55°

Remarks: (1) Jacks at Column Line 0.6 were shimmed with stacks of thin plates which were the cause of at least 1/4" of settlement reading (elevations were taken from top of shim pack). (2) Faulty pump necessitated unloading of Column Line 0.6 after 48.5 tons had been applied. Pump was replaced and load re-applied within 5 minutes. (3) Survey crews changed shifts between 3 and 4 hours after start of test and again for the final readings.

[illegible] POWER AT COLUMN LINE Pa

Time (Hrs.)	Column Line 0.7 Actual Load (Tons)	Gauge Reading (psi) Req'd.	Gauge Reading (psi) Actual	Top of Pier Elevation (Ft.)	Cumulative Settlement (In.)	Column Line 0.6 Actual Load (Tons)	Gauge Reading (psi) Req'd.	Gauge Reading (psi) Actual	Top of Pier Elevation (Ft.)	Cumulative Settl (In.
Start 11:45am				Top of Shim Pack					Top of Anchor Bolt	
0	0.0	0	0	635.067	0	0.0	0	0	634.177	0
0.00 - 0.25	9.3	450	600	635.049	7/32	15.5	750	800	634.173	3/6
0.25 - 0.50	18.6	900	900	635.047	15/64	29.9	1450	1500	634.173	3/6
0.50 - 0.75	28.9	1400	1400	635.042	5/16	45.4	2200	2200	634.170	5/6
0.75 - 1.00	38.2	1850	1850	635.039	11/32	59.8	2900	2900	634.178	---
1.00 - 1.25	48.5	2350	2350	635.037	23/64	75.3	3650	3650	634.178	---
1.25 - 1.50	57.8	2800	2800	635.033	13/32	89.7	4350	4350	634.178	---
1.50 - 1.75	67.0	3250	3250	635.030	7/16	105.2	5100	5100	634.177	0
1.75 - 2.00	76.3	3700	3700	635.028	15/32	119.6	5800	5800	634.177	0
2.00 - 2.25	86.6	4200	4200	635.028	15/32	135.1	6550	6600	634.177	0
2.25 - 2.50	95.9	4650	4650	635.027	31/64	150.6	7300	7300	634.177	0
2.50 - 2.75	105.2	5100	5100	635.026	31/64	165.0	8000	8000	634.177	0
2.75 - 3.00	115.5	5600	5600	635.027	31/64	180.5	8750	8800	634.176	0
4.0	115.5	5600	5600	635.019	37/64	180.5	8750	8700	634.165	9/6
5.0	115.5	5600	5600	635.018	19/32	180.5	8750	8500	634.170	5/6
6.0	115.5	5600	5600	635.019	37/64	180.5	8750	8550	634.165	9/6

[illegible] LOCATED AT COLUMN LINE Pa

Time (Hrs.)	Column Line 0.4 Actual Load (Tons)	Gauge Reading (psi) Req'd.	Gauge Reading (psi) Actual	Top of Pier Elevation (Ft.)	Cumulative Settlement (In.)	Column Line 0.6 Actual Load (Tons)	Gauge Reading (psi) Req'd.	Gauge Reading (psi) Actual	Top of Pier Elevation (Ft.)	Cumulat Settl (In
7.0	115.5	5600	5600	635.017	39/64	180.5	8750	8500	634.168	7/64
12.0 *	115.5	5600	5600	635.017	39/64	180.5	8750	8800	634.166	1,
24.0	115.5	5600	5600	635.018	19/32	180.5	8750	8800	634.162	3/16
24.0	0.0	0	0	635.026	31/64	0.0	0	0	634.173	3/64
					Permanent Deflection 1/2" - 1/4'					Permanen Deflect ≈ 3/64'

* Record Additional Readings Below If Required.

					≈1/4" (See Remarks)					

Elevations should be accurate to 0.005'

SB15S126

ADMINISTRATION BUILDING FOUNDATION LOAD TEST

STRIP FOOTER AT COLUMN LINE Nk

Date of Test: 11/11/78

Monitored By: D. Billings

J. Kelleher

Survey: Smith,

Frimodig, Durham

Weather Conditions: Overcast

Temperature at Time of Incremental Loading: 30°

Remarks: (1) No problems encountered with shim settlement or stability of survey points.

(2) Survey crews changed shifts between 3 and 4 hours after start of test and again for the final readings.

SB155127

STRIP FOOTER AT COLUMN LINE Mk

SB158128

Time (Hrs.)	Column Line 0.9 Actual Load (Tons)	Gauge Reading (psi) Req'd.	Gauge Reading (psi) Actual	Top of Pier Elevation (Ft.)	Cumulative Settlement (In.)	Column Line 0.6 Actual Load (Tons)	Gauge Reading (psi) Req'd.	Gauge Reading (psi) Actual	Top of Pier Elevation (Ft.)	Cumulat Settlem (In.)
art 1:30pm				Top of Anchor Bolt Lug					Top of Anchor Bolt Lug	
0	0.0	0	0	634.211	0	0.0	0	0	634.182	0
0 - 0.25	9.3	450	450	634.213	0	15.5	750	750	634.182	0
5 - 0.50	18.6	900	900	634.213	0	29.9	1450	1450	634.180	1/32
0 - 0.75	28.9	1400	1400	634.213	0	45.4	2200	2200	634.180	1/32
5 - 1.00	38.2	1850	1850	634.213	0	59.8	2900	2900	634.180	1/32
0 - 1.25	48.5	2350	2350	634.212	1/64	75.3	3650	3650	634.180	1/32
3 - 1.50	57.8	2800	2800	634.212	1/64	89.7	4350	4350	634.180	1/32
0 - 1.75	67.0	3250	3250	634.213	0	105.2	5100	5100	634.179	1/32
5 - 2.00	76.3	3700	3700	634.214	0	119.6	5800	5800	634.178	1/32
0 - 2.25	86.6	4200	4200	634.213	0	135.1	6550	6550	634.176	5/64
5 - 2.50	95.9	4650	4650	634.212	1/64	150.6	7300	7300	634.177	5/64
0 - 2.75	105.2	5100	5100	634.212	1/64	165.0	8000	8000	634.178	1/32
5 - 3.00	115.5	5600	5600	634.213	0	180.5	8750	8750	634.176	5/64
4.0	115.5	5600	5400	634.212	1/64	180.5	8750	8750	634.177	5/64
5.0	115.5	5600	5500	634.212	1/64	180.5	8750	8700	634.180	1/32
6.0	115.5	5600	5500	---	----	180.5	8750	8750	---	----

STEP TAPER AT COLUMN LINE Bk

Time (Hrs.)	Column Line 0.9 Actual Load (Tons)	Gauge Reading (psi) Req'd.	Gauge Reading (psi) Actual	Top of Pier Elevation (Ft.)	Cumulative Settlement (In.)	Column Line 0.6 Actual Load (Tons)	Gauge Reading (psi) Req'd.	Gauge Reading (psi) Actual	Top of Pier Elevation (Ft.)	Cumulat Settle (In.
7.0	115.5	5600	5550	---	----	180.5	8750	8700	---	----
*										
12.0	115.5	5600	5600	634.212	1/64	180.5	8750	8750	634.174	3/32
*										
24.0	115.5	5600	5600	634.208	1/16	180.5	8750	8750	634.173	1/8
24.0	0.0	0	0	634.213	0	0.0	0	0	634.175	5/64
					Permanent Deflection 0"					Permanen Deflecti ≈ 5/64"

* Record Additional Readings Below If Required.

Elevation should be accurate to 0.005'

SB15S129

United States Testing Company, Inc.
Power Generation Services Division

1415 PARK AVENUE
HOBOKEN, NEW JERSEY 07030 (201) 792-2400 (212) 943-0488

program audits
vendor surveillance
concrete testing
on-site inspection
nondestructive testing
environmental evaluation
training programs

File: C-208-222/1015.900
October 1, 1979

RECEIVED
OCT 1979
BECHTEL POWER CORP
JOB 7220
FILE 5065.2-208

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

Attention: Mr. J. F. Newgen

Subject: Midland Project Job 7220
Subcontract 7220-C-208
U.S. Testing's Response to "Geotech Review of U.S. Testing Field and Laboratory Tests on Soils

Dear Mr. Newgen:

Please find attached United States Testing's response to the Bechtel report "Review of U. S. Testing Field and Laboratory Tests on Soils" dated July 1979.

You requested that we respond solely to the summary contained in Section 8, however, we feel it is necessary to respond to all the sections, which in itself details Section 8.

Our response appendices the Bechtel report in so far that it closely follows its logic, answering questions or making statements on each particular point. This U. S. Testing report is not meant to point fingers in any direction but only to indicate, to Bechtel, some of the problems and concerns we faced.

If you have any questions, do not hesitate to contact me.

Very truly yours,

UNITED STATES TESTING COMPANY, INC.

M. Anselmo
Project Engineer

SB158134

MA:hg
Attachments

OUR LETTERS AND REPORTS ARE FOR THE EXCLUSIVE USE OF THE CLIENT TO WHOM THEY ARE ADDRESSED. AND THEY AND THE NAME OF THE UNITED STATES TESTING COMPANY, INC. OR ITS SEALS OR INSIGNIA ARE NOT TO BE USED UNDER ANY CIRCUMSTANCES IN ADVERTISING TO THE GENERAL PUBLIC AND MAY NOT BE USED IN ANY OTHER MANNER WITHOUT OUR PRIOR WRITTEN APPROVAL. SAMPLES NOT DESTROYED IN TESTING ARE RETAINED A MAXIMUM OF THIRTY DAYS.

UNITED STATES TESTING COMPANY'S

Response to the Bechtel Report

"Review of U. S. Testing Field
and Laboratory Construction
Test Data on Soils Uses as Fill"

Midland Units 1 & 2
Job No. 7220

Note: This U. S. Testing report must be read in connection with the Bechtel report in so far that it will provide clarification and rebut statements contained therein.

SB158135

1. Use of Laboratory Test Compaction Curves

This section of the Bechtel report is concerned with the implied ratio of Field Density Tests to Laboratory Compaction Tests (Ratio 20:1) given in Table 9-1 of Specification 7220-C-208 and the period of time lapse between Laboratory Tests vs. Field Tests.

It is the position of U. S. Testing that Bechtel was then and is now responsible for the monitoring, determining and communicating with U. S. Testing on the fill yardage for use in performing Lab Density Tests. In fact, there were more Lab Density Tests performed by U. S. Testing Technicians (who were double checking results) than directed by Bechtel. It should also be noted that, in most cases, our only Bechtel interface in the field was a labor foreman.

The testing of soil will yield the same densities no matter what time lapse has expired between original testing and subsequent re-tests as long as the material re-tested is representative of the original tests and the test method has not changed. The actual volume of soil that may be represented by any one compaction curve has not been nor can it now be determined. In addition, Bechtel did not control excavated material as required by their specifications and drawings (documented in report on Admin. Bldg.) and it would be likely that any given cubic yard of soil was not only placed several times but tested several times, i.e., the same proctor values would be employed each time a yard of that particular soil was placed.

SB158136

Visual proctor selection was many times backed-up by pounding a new proctor, in fact, most proctors on the job were generated in this manner as opposed to Bechtel maintaining a frequency list.

During the original submittal of U. S. Testing QA Manual, Bechtel (Project Engineering & Subcontracts) removed the provisions for performing one-point proctor tests for each Field Density Test.

2. Questionable Retests

The statement "A Field Density Test that fails to meet requirements of the specification should have been reported to Bechtel..." is incorrect. All failing test results were reported to either Q.C. or our field interface. However, it has become apparent that our field interface may not have been responsible for making these decisions. Any test U. S. Testing dispositioned as "clearing" was done so at the direction of Bechtel. The clearing of failing tests still is a Bechtel responsibility and on the occasions where U. S. Testing noted clearing tests, the report was a mode of conveying information from our interface. The Bechtel Report mentions three (3) cases where failing tests were cleared, one was "apparently resolved by merely using another Laboratory Compaction Curve...", another "tests labeled 'failed' were incorrectly cleared though the same laboratory standard was referenced.", and the third "two retests were dated prior to the time the original test failure." In fact,

SB158137

these 'clearings' were the action of Bechtel employees who were also in the habit of marking up U. S. Testing reports. It appears that the standard Bechtel procedure for the dispositioning of failures was to scan reports looking for passing results in the same general area. The direction of U. S. Testing to a test area and provisions for test locations is the responsibility of Bechtel, on those occasions where the Bechtel interface could not relate specific locations the suggestion may have been made by U. S. Testing personnel.

We agree with the Bechtel assumption that it was possible to encounter different soils in the same location, however, it is more likely that the different soils were encountered as a result of the non-control of excavated materials as opposed to the removal and replacement subsequent to a test failure.

U. S. Testing responsibility on this project is to perform testing not control its placement, and in fact, U. S. Testing was excluded from being involved in placement control.

3. Theoretically Impossible Test Results

Any given soil has individual components that cover a broad spectrum of specific gravity values. The major factor contributing to specific gravity values determined by the test method Bechtel requested (ASTM-D854) results from a 25 gram sample and thus the specific gravity values resulting there from should be interpreted with that in mind. The application of the likely

SB158138

band of specific gravity values represented in the Bechtel report figure 1 results in a 49 percent reduction of theoretically impossible results. The remainder of these test points falling above zero-voids line will be discussed in Section 6. However, specific gravity values from 2.57 to 2.82 for soil fractions are documented for material on this project.

The comment regarding the doubtfullness of the variation of soil properties is likely to be discounted by an examination of the data of the current soils evaluation program.

4. Repeated use of Questionable Laboratory Test Data

Although"...the fact that soil was not being placed or compacted according to specifications" was a major cause for concern. It is evident that another area of concern existed. Errors in calculations went unnoticed thru a good checking system. It is unfortunate that Bechtel's checking system simultaneously experienced difficulty.

5. Limits of Accuracy and Acceptability for Test Data

Although Bechtel statements conclude that only 25 to 40 percent of all clay tests represent compliance to specification, it should not be construed to represent the percentage of valid test data. The envelop of reasonably encountered test values would encompass the vast majority of test data. It has been demonstrated that the nominal scattering of data that may not have been anticipated was well within the statical variance that would be applied to this data.

SB158139

6. Accuracy of Test Equipment

The average deviation of the nuclear device from oven-dry moistures was +.12 % for a set of 30 tests. The range of differences was approximately from -3 % to + 4 %. It was the assumption of U. S. Testing that Bechtel Engineering was appropriately applying this data to placement tests.

Contrary to the assumption regarding figure 9 with its "impossibly high dry densities" current test data closely resembles this graphical representation.

The use of the nuclear device was employed at the consent of Bechtel to facilitate production.

7. Relative Density Tests

Some of the specification 7220-C-210 zone numbers are an area of concern because of the overlapping soil classifications, i.e., clay could be either zone 1 or 2. The inherent nomenclatural difficulties that plagued the Bechtel Organization in providing data was not addressed in the limited potential problem areas. A re-evaluation of test data, with this third concern in mind, would probably change Bechtel conclusions.

Regarding calculation errors of relative densities and assuming the validity of these errors, it is again unfortunate that our checking systems broke-down.

SB158140

The re-evaluation of maximum density by the wet method was in response to a relatively recent innovation of Bechtel assigning a geotechnical engineer to oversee the soils operation, here-to-fore there have been no "radical changes" or Bechtel material controls that would serve to flag the need for maximum density method re-determinations. Subsequent to this, the comparison of maximum density methods have been done routinely by U. S. Testing in response to material changes that were identifiable by newly instituted material controls and routine communication with assigned geotechnical representatives. These current comparisons have yielded maximum density variations that result in relative density changes from minimal to 20 %. The acceptability of high relative density results should have been evaluated as part of Bechtel process control that did not exist.

Summary

The Bechtel request that U. S. Testing respond to items 1 thru 5 has been detailed in this report.

The closing remarks of the Bechtel report makes the statement that"...on many occasions the inplace density was divided by the maximum density from the relative density test to get percent compaction..." is true. However, the report fails to mention that this method of calculation was a specific Bechtel directive.

SB156141

In conclusion, the problems and concerns attributed to U. S. Testing results from a lack of proper soil identification and material quantities normally covered in inspection and placement responsibilities, none of which are contractually the responsibility of the U. S. Testings scope of operations. We are the testing arm of Bechtel. Our function is the reporting of data not its evaluation.

SB158142

United States Testing Company, Inc.

Power Generation Services Division

1415 PARK AVENUE
HOBOKEN, NEW JERSEY 07030 (201) 792-2400 (212) 943-0488

program audits
vendor surveillance
concrete testing
on-site inspection
nondestructive testing
environmental evaluations
training programs

August 3, 1976
UST-13-76

RECEIVED
AUG 10 1976
BECHTEL POWER CORP.
JOB 7220
PER 192(2) C-20f

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

Attn: Tony Thompson

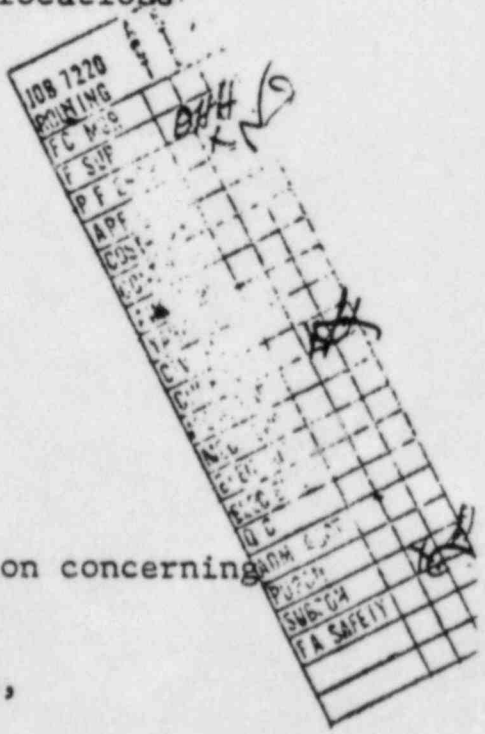
Dear Mr. J.F. Newgen:

The enclosed tests taken 7-29-76, were prepared from a new proctor, taken from this test area on the East Dike.

Any tests as of this date for the following locations and elevations should be considered void.

The locations and elevations are as follows:

Locations	Elevations
6 + 00	624
11 + 00	627.5
15 + 00	626.5
19 + 00	624.0
21 + 00	628.5
24 + 00	629.0
26 + 00	629.0



I hope this letter does clear up any confusion concerning the East Dike

Sincerely yours,

B.S. Waters
Lab Chief, Midland Project

BSW/dkm

SB158164

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COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE	DATE
CONTROL NO.	FILE NO.

1. PROJECT NO. 7220 2. DATE 7-29-76 PAGE ____ OF ____

SPEC. NO. 7220-C-208 5. ~~XXXXXXX~~ East Dike 6. TESTED WEEK OF ____

ATE KEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	Zone	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
	MD													
9-76	896	RB JR BW	11 + 00	627.5	--	142.0	12.3	126.5	277	13.4	2	121.0	104	P
	897		15+00	626.5	--	139.5	11.2	125.5	277	13.4	2	121.0	104	F(Moisture) .2 dry
	898		19 + 00	624.0	--	140.0	12.2	124.7	277	13.4	2	121.0	103	P
	899		21 + 00	628.5	--	123.5	15.2	107.2	277	13.4	2	121.0	89	F
	900		24 + 00	629.0	--	147.0	11.2	132.2	277	13.4	2	121.0	109	F(Moisture) .2 dry
	901		26 + 00	629.0	--	137.0	13.5	120.7	277	13.4	2	121.0	100	P
	902		6 + 00	624	--	134.1	13.9	117.7	277	13.4	2	121.0	97	P
														SB15S165
UST	J1-289													

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE | DATE | CONTROL NO. | FILE NO.

1. PROJECT NO. 7220 2. DATE 7-29-76 PAGE ____ OF ____

SPEC NO. 7220-C-208 5. DRAWING NO. XXXXXXXX East Dike 6. TESTED WEEK OF ____

ATE KEN	8. TEST NO. MD	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	Zone	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
27-76	890	RS	11 + 00 L. ℄	627.5	--	139.0	12.6	123.5	271	10.1	2	126.6	98	F(Moisture)
	891		6+00 L. ℄	624.0	--	132.5	11.6	118.8	271	10.1	2	126.6	94	F
UST	J1-282													

SB155166

DATE 8-4-76 21. RESPONSIBLE ENGINEER DATE

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE ____ DATE ____ CONTROL NO. ____ FILE NO. ____

1. PROJECT NO. 7220 2. DATE 7-29-76 PAGE ____ OF ____

4. SPEC. NO. 7220-C-208 5. XXXXXXXX East Dike 6. TESTED WEEK OF ____

7. DATE TAKEN	8. TEST NO. MD	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	Zone	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
7-28-76	892	RS	11 + 00 L. ℄	627.5	--	144.5	13.6	127.2	271	10.1	2	126.6	100	F(Moisture)
	893		24 + 00 L. ℄	628.0	--	142.0	12.5	126.3	271	10.1	2	126.6	100	F(Mositure)
	894		28+00 L. ℄	632.0	--	142.5	11.3	128.0	271	10.1	2	126.6	101	P
	895		6+00 L. ℄	624.0	--	133.5	13.3	117.7	271	10.1	2	126.6	93	F
UST	J1-284													

SB158167

United States Testing Company, Inc.

Engineering Inspection Division

1415 PARK AVENUE
HOBOKEN NEW JERSEY 07030 (201) 792-2400 (212) 943-0488

Testing & Inspection:
concrete
structural steel
soils
asphalt

Quality Control:
Construction Supervision
Investigations

May 30, 1974
UST Ma-25

RECEIVED
JUN 24 1974
BECHTEL POWER CORP.
JOB 7220
PER Q-208-27
ref: B-C-208-20

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

Attn: Mr. E. Felton

Re: Troxler Nuclear Gauge
Correlation

In response to your letter of May 21 1974, further comparisons between the Troxler Nuclear Gauges and oven-dry methods of moisture determinations have been made. Attached (Item "I") is a comparison as outlined by ASTM D-3017-72 and the manufacturers recommendations. In addition a statistical correlation was also performed and is attached for information purposes (Item "II").

Please give your considerations to this matter and advise as pertains to implementation of correction factors and use on Q-listed fill areas. If there are any questions please do not hesitate to call.

Respectfully,

United States Testing Co., Inc.

K Rademacher

Keith Rademacher
Lab Chief - Midland jobsite

Attachments

cc: D. Edley, UST, Hoboken, N.J.

KR/kls

SB158175

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Item "I"

MOISTURE CONTENT CORRELATION

Between

TROXLER NUCLEAR SURFACE MOISTURE DENSITY GAUGES

and

OVEN DRY MOISTURES

As per the guidelines set forth by the manufacture's manual, and by ASTM D 3017-72 a correlation was established between the two methods.

Test data was collected between May 30, 1974 and June 4, 1974 on various site areas and soil types. Two Troxler devices were used to determine the moisture content by the nuclear method. The test area was then removed and tested as per ASTM D 2216-71 (Laboratory Determination of Moisture Content of Soil), with the exception that the moisture samples ranged from 6 to 22 lbs. each in order to make a more accurate determination on the larger area encompassed by the Troxler. A sample set of 30 tests was collected and used in the computations. ASTM D 3017-72 section 6.3.1, requires an accuracy of $\pm.5$ lb/ft^3. Correlation results exceeding this would require a correction factor. Our correlation check showed the Troxler to be, on the average +.12% higher than the oven dry determination. This deviation from the average is within the Troxler stated precision of $\pm.2\%$.

Based on this correlation, a correction factor is not required.

SB158176

SB158177

Item "I"

MOISTURE CONTENT CORRELATION DATA

Between

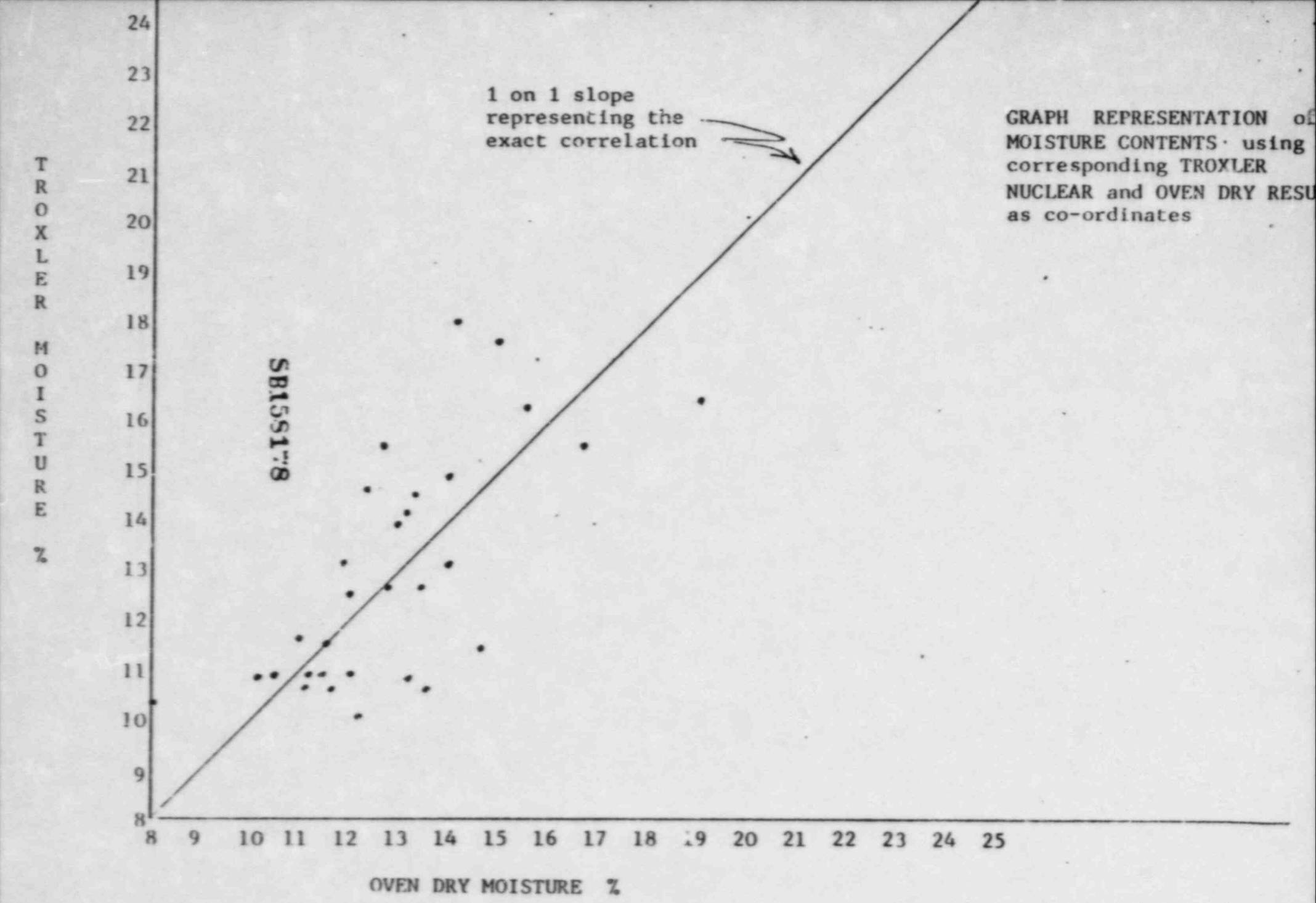
TROXLER NUCLEAR SURFACE MOISTURE DENSITY GAUGE

and

OVEN DRY MOISTURES

No.	TROXLER MOISTURE (%)	OVEN-DRY MOISTURE (%)	DIFFERENCE (%)	No.	TROXLER MOISTURE (%)	OVEN-DRY MOISTURE (%)	DIFFERENCE (%)
1.	16.4	19.0	-2.6	16.	10.2	12.2	-2.0
2.	14.8	13.9	+ .9	17.	17.6	14.8	+2.8
3.	15.5	16.6	-1.1	18.	15.5	12.7	+2.8
4.	13.1	13.8	- .7	19.	13.2	11.8	+2.4
5.	14.2	13.2	+1.0	20.	16.3	15.5	+ .8
6.	10.8	11.2	- .4	21.	10.6	11.6	-1.0
7.	11.4	14.6	-3.2	22.	12.5	11.9	+.6
8.	10.6	13.5	-2.9	23.	10.6	11.1	- .5
9.	10.8	10.2	+ .6	24.	14.5	13.3	+ .8
10.	10.8	13.2	-1.4	25.	18.0	14.1	+3.9
11.	10.8	11.4	-1.6	26.	10.8	12.0	-1.2
12.	10.4	8.0	+2.4	27.	10.8	10.4	+ .4
13.	11.5	11.5	±0.0	28.	12.7	13.4	-1.3
14.	11.6	10.8	+ .8	29.	14.7	12.3	+2.4
15.	12.6	12.7	- .1	30.	13.9	12.8	+1.1
							+3.7

+3.7 ÷ 30 = +.12% Ave. Deviation


1 on 1 slope
representing the
exact correlation
GRAPH REPRESENTATION of
MOISTURE CONTENTS · using
corresponding TROXLER
NUCLEAR and OVEN DRY RESU
as co-ordinates
SB1551-8
TROXLER MOISTURE %
OVEN DRY MOISTURE %
8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Item "II"

STATISTICAL CORRELATION

Between

TROXLER NUCLEAR SURFACE MOISTURE DENSITY GAUGES

and

OVEN DRY MOISTURES

The most frequently used correlational technique is product-moment correlation denoted by the symbol "r". The reason for the name "product-moment" correlation becomes obvious if one studies the algebraic manipulations illustrated in the formula for small-group product-moment correlations.

$$r = \frac{\mathcal{E}_{xy}}{\sqrt{\mathcal{E}_{x^2} \times \mathcal{E}_{y^2}}}$$

A "moment" is the sum of the score deviations from the mean after these deviations have been raised to some power and divided by "n". Since correlation deals with two tests, one "moment", and one therefore arrives at a "product-moment".

Results of thirty random samples, which were taken during the course of work at the Midland Nuclear Power Plant, were correlated in this particular analysis. The methods of testing used were the Troxler 2401 series Nuclear Surface Moisture Density Gauge (X) and oven drying samples (Y) according to ASTM D-2216 (Standard Method of Laboratory Determination of Moisture Content of Soil). The material tested was from zones 1 and 2, with both methods of testing being performed at the same locations. Basically, the test procedures incorporated are on a physical test vs. electronic device basis with the test results being translated into a numerical result. We believe that without a definite correlational procedure of statistical analysis there can be no true picture given of the Troxler vs. oven dried sample test results.

According to statistical procedure, the derived correlational coefficient is applied to the following scale:

± .00 to ± .20 - Indicates very slight or no relationship

± .20 to ± .40 - Indicates low relationship

± .40 to ± .70 - Indicates moderate relationship

± .70 to ±1.00 - Indicates high to perfect correlation between two sets of test scores.

The scored correlational coefficient of our test results was ± .98.

The Troxler Nuclear Gauge is a more efficient method of testing, eliminating human error, and giving a clearer picture of the area tested. Although not universally approved in the soil testing field the Troxler's results still have a very high correlation with sand cone, a proven but older method, which has too many flaws and inherent variances of error.

All statistical references were derived from statistical research and lectures given by Dr. Robert Sheehan of West Virginia University and his staff. Also specific reference can be made to A. L. Edwards' Statistical Method, New York; Holt, Rinehart and Winston, 1967.

CORRELATION STATISTICS

Using (X) as the representative symbol for Troxler moisture results and (Y) as the representative symbol for oven dry moisture results the correlation coefficient (r) can be determined giving you a correlation between the results of two small groups of test results.

mean of X = 15.7

mean of Y = 14.0

X	x	x^2	Y	y	y^2	xy
0.2	4.5	20.25	18.3	4.2	17.64	18.90
9.2	3.5	12.25	18.2	4.1	16.81	14.35
8.9	3.2	10.24	18.0	3.9	15.21	12.48
8.9	3.2	10.24	17.9	3.8	14.44	12.16
8.7	3.0	9.00	17.4	3.3	10.89	9.90
8.7	3.0	9.00	17.1	3.0	9.00	9.00
8.6	2.9	8.41	16.6	2.3	5.29	6.67
8.2	2.5	6.25	16.2	2.1	4.41	5.25
8.0	2.3	5.29	16.0	1.9	3.61	4.37
7.8	2.1	4.41	16.0	1.9	3.61	3.99
7.5	1.8	3.24	15.9	1.8	3.24	3.24
6.9	1.2	1.44	15.9	1.8	3.24	2.16
6.6	.9	.81	15.5	1.4	1.96	1.26
5.9	.2	.04	15.2	1.1	1.21	.22
5.6	-.1	.01	15.0	.9	.81	-.09
5.4	-.3	.09	14.5	.4	.16	.12
5.0	-.7	.49	14.0	-.1	.01	.01
5.0	-.7	.49	13.9	-.2	.04	.14
4.8	-.9	.81	13.7	-.4	.16	.27
4.6	-1.1	1.21	13.0	-1.1	1.21	.36
4.2	-1.5	2.25	12.6	-1.5	2.25	2.25
3.9	-1.9	3.61	12.2	-1.9	3.61	3.61
3.6	-2.1	4.41	11.7	-2.4	5.76	5.04
3.2	-2.5	6.25	10.7	-3.4	11.56	8.50
3.1	-2.7	7.29	10.5	-3.6	12.96	9.72
2.7	-3.0	9.00	10.3	-3.8	14.44	11.40
2.2	-3.5	12.25	10.0	-4.1	16.81	14.35
1.6	-4.1	16.81	8.7	-5.4	29.16	22.14
1.5	-4.2	17.64	8.7	-5.4	29.16	22.68
1.1	-4.6	21.16	8.3	-6.0	36.00	27.60

$$r = \frac{\Sigma_{xy}}{\sqrt{\Sigma_{x^2} \times \Sigma_{y^2}}}$$

$$r = \frac{232.05}{\sqrt{205.54 \times 274.66}}$$

$$r = \frac{232.05}{\sqrt{56453.616}}$$

$$r = \frac{232.05}{237.59}$$

$$r = .9766825 \quad \text{or} \quad .98$$

KEY:

Σ = sum of

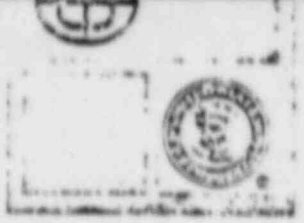
r = correlational coefficient

SV = standard of variance

The above statistical computation and correlation performed by Richard Peck, of United States Testing Co., Inc.

SB138182

United States Testing Company, Inc.
Engineering Inspection Division
1415 PARK AVENUE
HOBOKEN, NEW JERSEY 07030 (201) 792-2400 (212) 943-0488



Testing & Inspection
concrete
structural steel
soils
asphalt

Quality Control
Construction Supervision
Investigations

April 29, 1974
UST A-38

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

Attn: Mr. D. Grote

Re: Proposed Bullock
Creek Bridge Tests

Gentlemen:

Attached are the results of tests performed on the Shelby Tubes delivered to our lab and tested according to the directions of Mr. J. Wanzeck.

All tests were performed by Mr. P. Wang of our onsite staff with the exception of the consolidation samples which were forwarded to New Jersey.

If there are any questions, please do not hesitate to contact me.

Respectfully Submitted,

United States Testing Co., Inc.

Keith Rademacher
Lab Chief
Midland Jobsite

Attachments

cc: Mr. D. Edley, U.S.T., Hoboken, N.J.
KR:kls

SB155184

OUR LETTERS AND REPORTS ARE FOR THE EXCLUSIVE USE OF THE CLIENT TO WHOM THEY ARE ADDRESSED AND THEIR COMMUNICATION TO ANY OTHERS OR THE USE OF THE NAME OF UNITED STATES TESTING COMPANY, INC., MUST RECEIVE OUR PRIOR WRITTEN APPROVAL. OUR LETTERS AND REPORTS APPLY ONLY TO THE SAMPLE TESTED AND ARE NOT NECESSARILY INDICATIVE OF THE QUALITIES OF APPARENTLY IDENTICAL OR SIMILAR PRODUCTS. SAMPLES NOT DESTROYED IN TESTING ARE RETAINED A MAXIMUM OF THIRTY DAYS. THE REPORTS AND LETTERS AND THE NAME OF THE UNITED STATES TESTING COMPANY, INC., OR ITS SEALS OR INSIGNIA ARE NOT TO BE USED UNDER ANY CIRCUMSTANCES IN ADVERTISING TO THE GENERAL PUBLIC.

CALCULATION SHEET

DATE

SIGN BY Clarks DATE CHECKED BY SHEET NO.

PROJECT To. J.D. WANBECK 4-7-71 JOB NO.

87-353 Bridge E FILE NO.

Locations of 4-1275

TEST BORINGS AT BRIDGE

STA.		ELEV.	Boring No.
31+79	LT. 32'	614.3	#1
33+55	LT. 3'	610.1	#2
34+00	@ 0	610.1	#3
35+03	LT. -12	610.2	#4
35+53	LT. -10	608.5	#5
35+99	LT. -20	607.9	#6

SB158185

PROPOSED BRIDGE

TEST RESULTS

SB155186

ING O.	SAMPLE NO.	DEPTH	DIA. (inches)	MOISTURE CONTENT % ASTM D-2216	DRY DENSITY (LB/FT^3)	ATTERBURG LIMITS INDEX ASTM D-422	PL / LL	SPECIFIC GRAVITY ASTM D-854	UNCONFINED COMPRESSIVE STRENGTH ASTM D-2166	REMARKS
1	ST-5	13'-14'	3.0	SAMPLES FORWARDED TO NEW JERSEY						
-	LS-6	20'	3.0	11.1%	129.7	--	--	--	9374 PSF	Brownish gray silty clay w/some sand & gravel
1	ST-7	23'-24'	3.0	SAMPLES FORWARDED TO NEW JERSEY						
1	LS-8	30'	1.5	--	--	14.6	15.5 / 30.1	2.67	---	
1	LS-9	35'	1.5	--	--	13.3	15.3 / 28.6	2.69		Hydrometer rp attached
3	LS-5	15'	1.5	11.7%	128.9	9.5	11.7 / 21.2	--	10520 PSF	Brown clayey silt w/some sands & grave
3	LS-6	20'	1.5	19.7%	110.3	17.5	17.1 / 34.6	--	5011 PSF	
3	LS-7	25'	1.5	14.5%	121.4	--	--	--	8611 PSF	
3	LS-8	30'	1.5	17.4%	114.5	--	--	--	8323 PSF	
3	LS-9	35'	1.5	23.9	96.8	--	--	--	Note	Sample short broken no test
3	LS-10	40'	1.5	24.9	100.9	--	--	--	7157 PSF	
3	LS-11	45'	1.5	25.8	98.9	--	—	--	4953 PSF	
3	LS-12	50'	1.5	--	--	19.9	14.8 / 34.7	2.71	---	Hydrometer rp attached

PROPOSED BRIDGE

TEST RESULTS

ST-6	18'-19.3'	3	SAMPLE FORWARDED TO NEW JERSEY						
ST-10	44'-44.8'	2	14.9%	122.9	--	--	---	27936 PSF	Gray clay w/ some gravels
LS-6	20'	1.5	--	--	--	--	2.66	---	Hydrometer rpt. attached
LS-8	30'	1.5	23.6%	101.7	--	--	--	5054 PSF	
ST-9	35'	2	23.9%	105.8	--	--	--	14356 PSF	
ST-11	45'	2	15.6%	120.2	--	--	--	28425 PSF	Gray clay w/ some gravels

SB155187

UNITED STATES TESTING CO

Project No. [illegible]

Laboratory No. _____ Soils No. [illegible]

Date Received [illegible] Date Tested [illegible]

Tested By P. WANG

Checked By K. RADENACHER

MECHANICAL ANALYSIS & ATTERBERG LIMITS of SOILS

SPECIFIC GRAVITY

Wt. of Dry Soil and Flask W_1 = [illegible] g.

Wt. of Flask No. W_2 = [illegible] g.

Wt. of Dry Soil $W_1 - W_2 = W_s$ = [illegible] g.

Volume of Soil V_s = [illegible] c.c.

Apparent Sp. Gr. = $\frac{W_s}{V_s}$ = [illegible]

LIQUID LIMIT

	A	B
Wt. of Wet Soil and Dish	[illegible]	
Wt. of Dry Soil and Dish	[illegible]	
Wt. of Water	[illegible]	
Percent of Moisture	[illegible]	

	A	B
Wt. of Dry Soil and Dish	[illegible]	
Wt. of Dish	[illegible]	
Wt. of Dry Soil	[illegible]	

PLASTIC LIMIT

	A	B
Wt. of Wet Soil and Dish	[illegible]	
Wt. of Dry Soil and Dish	[illegible]	
Wt. of Water	[illegible]	
Percent of Moisture	[illegible]	

	A	B
Wt. of Dry Soil and Dish	[illegible]	
Wt. of Dish	[illegible]	
Wt. of Dry Soil	[illegible]	

SB158188

PLASTICITY INDEX (LL.–P.L.) = [illegible]

SIEVE ANALYSIS RETAINED ON No. — (W_1)

Sieve Number	Retained Weight (W_1)	Retained Percent (W_1)	Retained Per Ret. (W)	Cumulative % Ret.	Cumulative % Pass
	g	%	%	%	%
1—1½"					
1"					
¾"					
⅜"					
No. 4					
No. 10					
No. 40					
No. 200					
Pass					
Total					

SIEVE ANALYSIS FROM HYDROMETER ANALYSIS (W_2)

Sieve Number	Particle Size	Retained Weight	Retained Percent (W_2)	Retained Percent (W)	Cumulative % Ret. (W)	Cumulative % Pass (W_2)
	mm.	g	%	%	%	%
10	1.93	[illegible]	[illegible]			
20	0.833	[illegible]	[illegible]			
40	0.417	[illegible]	[illegible]			
60	0.246	[illegible]	[illegible]			
140	0.104	[illegible]	[illegible]			
200	0.074	[illegible]	[illegible]			
Pass	No. 200	[illegible]	[illegible]			
	Total	[illegible]	100			

Original Sample W = [illegible] g. 100%

Partial Sample W_1 = [illegible] g. [illegible]%

Partial Sample W_2 = [illegible] g. [illegible]%

HYDROMETER ANALYSIS OF MATERIAL PASSING No. [illegible] SIEVE (W_2)

Hydrometer No. [illegible] Sp. Gr. Corr a = — Wt. of Sample W_2 = [illegible] Gm.

Time	Time Min.	Temp. °C.	Hydrometer Reading ORIG	Hydrometer Reading Δ	Hydrometer Reading R	L	D	L	K	Diameter MM.	Corrected Diameter	% Pass of W_2
4-22-70 [illegible]						G.	D	L	K			
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.041	[illegible]	[illegible]
[illegible]	5		[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	.026	[illegible]	[illegible]
[illegible]	15		[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	.015	[illegible]	[illegible]
[illegible]	30		[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	.011	[illegible]	[illegible]
[illegible]	60		[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	.0074	[illegible]	[illegible]
[illegible]	250		[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	.0037	[illegible]	[illegible]
[illegible]	1440	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	.0015	[illegible]	[illegible]

NOTE—Percentages of W_2 also apply directly to W_2, the material passing the lowest sieve. These percentages, as well as those recorded in Column 7 (100 Ra ÷ W_2) of the Hydrometer Analysis, are converted to Percentages of the Total Sample, W, by multiplying the Ratio of the Partial Sample, W2, to the Total Sample, W.

UNITED STATES TES. G CO

Project No. [illegible]

Laboratory No. _____ Soils No. [illegible]

Date Received 7-19-24 Date Tested [illegible]

Tested By P. WANG

Checked By K. Radziwicka

MECHANICAL ANALYSIS & ATTERBERG LIMITS of SOILS

SPECIFIC GRAVITY

Wt. of Dry Soil and Flask W_1 = 92.20 g.

Wt. of Flask No. W_2 = 44.22 g.

Wt. of Dry Soil $W_1 - W_2 = W_s$ = 47.98 g.

Volume of Soil V_s = 2.20 c.c.

Apparent Sp. Gr. = $\frac{W_s}{V_s}$ = 21.81

LIQUID LIMIT

	A #30	B
Wt. of Wet Soil and Dish	72.9	
Wt. of Dry Soil and Dish	62.9	
Wt. of Water	9.2	
Percent of Moisture	39.7	

	A	B
Wt. of Dry Soil and Dish	62.6	
Wt. of Dish	26.3	
Wt. of Dry Soil	23.5	

PLASTIC LIMIT

	A #82	B
Wt. of Wet Soil and Dish	60.1	
Wt. of Dry Soil and Dish	57.1	
Wt. of Water	3.0	
Percent of Moisture	14.8	

	A	B
Wt. of Dry Soil and Dish	57.1	
Wt. of Dish	36.8	
Wt. of Dry Soil	20.3	

SB158189

PLASTICITY INDEX (LL – P.L.) = 19.9

SIEVE ANALYSIS RETAINED ON No. _____ (W_1)

Sieve Number	Retained Weight (W_1)	Retained Percent (W_1)	Per. Ret. (W)	Cumulative % Ret.	Cumulative % Pass
	g	%	%	%	%
1—1½"					
1"					
½"					
⅜"					
No. 4					
No. 10					
No. 40					
No. 200					
Pan					
Total					

SIEVE ANALYSIS FROM HYDROMETER ANALYSIS (W_2)

Sieve Number	Particle Size	Retained Weight	Retained Percent (W_2)	Retained Percent (W)	Cumulative % Ret. (W)	Cumulative % Pass (W)
	mm.	g	%	%	%	%
10	1.93	0	0		0	100
20	0.833	0.27	0.54		0.5	99.5
40	0.417	0.72	1.43		2.0	98.0
60	0.246	0.80	1.59		3.5	96.5
140	0.104	0.69	1.37		4.9	95.1
200	0.074	0.56	1.12		6.0	94.0
Pan	No. 200	46.89	93.76			
	Total	50.03	100			

Original Sample W = 50.03 g. 100 %

Partial Sample W_1 = 0 g. 0 %

Partial Sample W_2 = 50.0 g. 100 %

HYDROMETER ANALYSIS OF MATERIAL PASSING No. 10 SIEVE (W_2)

Hydrometer No. 151H/152H Sp. Gr. Corr a = — Wt. of Sample W_2 = 50.03 Gm.

Time	Time Min.	Temp. °C.	Hydrometer Reading ORIG	Hydrometer Reading ΔR	Hydrometer Reading R	G	P	L	K	Diameter MM.	Corrected Diameter	% Pass of W.
7-22-24 10:10				.0005								
10:12	2	21°C	1.0321		1.0326	1.0014	92.2	7.2	1.0132	.041	0.0[illegible]	92.2
10:15	5		1.0310		1.0315		95.2	6.9	1.0122	.026	0.0[illegible]	88.2
10:20	10		1.0300		1.0305		98.2	6.5	1.0112	.019	0.0[illegible]	83.2
10:40	30		1.0270		1.0275		97.2	6.0	1.0102	.011	0.0[illegible]	77.2
11:10	60		1.0250		1.0255		92.2	5.6	1.0092	.0074	0.0[illegible]	72.2
1:10	240		1.0210		1.0215		82.2	10.7	1.0081	.0037	0.0[illegible]	62.2
7-23-24 10:10	1440	21°C	1.0170		1.0175		71.8	11.4	1.0060	.0015	0.0[illegible]	51.8

NOTE—Percentages of W_2 also apply directly to W_2, the material passing the lowest sieve. These percentages, as well as those recorded in Column 7 (100 Ra ÷ W_2) of the Hydrometer Analysis, are converted to Percentages of the Total Sample, W, by multiplying the % of the Partial Sample, W2, to the Total Sample, W.

MECHANICAL ANALYSIS & ATTERBERG LIMITS of SOILS

Laboratory No _____ Soil No. _____

Date Received _____ Date Tested _____

Tested By P. IVANC

Checked By _____

SPECIFIC GRAVITY

Wt. of Dry Soil and Flask W_1 = _____ g.

Wt. of Flask No. W_2 = _____ g.

Wt. of Dry Soil $W_1 - W_2 = W_s$ = _____ g.

Volume of Soil V_s = _____ c.c.

Apparent Sp. Gr. = $\frac{W_s}{V_s}$ = _____

LIQUID LIMIT

	A	B
Wt. of Wet Soil and Dish		
Wt. of Dry Soil and Dish		
Wt. of Water		
Percent of Moisture		

	A	B
Wt. of Dry Soil and Dish		
Wt. of Dish		
Wt. of Dry Soil		

PLASTIC LIMIT

SB158190

	A	B
Wt. of Wet Soil and Dish		
Wt. of Dry Soil and Dish		
Wt. of Water		
Percent of Moisture		

	A	B
Wt. of Dry Soil and Dish		
Wt. of Dish		
Wt. of Dry Soil		

PLASTICITY INDEX (LL. – P.L.) = _____ _____

SIEVE ANALYSIS RETAINED ON No. _____ (W_1)

Sieve Number	Retained Weight (W_1)	Retained Percent (W_1)	Retained Per Ret. (W)	Cumulative % Ret.	Cumulative % Pass
	g	%	%	%	%
1—1½"					
1"					
¾"					
⅜"					
No. 4					
No. 10					
No. 40					
No. 200					
Pass					
Total					

SIEVE ANALYSIS FROM HYDROMETER ANALYSIS (W_2)

Sieve Number	Particle Size	Retained Weight	Retained Percent (W_1)	Retained Percent (W)	Cumulative % Ret. (W)	Cumulative % Pass (W)
	mm.	g	%	%	%	%
10	1.98	0	0		0	
20	0.833					
40	0.417					
60	0.246					
140	0.104					
200	0.074					
Pass	No. 200					
	Total		100			

Original Sample W = _____ g. 100 %

Partial Sample W_1 = _____ g. _____ %

Partial Sample W_2 = _____ g. _____ %

HYDROMETER ANALYSIS OF MATERIAL PASSING No. _____ SIEVE (W_2)

Hydrometer No. 152H 762 Sp. Gr. Corr a _____ Wt. of Sample W_2 _____ Gm.

Time	Time Min.	Temp. °C.	Hydrometer Reading ORIG	Hydrometer Reading Δr	Hydrometer Reading R						Diameter MM.	Corrected Diameter	% Pass of W.
						G_s	P	L	$\frac{30\eta}{\gamma}$	K			
	2										.041		
	5										.026		
	15										.015		
	30										.011		
	60										.0074		
	250										.0037		
	1440										.0013		

NOTE—Percentages of W_1 also apply directly to W_2, the material passing the lowest sieve. These percentages, as well as those recorded in Column 7 (100 Rs ÷ W_2) of the Hydrometer Analysis, are converted to Percentages of the Total Sample, W, by multiplying the % of the Partial Sample, W2, to the Total Sample, W.

United States Testing Company, Inc.

Engineering Inspection Division

1415 PARK AVENUE
HOBOKEN, NEW JERSEY 07030 (201) 792-2400 (212) 943-0488

Testing & Inspection:
concrete
structural steel
soils
asphalt

Quality Control
Construction Supervisor
Investigations.

February 4, 1974

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

Attn: Mr. P. Carpenter

Re: Test Code System for
Q.C. Documents

Gentlemen:

As per our conversation today with Mr. R. Brineman, lab coding of soil and aggregate tests shall be as follows:

G - Gradations	MD - Moisture & Density
H - Hydrometer Analysis	RD - Relative Densities
M - Moistures	BMP - Proctor Reports (Bechtel Modified Proctor)

Future test numbering and coding will begin with the following numbers as presented by Mr. Brineman.

Area	Dike No. on drawings	Moistures	Densities
Berm Backfill		M - 4	MD - 6
Plant Area - Fill		M - 1	MD - 3
Laydown Area - Fill		M - 61	MD - 113
Dike, Baffle		M - 35	MD - 34
Dike, West Plant	1	M - 10	MD - 25
Dike, North Miller	2	M - 8	MD - 15
Dike, Northwest	3	M - 12	MD - 13
Dike, West	4	M - 28	MD - 31
Dike, South	5	M - 1	MD - 1
Dike, East	6	M - 11	MD - 8
Dike, Northeast	7	M - 85	MD - 82
Dike, North Plant	8	M - 77	MD - 72

Compaction Tests BMP-100 (ASTM D-1557-70) AS MODIFIED BY BECHTEL pb
RD-100 (ASTM D-2049-69)

If there are any questions concerning this system please contact me.

Respectfully,

United States Testing Co., Inc.

Keith Rademacher

KR:kls

SB158205

OUR LETTERS AND REPORTS ARE FOR THE EXCLUSIVE USE OF THE CLIENT TO WHOM THEY ARE ADDRESSED. AND THEIR COMMUNICATION TO ANY OTHERS OR THE USE OF THE NAME OF UNITED STATES TESTING COMPANY, INC., MUST RECEIVE OUR PRIOR WRITTEN APPROVAL. OUR LETTERS AND REPORTS APPLY ONLY TO THE SAMPLE TESTED AND ARE NOT NECESSARILY INDICATIVE OF THE QUALITIES OF APPARENTLY IDENTICAL OR SIMILAR PRODUCTS. SAMPLES NOT DESTROYED IN TESTING ARE RETAINED A MAXIMUM OF THIRTY DAYS. THE REPORTS AND LETTERS AND THE NAME OF THE UNITED STATES TESTING COMPANY, INC., OR ITS SEALS OR INSIGNIA, ARE NOT TO BE USED UNDER ANY CIRCUMSTANCES IN ADVERTISING TO THE GENERAL PUBLIC.

Bechtel Power Corporation

Post Office Box 2167
Midland, Michigan 48640

January 13, 1975

Consumers Power Company
P. O. Box 1963
Midland, Michigan 48640

Attention: T. C. Cooke

Dear Mr. Cooke:

Job 7220 Midland Project
U. S. Testing Company
Subcontract 7220-C-208
Soil Testing
BCCC-863

Enclosed find copies of NCR's 26, 55, and 88. We are sending these to close out your IOM of December 11, 1973, Serial: 403 (Q2) that your Mr. D. Sibbald has raised questions about.

We will assume that this matter is now finalized.

Very truly yours,

E. E. Felton

EEF/JCC/JRS/ja

Attachment

SB158209

NONCONFORMANCE REPORT

DRAWING/PART NO.: 7220-C-208	REV.: 2	1. PAGE 1 OF 1	14. NCR NO.: 88
ITEM DESCRIPTION: Embankment Zone #2		7. PROJECT NO.: 7220	12. REPORTED BY: J.C. Eckel DATE: 4-17-74
SERIAL NUMBER: N/A		8. ITEM LOCATION: "Q" Lined Dikes	13. VALIDATED BY: N/A DATE: 4-17-74
PURCHASE ORDER NO.: Subcontract C-210 Rev. 2		9. STARTUP SYSTEM NO.: N/A	15. REPLACEMENT PART NO.: N/A REV.:
CONTRACTOR/LOCATION: Raymond Const. Co. Grand Haven Mich.		10. QC FIELD INSPECTION PLAN NO.: C-210 17, 18, 24, 28, 31, 32, 33 & 34	16. REPLACEMENT SERIAL NO.: N/A
		11. ASME CODE ITEM: ☐ YES ☒ NO	17. SOURCE: Site/Contract

ROUTING INSTRUCTIONS: ☒ ROUTE TO FIELD ENGINEERING ☐ ROUTE TO MATERIAL SUPERVISOR

19. DISPOSITION CODE (USE NO.): REWORK 1, REPAIR 2, USE AS-IS 3, SCRAP 4

BECHTEL: [signature] 5/3/74
PROJECT ENGINEER: [signature] DATE: 5/3/74
PROJECT FIELD QC ENGINEER: [signature] DATE: 4-30-74
AUTHORIZED INSPECTOR: DATE:

CONFORMING CONDITION: Spec 7220-C-208, Table 9-1, page 14a states in part: field densities, moisture content test frequency will be one per every 500 cubic yards of fill. Actual test taken was one per every 2300 cubic yards. Ref: NCR #C-26 & NCR #55 It was recommended by Project Engineering borings be taken to evaluate the in place density of affected areas. Approx. 500 samples were taken in areas as designated by Project Engineering (work done under subcontract FSC-60, Raymond Internation) Out of all samples taken 5% are actually failures.

SB15S210

☐ FIELD DISPOSITION ☒ FIELD RECOMMENDATION/ROUTE TO PROJECT ENGINEERING

Disregard failures as they are widley spread out and not far out of spec. A large percentage of these failures are also in the top one to two feet of dike and would have to be reconditioned before placement of embankment anyway. We recommend leaving dike as is with reconditioning of top lift as required. J.C. Eckel 4/19-74

21. FIELD DISPOSITION RESULTS:

RECEIVED
MAY 3 1974
BECHTEL POWER CORP.
JOB 7220
PER

ENGINEERING DISPOSITION

Based upon evaluation of data from the boring program initiated in response to NCR C-26, Engineering recommends the Plant Area fill be "used-as-is". A summary of the results of the boring program is being completed and will be forwarded under separate cover. Earthwork may proceed on the plant Area Fill. R.C. 4-30-74 J.C.E. 4-30-74

23. ENGINEERING DISPOSITION RESULTS:

IS DESIGN CHANGE REQUIRED ☒ NO ☐ YES, SEE ATTACHED:
DRAWING ____ REV. ____ DCN ____
SPEC ____ REV. ____ ADD. ____

26. REJECTED MATERIAL DISPOSITION ☐ RETURN TO SUPPLIER ☐ SCRAP
REMARKS

27. QC ACCEPTANCE [signature] 5/15/74
QC ENGINEER DATE
AUTHORIZED INSPECTOR DATE

ORIGINAL QC-G3-2

NONCONFORMANCE REPORT

1. PAGE 1 OF 5				14. NCR NO. 55	
2. DRAWING/PART NO. SK-C-12 & C-109 Q	3. REV. 6	7. PROJECT NO. 7220	12. REPORTED BY L. Shively	DATE 1/28/74	25. DISPOSITION CONCURRENCE
4. ITEM DESCRIPTION Earthwork Zone 1 & 2		8. ITEM LOCATION Q Listed Dikes	13. VALIDATED BY [illegible]	DATE 2-4-74	
5. SERIAL NUMBER NA		9. STARTUP SYSTEM NO. NA	15. REPLACEMENT PART NO. NA	REV.	PROJECT ENGINEER [illegible] DATE
6. PURCHASE ORDER NO. C-210 Rev. 2		10. QC FIELD INSPECTION PLAN NO. C-210 18,28,24,31,32,17,33 and 34	16. REPLACEMENT SERIAL NO. NA		PROJECT FIELD QC ENGINEER DATE
6. CONTRACTOR/LOCATION Canonie Const. Co. South Haven, Michigan		11. ASME CODE ITEM ☐ YES ☒ NO	17. SOURCE Sub-Contractor		AUTHORIZED INSPECTOR DATE

ROUTING INSTRUCTIONS: ☐ ROUTE TO FIELD ENGINEERING ☐ ROUTE TO MATERIAL SUPERVISOR

18. NONCONFORMING CONDITION: Spec. C-210-Rev. 2, section 12.6.1 states in part "The water content during compaction shall not be more than 2 percentage points below optimum moisture content and shall not be more than 2 percentage points above optimum moisture content..."

Contrary to the above, compaction test records indicate that material with out-of-specification moisture content was placed as shown in the following list:

SB155211

☐ FIELD DISPOSITION ☒ FIELD RECOMMENDATION/ROUTE TO PROJECT ENGINEERING

As per IOM BEBC-104 dated Nov. 7, 1973, the optimum moisture content range was relaxed to 2% dry to 5% wet on zone 2 material in the Bullock Creek area and the other selected areas of the dike as specified by the Bechtel representative. The following data from ck 19 is on zone 2 material and within 2% dry to 5% wet of optimum. It is listed separately for project engineering's evaluation to BEBC-104

21. FIELD DISPOSITION RESULTS:

ENGINEERING DISPOSITION

Based on a review of test results listed on pages 2 thru 5 of this NCR and also on various test results submitted as a response to NCR C-26, Engineering concludes that the in-place material is satisfactory. A summary of the results of our evaluation will be forwarded under separate cover.

Engineering recommends proceeding with the Plant Area Fill work, and also recommends to "use-as-is" the in-place material described in this NCR.

23. ENGINEERING DISPOSITION RESULTS:

IS DESIGN CHANGE REQUIRED ☐ NO ☐ YES, SEE ATTACHED:

DRAWING _____ REV. _____ DCN _____

SPEC. _____ REV. _____ ADD. _____

26. REJECTED MATERIAL DISPOSITION ☐ RETURN TO SUPPLIER ☐ SCRAP

REMARKS

27. QC ACCEPTANCE [signature] 2/05/74

QC ENGINEER DATE

AUTHORIZED INSPECTOR DATE

TEST NO.	DATE	STATION	ELEV.	MOISTURE CONTENT	OPTIMUM MOISTURE	CURVE NO.	RIGHT OR LEFT ℄	
				North Plant Dike				
8- 1	9-12-73	7 + 32	610	10.4	7.1	COP 2Q	215' R	No Action Taken
3	9-12-73	8 + 93	610	9.6	12.6	COL 12	215' R	No Action Taken
4	9-14-73	10 + 50	612	6.8	11.8	COB 2	200' L	
5	9-14-73	9 + 50	612	6.6	11.8	COB 2	250' L	
8	9-18-73	9 + 19	610	4.5	7.1	COP 2Q	238' L	
9	9-18-73	6 + 52	610	13.0	10.3	COD-1	92' R	
12	9-25-73	4 + 09	608	10.0	7.4	COL-11	80' R	Reworked-No Retest
13	9-25-73	6 + 08	609	14.2	9.4	COD-8	105' R	Reworked-No Retest
14	9-25-73	9 + 08	612	17.2	9.4	COD-8	200' R	Reworked-No Retest
15	9-25-73	5 + 10	609	12.1	8.6	COF-2	80' R	Reworked-No Retest
19	9-25-73	8 + 59	611	15.9	11.2	COD-5	82' R	
23	10-06-73	8 + 92	613	20.7	10.8	COL-15	212' R	Material Replaced-No Retest
24	10-06-73	6 + 90	613	24.0	10.8	COL-15	212' R	Material Replaced-No Retest
29	10-08-73	4 + 25	613	18.3	14.7	COD-7	92' R	No Retest
32	10-12-73	1 + 00	615	6.9	9.4	COD-8	50' L	
36	10-17-73	8 + 82	615	15.2	10.8	COL-15	40' R	
37	10-17-73	7 + 82	615	14.2	10.8	COL-15	40' R	
38	10-19-73	8 + 99	615	19.4	10.8	COL-15	110' R	Reworked Area-No Retest
39	10-19-73	9 + 52	615	17.3	10.8	COL-15	110' R	No Retest
40	10-19-73	8 + 49	615	15.2	10.8	COL-15	210' R	
41	10-24-73	3 + 00	617	13.8	11.2	COD-4	150' R	Reworked Area
46	10-24-73	8 + 03	624	19.5	16.4	COD-2	℄	
47	10-25-73	6 + 03	621	10.0	7.4	COL-11	70' R	
48	10-25-73	6 + 03	621	12.6	9.4	COD-8	150' R	
54	11-08-73	4 + 00	624	14.6	11.2	COD-5	20' R	Retested Not Passed-See WOD

SB155212

ORIGINAL

NONCONFORMANCE REPORT (CONT'D) 1. PAGE 3 OF 5 14. NCR NO. 55

T NO.	DATE	STATION	ELEV.	MOISTURE CONTENT	OPTIMUM MOISTURE	CURVE NO.	RIGHT OR LEFT ℄	
8-55	11-08-73	4 + 00	623	18.3	11.2	COD-5	20' R	
59	11-10-73	5 + 00	624	16.5	11.8	COB-2	20' L	Moisture Too High
61	11-10-73	4 + 00	623	14.3	10.3	COD-1	200' R	No Action Until Spring
64	11-13-73	5 + 50	622	10.5	8.0	?	50' L	"Start Up"
				West Plant Dike				
1- 1	9-11-73	5 + 30	610	4.8	12.0	COB 1	80' R	No Retest
2	9-11-73	3 + 85	610	4.7	12.0	COB 1	80' R	No Retest
3	9-11-73	2 + 70	610	5.0	12.0	COB 1	80' R	Reworked Area-No Retest
14	10-24-73	3 + 52	624	13.7	11.2	COD-5	75' R	
16	11-08-73	5 + 00	633	10.3	8.0	COD-11	25' R of shoulder	
				North East Dike				
7-35	9-12-73	27 + 00	608	10.3	7.4	COL 11	?	
46	9-25-73	33 + 00	616	19.5	16.4	COD 2	10' R	Reworked-Retested (see below)
47	9-25-73	31 + 00	616	19.6	12.7	COB 3	10' R	Reworked-Retested
58	10-02-73	28 + 45	612	20.1	16.4	COD 2	85' R	
64	10-11-73	32 + 00	614	18.3	14.2	COL 8	90' R	
69	10-12-73	31 + 00	616	21.0	12.7	COB 3	12' R	Retest-See WOD 7-47
74	10-20-73	28 + 00	617	23.0	20.5	COD 6	10' R	
78	11-14-73	30 + 00	622	16.3	11.2	COD-5	10' R	
80	11-13-73	31 + 00	616	17.1	12.6	COD 12	20' R	Retest of 47 & 69 (failed)

SB155213

QC-G3-3

BLOCK 20 CONTINUED

TEST NO.	ZONE	MOISTURE CONTENT	OPTIMUM MOISTURE	DIFFERENCE FROM OPTIMUM	% COMPACTION
WOD8-9	2	13.0	10.3	+2.7	97.6
WOD8-12	2	10.0	7.4	+2.6	100.2
WOD8-13	2	14.2	9.4	+4.8	97.7
WOD8-19	2	15.9	11.2	+4.7	96.0
WOD8-29	2	18.3	14.7	+3.6	99.6
WOD8-36	2	15.2	10.8	+4.4	103.2
OD8-37	2	14.2	10.8	+3.4	101.9
WOD8-40	2	15.2	10.8	+4.4	100.4
WOD8-41	2	13.8	11.2	+2.6	100.2
WOD8-47	2	10.0	7.4	+2.6	99.4
WOD8-48	2	12.6	9.4	+3.2	100.0
WOD8-59	2	16.5	11.8	+4.7	102.4
WOD8-61	2	14.3	10.3	+4.0	96.8
WOD1-14	2	13.7	11.2	+2.5	99.3
WOD7-35	2	10.3	7.4	+2.9	97.1
WOD7-46	2	19.5	16.4	+3.1	98.4
WOD7-58	2	20.1	16.4	+3.7	96.2
WOD7-64	2	18.3	14.2	+4.1	95.3
WOD7-74	2	23.0	20.5	+2.5	96.6

On the remainder of tests the field submits the following supplemental data for Project Engineering review & evaluation.

WOD8-1	2	10.4	7.1	+3.3	84.9
WOD8-3	2	9.6	12.6	-3.0	103.3
WOD8-4	1	6.8	11.8	-5.0	100.7
WOD8-5	1	6.6	11.8	-5.2	101.1

SB155214

QC-63

ORIGINAL

BLOCK 20 CONTINUED

NONCONFORMANCE REPORT (CONT'D) PAGE 5 OF 5 NCR NO. 55

TEST NO.	ZONE	MOISTURE CONTENT	OPTIMUM MOISTURE	DIFFERENCE FROM OPTIMUM	% COMPACTION
WOD8-8	2	4.5	7.1	-2.6	97.7
WOD8-14	2	17.2	9.4	+7.8	86.3
WOD8-15	2	12.1	8.6	+3.5	94.9
WOD8-23	2	20.7	10.8	+9.9	94.9
WOD8-24	2	24.0	10.8	+13.2	100.8
WOD8-32	1	6.9	9.4	-2.5	95.7
WOD8-38	2	19.4	10.8	+8.6	95.2
WOD8-39	2	17.3	10.8	+6.5	95.6
WOD8-46	1	19.5	16.4	+3.1	97.8
WOD8-54	1	14.6	11.2	+3.4	97.4
WOD8-55	1	18.3	11.2	+7.1	90.5
WOL8-64	1	10.5	8.0	+2.5	100.5
WOD1-1	1	4.8	12.0	-7.2	95.9
WOD1-2	1	4.7	12.0	-7.3	98.7
WOD1-3	1	5.0	12.0	-7.0	93.7
WOD1-16	1	10.3	8.0	+2.3	99.6
WOD7-47	2	19.6	12.7	+6.9	87.3
WOD7-69	2	21.0	12.7	+8.3	93.3
WOD7-78	2	16.3	11.2	+5.1	97.3
WOD7-80	2	17.1	12.6	+4.5	93.9

SB15S215

If necessary, field recommends evaluation of affected in-place material be done at the same time that evaluation of areas affected by NCR C-26 are conducted.

Gary W. Knell 3-6-74

NONCONFORMANCE REPORT

PROJECT NO. 7220

SKETCH ATTACHED Yes ☐

NO. 1.C-26 REV. 1

3. DATE MO 12 DAY 5 YR 73

4. ITEM LOCATION AREA/BLDG.: Cooling Pond

5. DWG/PART No.: 7220-C-109 REV.: 6

6. ITEM NAME: Dike Density Q No. 1.5.1 & 1.8

7. INSPECTION CRITERIA: DWG ☐ SPEC ☒ OTHER ☐ (EXPLAIN) DOCUMENT NUMBER & TITLE: 7220-C-208 Material Testing Services

8. SOURCE: ENGRG. ☐ CONSTR ☒ OTHER ☐ (EXPLAIN) ADDRESS

9. P.O. No.: 7220-C-210

10. No.	11. NONCONFORMANCE (DISCREPANCY) DESCRIPTION: (LIST SERIAL NUMBERS WHERE APPLICABLE) ASME YES ☐ NO ☒
1	Testing intervals for earthwork field densities taken during the interim material testing services subcontract (Specification 7220-C-208A) were established in Pittsburg Testing Laboratory's Quality assurance Manual. This interval was one (1) test per 500 cubic yards placed.
	Testing intervals for earthwork field densities taken under the permanent material testing service subcontract is established in table 9-1, page 14a of specification 7220-C-208. This interval is one (1) test per 500 cubic yards placed. , (Continued on Sheet 2.)

12. NCR PREPARED BY: Responsible Engr. [signature] Date 12/7/73

CONCURRENCE: Responsible Lead Engr. [signature] Date 12/11/73

13. FIELD DISPOSITION: REWORK ☐ REJECT ☐ ROUTE TO PROJECT ENGRG ☒ NOTIFY AUTHORIZED INSP. ☐ ROUTE TO MAT'L SUPV. ☐

1	Field recommends that borings be taken to evalute the in-place density of affected areas.
	Additional training and instruction will be given the inspectors to thoroughly educate them in the specification governing work they are involved in. Closer control will be maintained on the testing laboratory to insure their compliance with governing criteria.

14. FIELD DISPOSITION BY: [signature] Date 12/13/73

APPROVAL OF FIELD DISPOSITION: PE CONCURRENCE AUTH. INSP. [signature] Date 12/17/73

15. ENGRG DISPOSITION: REPAIR ☐ REJECT ☐ USE AS IS ☐ SEE BELOW ☒ DCN REQD: YES ☐ NO ☒ DCN No.

1	Engineering has requested that the GeoTech group evaluate the testing frequency required and the frequency achieved and recommend a program of corrective action. (IOM to J. H. Allen dated Jan. 17, 1974). Pending re-evaluation of required frequency all testing done shall be in accordance with existing specifications.
	~~(see continuation sheet)~~

16. APPROVAL OF DISPOSITION: ENGRG. PE [signature] Date 3/15/74; PFE [signature] Date 3/15/74; PFE CONCURRENCE AUTH. INSP. [signature] Date

17. REINSPECTION: ACCEPT ☒ REJECT ☐ Responsible Engr. [signature] Date 5/15/74; Responsible Lead Engr. [signature] Date 5/15/74; CONCURRENCE Auth. Insp. [signature] Date

WHITE – Q.C. ENGR. CANARY – FIELD ENGR. PINK – Q.A. ENGR. GOLDENROD – RESP. ENGR. SHADED AREAS APPLICABLE TO ASME COMPONENTS

2510 (7-72) QC – 2NCR REV. 7-1-72

SB158216

NONCONFORMANCE REPORT

CONTINUATION SHEET

PROJECT NO. 7220

2 OF 2

No. C-26

SKETCH ATTACHED Yes ☐

3. DATE MO 12 DAY 5 YR 73

10. No. CONT'D | 11. NONCONFORMANCE (DISCREPANCY) CONT'D or ☒ | 13. FIELD DISPOSITION CONT'D or ☐ | 15. ENGRG. DISPOSITION CONT'D and ☒

1.) Field densities taken on the west plant dike, north plant dike, and the 100 ft. berm in the northeast dike average one (1) test per 2300 cubic yards placed.

15. Engrg. Disposition Cont'd.

1.) Based upon Geotech's evaluation, Engineering recommends that the testing frequency remain as specified and the boring program recommended in BEBC 238, be implemented. RFP 3/15/74 for JCH 3/15/74

Based upon IOM dated March 21, 1974 J. P. Connolly to P. A. Martinez (QCFM - 088), Engineering has reviewed the response in block 15 above and adds the following comments:

1. A further memo (BEBC 249) containing additional information as to the type of tests, etc. has been forwarded to E. E. Felton on March 22, 1974. This resolves QC's question as to testing procedures and other test information to resolve this NCR.

2. The Geotech group was consulted on the engineering disposition of this NCR. Nothing in our response to this NCR or in BEBC 238 is meant to abrogate Field Quality Control responsibilities.

3. The above comments close NCR C-26, ~~Revision 1.~~ Revision 2. 4/17/74

JCH 4/17/74

4/17/74

SB158217

WHITE – Q.C. ENGR. PINK – Q.A. ENGR
CANARY – FIELD ENGR. GOLDENROD – RESP. ENGR.
2511 (7-72)

QC – 3NCR
REV. 7-1-72

NONCONFORMANCE REPORT

PG. 1 OF 2 | NO. 110-26 Rev. 1

PROJECT NO. 7220 | SKETCH ATTACHED Yes ☐ | DATE 12/5/73

4. ITEM LOCATION AREA/BLDG.	5. DWG/PART No	REV.	6. ITEM NAME
Cooling Pond	7220-C-109	6	Dike Density

7. INSPECTION CRITERIA: DWG ☐ SPEC ☒ OTHER ☐ (EXPLAIN) — DOCUMENT NUMBER & TITLE: 7220-C-208 Material Testing Services

8. SOURCE: ENGRG. ☐ CONSTR ☒ OTHER ☐ (EXPLAIN) — ADDRESS — 9. P.O. No. 7220-C-210

10. No.	11. NONCONFORMANCE (DISCREPANCY) DESCRIPTION (LIST SERIAL NUMBERS WHERE APPLICABLE)	ASME YES / NO
1	Testing intervals for earthwork field densities taken during the interim material testing services subcontract (Specification 7220-C-208A) were established in Pittsburg Testing Laboratory's Quality assurance Manual. This interval was one (1) test per 500 cubic yards placed.	
	Testing intervals for earthwork field densities taken under the permanent material testing service subcontract is established in table 9-1, page 14a of specification 7220-C-208. This interval is one (1) test per 500 cubic yards placed. (Continued on Sheet 2.)	

12. NCR PREPARED BY: Responsible Engr. [signature] Date 12/7/73 — CONCURRENCE: Responsible Lead Engr. [signature] Date 12/11/73

13. FIELD DISPOSITION: REWORK ☐ REJECT ☐ ROUTE TO PROJECT ENGR ☒ NOTIFY AUTHORIZED INSP. ☐ ROUTE TO MAT'L SUPV ☐

1	Field recommends that borings be taken to evalute the in-place density of affected areas. SB15S218
	Additional training and instruction will be given the inspectors to thoroughly educate them in the specification governing work they are involved in. Closer control will be maintained on the testing laboratory to insure their compliance with governing criteria.

14. FIELD DISPOSITION BY: [signature] Date 12/13/73 — APPROVAL OF FIELD DISPOSITION: PEE CONCURRENCE/AUTH. INSP. [signature] Date 12/17/73

15. ENGRG DISPOSITION: REPAIR ☐ REJECT ☐ USE AS IS ☐ SEE BELOW ☒ — DCN REQD: YES ☐ NO ☒ — DCN No.

1	Engineering has requested that the GeoTech group evaluate the testing frequency required and the frequency achieved and recommend a program of corrective action. (IOM to J. H. Allen dated Jan. 17, 1974). Pending re-evaluation of required frequency all testing done shall be in accordance with existing specifications.
	[illegible] (see continuation sheet)

RECEIVED
APR 19 1974
BECHTEL POWER CORP.

16. APPROVAL OF ENGRG. DISPOSITION: PE [signature] Date 2/5/74 — PEE CONCURRENCE/AUTH. INSP. [signature] Date 2/7/74

17. REINSPECTION: ACCEPT ☐ REJECT ☐ — JOB 7220 — Responsible Engr. [signature] Date — Responsible Lead Engr. [signature] Date

WHITE – Q.C. ENGR. PINK – Q.A. ENGR. GOLDENROD – RESP. ENGR. CANARY – FIELD ENGR. — SHADED AREAS APPLICABLE TO ASME COMPONENTS — QC – NCR REV 7-1-72

2510 (7-72)

NONCONFORMANCE REPORT

CONTINUATION SHEET

PROJECT NO. 7220

PAGE 2 OF 2

No. C-26

SKETCH ATTACHED Yes ☐

3. DATE MO 12 DAY 5 YR 73

10 No. CONT'D | 11. NONCONFORMANCE (DISCREPANCY) CONT'D or ☒
13. FIELD DISPOSITION CONT'D
15 ENGRG. DISPOSITION CONT'D and ☒

1.) Field densities taken on the west plant dike, north plant dike, and the 100 ft. berm in the northeast dike average one (1) test per 2300 cubic yards placed.

15. Engrg. Disposition Cont'd.

1.) Based upon Geotech's evaluation, Engineering recommends that the testing frequency remain as specified and the boring program recommended in BEBC 238, be implemented. RFR 3/15/74 CJH 3/15/74

Based upon IOM dated March 21, 1974 J. P. Connolly to P. A. Martinez (QCFM - 088), Engineering has reviewed the response in block 15 above and adds the following comments:

1. A further memo (BEBC 249) containing additional information as to the type of tests, etc. has been forwarded to E. E. Felton on March 22, 1974. This resolves QC's question as to testing procedures and other test information to resolve this NCR.

2. The Geotech group was consulted on the engineering disposition of this NCR. Nothing in our response to this NCR or in BEBC 238 is meant to abrogate Field Quality Control responsibilities.

3. The above comments close NCR C-26, Revision 1.

J C Hinds 4/17/74

4/17/74

SB158219

WHITE – Q.C. ENGR. PINK – Q.A. ENGR.
CANARY – FIELD ENGR. GOLDENROD – RESP. ENGR.
2511 (7-72)

CC – 3NCR
REV. 7-1-72

To GSKeeley

From TCCooke

Date December 11, 1973

Subject Midland Project CWO 7020
Soil Testing
File: C-208 Serial: 403 (Q2)

Consumers Power Company

Internal Correspondence

cc File
EEFelton (Bechtel)

NCR 248

It has come to our attention that there may be a problem with the frequency of soil testing during the time that the testing was being performed by Pittsburgh Testing under an interim contract. For the portion of the earthwork which was Q-listed, Bechtel's governing specification at the time called for tests to be taken at the direction of the Contractor. The personnel requesting the tests were from Geotech under temporary assignment to the Subcontract Administrator.

In performing an in depth review of their test frequency after questions were raised by Consumers Power Midland Project personnel and by Bechtel QA, Bechtel first thought the frequency was satisfactory and told us so. In order to be sure, we asked them to give us the number of yards placed in the plant fill (which is Q-list) and the number of tests taken. During their further investigation, they found that the frequency called for in PTL's "Quality Control Procedure" was one per 500 cubic yards which is the same as required of U. S. Testing under C-208. Approximately 20-25% of the tests required by that frequency have been taken.

We feel that the frequency of testing by U. S. Testing should also be investigated as it could also be incorrect. However, since they did not assume responsibility for the testing until October 22, there is less chance than with PTL of this being the case.

In our review of the files regarding this work, we found that Geotech personnel often signed off the inspection plans or parts thereof as both Field Engineer and Quality Control Engineer which seems to us to be inappropriate. In discussing this situation with Mr. T. Valanzano, Bechtel Field, it would appear that Geotech personnel were given a free hand insofar as the inspection process was were concerned since they are considered the experts in this area. While this may be an acceptable practice, it does nothing for proper documentation of the QA/QC program. At this point in time, Bechtel has written one NCR and is carrying out extensive investigations on the subject. I noted to Mr. Velanzano that we would need some assurances that proper reviews would in the future prohibit utilization of subcontractors approved QA/QC programs

SB158220

which spelled out inspection criteria which differs from that which will be used and/or Bechtel specifications. Differences must be ironed out prior to starting work operations. Mr. Velanzano also indicated that Bechtel Engineering may require additional soil borings or trench inspection.

Since Bechtel is currently reviewing the situation, I would not propose a Consumers Power nonconformance be issued at this time which would duplicate existing paper. By copy of this letter, however, I am requesting a reply on above questions from Mr. E. E. Felton with a copy to be sent to your office.

SB158221

Bechtel Associates Professional Corporation

Inter-office Memorandum

GROTE
JEFFERS
HUDSON

BEBC - 104

To E. E. Felton

Date November 7, 1973

Subject Midland Plant Units 1 & 2
Job No. 7220
Earthwork Moisture Content
File: C-210, C-208, 0274

From P. A. Martinez

Of Engineering

At Ann Arbor

Copies to J. H. Allen
J. C. Hink
R. L. Rixford
L. F. Wilcox

Reference: a) FCR-C-18 dated November 2, 1973

In response to your FCR (ref. a) and based on laboratory test data, compaction data, and location of the material being placed, specification C-210 can be relaxed with the following stipulations:

The optimum moisture content range can be specified as 2% dry to 5% wet of optimum provided that if the moisture content exceeds 2% wet of optimum the fill shall be placed with a compactive effort equal to at least 95% of the Bechtel modified proctor test result (20,000 foot pounds effort). This will be done at no additional cost to Bechtel. This also applies only to zone 2 material which is placed in the Bullock Creek area and in other selected areas of the dike as specified by the Bechtel representative. The moisture control specifications originally written for zone 1 material still apply to zone 1 material. That is, zone 1 material must be placed within a moisture content range of 2% dry to 2% wet.

The above change in allowable range of optimum moisture content for the zone 2 material may result in more than four passes of compaction equipment. However, as pointed out above, this additional effort will not be at the expense of Bechtel since it is being done to allow construction to continue and give the contractor the best utilization of his equipment and people.

P. A. Martinez

RLR/rc

SB158228

CBC Exc 1/3/H
Marz LMK

WU INFOMASTER

BECHTEL MIDL

003468C364 0937EST
2071 MIDLAND, MI 12/30/77

TLX 12-6493 U.S. TESTING HBKN
ATTN: DAVE EDLEY

SUBJECT: JOB 7220 MIDLAND PROJECT
SUBCONTRACT 7220-C-208
FAILURE OF ADMINISTRATION
BUILDING GRADE BEAM AT 0.4 LINE
C-208-B-283

ON AUGUST 23, 1977 WE NOTED A FAILURE OF THE SOIL SUPPORTING THE SUBJECT GRADE BEAM. THIS GRADE BEAM WAS PLACED ON FILL FOR WHICH U.S. TESTING PROVIDED SOIL COMPACTION TESTING DURING THE INSTALLATION PERIOD. OUR ENGINEERING ANALYSIS INDICATES THAT THERE MAY HAVE BEEN AN ERROR ON THE PART OF U.S. TESTING COMPANY IN THE SELECTION OF THE PROCTOR FOR THIS WORK. WE ARE EVALUATING ALL OF THE CIRCUMSTANCES (INCLUDING SUBSEQUENT TESTS THAT HAVE BEEN PERFORMED) AND WILL ADVISE YOU IN THE NEAR FUTURE AS TO ANY LIABILITY WE FEEL U.S. TESTING COMPANY MAY HAVE PER ARTICLE 14, "INDEMNITY" OF EXHIBIT "A", "GENERAL TERMS AND CONDITIONS" OF TECHNICAL SUBCONTRACT 7220-C-208.

QUESTIONS ON THIS MATTER SHOULD BE REFERRED TO MR. J. C. CHURCH, FIELD CONTRACTS ADMINISTOR.

J. F. NEWGEN
BECHTEL MIDL

JFN/JCC/AJB/KM

CC: JOHN SPELTS, UST CO
P. A. MARTINEZ
R. HERMESTON
P. A. BECNEL, SFHO
J. C. CHURCH

SB1582.2

\-

ACCEPTED
02071

1-PC

9.1

CONTROL NO. | FILE NO.

1. PROJECT NO. 7220 | 2. DATE 11-1-74 | PAGE 1 OF 1

SPEC. NO. 7220-C-208 | 5. DRAWING NO. Structural Backfill | 6. TESTED WEEK OF 11-2-74

DATE TAKEN	8. TEST NO. MDR	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
									Relative Density Max/Min		RD	
-23	9	JK TM	280° cnt.#1 4'from wal	584.5	N/A	110.0	4.2	105.5	15	119.1 / 97.7	41.1	Cleared by F MDR 14
"	10	"	240° 4'	583.5	N/A	116.0	6.8	108.6	15	119.1 / 97.7	55.9	Cleared by F MDR 13
"	11	RB RP	200° 3'	583.5	N/A	118.0	8.5	108.8	15	119.1 / 97.7	56.8	Cleared by F MDR 13
					CORRECTED CLASSIFICATIONS ON MDR 9, MDR 10 KA							
			UST N-127									
									SB158455			

PREPARED BY (Signature) Kathleen Rodriguez DATE 11-27-74 21. RESPONSIBLE ENGINEER Marc W. Hopkins DATE 12/2/74

(3-73)

COMPACTED FILL DENSITY TEST REPORT

CONTROL NO. ____ FILE NO. ____

1. PROJECT NO. 7220 2. DATE 12-13-74 PAGE 1 OF 1

SPEC. NO. 7220-C-208 5. DRAWING NO. Structural Backfill 6. TESTED WEEK OF 12-14-74

DATE TAKEN	8. TEST NO. MDR	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION % Max. Density	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
12-11	56	JG TM	10'W 6.6 line 2' from H line wall	586	N/A	121.4	6.3	114.2	RD 16 80%	119.2 / 100.0	77.2	Cleared by F MDR 58
	57		36' E. 6.6 2' from H line wall	586	N/A	119.8	6.2	112.8	RD 16 80%	119.2 / 100.0	70.4	Cleared by F MDR 58
	58		10'E. 6.6 2' from H line wall	586	N/A	125.5	7.7	116.5	RD 16 80%	119.2 / 100.0	87.9	P
			UST D-156									

SB158456

PREPARED BY (Signature) Kent Richards DATE 12-13-74 21. RESPONSIBLE ENGINEER Marc W Hopkins DATE 12/13/74

1. PROJECT NO. 7220 | 2. DATE 12-16-74 | CONTROL NO. | FILE NO. | PAGE 1 OF 1

4. SPEC. NO. 7220-C-208 | 5. DRAWING NO. Structural Backfill | 6. TESTED WEEK OF 12-21-74

7. DATE TAKEN	8. TEST NO. MDR	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION % Max. Density	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
12-13	59	TM	21' West of 8.7 line 2' from A line	583	N/A	127.9	13.1	113.1	RD 16 80%	119.2 100.0	71.9	To Be X Cleared at F future dat
	60	TM JK	C 6.6 line 2' from H line wall	588	N/A	123.5	8.4	113.9	RD 16 80%	119.2 100.0	75.8	Cleared by F MDR 61
	61	TM	3' East 6.6 line 2' from H line wall	588	N/A	125.3	8.6	115.4	RD 16 80%	119.2 100.0	82.8	P
	62	TM JG	10' East 6.6 line 2' from H line wall	590	N/A	126.6	8.3	116.9	RD 16 80%	119.2 100.0	89.7	P
			X WORK DISCONTINUED IN THIS AREA-HK									
			UST D-173									SB158457

PREPARED BY (Signature) Hank Rolwes DATE 12-29-74 | 21. RESPONSIBLE ENGINEER Marc A Hoffmann DATE 1/7/75

(1/74)

SB158458

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE	DATE
CONTROL NO.	FILE NO.

1. PROJECT NO. 7220 2. DATE 12-10-74 PAGE 1 OF 1

PEC. NO. 7220-C-208 5. DRAWING NO. Structural Backfill 6. TESTED WEEK OF 12-14-74

TE KEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
	MDR	RB	28'E.of 6.5									
-10	54	JG	line 3'out from H line wall	584	N/A	124.9	5.7	118.2	RD 16	% of relative density, need 80% compaction 119.2 100.0	95.6	Pass
	55		24'W.of 6.5 line 3'out from H line wall	584	N/A	128.9	12.1	115.0	RD 16	% of relative density, need 80% compaction 119.2 100.0	81.0	Pass
			UST D-113									

SB158458A

COMPACTED FILL DENSITY TEST REPORT

QC ACCEPTANCE	DATE
CONTROL NO.	TEST NO.

1. PROJECT NO. 7220 2. DATE 12-10-74 PAGE 1 OF 1

EC. NO. 7220-C-208 5. DRAWING NO. Plant Area Fill 6. TESTED WEEK OF 12-14-74

E EN	8. TEST NO.	9. TEST-ED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
10	MD 126	JG RB	20'W.of 6.6 line 33'out from H line wall	584	N/A	128.6	5.7	121.7	% of maximum RD 16 density, 95% compaction	need 119.2	102.1	Pass
	127		31'E.of 6.6 line 33'out from H line wall	584	N/A	136.1	10.3	123.4	% of maximum RD 16 density, 95% compaction	need 119.2	103.6	Pass
												SB158459
			UST D-114									

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE	DATE
CONTROL NO.	T.B.J. NO.

1. PROJECT NO. 7220 2. DATE 11-29-74 PAGE 1 OF 1

C. NO. 7220-C-208 5. DRAWING NO. Structural Backfill 6. TESTED WEEK OF N/A

E N	8. TEST NO. MDR	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
		RTS	178° Cont #1						% RD Need	119.2		
27	35	KR	1'F/wall	586	N/A	128.6	11.2	115.6	RD16 80% comp.	100.0	83.8	P
27	36	↓	VOID due to incorrect logging						↓	↓		
		JG	180° Cnt. #1						% of RD	119.2		
26	37	RB	1'F/wall	586	N/A	123.7	12.4	110.1	RD16 Need 80%	100.0	57.0	F Cleared by MDR 35
27	38		190° 2'	587	N/A	124.6	10.4	112.9	RD16		70.9	F Cleared by MDR 43
27	39		50° Cnt. #2 5' F/wall	589	N/A	119.3	4.8	113.8	RD16		75.3	F Cleared by MDR 45
27	40		45° 5'	589	N/A	124.6	9.5	113.8	RD16		75.3	F Cleared by MDR 45
-29	41	JG	195° Cnt. #1 1'F/wall	587	N/A	123.0	8.9	112.9	RD16		70.9	F Cleared by MDR 43
29	42	JG	185° 2'	587	N/A	128.0	12.0	114.3	RD16		77.7	F Cleared by MDR 43
2	43		180° 3'	587.5	N/A	130.4	10.0	118.5	RD16		96.9	P
2	44		50° Cnt. #2 3' F/wall	589	N/A	108.7	4.3	104.2	RD16		24.0	F Cleared by MDR 45
2	45		47° 2'	589	N/A	124.7	6.7	116.9	RD16		89.8	P
2	46	JG	30° 2'	589	N/A	129.2	9.5	118.0	RD16		94.7	P
		RCS	185° Cnt. #1									
3	47	JG	2' F/wall	588.5	N/A	119.9	7.8	111.2	RD16		62.5	F Cleared by MDR 49
3	48	↓	175° 3'	588.5	N/A	122.3	7.5	113.8	RD16		75.3	F Cleared by MDR 49
3	49	JG	180° 3'	588.5	N/A	131.2	11.5	117.7	RD16 ↓	↓	93.4	P
												SB158460
			UST D-20									

COMPACTED FILL DENSITY TEST REPORT

QC ACCEPTANCE	DATE
CONTROL NO.	FILE NO.

1. PROJECT NO. 7220 2. DATE 12-4-74 PAGE 1 OF 1

SPEC. NO. 7220-C-208 5. DRAWING NO. Structural Backfill 6. TESTED WEEK OF 12-7-74

DATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
	MDR											
12-4	50	JG	50'Cont.#2 'from wall	590	N/A	123.9	8.7	114.0	RD 16 % of RD need 80% compaction	119.2 / 100.0	76.2	Cleared by F MDR 52
	51		190'Cont. 1 ' from wall 1		N/A	129.3	11.1	116.4	RD 16		87.5	P
	52		40'Cont.#2 'from wall		N/A	128.0	9.2	117.2	RD 16		91.1	Clears P MDR 50
	53		10'Cont. 2 'from wall		N/A	126.5	8.2	116.9	RD 16		89.8	P

SB158-161

USE D-45

INSPECTOR [illegible] DATE 12/5/74 21. RESPONSIBLE ENGINEER [illegible]

COMPACTED FILL DENSITY TEST REPORT

QC ACCEPTANCE DATE

CONTROL NO. TEST NO.

1. PROJECT NO. 7220 2. DATE 11-5-84 PAGE 1 OF 1

4. SPEC. NO. 7220-C-208 5. DRAWING NO. Baffle Dike 6. TESTED WEEK OF 11-2-74

7. DATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	Zone	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
		TM	19+00											
11-4	103	GM	20'L	622	10	145.5	10.9	131.25	179	9.1	2	129.7	101.2	P
	104		16+00 20'L	615	17	144.5	11.2	130.0	179	9.1	2	129.7	100.2	P
	105		12+00 20'L	616	16	146.5	11.0	132.0	179	9.1	2	129.7	101.8	P
	106		19+00 20'L	623	9	136.5	19.5	114.25	168	14.3	2	117.8	97.0	P
	107		17+50 20'R	618	14	130.0	21.2	107.25	174	17.2	2	110.4	97.1	P
	108		16+00 20'R	616	16	133.0	19.8	111.0	191	15.0	2	115.4	96.2	P
	109		14+50 20'R	616	16	139.5	16.0	120.25	169	13.4	2	120.8	99.5	P
	110		13_00 20'R	617	15	133.5	17.4	113.75	191	15.0	2	115.4	98.6	P
	111		12+00 20'R	617	15	124.0	18.1	105.0	174	17.2	2	110.4	95.1	P
	112		14+00 20'R	617	15	124.0	21.3	102.25	112	20.0	2	103.4	98.9	P
	113		16+00 20'R	618	14	132.5	19.4	111.0	191	15.0	2	115.4	96.2	P
	114		18+00 20'R	623	9	126.0	20.6	104.5	112	20.0	2	103.4	101.1	P
	115		20+00 15'R	625	7	134.0	18.6	113.0	191	15.0	2	115.4	97.9	P
													SB1585-16	
	UST	N-113												

20. PREPARED BY (Signature) Kurt Vadnais DATE 11-7-74 21. RESPONSIBLE ENGINEER Paul Conpity DATE 11-7-74

COMPACTED FILL DENSITY TEST REPORT

QC ACCEPTANCE DAT
CONTROL NO. FILE

1. PROJECT NO. 7220 2. DATE 10-11-74 PAGE 1 OF 1

4. SPEC. NO. C-208 Rev. 3 5. DRAWING NO. Area Baffle Dike 6. TESTED WEEK OF 10-12-74

7. DATE TAKEN	8. TEST NO. MD	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
10-9	101	GM JK	31+00 ℄	631.5	0	131.0	14.4	114.5	173	14.6	2	116.5	98.3	P
	102		35+00 ℄	631.5	0	133.5	13.4	117.75	171	12.9	2	120.7	97.6	P

Checked by: J. George

SB158547

COMPACTED FILL DENSITY TEST REPORT

QC ACCEPTANCE

CONTROL NO.

1. PROJECT NO. 7220 2. DATE 10-11-74 PAGE 1 OF

4. SPEC. NO. C-208 Rev. 3 5. DRAWING NO. Area Baffle Dike 6. TESTED WEEK OF 10-12-74

7. DATE TAKEN	8. TEST NO. MD	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
10-8	96	TJM	43+10 ℄ 10'R	626	5.5	125.5	24.0	101.25	118	21.4	2	103.2	98.1	P
	97		42+80 ℄ 10'L	628	3.5	128.0	23.4	103.75	118	21.4	2	103.2	100.5	P
	98		42+00 ℄	630	1.5	125.25	23.1	101.75	118	21.4	2	103.2	98.6	P
	99		43+00 ℄	628	3.5	127.5	22.9	103.75	118	21.4	2	103.2	100.5	P
	100		42+50 ℄	631.5	0	126.0	22.9	102.5	118	21.4	2	103.2	99.3	P Final

Checked by: J. George

SB155548

J. Barga 10/11

COMPACTED FILL DENSITY TEST REPORT

QC ACCEPTANCE | DATE
CONTROL NO. | FILE NO.

1. PROJECT NO. 7220 2. DATE 10-7-74 PAGE 1 OF 1

4. SPEC. NO. 7220-C-208 5. DRAWING NO. Baffle Dike 6. TESTED WEEK OF 10-12-74

7. DATE TAKEN	8. TEST NO. MD	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
10-7	92	TM	43+25 5'R CL	624	8	123.00	24.2	99.00	118	21.4	2	103.2	95.9	P
	93		42+2_ CL	630	2	128.00	20.8	106.00	174	17.2	2	110.4	96.0	P
	94		43+00 CL	626	6	128.00	24.0	103.25	118	21.4	2	103.2	100.0	P
	95		42+50 10'L CL	628	4	126.50	21.9	103.75	134	18.0	2	109.0	95.2	P

Checked by: K. Rademacher

SB158549

COMPACTED FILL DENSITY TEST REPORT

QC ACCEPTANCE

CONTROL NO.

1. PROJECT NO. 7220 2. DATE 10-5-74 PAGE 1 OF 1

4. SPEC. NO. 7220-C-208 5. DRAWING NO. Area Battle Dike 6. TESTED WEEK OF 10-5-74

7. DATE TAKEN	8. TEST NO. MD	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION DMP	OMC	ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
10-5	80	RB JG	20+00 DIKE ℄	631.5*	0	122.5	15.3	106.25	174	17.2	2	110.4	96.2	P Final T
	81		41+00 DIKE ℄	630.5	1	137.0	9.4	125.25	176	10.4	2	126.6	98.9	P
	82		28+50 DIKE ℄	630.5	1	140.0	12.2	124.75	116	11.6	2	125.2	99.6	P
	83		42+00 DIKE ℄	631.5*	0	135.5	12.0	121.0	184	12.4	2	121.3	99.8	P Final T
	84		29+00 DIKE ℄	631.0	0.5	125.0	11.6	112.0	104	13.0	2	110.4	96.2	P
10-4	85	JK TM	28+50 ℄ 5'R	629.0	2.5	124.5	20.3	103.5	118	21.4	2	103.2	100.3	P
	86		33+00 ℄	630.5	1.0	134.0	17.5	114.0	172	15.9	2	114.5	99.6	P
	87		38+00 ℄ 5'L	631.0	0.5	129.0	22.6	105.25	134	18.0	2	109.0	96.6	P
	88		41+50 ℄	629.0	2.5	131.5	21.8	108.0	134	18.0	2	109.0	99.1	P
	89		42+00 DIKE ℄	630.0	1.5	131.0	14.7	114.25	173	14.6	2	116.5	98.1	P
	90		35+00 ℄ 5'R	631.0	0.5	131.0	15.2	113.75	173	14.6	2	116.5	97.6	P
	91		28+00 DIKE ℄	630.0	1.5	128.5	17.1	109.75	174	17.2	2	110.4	99.4	P

*At Grade

J Cerpa

SB158550

Checked by: K. Rademacher

COMPACTED FILL DENSITY TEST REPORT

QC ACCEPTANCE
CONTROL NO.

1. PROJECT NO. 7220 2. DATE 10-3-74 PAGE 1 OF

4. SPEC. NO. 7220-C-208 Rev. 3 5. DRAWING NO. Area Baffle Dike 6. TESTED WEEK OF 10-6-74

7. DATE TAKEN	8. TEST NO. M	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
10-3	35	TM	34+00 $\mathbb{C}$ L	630.5	1.5	134.00	21.3	110.50	-	-	2	-	-	-
	36		38+00 $\mathbb{C}$ 5'L	631.0	1.0	128.50	23.3	104.25	-	-	2	-	-	-
			Moisture Checks											
			Checked by: K. Rademacher											

SB158551

20 PREPARED BY (Signature) Mel Rademacher DATE 10-4-74 21. RESPONSIBLE ENGINEER Paul Garbarini 10-7-74

corrected copy

COMPACTED FILL DENSITY TEST REPORT

QC ACCEPTANCE | DATE
CONTROL NO. | TEST NO.

1. PROJECT NO. 7220 | 2. DATE 9-30-74 | PAGE 1 OF 1

4. SPEC NO. 7220-C-208 | 5. DRAWING NO. Area: Battle Dike | 6. TESTED WEEK OF 9-23-74

7. DATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
	ND	GM	13+00 ℄ 5'R											
9-27	76a*	LS		632	–	133.0	14.4	116.25	155	14.0	1	119.6	97.2	P
	77		38+00 ℄ 5'L	632	–	132.5	12.3	118.0	157	12.8	1	120.4	98.0	P
	78		33+00 ℄	632	–	129.0	14.2	113.0	154	15.4	1	116.1	97.2	P
	79		28+00 ℄ 2'R	632	–	132.5	13.2	117.0	155	14.0	1	119.6	97.8	P

* Inadvertantly double numbered, reissued as 76a

Checked by: K. Radenacher

SB158552

COMPACTED FILL DENSITY TEST REPORT

QC ACCEPTANCE | DATE
CONTROL NO. | FILE NO

1. PROJECT NO. 7220 2. DATE 9-30-74 PAGE 1 OF 1

4. SPEC NO. 7220-C-208 5. DRAWING NO. Area Baffle 6. TESTED WEEK OF 9-23-74

7. DATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
	MD	GM												
9-25	64	LS	27+00 $\frac{\text{C}}{\text{L}}$ 10'L	626	6	142.0	10.7	128.25	119	10.2	2	128.0	100.2	P
	65		29+10 $\frac{\text{C}}{\text{L}}$ 20'L	626	6	138.5	11.9	123.75	152	12.2	2	123.6	100.1	P
	66		31+20 $\frac{\text{C}}{\text{L}}$ 30'L	626	6	137.0	11.6	122.75	153	12.2	2	122.3	100.4	P
	67		33+30 $\frac{\text{C}}{\text{L}}$ 10'L	626	6	132.0	13.5	116.25	149	14.2	2	112.1	100.1	P
	68		35+40 $\frac{\text{C}}{\text{L}}$	626	6	131.0	13.7	115.25	121	13.0	2	118.0	97.6	P
	69		37+50 $\frac{\text{C}}{\text{L}}$ 10'R	626	6	133.0	12.8	118.0	121	13.0	2	118.0	99.9	P
	70		39+60 $\frac{\text{C}}{\text{L}}$ 20'R	626	6	132.0	14.1	115.75	154	15.4	2	116.1	99.6	P
	71		41+70 $\frac{\text{C}}{\text{L}}$ 30'R	626	6	136.0	11.9	121.5	153	12.2	2	122.3	99.4	P
	72		42+80 $\frac{\text{C}}{\text{L}}$ 20'R	626	6	124.5	19.1	104.5	134	18.0	2	109.0	96.0	P
	73		28+00 $\frac{\text{C}}{\text{L}}$ 20'L	617	15	127.0	14.7	110.75	132	15.5	2	114.5	96.7	P
	74		32+00 $\frac{\text{C}}{\text{L}}$	617	15	132.0	14.8	115.0	133	15.4	2	115.3	99.7	P
	75		36+00 $\frac{\text{C}}{\text{L}}$ 10'R	617	15	125.0	17.9	106.0	105	17.1	2	110.6	95.8	P
	76		40+50 $\frac{\text{C}}{\text{L}}$ 15'R	617	15	130.0	13.3	114.75	131	14.5	2	115.5	99.4	P

Checked by: K. Radenacher

J Gaspar 10/3/74

SB158553

UST 0-37

COMPACTED FILL DENSITY TEST REPORT

QC ACCEPTANCE | DAT
CONTROL NO. | FILE N

1. PROJECT NO. 7220 2. DATE 9-30-74 PAGE 1 OF 1

4. SPEC. NO. 7220-C-208 5. DRAWING NO. Baffle Dike 6. TESTED WEEK OF 9-28-74

7. DATE TAKEN	8. TEST NO. MD	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
9-24	51	GM LS	43+00 CL	626	6	128.0	18.8	107.75	134	18.0	2	109.0	98.9	P
	52		41+25 CL 10'L	626	6	125.5	19.8	104.75	134	18.0	2	109.0	96.1	P
	53		39+50 CL 15'R	626	6	130.5	19.2	109.5	105	17.1	2	110.6	99.0	P
	54		37+75 CL 5'L	626	6	129.0	19.7	107.75	134	18.0	2	109.0	98.9	P
	55		36+00 CL 15'R	626	6	136.0	17.2	116.0	163	14.2	2	118.0	98.3	P
	56		34+25 CL	626	6	138.5	11.9	123.75	161	10.9	2	126.3	98.0	P
	57		35+50 CL 10'R	626	6	135.5	14.3	118.5	155	14.0	2	119.6	99.1	P
	58		30+75 CL 5'L	626	6	129.0	16.2	111.0	132	15.5	2	114.5	96.9	P
	59		23+00 CL	626	6	129.5	17.5	110.25	105	17.1	2	110.6	99.7	P
	60		29+00 CL 10'L	626	6	135.5	11.8	121.25	153	12.2	2	122.3	99.1	P
	61		27+25 CL 10'R	626	6	133.5	13.6	117.5	155	14.0	2	119.6	98.2	P
	62		25+50 CL	626	6	130.5	17.3	111.25	130	15.2	2	112.9	[illegible]3.5	Due to Tro[illegible] P Accuracy
	63		23+75 CL 5'L	626	6	131.5	16.4	113.0	132	15.5	2	114.5	98.7	P

Checked by: K. Rademacher

SB158554

COMPACTED FILL DENSITY TEST REPORT

QC ACCEPTANCE	DATE
CONTROL NO.	FILE NO

1. PROJECT NO. 7220 2. DATE 9-19-74 PAGE 1 OF 1

4. SPEC. NO. 7220-C-208 5. DRAWING NO. Area Baffle Dike 6. TESTED WEEK OF 9-21-74

7. DATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
9-17	MD 47	TM	33+00 ℄ 10'R	624	8	125.0	16.0	107.75	105	17.1	2	110.6	97.4	P
	48		36+00 ℄ 10'L	624	8	128.0	16.9	109.5	105	17.1	2	110.6	99.0	P
	49		39+00 ℄	624	8	126.5	16.6	108.5	105	17.1	2	110.6	98.1	P
	50		42+00 ℄	624	8	128.5	15.2	111.5	156	15.7	2	115.4	96.6	P

Checked by: K. Radenacher

SB158555

COMPACTED FILL DENSITY TEST REPORT

1. PROJECT NO. 7220 2. DATE 9-10-71 PAGE 1 OF 1

4. SPEC. NO. 7220-C-203 5. DRAWING NO. Approved Bottle Dike 6. TESTED WITH OF 9-24-71

7. DATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BHP	OMC	ZONE	17. MAX. LAB DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
9-13	MD 34	TM JS	41+50 $\underset{L}{C}$ 5'R	623	9	145.0	10.1	131.75	159	9.3	1	129.5	101.7	P
	35		38+50 $\underset{L}{C}$ 15'L	623	9	140.0	11.3	125.75	151	11.3	1	124.6	100.9	P
	36		35+50 $\underset{L}{C}$ 10'R	623	8	142.5	10.7	128.75	159	9.3	1	129.5	99.4	P
	37		32+50 $\underset{L}{C}$ 20'L	624	9	143.5	10.9	130.5	159	9.3	1	129.5	100.8	P
	38		29+50 $\underset{L}{C}$ 5'L	623	9	136.75	11.0	123.25	151	11.3	1	124.6	98.9	P
	39		26+50 $\underset{L}{C}$ 20'R	623	9	146.0	10.2	132.5	160	9.4	1	129.5	102.3	P
	40		23+50 $\underset{L}{C}$ 15'L	623	9	143.5	10.0	130.5	160	9.4	1	129.5	100.8	P
	41		20+50 $\underset{L}{C}$	621	11	148.5	10.4	134.5	160	9.4	1	129.5	103.9	P
	42		31+00 20'R	627	7	135.5	15.3	117.5	133	13.9	2	118.2	99.3	P
	43		33+00 $\underset{L}{C}$ 30'L	627	7	135.5	17.1	115.75	154	15.4	2	116.1	99.7	P
	44		36+00 $\underset{L}{C}$ 10'L	627	7	130.5	18.7	110.0	130	15.2	2	112.9	97.4	P
	45		39+00 $\underset{L}{C}$	627	7	135.0	22.1	110.5	105	17.1	2	110.6	99.9	P
↓	46	↓	41+50 $\underset{L}{C}$ 10'R	627	7	128.5	23.6	104.0	112	20.0	2	103.4	100.5	P

Checked by: K. Rademacher

SB156556

COMPACTED FILL DENSITY TEST REPORT Resubmittal

QC ACCEPTANCE | CONTROL NO.

1. PROJECT NO. 7220 2. DATE 5-31-74 PAGE 1 OF

3. SPEC NO. 7220-C-205 5. DRAWING NO. N. Plant Dike 6. TESTED WEEK OF 6-1-74

4. DATE TESTED	8. TEST NO. MD	7. TEST BY EV	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION			17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS Pass/Fail
5-31	147	JC/ /pp	8+00 $\mathcal{L}$	629	5	121.7	9.6	110.0	BMP 104	OMC 13.0	Zone 2	116.4	95.4	Retest F MD-158
	148		4+15 15'R Zone 3	627	7	130.9	11.3	117.6	103	13.3		119.3	98.6	P
	149		5+00 75'R Zone 3	627	7	124.1	12.8	110.0	COD 7	14.7		113.7	96.7	P
	150		0+00 $\mathcal{L}$	622	12	121.9	9.0	111.9	BMP 104	13.0		116.4	96.1	Retest F MD-151
	151		7+00 $\mathcal{L}$	628	6	129.3	14.9	112.9	108	12.8		116.3	96.7	P
	152		3+00 30' R Zone 1&2 Mark	632	2	126.2	8.2	116.6	106	12.5	✓	120.5	96.8	Retest F MD-162

SB158557

COMPACTED FILL DENS. / TEST REPORT Resubmittal

4. QC ACCEP. ... DA...
CONTROL NO. ... FIL...

1. PROJECT NO. 7220 2. DATE 5-30-74 PAGE 1 OF ...

3. SPEC NO. 7220-C-208 5. DRAWING NO. N. Plant Dike 6. TESTED WEEK OF 6-1-74

DATE TAKEN	TEST NO. MD	TEST ED BY	LOCATION	ELEV. OF TEST	DEPTH BELOW FINAL GRADE (FT.)	IN PLACE WET DENSITY (LB./C.F.)	MOISTURE CONTENT (%)	IN PLACE DRY DENSITY (LB./C.F.)	SOIL CLASSIFICATION			MAX. LAB. DRY DENSITY (LB./C.F.)	PERCENT COMPACTION	REMARKS Pass/Fail
5-30	142	TM/LS	1+00 40'R ℄	625	9	138.7	10.3	125.7	COD 11	OMC 8.0	Zone 1	132.0	95.2	P
	143		3+00 40'R ℄	625	9	126.6	11.4	113.6	BMP 111	13.8		118.8	95.7	P
	144		5+00 30'R ℄	627	7	130.5	15.0	113.5	106	12.5		120.5	94.2	F Retest MD-14
	145		7+00 50'R ℄	628	6	138.3	10.4	125.3	COD 11	8.0		132.0	94.9	F Retest MD-1[illegible]
	146		9+00 40'R ℄	632	2	127.9	14.9	111.3	BMP 106	12.5		120.5	92.4	F Retest MD-1[illegible]

SB158558

CONTROL NO. FILE NO.

1. PROJECT NO. 7220 2. DATE 9-19-74 PAGE 1 OF 1

NO. 7220-C-203 5. DRAWING NO. Area Plant 6. TESTED WEEK OF 9-21-74

8. TEST NO. MD	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION			17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
								BMP	OMC	ZONE			
19	TM	Embankment N. of Liebherr Crane	590'	-	109.7	2.5	107.0	RD-12	-	1	112.9/ 94.8	71.1	P **
20		NW. Quad. Unit 1-50' Out	594'	-	140.0	10.2	127.0	120	10.4	1	127.4	99.7	P
21		NW Quad Unit 1-50' Out	594'	-	130.0	11.6	116.5	108	10.8	1	116.3	100.2	P
22		NW Quad Unit 1-50' Out-75' W of NS ℄	594'	-	128.5	10.8	116.0	108	12.8	1	116.3	99.7	P
23		NW Quad Unit 1-50' Out-95' W of NS ℄	604'	-	129.0	16.7	110.5	105	17.1	1	110.5	100.0	P

** Percentage of relative density taken on natural material

*Elevation Approximate

Checked by: K. Rademacher

SHEET 3

PREPARED BY (Signature) Karl Rademacher DATE 9/21/74 21. RESPONSIBLE ENGINEER Paul Campanella DATE 9-21-74

CONTROL NO. | FILE NO.

1. PROJECT NO. 7220 | 2. DATE 8-29-74 | PAGE 1 OF 1

NO. 7220-C-208 | 5. DRAWING NO. Plant area backfill | 6. TESTED WEEK OF 8-24-74

8. TEST NO. MD	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION DWP	OMC	ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION *	19. REMARKS
17	TM	330° 10'R Wall	585	-	121.6	5.6	115.2	RD-5	-	-	102.5 120.4	74.2	F
18		315° 17'R Wall	586	-	122.3	2.8	119.0	RD-5	-	-	102.5 120.4	93.3	P

* Percent of relative density

Checked by:, K. Rademacher

SR[illegible]5754

PREPARED BY Engineer K. A. Schmeckpeper | DATE 9-2-74 | 21. RESPONSIBLE ENGINEER Paul Carpenter | DATE 9/4/74

COMPACTED FILL DENSITY TEST REPORT

QC ACCEPTANCE | DA
CONTROL NO. | FAI

1. PROJECT NO. 7220 2. DATE 11/..17 PAGE 1 OF

4. SPEC. NO. 7220-C-2[illegible] 5. DRAWING NO. River Intake Structure 6. TESTED WEEK OF 4/2 11 - 4/[illegible]

7. DATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
	HD								EMP QC Zone			
4/4/17	014	RS	5'W of 1 at [illegible]	576	—	119.6	3.6	115.4	293 6.0 4	139.6	82.7	Fail ok
4/[illegible]/17	012	RS/SM/GJ	5'W of L-4-1[illegible]	576	—	119.5	4.4	114.5	293 6.0 4	139.6	82.0	Fail ok
"	013	"	4'E of L-4-1[illegible]	576	—	131.9	5.8	124.7	293 6.0 4	139.6	89.3	Fail ok
"	014	"	1'W of L-4-1[illegible]	576	—	141.2	4.6	135.0	293 6.0 4	139.6	96.7	Pass Thin: ND-01
"	015	"	1'E of L-4-1[illegible]	576	—	143.4	4.4	137.4	293 6.0 4	139.6	98.4	Pass Thin: ND-0
4/3/17	016	RS/SM/GJ	10' N of N.W.P. Grout Neck	571	—	155.5	4.9	148.2	293 6.0 4	139.6	106.7	Pass
"	017	"	1'W of L-4-1 N end	576	—	135.6	5.1	129.0	293 6.0 4	139.6	92.4	Fail SEE #15
4/3/17	018	RS/GJ	1'W of L-4-1 N end	573	—	123.5	3.7	119.1	293 6.0 4	139.6	85.3	Fail SEE #15
"	019	"	20'W of [illegible]	573	—	157.0	5.6	149.7	293 6.0 4	139.6	106.5	Pass
4/[illegible]/17	020	RS/GJ	3'W of W.P. [illegible]	572	—	153.7	5.8	145.3	293 6.0 4	139.6	104.1	Pass
"	021	"	4'W of N.W.P. [illegible]	572	—	147.2	5.2	139.9	293 6.0 4	139.6	100.2	Pass

SB1549988

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE ____ DAT
CONTROL NO. ____ FILE

1. PROJECT NO. 7220 2. DATE 4/19/77 PAGE 1 OF 2

4. SPEC. NO. 7220-C 203 5. DRAWING NO. River Intake Structure 6. TESTED WEEK OF ____

DATE TAKEN	8. TEST NO. MD	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
									RD UNIC ZONE	117.6	As per EO	
4/12/77	026	SM	5' N. of River Intake 13' W. of Intake Pipe	57½	—	115.1	6.5	108.1	6.0 N/A 3	122.9	56.3	Fail

COMPACTED FILL DENSITY TEST REPORT

QC ACCEPTANCE | CONTROL NO.

1. PROJECT NO. 72..C. 2. DATE PAGE 1 OF

4. SPEC. NO. 72.C.CCS 5. DRAWING NO. 1..1.1..1..1.. 6. TESTED WEEK OF 1/1.. 11.. 4/1

7. DATE TAKEN	8. TEST NO. ND	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION Clip one [illegible]	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
1/[illegible]/22	022	R..	[illegible] N. [illegible]	575	—	126.1	4.2	121.0	293 6.0 4	139.6	86.7	Fail 2nd TEST
"/22	023	RS	30' N. of Stub 5.5' W. of L 24" Pipe	575	—	149.7	5.1	142.4	293 6.0 4	139.6	102.0	Pass
4/3/22	024	SH	10' [illegible] of Pipe	579	—	150.6	5.1	143.3	293 6.0 4	139.6	102.7	Pass
"	025	"	15' N. of Stub 10' E. of L of Pipe	575	—	121.2	4.0	116.5	293 6.0 4	139.6	83.5	Fail
"	026	"	[illegible]	577	—	~~115.1~~	~~6.5~~	~~108.1~~	[illegible] Pipe	EXCAVATED FOR A NEW PIPE		
4/5/22	027	RS, SH, BT	45' N. of Stub 5' W. of L of Pipe	575	—	144.7	5.2	137.5	293 6.0 4	139.6	98.5	Pass
"	028	"	15' N. of Stub 30' West Pipe	576	—	151.4	5.0	144.2	293 6.0 4	139.6	103.3	Pass
4/6/22	029	RS	[illegible]	575	—	142.6	4.6	136.3	293 6.0 4	139.6	97.6	Pass
"	030	"	[illegible]	577	—	144.1	5.7	136.3	293 6.0 4	139.6	97.6	Pass
4/7/22	031	RS	[illegible]	577	—	137.0	4.1	131.6	293 6.0 4	139.6	94.3	Pass
"	032	"	[illegible]	576	—	145.3	11.0	130.9	293 7.2 1	130.6	100.2	Pass

SB158990

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE ____ DATE ____ CONTROL NO. ____ FILE NO. ____

1. PROJECT NO. 7220 2. DATE 4/28/77 PAGE 1 OF 1

SPEC. NO. 7220-C-208 5. ~~DRAWING NO.~~ River Intake Structure 6. TESTED WEEK OF 4/14/77 thru 4/22/77

DATE TAKEN	8. TEST NO. MD	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BHP OMC ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
4/15/77	033	SM	30'N. of MH#5 6'E. of ℄ Pipe	580	—	131.9	4.0	126.8	293 6.0 (4)	139.6	90.8	See #23 & Fail #40
"	034	"	25'S. of River Intake Structure 6'E. of ℄ Pipe	588	—	132.9	11.5	119.2	294 9.9 2	124.6	95.7	Pass Cite #30
4/18/77	035	RS	50'N. of MH#5 5'E. of ℄ 96" Pipe	550	—	134.5	4.3	130.9	293 6.0 (4)	139.6	93.8	Fail
"	036	"	30'N. of MH#5 6'W. of ℄ 96" Pipe	580	—	142.7	5.0	135.9	293 6.0 (4)	139.6	97.3	Pass
4/19/77	037	RS/SM	30'N. of MH#5 7'W. of ℄ of Pipe	583	—	130.9	15.0	113.8	294 (9.9) 2	124.6	91.4 (3)	See #36 Fail #40
"	038	"	51'N. of MH#5 on ℄ of Pipe	583	—	123.6	3.6	119.3	293 (6.0) (4)	139.6	85.5	Fail 5
~~4/20/77~~	~~039~~											
4/20/77	040											NO RETEST
												TEST LOCATION 2' ABOVE PIPE - NON-CRITICAL
7/15	T Dia-6											

SB158991

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE DATE

CONTROL NO. FILE NO.

1. PROJECT NO. [illegible] 2. DATE 5/4/77 PAGE 1 OF 1

SPEC. NO. [illegible] 5. DRAWING NO. [illegible] 6. TESTED WEEK OF [illegible]

DATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
4/29	39	[illegible]	[illegible]	516	—	135.5	13.1	119.8	30 26.1	120.3	99.4	Pass
	40	"	[illegible]	512	—	138.0	14.9	120.2	30 13.6 1	120.8	99.5	Pass
4/29	41	16	[illegible]	511	—	136.0	16.5	116.9	30 13.6 1	120.8	96.9	Pass

SB158992

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE ____ DATE ____
CONTROL NO. ____ FILE NO ____

1. PROJECT NO. 7100 2. DATE 4/27 PAGE 1 OF 1

SPEC. NO. 7100-C-265 5. DRAWING NO. Final Tie-In Alignment 6. TESTED WEEK OF 4/24/96

DATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
	116								LEAN CLAY			
4-11	092	RS	N. of Prod. Mtg. of 16" Pipe	555	—	131.0	13.7	122.7	250 13.6 1	120.5	101.6	Pass
"	093	"	N. of Prod. Mtg. of 16" Pipe	555	—	145.5	13.5	126.7	250 13.6 1	120.5	104.9	Pass

SB158993

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE _____ DATE _____
CONTROL NO. _____ FILE NO. _____

1. PROJECT NO. 7120 2. DATE 5-[illegible]-77 PAGE 1 OF 1

4. SPEC. NO. 1120-C 706 5. DRAWING NO. Lower Falls Street 6. TESTED WEEK OF 5-7-77 thru 5-13

DATE TAKEN	8. TEST NO. MD	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
									Silt Loam Fill			
5-[illegible]-77	044	SH	45' N. of Mon. #3 12' W. of "96" Line	585	—	137.5	16.8	117.8	180 13.6 1	170.8	17.5	Fail
" 77	045	KS	75' N. of Mon. #3 2' W. of "96" Line	585	—	136.5	15.0	118.7	180 13.6 1	170.8	18.3	Pass 4" Lifts MD-045
" 77	046	KS	35' N. of Mon. #3 14' W. of "96" Line	592	—	131.5	10.8	118.7	180 13.6 1	170.8	1.5	Fail ok
"	047	"	35' N. of Mon. #3 17' W. of "96" Line	592	—	156.5	10.4	141.8	180 13.6 1	170.8	117.4	Fail ok
" 77	048	KS	35' N. of Mon. #3 14' W. of "96" Line	592	—	139.0	12.6	123.4	180 13.6 1	170.8	102.2	Pass 6" Lifts MD-048

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE | DA
CONTROL NO. | FILE

1. PROJECT NO. 7110 2. DATE 5-31-77 PAGE 1 OF 1

4. SPEC. NO. 7110-C-226 5. DRAWING NO. Tree Intake Structure 6. TESTED WEEK OF 5-14-77 Mon 5-

DATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
	MO								Silt one Zone			
5-16-77	049	KS	[illegible]	573	—	154.1	4.8	147.0	293 6.0 1	139.6	105.[illegible]	Pass
"	1050	KS	5'S. of N.E. & 16'E. of Spec. Pt. 2'E. of E. Side Pipe	575	—	144.4	5.6	136.7 ~~137.0~~	293 6.0 4	139.6	97.9	Pass

COMPACTED FILL DENSITY TEST REPORT

QC ACCEPTANCE ____ DATE ____
CONTROL NO. ____ FILE NO. ____

1. PROJECT NO. 7220 2. DATE 6-13-77 PAGE 1 OF 1

SPEC. NO. 7220-C-208 5. DRAWING NO. River Intake Structure 6. TESTED WEEK OF 5-22-77 thru 5-28-77

DATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP OMC COMP	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
	MD											
5/27/77	C51	SM	50'S of River Int. Structure 2'E of 96" S.D.P.	576	—	142.9	5.0	136.0	293 6.0 (4)	139.6	97.4	PASS
1	C52	RS	40'N of M.H.P.S. 3'W of 96" S.D.P.	576	—	125.6	3.0	121.9	293 6.0 (4)	139.6	87.3	See #536 FAIL #50

SB158996

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE _____ DA
CONTROL NO. _____ FILE

1. PROJECT NO. 7220 2. DATE 6-27 PAGE 1 OF 1

4. SPEC. NO. 7220-C-205 5. DRAWING NO. Floor Plan Structure 6. TESTED WEEK OF 5/4/77 to 6/3

DATE TAKEN	TEST NO.	TESTED BY	LOCATION	ELEV. OF TEST	DEPTH BELOW FINAL GRADE (FT.)	IN PLACE WET DENSITY (LB./C.F.)	MOISTURE CONTENT (%)	IN PLACE DRY DENSITY (LB./C.F.)	SOIL CLASSIFICATION	MAX. LAB. DRY DENSITY (LB./C.F.)	PERCENT COMPACTION	REMARKS
6/27	351	RS	N 0+98 E 16'	578	—	1350	13.4	1190	SP-SM	1206	98.5	OK

SB158927

COMPACTED FILL DENSITY TEST REPORT

QC ACCEPTANCE | DATE
CONTROL NO. | FILE NO.

1. PROJECT NO. 7320 2. DATE 6-20-77 PAGE 1 OF 1

SEC. NO. 7320-C-208 5. DRAWING NO. River Intake Structure 6. TESTED WEEK OF 6/19/77 - 6/25/77

3. TE CEN	4. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
	001								Bkfl one Zone			
7/7	054	J.T.	75'-11"-0.195 13' W. of 96" pipe	589	—	143.0	13.8	125.7	220 13.6 1	120.8	104.1	Pass
7/7	055	R.S.	35'-11"-0.193 E of 96" pipe	590	—	144.0	12.5	128.0	220 13.6 1	120.8	106.0	Pass

SB18998

COMPACTED FILL DENSITY TEST REPORT

DWP 7/20 Filed 7/6

1. PROJECT NO. 7220 — 2. DATE 6-27-77 — PAGE 1

4. SPEC. NO. 7220-C-208 — 5. RIVER INTAKE — 6. TESTED WEEK OF 6/11/77

7. DATE TAKEN	8. TEST NO. M&D	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION (BMP ONE ZONE)	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
6/14/77	056	RG	120'W of MH#5 & over 96" pipe	591	—	141.0	16.5	121.0	280 13.6 1	120.8	100.2	Fail
"	057	"	128'W of MH#5 20' W of 96" pipe	589	—	129.5	9.3	118.5				
6/14/77	058	RV	120'W of MH#5 & over 96" pipe	591	—	137.5	13.6	121.0	280 13.6 1	120.8	98.1	Fail
"	059	"	128'W of MH#5 20' W of 96" pipe	589	—	137.0	16.9	117.2	280 13.6 1	120.8	100.2	Fail
"	060	"	128'W of MH#5 20' W of 96" pipe	589	—	136.0	15.1	118.2	280 13.6 1	120.8	97.0	Fail
6/14/77	061	RS	70'W of MH#5 5'E of 96" pipe	592	—	138.0	16.3	118.7	280 13.6 1	120.8	97.8	Pass
"	062	"	70'W of MH#5 5'E of 96" pipe	592	—	139.5	13.2	123.2	280 13.6 1	120.8	98.2	Fail
6/15/77	063	BT	85'E of W/W & 5'S of Retaining wall	578	—	135.0	13.7	118.7	280 13.6 1	120.8	98.3 / 102.0	Pass
"	064	"	75'W of MH#5 & over 96" pipe	594	—	138.0	12.7	122.4	280 13.6 1	120.8	98.3	Pass
6/16/77	065	RS	44'E of W/W-intake wall 12'S of W/W Retaining	588	—	136.5	12.2	121.7	280 13.6 1	120.8	101.3	Pass
6/16/77	066	RS	50'W of W/W-intake wall 14'S of W/W Retaining	589	—	133.0	14.7	116.0	280 13.6 1	120.8	100.7	Pass
6/17/77	067	BT	50'W of W/W-Int. Structure 15'S of W/W Retaining	592	—	140.0	12.4	124.5	280 13.6 1	120.8	96.0	Pass
"	068	"	100'W of W/W-intake wall 15'S of W/W Retaining	590	—	138.0	12.0	123.2	280 13.6 1	120.8	103.1	Pass
"	069	"	150'W of W/W-intake wall 15'S of W/W Retaining	588	—	136.5	11.9	122.0	280 13.6 1	120.8	101.0	Pass

SB15:30

20. PREPARED BY (Signature) R Smith — DATE 6/25/77 — 21. RESPONSIBLE ENGINEER NON-G

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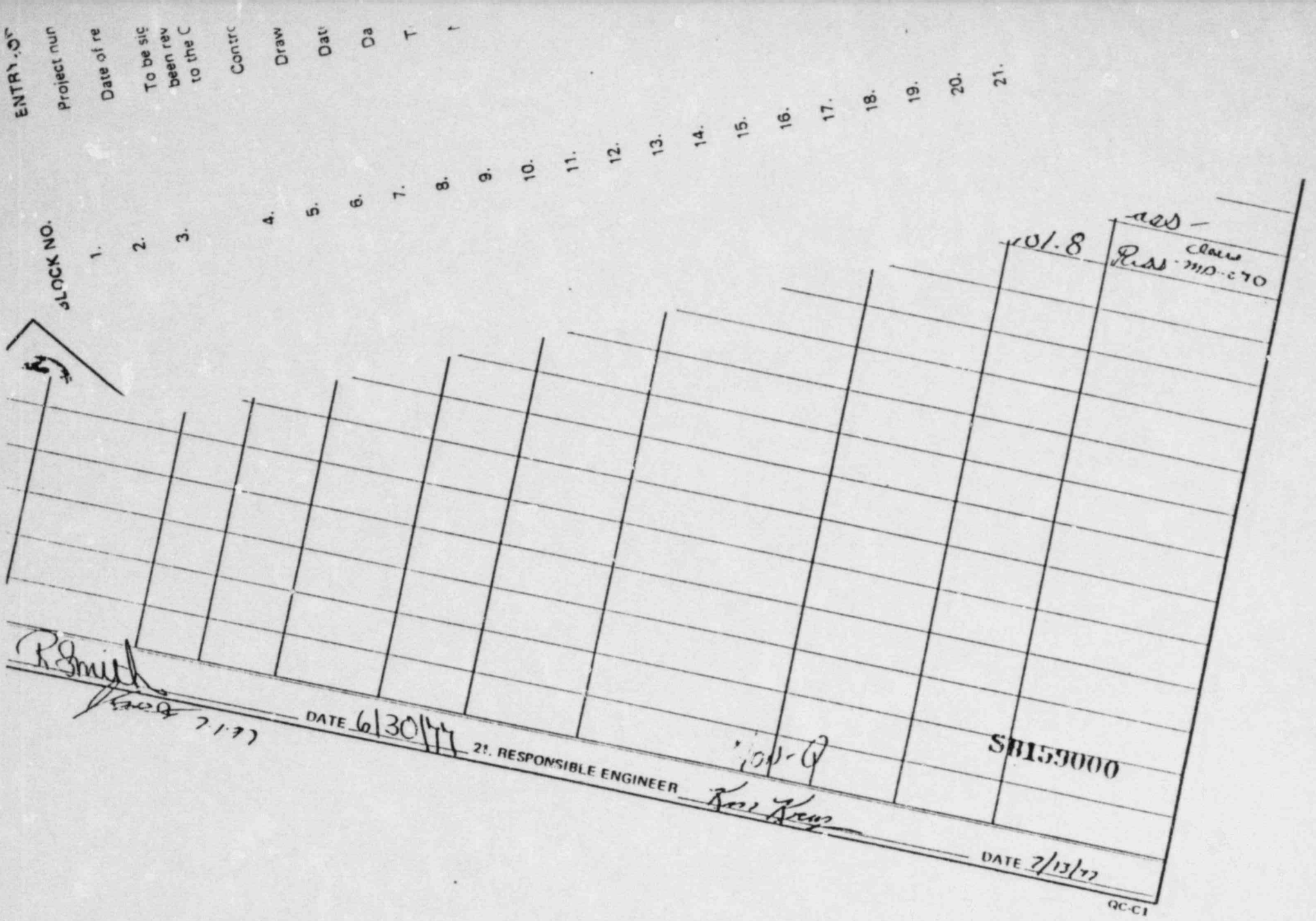
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R Smith
7-1-77
DATE 6/30/77
21. RESPONSIBLE ENGINEER
DATE 7/13/77
SB159000
QC-C1

COMPACTED FILL DENSITY TEST REPORT

File-C-11 DMP

3. QC ACCEPTANCE ____ DATE ____ CONTROL NO. ____ FILE NO ____

1. PROJECT NO. 7220 2. DATE 7.21.77 PAGE 1 OF 1

4. SPEC. NO. 7220-C-208 5. DRAWING NO. River Intake Structure 6. TESTED WEEK OF 6/25/77 to 7/1/77

7. DATE TAKEN	8. TEST NO. MD	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP omc zone	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
6/28/77	074	BT	50's of River Int. Str. 5'E of B7B" Dia.	548	—	1350	19.3	1132	280 13.6 1	120.8	93.7	Fail - see 77
"	075	"	50'E of River Int Str. 4'S of E. Footer Wall	580	—	1350	15.7	116.7	280 13.6 1	120.8	96.6	Fail ✓ 7/9/77 see 081
6/29/77	076	BT	50's of River Int. Str. 5'E of B7Z" Pipe	548	—	137.5	15.8	118.7	280 13.6 1	120.8	98.3	Fail ✓ see 77
"	077	"	50's of River Int. Str. 5'E of B7Z" Pipe	548	—	1375	15.1	119.5	280 13.6 1	120.8	98.9	Pass - Clears MD 074 and 076

SB159001

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE _____ DATE _____
CONTROL NO. _____ FILE NO _____

1. PROJECT NO. 7220 2. DATE 7-21-77 PAGE 1 OF 1

SPEC. NO. 7220-C-208 5. ~~DRAWING NO.~~ RIVER INTAKE STRUCTURE 6. TESTED WEEK OF 7/2/77 to 7/8/77

DATE TAKEN	8. TEST NO. MD	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
6/77	018	RS	23'3. OF W RET. WALL 50'W. OF W RIVER INT STRUCTURE WALL	597	—	128.5	16.6	110.2	280	13.6	1	120.8	91.2	FAIL MD 018
6/77	019	BT	15'S OF W RET WALL 50'W OF W. RIVER INT. STRUCTURE WALL	597	—	135.5	13.7	119.2	280	13.6	1	120.8	98.7	CLEARS PASS MD 018

SB159002

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE ____ DA
CONTROL NO. ____ FILE

1. PROJECT NO. 7220 2. DATE 8/1/77 PAGE 1 OF 1

4. SPEC. NO. 7220-C-208 5. ~~DRAWING NO.~~ RIVER INTAKE STRUCTURE 6. TESTED WEEK OF 7/23/77 To 7/29/77

7. DATE TAKEN	8. TEST NO. MD	9. TESTED BY	10. LOCATION	11. ELEV OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
7/25/77	081	BT	35' E. OF RIVER INT. STRUCTURE 20'S OF E. RET. WALL	593	—	136.5	13.1	120.7	280	13.6	1	120.8	99.9	PASSED ✓

S/C C-11
BMP 5/15

SB159003

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE ____ CONTROL NO. ____

1. PROJECT NO. 7220 2. DATE 7-25-77 PAGE 1 OF ____

4. SPEC. NO. 7220-C-208 5. ~~DRAWING NO.~~ RIVER INTAKE STRUCTURE 6. TESTED WEEK OF 7/16/77 TO 7/22

7. DATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	CMC	ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
	MD													
7/19/77	081	BT	~~SE~~ of River Int. Struc. 4'S. of & Ref. Well	580	—	135.0	14.2	118.2	280	13.6	1	120.8	97.8	Pass

SR159004

COMPACTED FILL DENSITY TEST REPORT

QC ACCEPTANCE | DATE
CONTROL NO. | TEST NO.

1. PROJECT NO. 7220 2. DATE 1-19-77 PAGE 1 OF 1

SPEC. NO. 7220-C-208 5. DRAWING NO. RIVER INTAKE STRUCTURE 6. TESTED WEEK OF 9/3/77 to 9/9/77

7. DATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
	MD								SAME ONE TEST			
8/77	082	KH	75'W. & E. EXP. E. RETAINER 7.5 Q RET.	594	—	138.5	15.7	119.8	280 13.6 1	120.8	99.2	FAIL (4
	083	BV	75'W. & E. EXP. E. RETAINER 7.5 Q RET.	594	—	139.0	18.3	117.5	280 13.6 1	25 blows 120.8	97.3	FAIL D/C
	084	"	75'W. & E. EXP. E. RETAINER 7.5 Q RET.	594	—	136.5	16.2	117.5	280 13.6 1	120.8	97.3	FAIL
7/77	085	CS	75'W. & E. EXP. E. RETAINER 7.5 Q RET.	594	—	143.0	15.3	124.0	280 13.6 1	120.8	102.6	PASS CLEARS MD 082 & CS3 & 084

TEST FAILURE

Q.C. Rep. Notified MD 082, CS3 & 084

Time & Date of Notification AT TIME OF TEST

Reporting Person B. Thompson & K. Hall

SR159005

COMPACTED FILL DENSITY TEST REPORT

FILE C-11

QC ACCEPTANCE

CONTROL NO.

1. PROJECT NO. 7220 2. DATE 10/6/77 PAGE 1 OF

4. SPEC. NO. 7220-C-208 5. ~~DRAWING NO.~~ RIVER INTAKE STRUCTURE 6. TESTED WEEK OF 9/10/77 TO 9/16/77

DATE TAKEN	TEST NO. MD	TESTED BY	LOCATION	ELEV. OF TEST	DEPTH BELOW FINAL GRADE (FT.)	IN PLACE WET DENSITY (LB./C.F.)	MOISTURE CONTENT (%)	IN PLACE DRY DENSITY (LB./C.F.)	SOIL CLASSIFICATION BMP	SOIL CLASSIFICATION OMC	SOIL CLASSIFICATION ZONE	MAX. LAB. DRY DENSITY (LB./C.F.)	PERCENT COMPACTION	REMARKS
9/12/77	086	RG	75'E. OF RIS. FISHER	597	—	138.0	14.0	121.0	280	13.6	1	120.8	100.2	PASS ✓
9/15/77	087	RG	3" N. OF RIVER INTAKE	599	—	142.0	11.8	127.0	280	13.6	1	120.8	105.1	PASS ✓
	088	"	25'E 30'N RET WALL	600	—	131.0	12.0	117.0	280	13.6	1	120.8	96.9	PASS ✓
"	089	"	8'S. OF RET WALL 60'E OF RIVER INK	597	—	136.5	15.2	118.5	280	13.6	1	120.8	98.1	PASS ✓
"	090	"	MUPS. STRUCT. 12'W OF MUP 25'OFF S.W. COR.	616	—	132.0	12.1	117.7	280	13.6	1	120.8	97.4	PASS ✓
"	091	"	10'S. OF MUP 10'W. OF MUP	612	—	131.5	12.7	116.7	280	13.6	1	120.8	96.6	PASS ✓
"	092	"	MIDDLE OF MUP 12' N	603	—	139.5	13.2	123.2	280	13.6	1	120.8	102.0	PASS ✓
"	093	"	10' OFF MUP 18' OFF NE. COR.	611	—	137.0	16.4	117.7	280	13.6	1	120.8	97.4	NOT CLEAN FAILED ✓
"	094	"	12' OFF MUP 14' S.E. CORNER	615	—	134.0	16.5	115.0	280	13.6	1	120.8	95.2	NOT CLEAN FAILED ✓
"	095	"	30'N RETAINER 35'E RIVER INTAKE	600	—	131.0	15.7	113.2	280	13.6	1	120.8	93.7	NOT CLEAN FAILED ✓

Q.C. Rep. Notified: T. Nicholls

Time & Date of Notification: 15:20 09/16/77

Reporting Person: R. Gonzalez

SB159006

093 + 094 + 095

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE
CONTROL NO.

1. PROJECT NO. 7220 2. DATE 10/7/77 PAGE 1 OF

4. SPEC. NO. 7220-C-208 5. ~~DRAWING NO.~~ RIVER INTAKE STRUCTURE 6. TESTED WEEK OF 9/17/77 TO

7. DATE TAKEN	8. TEST NO. MD.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP OMC ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
9/21/77	096	RS	10'OFF MUP 18'OFF NE.COR.	611	—	137.0	16.6	117.5	280 13.6 1	120.8	97.3	FAILED
"	097	"	12' OFF MUP 14'S.E. COR.	615	—	138.5	16.9	118.5	280 13.6 1	120.8	98.1	FAILED
"	098	"	30'N. RETAINER 35'E OF RIVER INT.	600	—	133.5	13.8	121.7	280 13.6 1	120.8	100.7	PASS
"	099	"	30'S. OF N. MUPS WALL 35' N. OF W. WALL	616	—	137.5	15.5	119.0	280 13.6 1	120.8	98.5	PASS
"	100	"	40'S. OF GOOSENECK RIVER INT. STRUCT & CVER. 96" PIPE	599	—	139.5	11.6	125.0	270 11.1 1	124.6	100.3	PASS
"	101	"	30'S. OF GOOSENECK RIVER INT. STRUCT 6'CE. OF E. WALL	602	—	144.5	11.5	129.5	260 10.6 1	129.8	99.8	PASS
9/22/77	102	RS	40'S. OF INTAKE STRUCT 20'W OF W. WALL	600	—	137.5	16.0	118.5	278 15.2 1	117.0	101.3	PASS
"	103	"	40'S. OF INT. STR. 20'W. OF W. WALL	600	—	141.0	11.0	127.0	270 280 BS 10/6/77 11.1 1	124.6	101.9	PASS
"	104	"	20'S. OF INT. STR. 4'E. OF E. WALL	600	—	139.0	13.9	122.0	280 ~~260~~ BS 10/7/77 13.6 1	120.8	101.0	PASS
"	105	"	25'W. OF W. MUPS W. WALL 20'S. OF N. WALL	622	—	136.0	12.4	121.0	280 13.6 1	120.8	100.2	PASS
"	106	"	20'W OF W. MUPS WALL 54'S. OF N. WALL	626	—	137.0	14.2	120.0	280 13.6 1	120.8	99.3	PASS

CONSUMERS POWER COMPANY
MIDLAND PLANT PROJECT
MIDLAND, MICHIGAN

CONSUMERS POWER COMPANY
RECEIVED
OCT 31 1977
FIELD QUALITY ASSURANCE
MIDLAND, MICHIGAN

QC Rep. Notified
Time & Date of Test
Reporting Person Notified date of
MD-096 & MD-097
SR13007

COMPACTED FILL DENSITY TEST REPORT

1. QC ACCEPTANCE — DATE
CONTROL NO. — FILE NO.

PAGE 1 OF 1

1. PROJECT NO. 7220 — 2. DATE 10/17/77

SPEC. NO. 7220-C-208 — 5. ~~DRAWING NO.~~ RIVER INTAKE STRUCTURE — 6. TESTED WEEK OF 9/25/77 TO 10/1/77

ATE TAKEN	8. TEST NO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
	MD								BMP OMC ZONE			
7/77	107	RS	10'S OF MUP'S 18' OF N.E CORNER	611	—	142.0	13.9	124.7	280 13.6 1	120.8	103.2	PASS
	108	"	12' OF MUP'S 14'S. E CORNER MUP'S	615	—	142.0	14.3	124.2	280 13.6 1	120.8	102.8	PASS
28/77	109	KN	10'S OF S.W. COR. OF MUP. 15' N. OF SE. OF MUP	629	—	140.0	13.6	123.3	277 13.4 1	121.0	101.9	PASS
	110	"	12' N. OF S. W. COR. OF MUP. 20' W OF COR. OF MUP.	623.5	—	138.5	15.7	119.8	277 13.4 1	121.0	99.0	PASS

SB159008

Bechtel Power Corporation

Interoffice Memorandum

To G. L. Richardson

Subject Response to NRC 50.54 Request, Item 1 Relating to the Diesel Generator Building, Midland Project, Job No. 7220

Copies to J. L. Newgen
R. A. Simanek
W. L. Barclay

File No.

Date APR 9 1979

From D. R. Johnson

Of SFPD Construction Quality Control

At 425 Market St. Ext. 8-0343
32nd Floor D10

In reply reference:

2-CQC- 402679

Reference: IOM, G. L. Richardson to Distribution, same subject, dated March 29, 1979.

What follows is Construction Quality Control's best effort attempt to prepare replies to those questions which you assigned to the PFQCE in the above referenced IOM:

1. Variance 6, Items 4, 5, and 6

A. There is no variance to the Bechtel QA program requirements for construction quality control based upon the following evidence:

RECEIVED
ANN ARBOR
QUALITY ASSURANCE
APR 12 '79

Route	Info.	Act.	Copy To
MGR.			
PEOS			
[illegible]			
7220			
[illegible]			
[illegible]			
[illegible]			
QA MGR.			
[illegible]			
NC.			

The Bechtel construction quality control program of surveillance inspection over work performed by Canonie and inspection over work performed by Bechtel was complied with for the compacted backfill operations at the Midland jobsite. In the case of Canonie, they performed and were totally responsible for their own work, inspection, documentation and quality assurance; all in accordance with their Bechtel approved QA manual. Bechtel Construction Quality Control performed surveillance inspection over Canonie in accordance with FIP C-210 and QCI S/C1.10. As stated in Bechtel's construction quality control program document SF/PSP G-6.1, the purpose of surveillance inspection is to determine if an action has been accomplished or if documents have been prepared in accordance with selected requirements of the contract documents. Surveillance inspection does not mean that all or all of any subcontractor activities are observed for the purpose of determining compliance. Surveillance inspection is intended to provide a degree of added confidence that subcontractor work meets contract document requirements.

SB121111

In the case of soil compaction performed by Bechtel, Construction Quality Control was responsible for inspections in accordance with FIP C-211 and QCI C-1.02. Because soil compaction is an activity where inspection of the completed work to verify quality is ineffective, QCI C-1.02 is designed to provide in-process monitoring by surveillance to verify conformance with the documented instructions, i.e. Project Engineering's specifications. This type of inspection program is consistent with the requirement in Criterion X of 10CFR50, Appendix B which states in part:

> "If inspection of processed material or products is impossible or disadvantageous, indirect control by monitoring processing methods, equipment and personnel shall be provided."

A brief description of the work performed by Canonie and Bechtel as well as the surveillance inspection and monitoring performed by Construction Quality Control follows:

1) Canonie

1975: Canonie started fill operations south of the Q line on 10/29/75 for the south access ramp and lay down area for the turbine building. Work proceeded through 11/13/75 to elev. 616 ±. Construction Quality Control surveillance inspection was provided by FIP C-2.10-4-53.

1976: Canonie started fill operations adjacent to the south access ramp 7/11/76 and proceeded to elev. 623 ±. Construction Quality Control surveillance inspection was provided by FIP's C-2.10-4-58 and C-2.10-4-62.

1977: Canonie started fill operations at elev. 623 ± on 6/22/77 for the diesel generator building footings, and completed fill to the bottom footing elev. 628 ± on 7/30/77. Construction Quality Control surveillance inspection was provided by QCI S/C 1.10-1, 2, 3, 4, 5 and 6.

2) Bechtel

1975: Structural backfill (Plant Area Fill) started on 10/17/75 in the area south of and adjacent to the Q line wall from elev. 589' to 612'. Construction Quality Control inspection was provided by FIP 2.11-1-12.

1976: Structural backfill started 7/9/76 for a 3 foot wide area adjacent to the Q line wall from elev. 606 to 618 ± Line 1 through 12. Construction Quality Control inspection was provided by FIP C-2.11-1-19.

1977: Structural backfill began 2/15/77. The majority of work consisted of backfill around the circulating water discharge piping, service water piping and electrical conduit encasement (primarily hand work with some motorized equipment used for small sliver fills in D. G. area). The Bechtel work was performed in the same time period as work performed by Canonie to bring the fill material to elev. 628 ±.

Documentary evidence that the Construction Quality Control program for surveillance inspection over Canonie's implementation of their QA program commitments is provided by the completed FIP's, IR's, NCR's, Bechtel QA audit reports and Canonie inspection reports; all of which are on file at the jobsite.

Documentary evidence that the Construction Quality Control program for inspection of soil compaction performed by Bechtel is similarly provided by the completed FIP's, IR's, DR's, NCR's and Bechtel QA audit reports; all of which are on file at the jobsite.

B. Since there is no variance, the question of generic application is not relevant.

C. The remedial action taken by Project Engineering in revising the specification requirements for proctor curves, lift thickness, density testing, etc., will be reflected in changes to the inspection criteria contained in the QCI's.

D. Except for changes in the inspection criteria referenced in the QCI's to reflect Project Engineering changes to the specifications, no other changes in the Construction Quality Control program are needed for corrective action.

2. Variance 6, Items 7 and 8

A. There is no variance to the Bechtel QA program requirements for construction quality control based upon the following evidence.

1) Evaluations of motorized compaction equipment did occur and are recorded in the following memoranda:

Buchanan to Jeffers of 9/18/73
Dragicevic to Church of 10/5/73
Jeffers to Valenzano of 11/16/73

The motorized equipment described in the above correspondence was used by both Canonie and Bechtel for compaction work. Evaluation of hand held equipment was accomplished on initial use based upon satisfactory compaction reports. Formal evaluation reports were not required by specification nor provided by Field Engineering. The documented telephone conversation between Grote and Rixford on 9/18/74 should also be noted as it clearly indicates that Project Engineering's position was that equipment capacity is not important provided the main objective of obtaining acceptable compaction test results is achieved.

2) The completed Quality Control Inspection Plans and Inspection Records on file at the jobsite provide documentary evidence that lift thicknesses did not exceed the 12 inch limit. No changes to the maximum lift thickness were made by Field Engineering, and the inspection records show that the specification requirements were met.

B. Since there is no variance, the question of generic application is not relevant.

C. Same as for 1C above.

D. Same as for 1D above. If it is now believed that formal documentation for reporting equipment evaluation is necessary, this requirement should be added to the Project Engineering specification.

3. Variance 7, Items 4 and 5

A. There is no variance to the Bechtel QA program requirements for construction quality control based upon the following evidence:

1) Construction Quality Control through their surveillance of U. S. Testing did in fact identify the lack of moisture testing. As illustrated in the following listed documents, it is apparent that not only QC, but Construction, Project Engineering and QA were all aware of the lack of testing:

NCR-55 of 2/4/74
NCR-324 of 8/6/75
NCR-421 of 5/16/76
QAR SD-40 of 7/22/77
Memo Newgen to Castleberry of 8/15/77
Memo Castleberry to Newgen of 9/30/77
Telecon Hook to Roa of 10/10/77
Telecon Hook to Roa of 10/13/77
NCR-1005 of 10/26/77
Memo Newgen to Castleberry of 11/18/77
Memo Castleberry to Newgen of 12/15/77
Memo Newgen to Richardson of 12/21/77
Telecon Dean/Osborn to Roa of 4/7/78

2) Following the issuance of QAR SD-40, U. S. Testing did perform moisture tests in the borrow area and they maintained an informal moisture log for this activity starting 8/1/77.

A review of this log by CPCO - QA in January 1978 revealed some inconsistency in reporting dates and moisture contents. As a result, Bechtel QC added a formal review of the U. S. Testing Log to the current inspection plan QCI C-1.02 on 2/13/78 - and this log is now being retained in the QC vault.

B. Same as 1B.

C. No remedial action is needed.

D. No corrective action is needed.

4. Variance 8, Item 1

A. There is no known variance (Geo-Tech has not completed their investigation) to the Bechtel QA program requirements for construction quality control based upon the following evidence:

1) Geo-Tech has not prepared their report as of this writing, but from what we have been told it is their belief that testing frequency and material classification (matching laboratory comparison samples with field samples) were performed incorrectly.

2) U. S. Testing Procedure

U. S. Testing soils technicians selected the lab standard (Proctor curve) used for comparison with the in-place soil material at the time of in-place density testing. They accomplished this by visual comparison of the in-place samples to jarred laboratory samples brought to the field. An approximation of the active jarred samples to select from ranged from 10 to 25 at any given time. These samples included cohesive and non-cohesive material. The laboratory samples representing soils that were encountered frequently remained in this active collection. When a jar sample was no longer being used, it would be placed in the inactive collection retained at the laboratory. Material such as that represented by BMP 278 was encountered frequently, and that is the reason it remained active for such an extended period. The values for BMP 278 were periodically checked with information from either a one point sample or complete proctors. Documentation of these checks was not required by specification and was not maintained.

When an in-place soils sample could not be readily classified through visual comparison, the U. S. Testing technician would bring the soils sample to the test laboratory and perform a one point proctor to assist in the selection. If classification could still not be made, a complete proctor was prepared, and the sample was added to the laboratory's active proctor collection.

3) Construction Quality Control

The Construction Quality Control Engineer assigned to monitor Bechtel soil compaction also monitored the U. S. Testing technician's visual comparison of laboratory samples with in-place density test samples. If the fill being tested was placed by Canonie, this visual comparison was also observed by the responsible Canonie Inspector. Construction Quality Control also monitored the U. S. Testing technician's technique in performing in-place density tests.

Construction Quality Control, in their role of providing technical direction and surveillance of the laboratory, monitored the procedures used for making Proctor curves and one point proctors when visual classification could not be accomplished in the field.

None of the specified testing methods (ASTM D1556, 1557, 2049, etc.) identify comparison of field moisture and density test results with saturation conditions (zero air voids) as a method of checking the validity of test results.

To establish whether or not a particular group of field tests are in error, it will be necessary to incorporate inherent errors in testing methods (sand cone and nuclear methods). The specified test methods (and geotechnical literature) indicate a standard deviation on density measurement of 3 to 5 lbs./cu.ft., and a standard deviation on moisture content on the order of one half to one percent moisture.

Incorrect calculation of relative density test results was identified in 1975 and the correct method of calculation has been employed ever since.

Material gradation specified in specification C-211 was not intended to match that specified as Zone 3 material in C-210. However, Zone 3 material did meet the gradation requirements of C-211 and was used as structural backfill (cohensionless, free-draining material).

Using different laboratory curves to clear failing tests was recognition that the material had been incorrectly identified initially.

In summary, the methods employed at the time were believed to be correct methods. In particular, careful evaluation of the soil encountered in the field when determining the proper curve or laboratory maximum density to use is believed to be consistent with the specification and superior to using one laboratory maximum density test for every 20 field tests without consideration of soil type.

B. Since, at this point in time, no variance has been identified, the question of generic application is not relevant.

C. No remedial action required.

D. No corrective action necessary.

5. Variance 8, Items 2, 3 and 4

A, B, C, D } Refer to 4A, B, C and D above

6. Variance 8, Item 4, 5 and 6

A. There is no variance to the Bechtel QA program requirements for construction quality control based upon the following evidence:

1) The jobsite records indicate that the minimum testing frequency requirements were exceeded. These records show that one test was perfomed for approximately every 300 cu. yds. of fill under the diesel generator building rather than the required one test per 500 cu. yds.

2) There was no QA program nor QC program requirement to generate a supplementary record listing actual test frequencies. By program, the Quality Control Engineer was instructed to monitor field in-place density testing by surveillance as defined in PSP G-6.1 and verify that he did so by initialing and dating the IR. The Construction Quality Control Engineer did this. The approved program was implemented.

B. Since there is no variance, the questions of generic application is not relevant.

C. No remedial action required.

D. No corrective action necessary.

7. Variance 8, Item 4

A. QCI C-1.02, Rev. 2 dated 8/77 and Rev. 3, dated 2/78 do not reference the test frequency requirement found in paragraph 5.6 of specification 7220-C-211 as the appropriate inspection criteria. However, under activity number 3-1.b of QCI C-1.02 Rev. 2 and 3, a review of the testing frequency was and is required. Paragraphs 5.1 and 5.5 of specification C-211 are referenced as the inspection criteria for proper test method and technical adequacy. Thus, Rev. 2 and 3 of QCI C-1.02 was written and approved for use with the additional requirements of paragraph 5.6.3 being omitted.

It should be noted that for the time period during fill placement up to the footing level for the diesel generator buildings Rev. 1 of QCI C-1.02 was in effect which called out the proper specification paragraph reference for testing frequency.

B. No, this variance is not of a generic nature for the frequency paragraph reference omission was due to a format revision of C-1.02 from Rev. 1 to Rev. 2. A review of C-1.20 Rev. 2 and 3 indicates that all other references were carried through.

C. QCI C-1.02 will be revised to include paragraph 5.6 of specification 7220-C-211 Rev. 5 as the appropriate inspection criteria for testing frequency.

D. No corrective action is required to preclude repetition.

8. Variance 12, Items 1 and 2

A. There is no variance to the Bechtel QA program requirements for construction quality control based upon the following evidence:

Bechtel Quality Control did implement the information feedback and corrective action requirements addressed in SF/PSP G-3.2.

1) The following listing represents particular actions taken within QC to correct and improve the Quality Control soils program operations:

QC Corrective Action Report	Based On
QC-19 - 9/14/76	NCR-510
QC-36 - 2/16/77	CPCO QF-142
QC-37 - 2/24/77	CPCO QF-150
QC-63 - 11/1/77	NCR-1006
QC-64 - 11/21/77	CPCO QF-199

2) Quality Control also routes copies of NCRs to the group responsible for the control of the activity apparently caused the nonconformance. This was accomplished for the following identified NCRs.

	Opened	Closed	Sent To	On
NCR-421	5/5/76	6/23/76	Proj. Super.	6/23/76
NCR-686	2/11/77	3/7/77	Proj. Super.	3/7/77
NCR-698	2/9/77	3/7/77	Proj. Super.	3/7/77
NCR-1005	10/26/77	3/24/78	Proj. Super.	3/24/78

B. Since there is no variance, the question of generic application is not relevant.

C. No remedial action required.

D. No corrective action necessary.

In summary, except for Item 7 above, none of the evidence presented to date is indicative of a variance from the established QA program requirements by Construction Quality Control.

D. R. Johnson

DRJ/adm

S3121119

402679

G. RICHARDSON

MEETING NOTES - MEETING WITH U.S. TESTING, CPCO AND BECHTEL AT U.S. TESTING HEADQUARTERS IN HOBOKEN, N.J. ON 4-9-79

ATTENDEES:

E. BASILE	U.S. TESTING
E. ZADENA	"
D. EDLEY	"
M.	"
J. SPELTZ	"
B. MARGUGLIO	CPCO
D. HORN	"
R. WHEELER	"
D. PALMER	BECHTEL
G. RICHARDSON	"

BEN MARGUGLIO OPENED THE MEETING BY ESTABLISHING THE FOLLOWING AGENDA.

1. DISCRIBE THE PROBLEMS RELATING TO THE MIDLAND SOILS PROBLEM WITHOUT POINTING FINGERS OR PLACING BLAME.
2. WHAT USTESTING THINKS MAY BE THE PROBLEM = WHERE DID USTESTING CONTRIBUTE TO THE PROBLEM
3. WHAT DID USTESTING SAY TO THE NRC DURING THE NRC INVESTIGATION.

BEN MARGUGIO PRESENTED THE FOLLOWING TO DISCRIBE THE TYPES OF PROBLEMS.

1. INCONSISTENCIES IN THE SAR
2. SAR REQUIREMENTS NOT TRANSLATED ACCURATELY/ CLEARLY INTO THE SPECS.
3. REQUIREMENTS FOR TESTING WERE NOT TOTALLY STATED "CALLOUT FOR PROCTOR NOT TOTAL STORY
4. INTERPETATIONS WERE VARIED AND NOT RELEASED THROUGH NORMAL SPECIFICATION CHANNELS.
5. SUSPECTS THERE WAS NOT A TOTAL UNDERSTANDING

6. MAY HAVE BEEN INCORRECT PROCTOR SELECTION
7. MAY NOT HAVE BEEN TIMELY CORRECTIVE ACTION IN IDENTIFYING THE EXTENT OF THE PROBLEM AND IDENTIFICATION OF THE PROBLEM AS OPPOSED TO FIX.
8 ACCOUNTABILITY FOR INSPECTION MAY HAVE BEEN LACKING
   - WHO INSPECTED
   - WHAT INSPECTED
   - HOW INSPECTED, ETC.
9. MAY HAVE WENT TO A SAMPLING PROCESS WITHOUT A SUFFICIENT HISTORICAL BACK GROUND ON THE PROCESS.
10 MAY HAVE FAILED TO QUALIFY THE TEST OR INSPECTION PROCESS.

BEN ADDED THAT ALL OF THE ABOVE CONTRIBUTED OR COULD HAVE CONTRIBUTED TO THE PROBLEM.

THE MAIN DISCUSSIONS DURING THE MEETING CENTERED AROUND THE ABOVE. THE FOLLOWING IS A BRIEF DISCRIPTION OF THE IMPORTANT POINTS OF THIS DISCUSSION.

1. BEN DISCUSSED THE CONFICTING TEST METHODS IN SPEC-C-210 AND ASKED WHAT DID UST DO TO ASSURE THEMSELVES THAT THEY HAD A CLEAR SPEC. TO WORK TO.

   UST RESPONDED THAT THERE DIRECTION TO USE BECHTEL MODIFIED PROCTOR CAME FROM BECHTEL AS DID DIRECTION OF WHEN TO TAKE MOISTURES. THERE WAS NOTHING IN WRITING - DIRECTION WAS VERBAL.

   UST ESTING ADDED THAT IT WAS NOT THEIR RESPONSIBILITY TO DETERMINE WHEN OR WHERE TO TAKE A TEST.

BEN STATED THAT ON CPRD JOBS (FUTURE) HE EXPECTS UST TESTING TO ASSURE THAT SPEC INTERPETATIONS/CHANGES ARE OCTHINED OFFICIALLY - ADDED THAT UST QA SHOULD NOT ALLOW THIS TO HAPPEN

UST RESPONDED THAT THEIR CONTRACT DOES NOT PROVIDE FOR THIS TYPE OF QA INVOLVEMENT.

2. BEN ASKED WHAT TYPE OF MECHANISM DID UST USE TO DETERMINE WHEN A NEW PROCTOR WAS REQUIRED,

UST RESPONDED THAT THIS WAS (IS) NORMALLY TRIGGERED BY THE LAB TECHNICIAN DURING SELECTION OF THE PROCTOR IN RESPONSE TO A FIELD TEST

UST ADDED THAT THERE ARE NO PROCEDURES TO COVER THIS OPERATION THAT; IT IS A JUDGEMENT OPERATION THAT WOULD BE DIFFICULT TO PROCEDURIZE

3 BEN ASKED WHO NOTIFIED UST WHEN A NEW PROCTOR WAS NEEDED.

UST RESPONDED THIS WAS AN ONGOING ITEM AND PROCTORS WERE TAKEN AS A REGULAR THING AND WERE TAKEN AT MATERIAL CHANGES AND NEW BORROWS - AGAIN THERE WERE NO PROCEDURES.

UST ESTING STATED THAT THEY COULD NOT REMEMBER EVER BEING REQUESTED BY BECHTEL TO TAKE A SAMPLE SPECIFICALLY TO DEVELOP A PROCTOR.

UST ADDED IT WAS NOT THERE RESPONSIBILITY TO MAINTAIN THE TEST FREQUENCY AND THAT THEY WERE NOT PRIVILEGED TO QUANTITY

UST ADDED THEY FELT THAT THEY DID MORE THAN THEIR CONTRACT REQUIRED IN:

- DETERMINING NEW SOURCES AND MATERIAL CHANGES WHERE NEW PROCTORS ARE REQUIRED
- SELECTION OF THE APPROPRIATE PROCTOR TO COMPARE TO THE FIELD DENSITY
- OVER INVOLVENT WITH CANONIE.

4. BEN ASKED HOW DID UST IDENTIFY THE PROPER CURVE TO USE WHEN THE CURVE MAY BE SIX MONTHS OLD.

UST RESPONDED THEY KEPT APPROX. 15 SAMPLES TO BE USED.

BEN ADDED FOLLOWING STATEMENT:
FOR CPCO PROJECTS UST SHOULD TAKE THE ATTITUDE THAT IN THE ABSENCE OF A CONTROLLED SINGLE SOURCE OR SPECIFIC DESIGNATION AS TO WHAT A REAL CHANGE IN SOILS IS THAT THE MOST CONSERVATIVE APPROACH SHOULD BE TAKEN.

5. GENERAL DISCUSSION ON TESTING CALCULATIONS
   A. SOME CONFLICTS NOTED IN D. HORN'S AUDITS - UST SHOULD CONSIDER.
   B. ALL TEST REPORTS SUBMITTED TO BECHTEL QC FOR REVIEW - DOES NOT INCLUDE ACTUAL CALCULATIONS
   C. THERE NORMALLY WAS NOT A PLOT OF FIELD TEST RESULTS ON THE PROCTOR CURVES - NO COMPARISONS TO ZERO AIR-VOIDS CURVE.
   D. IF TEST PLOTS ON WRONG SIDE OF ZERO AIR-VOIDS CURVE THERE IS AN ERROR

E ERRORS ARE INHERENT IN TEST METHODS BEING APPLIED
- TROXLER HAS ± 3 % ERROR
- RESULTS ARE CONSERVATIVE

6. BEN ASKED WHAT DID UST THINK MIGHT BE THE PROBLEM - UST HAD NO INPUT

7 BEN ASKED IF UST HAD RECOMMENDATIONS FOR FUTURE WORK — UST RESPONDED
A. TAKE A LOOK AT THE ROLE YOU WANT THE TEST LAB TO PERFORM
B. U.S.T ADDED THAT IT WAS BECHTELS RESPONSIBILITY TO DETERMINE WHEN A NEW PROCTOR IS NEEDED
- THIS UNDESTANDING NEEDS TO BE CLEAR

C REVIEW AREA OF WHAT IS ACCEPTABLE MATERIAL

MEETING WITH U.S. TESTING
AT HOBOKEN, N.J.
4-9-79

CEN MARGUGLIO

1. DISCRIBE PROBLEM WITHOUT ?
2. WHAT UST THINKS.
   - DID THEY CONTRIBUTE
   - WHERE DO YOU THINK ~~=~~ THE PROBLEMS
   - WHAT WAS SAID TO NRC.

DISCUSSION. BY B.M.

- TYPE OF PROBLEMS
  - INCONSISTENCIES IN THE SAR
  - SAR REQUIREMENTS NOT TRANSLATED ACCURATELY/CLEARLY INTO ~~SAR~~ SPEC
  - REQUIREMENTS FOR TESTING WERE NOT TOTALLY STATED
    - CALLOUT OF PROCTOR NOT TOTAL STORY
  - INTERPETATIONS WERE VARIED AND NOT RELEASED SPEC. CHANNELS

SUSPECTS →

- WAS NOT A TOTAL UNDESTANDING OF THE PROCESS BY ANY ONE INDEVIDUAL
  - Lack of expertise
- Incorrect (may have been) Proctor selection
- may not have been timely corrective action on I.D. extent of problem & I.D. problems as opposed to the fix.
- Accountability for inspection may have been lacking
  - WHO
  - WHAT was insp
  - How ck
- May have went to a sampling process with out a sufficient technical background on the process
- May have failed to qualify the

- all of above contributed or could have.

Basil - want to discuss
- Selection of proctor
- accuracy of calculation
- Qualification of method
- Clarification of test method.

- BEN assumed spec called out 13.7 vs 12.9?
  - What did UST do to assure ~~[illegible]~~ itself that they had a clear spec to operate to.
    - BECHTEL TOLD US SO.
    - worked under direction to BMP - Paper worked showed what
    - always used BMP
  - Moisture direction did vary - be ~~[illegible]~~ verbal direction - no written direction.

1.

BEN - for future - when spec needs to be interpreted it should be written not verbal.
- There was a laxity in the process that allows certain decision to be made well out follow up.
-

Δ Sales pitch = testing should work directly for utility.

UST did not provide response THAT THEY TAKE TEST?? at + WHERE

UST
- PRESENTED FOUR RECENT LETTERS TO BPC DEALING WITH SPEC C-208.

• WHEFLER - UST • UNDER TECH SUPERVISION OF BECHTEL.

Ben - ON CPCo Jobs we expect UST QA to assure spec changes/interp. are obtained officially.
• feels their QA program should not allow testing ~~not~~ unless spec is clear.

feels UST may have succumbed to pressures.

UST Response - there is no compensation for this type of QA. (Good point

---

BEN CPCO/Bechtel - Review UST QA program and feed back.

B.H

2A. What mechanism had UST used to determine when a new proctor was required?

- Response - field personnel would trigger during selection of proctor in response to a fail test.

B. Are there any procedures to to describe this program.

- Answer - Judgement but unwritten. To trigger new proctor

+ Spec requirement or quantity.

- Who notified UST.
  - Proctor ongoing – no notification
  - UST not notified as to when do.
  - Proctors were taken as a regular thing – proctors run at changes such as new borrows

- Any procedures?
  - Only for frequency
  - no -
  - A procedure could be developed.

- UST feels frequency was OK but they did not have info to keep frequency

- Is it UST's responsibility to keep frequency?

  - answer NO – UST only tests it does not inspect.
  - UST takes tests does not decide where or when.

  - UST Feels they were doing more than required when they determined a new SORCE and developed a new proctor.

  - were also over involved with CANONIC.

1. How do you identify a particular curve when the curve may be six month. old
   - kept ISI samples to compare.

   - Is there a ~~one~~ curve to relate proctors per ~~one~~ week vs employee numbers involved.
     vs total tests

     - No of proctors developed by How many Techs — use NO of FLO's for a base.

B.H Project Principle - CQC project UST sales take the attitude that in the absence of a controlled ~~single~~ single source or specific determination as to what a real change is and that the ~~most~~ most conservative approach be taken.

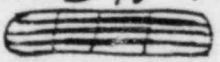
---

3. Calculations - some conflict indicated from D. Horns audits.
   - are these valid — UST response - should not encounter this possibility.

   - Test reports submitted to Bechtel QC for review.

   - # Were there any physical comparison vs proctor curves.
     - No - UST ~~NEVER~~ NORMALLY DID NOT plot field γ & M.C on proctor curve or zero air-voids curves

CPC
- If you found plat on wrong sub zero air-work what would you do
  - UST - you would have a failure per E. Dudley.

UST-Response
- Errors inherent in methods being applied
  - Moisture error ±3% for ~~Proctors~~ Troxler
  - 

- Was U.S.T aware that trench could be this much in error?
  Ans
  - Yes this is common - result are conservative.

B.M
- Request U.S.T to go back and look at this possibility.
  - Did we fail a test using one proctor and later pass with a different proctor?

B.M. FROM QA Point of view
- failure to provide
  ?
  - read from his test he gave us.

II A. WHAT DOES USTESTING THINK CAUSED THE PROBLEM.

- NO REAL ANSWER

B. RECOMMENDATIONS FOR FUTURE.

- Take a look at the role that you want the test lab to perform - Determine scope and limit
  - B.H. • Think UST & Bechtel must sit down and discuss who is responsible for what.

C. U.S. TESTING SAYS IT WAS BECHTELS RESPONSIBILITY TO DETERMINE WHEN A NEW PROCTOR IS NEEDED.

we need to understand who has the responsibility to select proper proctor to compare with the field density.

IMPORTANT TO ARRIVE AT THIS INFORMATION → MUST BE RESOLVED

- BEN WILL PUBLISH CRITERIA TO BECHTEL ON ITEMS TO BE ACCOMPLISHED PRIOR TO RESUMPTION OF WORK ON SOILS.

- UST SAYS THEY DID CERTAIN ITEMS TO FILL VOIDS ⇐ SO WORK CAN PROCEED EVEN THO IT WAS NOT A CONTRACT REQUIREMENT.

WHERE ELSE CAN WE IMPROVE THE PROCESS

- Review area of what is acceptable material.
- USE OF A SELECTED MATERIAL FOR BUILDING BACKFILL.
  - RANDOM BACKFILL REQUIRES MORE BA
- Nuclear Densometer
  - Have a ~~[illegible]~~ Tremendous success in past.

ADMIN. BUILDING – (Bob Wheeler)

- What conclusions did UST come to.
  - ONLY CONCLUSION was that UST was not at fault – did not draw other CONCLUSIONS.

III WHAT WAS TOLD TO NRC.

NOTES INITIATED SAME DAY AS INTERVIEWS.

S3121290

BECHTEL

MOISTURE CONTROL

PROGRAM REQUIREMENTS	QA VARIANCE
1 SPECIFICATION 7220-C-210, REV 2-6 PARA. 13.6 REQUIRES MOISTURE CONTROL FOR PLANT FILL TO BE IN ACCORDANCE WITH PARA. 12.6	1-2 PRIOR TO 1976 MOISTURE CONTENT WAS CONTROLLED BY TAKING TESTS AFTER COMPACTION. NO TEST WERE TAKEN ON THE FILL PRIOR TO COMPACTION TO VERIFY ADHERENCE TO THE TECHNICAL REQUIREMENTS OF SPECIFICATION 7220-C-210 PARA. 12.6. (SEE ATTACHED CHART).
2 PARA. 12.6 STATES IN PART - "THE WATER CONTENT DURING COMPACTION SHALL NOT BE MORE THAN 2 PERCENTAGE POINTS BELOW OPTIMUM MOISTURE CONTENT AND SHALL NOT BE MORE THAN 2 PERCENTAGE POINTS ABOVE OPTIMUM MOISTURE CONTENT----." IT ALSO STATES IN PART "AFTERPLACEMENT OF LOOSE MATERIAL ON THE FILL, THE MOISTURE CONTENT SHALL BE FURTHER ADJUSTED AS NECESSARY TO BRING SUCH MATERIAL WITHIN THE MOISTURE CONTENT LIMITS REQUIRED FOR COMPACTION."	3 ADMINISTRATION BY THE SUB-CONTRACT ENGINEER DID NOT IDENTIFY THIS LACK OF TESTING TO VERIFY MOISTURE CONTENT.
3 SUBCONTRACT ADMINISTRATIVE PROCEDURE MANUAL SECTION II (12/75) STATES ON PAGE 11 THAT THE SUB CONTRACT FIELD ENGINEER IS ACCOUNTABLE FOR THE SUBCONTRACTOR COMPLYING WITH ALL REQUIREMENTS OF THE SUB CONTRACT	4-5 QUALITY CONTROL SURVEILLANCE DID NOT IDENTIFY THE LACK OF TESTING TO VERIFY MOISTURE CONTENT EVEN AFTER ISSUANCE OF QAR 50-40
4 QUALITY CONTROL INSPECTION PLANS OR INSTRUCTIONS CALLED FOR QC SURVEILLANCE TO ASSURE PROPER MOISTURE CONTENT AND REFERENCE SPECIFICATION 7220-C-210	

SB1.21391

PROGRAM REQUIREMENTS	QA VARIANCE
• FIP C-210-4 • QCIR C-102 • QCIR SC-1.10 A TYPICAL EXAMPLE OF THIS INSPECTION CALLOUT IS: • QCIR C-1.02 Rev I DATED 8/2/77. ACT 2.3.3.3: "BACKFILL MATERIAL SHALL BE CONDITIONED TO THE REQUIRED MOISTURE CONTENT THROUGH THE USE OF APPROVED PROCEDURES. ACT 2.3.3.3 REFERENCES SPEC 7220-C-210, PARA 13.6 AND 12.6 AND HAS AN INSPECTION CODE OF S(V) (5) NOTE: QUALITY ASSURANCE ISSUED QAR SD-40 ON 7/22/77 TO IDENTIFY THIS PROBLEM. PROJECT ENGINEERINGS RESPONSE WAS THAT TESTS TO CONTROLL MOISTURE SHOULD BE TAKEN PRIOR TO COMPACTION.	

BECHTEL P[illegible]ER CORPORATION — APPENDIX A
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM — DATE_____

DEFICIENCY CATEGORIES — RL Rixford

CATEGORY NO.	DESCRIPTION	GENERIC IMPLICATIONS	REMARKS
1	FSAR requirements for compaction not clearly reflected in spec.	[illegible]	
2	Combined with No. 6	NA	
3	Specifications not adequately clarified.	[illegible]	
4	FSAR contained conflicting information within.	[illegible]	[illegible] only
5	Settlement calculations inconsistent with design basis.	[illegible]	
6	Fill not placed adequately	[illegible]	
7	Soil moisture not tested at specified time.	[illegible]	
8	Possible deficiencies in soil test results	[illegible]	[illegible]
9	Lack of Subcontractor Soil Test Procedures	[illegible]	
10	Duck bank interfered with settlement.	[illegible]	
11	Corrective action not timely.	[illegible]	
12	Inadequate corrective action for repetative conditions.	[illegible]	[illegible]
13	Audits lacked sufficient depth.	[illegible]	

SD121496

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 1

DATE 4-6-79

DESCRIPTION ESAR REQUIREMENTS FOR COMPACTION NOT CLEARLY REFLECTED IN SPEC.

PAGE 1 OF

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
R, Amendment 3, Supplement (dated, 3/15/69) Dames & Moore Report of 6/28/68, page 16 es recommended minimal compaction criteria support of structures as: 85% relative density per ASTM D 2049-64T for sand soils 100% maximum density per ASTM D 698, modified to 20000 ft-lbs for clay soils.	Contrary to Program Requirement No: 1, 3, 4, 5 Specification 7220-C-210, Revisions 2 thru 6, Para. 13.4, 13.7 and 12.4 was interpreted and implemented to require a minimum compaction of 95% of Bechtel modified proctor for cohesive plant fill materials, including those under structures.
R, Amendment 3, Supplement (dated, 3/15/69) Dames & Moore Report of 6/28/68, page_____ tes, "If filling and backfilling operations discontinued during periods of cold weather is recommended that all frozen soil be oved or recompacted prior to the resumption operations."	1, 3 ~~(1-3-80)~~ Specification 7220-C-210 Revs. 1-4, para 13.7, originally required 95% compaction for cohesionless soils based on maximum density as determined by modified proctor method (ASTM 1557, Method D). Revision 5 to this specification added a requirement (Para 13.7.2) to compact cohesionless soils to 80% relative density as determined by ASTM D 2049.
il-Structural Design Criteria, 7220-C-501, . 9, Sect. 6.1.1, gives recommended imum compaction criteria for support of uctures as: 85% relative density per ASTM D 2049-69 for sand soils - % maximum density per ASTM D 1557, method D, *as modified by the Bechtel modified proctor test for clay soils. he percentages and basic standards appear be Rev. 3 (6-18-73) while the notation ..as modified by the Bechtel Modified roctor Test" appears to be Rev. 6 (8-20-76)	1, 3 ~~(1-3-80)~~ Specification 7220-C-211, Rev. 5, "Technical Specification for Structural Backfill," Para. 5.5 requires compaction of cohesive soils to 95% of Bechtel modified proctor and cohesionless soils to 80% relative density. This specification includes materials under structures.
chk this next no. ecification 7220-C-210, Rev. 5 & 6, Sect. .2.1) states "All cohesive backfill in the ant area and berm shall be compacted to not ss than 95 percent of maximum density as termined by ASTM D 1557, Method D."	2 ~~(1-3-80)~~ Specification 7220-C-211, Rev. 5 does not provide for frost protection or removal/recompaction of frozen/thawed materials. The NRC has concluded that paragraphs 10.1, 11, 12.5.1 and 12.10 of Spec 7220-C-210 do not adequately address frozen/thawed material treatment.

) SPEC. 7220-C-210, REVS 1-4, SECT. 13.7 STATES, IN PART, "ALL BACKFILL IN THE PLANT AREA AND THE BERM SHALL BE COMPACTED TO NOT LESS THAN 95 PERCENT OF MAXIMUM DENSITY AS DETERMINED BY MODIFIED PROCTOR METHOD (ASTM 1557, METHOD D) ---.

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APPENDIX B

CATEGORY NO. 1

DATE 4-6-79

DESCRIPTION FSAR Requirements for Compaction not Clearly Reflected into Specs.

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
(6) Job 7220 procedure titled "Design Document Requirement Procedure" Rev. 1, issued for use on 11/30/78 states: Para. 3.1 "The engineer responsible for the origination of a design document shall fill out the attached design requirement check list as he develops the design document. The purpose is to assure all applicable design and quality criteria contained in each applicable document have been incorporated into the subject design and to verify that no omission or conflict exists. The engineer shall initial the applicable blocks provided." Exhibit 1 (DRVCL) includes under Item 1 - "Commitment List (PSAR/FSAR and Licensing)" (7) EDPI 4.1.1, Rev. 0, Issued 7/15/794 states: 3.1 The Discipline Engineer who originates a design document shall fill out the attached Design Requirement Verification Checklist (DRVCL) as he develops the design document to assure that all applicable design criteria contained in each referenced document have been incorporated into the design document and to verify that no omission or conflict exists. If a particular Design Requirements Document is not applicable to the design document, place "N/A" in the space provided for identification. Exhibit 1 (DRVCL) includes under Item 1 - "PSAR/FSAR."	Contrary to Program Requirement No: 6,7 ~~(4, 5, 8, 9, 10)~~ The engineering preparation, review and approval of specs 7220-C-210 and C-211 did not accurately incorporate PSAR requirements.

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QA PROGRAM

APPENDIX B

CATEGORY NO. 1

Revised 4-9 11:30 am DATE 4-6-79

DESCRIPTION FSAR REQUIREMENTS FOR COMPACTION NOT CLEARLY REFLECTED INTO SPECIFICATIONS

PAGE 3 OF ___

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
WHEN SPECIFICATIONS 7220-C-210 AND 7220-C-211 WERE GENERATED THE COGNIZANT ENGINEER CONSIDERED THE PSAR BUT DID NOT CONSIDER THE DAMES & MOORE REPORT AS AN ACTUAL COMMITMENT ON AN ITEM BY ITEM BASIS AS IT WAS AN ATTACHMENT TO THE PSAR. THE ~~DAMES-MOORE~~ REPORT WAS NOT CHECKED IN DETAIL DURING PREPARATION OF THESE SPECIFICATIONS.	SPECIFICATIONS 7220-C-210 AND 7220-C-211 HAVE BEEN REVISED TO INCORPORATE COMPACTION REQUIREME FOUND IN THE FSAR. BY ISSUING: SCN C-210-9001 DATED 3-30-79 SCN C-211-9001 DATED 4-2-79 A COMPLETE REVIEW OF THE DAMES MOORE REPORT TO ASSURE NO OTHER ~~DEFICI~~ INCONSISTENCIES EXIST WIL BE COMPLETED BY _____.
THIS ITEM IS CONSIDERED NOT TO HAVE GENERIC IMPLECATIONS BECAUSE OF THE FOLLOWING: A. THERE ARE NO OTHER ATTACHMENTS TO THE PSAR WHICH, LIKE THE DAMES&MOORE REPORT, INCLUDE RECOMMENDATIONS THAT COULD BE CONSTRUED AS SPECIFIC DESIGN REQUIREMENTS. B. EDPI 4.1.1 AND ITS PREDECESSOR PROVIDE A POSITIVE SYSTEM TO ASSURE THE PSAR WAS CONSIDERED DURING THE DEVELOPMENT OF ALL DESIGN DOCUMENTS. ENGINEERING FEELS THAT FROST PROTECTION IS ADEQUATELY ADDRESSED AS PREVIOUSLY STATED IN THEIR RESPONSE	this is not correct! It was checked in detail. Based upon O&M's recommen Spec C-10, and our Geotech's recommendation (including H.C & W. Firms of SAMS H&CE) c... ares developed.

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APPENDIX B

CATEGORY NO. 3

DATE 4-9-79

DESCRIPTION SPECIFICATION NOT ADEQUATELY CLARIFIED

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
(1) NQAM, Section II, Number 5, Para 3.2 states, inpart, "Design changes shall be initiated and controlled in accordance with written procedures. These procedures shall provide for the following:..." Para. 3.2.6, states, "The controls applied to assure that design change commitments initiated through non-conformance reports and through ~~after~~ *other* communications (such as TWX's, memos, etc.) are properly documented and processed into approved design output documents."	Contrary to Program Requirement No: 1. Specification 7220-C-210, Para 13.7 originally required cohesive soils to be compacted to 95% of modified proctor method (ASTM-1557, Method D). This paragraph was later clarified in Rev. 5 to read 95% as determined by ASTM D-1557, Method ~~D~~. Paragraph 13.4 requires testin to be performed in accordance with the tests listed in Section 12.4. Para. (section) 12.4.5.1 requires cohesive soil maximum density to be determined using ASTM D-1557, Method D modified to 20,000 ft/lbs of compactive effort, (Bechtel Modified Proctor). (BMP) The above conflict between paragraphs 12. and 13.7 were subject of clarification telecons and confusion still exists as to which standard to use, (ASTM or BMP) however the specification has not been revised.

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DESCRIPTION SPECIFICATION NOT ADEQUATELY CLARIFIED PAGE 5 OF ___

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
LETTERS, TWXS, TELECONS AND REMS, ARE OFTEN USED TO CLARIFY THE INTENT OF THE SPECIFICATIONS. IT IS POSSIBLE THAT IN SOME SITUATIONS THE CLARIFICATION PROVIDED THROUGH THE ABOVE METHODS MAY HAVE MODIFIED THE SPECIFICATION WITHOUT FORMALLY CHANGING THE WORDS OF THE SPECIFICATION. TO THE ABOVE EXTENT THIS ITEM IS CONSIDERED POSSIBLY GENERIC TO OTHER AREAS.	SPECIFICATION C-210 HAS BEEN REVISED IN SCN C-210-9001 DATED 3-30-79 [redacted] ON 4-3-79 AT THE GROUP SUPERVISORS MEETING THE COGNIZAN INDIVIDUALS WERE REMINDED TO EXERCISE CARE WHEN INTERPRETING THE SPECIFICATIONS BY MEM TWXS, ETC. THE CLARIFICATIONS GIVEN SHOULD NOT CAUSE ANY CHANGE OF THE SPECIFICATION MATERIAL BUT BE CONSISTANT WITH THE PRESENT WORDING. THE ABOVE HAS BEEN REITERATE IN A MEMO FROM THE PROJECT ENGINEER TO ALL MIDLAND GROUP SUPERVISORS DATED [redacted].

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BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 4

DATE 4-6-79

DESCRIPTION CONFLICTING INFORMATION WITHIN THE FSAR

PAGE 6 OF

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
1) QAM, Section II, Number 2, Para. 1.0, states, "This policy contains the requirements for providing procedures necessary to control design activities...." 2) Para. 3.1 states, in part, "The following activities shall be described in Engineering Department procedures....(19) SAR preparation and change controls...." 3) DP 4.22, Rev. 1, Section 1.0, states, in part, "This procedure describes the mechanics of preparing and controlling Safety Analysis Reports..." 4) Sect. 4.3, states, in part, "Between the construction permit and operating licensing phases.....particular attention shall be paid to the Engineering Department Procedure on SAR change control which will provide inputs for SAR preparation on significant changes in FSAR commitments and basic design concepts..." 5) Sect. 5.1, states, in part, "An SAR flow chart shall be prepared by Project Engineering showing the personnel and organizational responsibilities and the interfaces for the preparation, coordination, review, approval and publication of the SAR..." 6) DP 4.22, Exhibit A, SAR Preparation Flow Chart, Step 2 requires the EGS to review the originator's draft for technical accuracy and compliance with the standard format guide.	Contrary to Program Requirement No: 1, 2, 3, 4, 5 and 6, The FSAR submitted to the NRC (thru Amend. [redacted] 17) contained certain inconsistencies: • Tables 2.5-9 and 2.5-14 identify the foundations under the Diesel Generator Building to be cohesive fill. The actual material specified and used was random fill which includes both cohesive and cohesionless material. • FSAR, Paragraph 3.8.5.5 indicates a settlement of 1/2 inch for shallow spread footings (such as the Diesel Generator Building), FSAR Table 2.5-48 indicates a settlement of the Diesel Generator Building of approximately 3 inches. The difference between the two values is not clear. 5 and 6, The preparation and review of the FSAR did not identify these discrepancies.

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DATE 4-6-79

DESCRIPTION Conflicting Information Within the FSAR

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DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
This category of deficiency has generic implications only for sections of the FSAR which could be considered 'inactive'. Prior to the identification and investigation of the Diesel Gen. Bldg. Settlement, Tables 2.5-9 and 2.5-14, and Para. 3.8.5.5 (pg 3.8-59) had not been revised since Rev. 0 of the FSAR (8-29-77).	FSAR sections 2.5 and 3.8 were reviewed by the Diesel Gen. Bldg. Task Force and FSAR change notices were written to correct the inconsistencies found or to add clarification to the material presented.
No NRC questions had been received that affected these areas, and no project design documents had undergone a significant revision that affected these areas.	These FSAR change notices were incorporated into the FSAR in Rev. 18 (2-28-79).
Thus, ofter the initial FSAR preparation, there has been no occasion nor need to re-review these areas.	To ensure that no inconsistencies exist in other sections of the FSAR that could also be classified as 'inactive', a review of those sections will be made.
	No review of 'active' sections is felt to be necessary due to the numerous reviews that have taken place as a result of the normal design evolution process and response to NRC questions.
	A Bechtel QA Audit (Audit No. 4.0-Special-1) performed 1-22 to 30-79, confirmed that a system was being implemented to assure that design changes are reflected in the FSAR.

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APPENDIX B

CATEGORY NO. 5

DATE 4-6-79

DESCRIPTION SETTLEMENT CALCULATIONS INCONSISTANT WITH DESIGN BASIS

PAGE ____ OF ____

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
(1) DP 4.37, Rev. 2, Sect. 4.0, concerns check-ng of design calculations. The 4th para-raph states, in part, "After verifying the asis of a calculation, the checker..."	Contrary to Program Requirement No:
(2) ect. 4.1, lists checker responsibilities nd states, in part, "Checking calculations gainst input design documents to verify onformance with specified configurations, imensions,....checking calculations for ssumptions..."	1,2 Settlement calculations for the Diesel Generator Building contained the followir discrepancies: °A uniform load 3000 PSF was used rathe than the 4000 PSF shown in Section 3.8.4.1.2 of the FSAR. °An index of .001 was used rather than the index of .003 shown in Table 2.5-1 of the FSAR. °The calculations assumed a mat foundat rather than the actual design which is a spread footing foundation. The checker of these calculations failed identify these errors.
(3) DP 4.22, Rev. 1, Sect. 5.1, states, in part, An SAR flow chart shall be prepared by roject Engineering showing the personnel and rganizational responsibilities and the inter-aces for the preparation, coordination, eview, approval, and publication of the AR..."	3,4. [redacted] The results of these calculations were included in the FSAR in contradication to other information in FSAR.
(4) DP 4.22, Exhibit A, SAR Preparation Flow hart, Step 2, requires the EGS to review he originator's draft for tec.nical ccuracy.	

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CATEGORY NO. 5

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DESCRIPTION SETTLEMENT CALCULATIONS INCONSISTANT WITH DESIGN BASIS.

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DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
THIS IS NOT CONSIDERED A GENERIC PROBLEM AS GEO-TECH IS THE ONLY OFF PROJECT GROUP ~~WHO~~ WHICH PROVIDES CALCULATIONS ~~WHO~~ BUT DOESNOT WORK TO THE PROJECT PROCEDURES FOR CALCULATIONS.	

IS IT GENERIC TO ALL OTHER GEOTECH CALCS THEN ?

+ GEO TECH RESPONSE

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CATEGORY NO. 6

DATE 4-6-79

DESCRIPTION FILL NOT PLACED ADEQUATELY

PAGE ____ OF ____

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
AM Section I, No. 9, RE 1-B (6/30/77) ra. 3.1; states that the Project Superin- ndent is responsible for the Project Con- ruction Teams adherence to the Quality surance Program.	Contrary to Program Requirement No:
eld Procedure FPG-3.000, Rev. 0, dated /5/77: °Matrix PFS-1 (duties of superintendents) includes - "Compliance with drawings and specifications" and "overall quality of workmanship." °Matrix PFE-1 (duties of field engineers) "Periodic checking to assure technical direction has been clear enough so that construction conforms to drawings and specifications."	1,2,3 Drill samples taken subsequent to the discovery of the Diesel Generator Building Settlement Problem indicate cohesive and cohesionless soils ~~have been~~ ARE IN placed at densities less than those specified. These areas are currently known to exist under the following structures that are setting on plant fill. °Diesel Generator Building °Service Water Structure °Diesel Fule Storage Tanks °Borated Water Storage Tanks °Auxilary Building in the Railway Bay Area °United ONe Electrical Penetration Room °Unit One and Two Valve Pits
ecifications 7220-C-210, Revs. 2-6, Para .7 and 7220-C-211, Revs. 0-5 Para 5.5 quire cohesive soils to be compacted to % of EMP and cohesionless soils to be mpacted to 80% relative density. RONG! inconsistent w/ Qual. Deficiencies in Category I -210 Rev 2-6 were interpreted as 95% EMP -210 Rev 8-4 95% for cohesionless (155?) Rev 5 Pg 2 " " (70%?)	1,2,3 ~~[redacted]~~ The supervision and technical guidance provided by Bechtel did not result in acceptable compaction in all cases. Reword this
F)(4) AR, Amendment 3, Supplement (dated 3/15/69) Dames & Mocre Report of June 28, 1968, ge 16, states, inpart, "Filling operations ould be performed under the continous chnical supervision of a qualified soils gineer..."	4,5 There was no qualified Soils Engineer assigned to the Midland jobsite after 1974. Soil operations and testing was directed by supervision, field engineering, labor foreman and Quality Control for Bechtel operations. Canonie operations were directed by their supervision and testing was requested by their QC Engineer. A Bechtel subcontracts engineer coordinated Canonie's work. U. S. Testing performed all the tests for both operations.
) (5) vil-Structural Design Criteria, 7220-C-501, v. 9, Sect. 6.1.1, states, inpart, "Filling erations shall be performed under the tech- ical supervision of a qualified soils gineer..."	~~[redacted]~~ NOTE: This requirement was not included in the implementing procedures or specifications for soils operation. Note: There have been no positions established in the field that specifically identify personnel as responsible for soils such as: °Field Soils Engineer

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DESCRIPTION Fill Not Placed Adequately

PAGE ____ OF ____

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
(1,2,3) The specifications for backfill and structural backfill are performance type specifications and the acceptance of this fill was based on satisfying the acceptance test requirements. The Field Supervison and Engineering structured their direction around this concept and supplemented it by monitoring of the actual soils operation. The soils test generally showed good compaction and this information was utilized by the field personnel in determining the amount of direction necessary. This area is not considered generic in that soils operations are unique because there no physical attributes available to supervision to check the quality of compactive effort other than by test results. Each life is subsequently covered by the following lift. This is unlike other work such as piping where the results of the work efforts are visble such as alignment at subassembly closure points.	Bechtel Project Management has stopped all permanent fill operations until a qualified Soils Engineer is on site to monitor soils operations.

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DESCRIPTION Fill Not Placed Properly

PAGE ____ OF ____

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
(4-5) The field was not aware of the Design Criteria requirement. This item is not considered generic as there are no other similar requirements in the Design Standards. Other areas of construction do have specific engineers assigned such as for concrete, resteel, piping, etc.	Same as for 1, 2 and 3 SPECIFICATION CHANGE NOTICE C-211-9001 ADDS THE REQUIREMENT FOR SOILS WORK TO BE PERFORMED UNDER THE DIRECTION OF A QUALI SOILS ENGINEER

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DESCRIPTION FILL NOT PLACED ADEQUATELY

PAGE ____ OF ____

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
(6) ality Control Inspection Plans or structions provide for Quality Control rveillance to assure the materials are operly compacted to the specified criteria. ese instructions included the following: • FIP C-210-4 • FIP C-211-1 • QCIR C-1.02 (7) IR C 1.02 Rev 1, dated 4/k3/77 had the llowing callout for compaction: • ACT 2.3.5 - "Compaction shall be achieved through the use of approved compaction equipment. All materials shall be compacted to the specified densities for the indicated zone. The entire lift shall be consistant." • Reference to Spec C-210, Para 12.7, 13.7 and 12.8.1 • Inspection Code is S • Similar Act for Spec C-211 (2.2.5) (8) IR c-1.02, Rev 2 dated 8/2/77 only address mpaction under Act 2.4 "Testing" and states erify that testing performance and results e in accordance with engineering require- nts. a. Materials b. Moisture c. Compaction spection callout is S(V) ference is made to the applicable paragraphs specs C-208, C-210 and C-211.	Contrary to Program Requirement No: ~~5~~ 6,7,8 The inspection (surveillance) by Quality Control was not sufficiently in depth to identify these areas not meeting the specified requirements.

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APPENDIX R

CATEGORY NO. 6

DATE 4-6-79

DESCRIPTION FILL NOT PLACED PROPERLY

PAGE ____ OF ____

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
6, 7, 8 SEE ATTACHED IOM	NONE REQUIRED

SB121510

Bechtel Power Corporation

Interoffice Memorandum

To G. L. Richardson

Subject Response to NRC 50.54 Request, Item 1 Relating to the Diesel Generator Building, Midland Project, Job No. 7220

Copies to J. L. Nuwgen
R. A. Simanek
W. L. Barclay

File No.

Date

From D. R. Johnson

Of SIPD Construction Quality Control

At 425 Market St. Ext. 8-0343
32nd Floor D10

In reply reference:

2-CQC-

Reference: ICM, G. L. Richardson to Distribution, same subject, dated March 29, 1979.

What follows is Construction Quality Control's best effort attempt to prepare replies to those questions which you assigned to the PFQCE in the above referenced ICM:

1. Variance 6, Items 4, 5, and 6 (NOW NOS. 6, 7 AND 8)

A. There is no variance to the Bechtel QA program requirements for construction quality control based upon the following evidence:

The Bechtel construction quality control program of surveillance inspection over work performed by Canonie and inspection over work performed by Bechtel was complied with for the compacted backfill operations at the Midland jobsite. In the case of Canonie, they performed and were totally responsible for their own work, inspection, documentation and quality assurance; all in accordance with their Bechtel approved QA manual. Bechtel Construction Quality Control performed surveillance inspection over Canonie in accordance with PIP C-210 and QCI S/C1.10. As stated in Bechtel's construction quality control program document SP/PSP C-6.1, the purpose of surveillance inspection is to determine if an action has been accomplished or if documents have been prepared in accordance with selected requirements of the contract documents. Surveillance inspection does not mean that all or all of any subcontractor activities are observed for the purpose of determining compliance. Surveillance inspection is intended to provide a degree of added confidence that subcontractor work meets contract document requirements.

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In the case of soil compaction performed by Bechtel, Construction Quality Control was responsible for inspections in accordance with FIP C-211 and QCI C-1.02. Because soil compaction is an activity where inspection of the completed work to verify quality is ineffective, QCI C-1.02 is designed to provide in-process monitoring by surveillance to verify conformance with the documented instructions, i.e. Project Engineering's specifications. This type of inspection program is consistent with the requirement in Criterion X of 10CFR50, Appendix B which states in part:

> "If inspection of processed material or products is impossible or disadvantageous, indirect control by monitoring processing methods, equipment and personnal shall be provided."

A brief description of the work performed by Canonie and Bechtel as well as the surveillance inspection and monitoring performed by Construction Quality Control follows:

1) Canonie

1975: Canonie started fill operations south of the Q line on 10/29/75 for the south access ramp and lay down area for the turbine building. Work proceeded through 11/13/75 to elev. 616 ±. Construction Quality Control surveillance inspection was provided by FIP C-2.10-4-53.

1976: Canonie started fill operations adjacent to the south access ramp 7/11/76 and proceeded to elev. 623 ±. Construction Quality Control surveillance inspection was provided by FIP's C-2.10-4-58 and C-2.10-4-62.

1977: Canonie started fill operations at elev. 623 ± on 6/22/77 for the diesel generator building footings, and completed fill to the bottom footing elev. 628 ± on 7/30/77. Construction Quality Control surveillance inspection was provided by QCI S/C 1.10-1, 2, 3, 4, 5 and 6.

2) Bechtel

1975: Structural backfill (Plant Area Fill) started on 10/17/75 in the area south of and adjacent to the Q line wall from elev. 589' to 612'. Construction Quality Control inspection was provided by FIP 2.11-1-12.

1976: Structural backfill started 7/9/76 for a 3 foot wide area adjacent to the Q line wall from elev. 606 to 618 ± Line 1 through 12. Construction Quality Control inspection was provided by FIP C-2.11-1-19.

1977: Structural backfill began 2/15/77. The majority of work consisted of backfill around the circulating water discharge piping, service water piping and electrical conduit encasement (primarily hand work with some motorized equipment used for small sliver fills in D. G. area). The Bechtel work was performed in the same time period as work performed by Canonic to bring the fill material to elev. 628 ±.

Documentary evidence that the Construction Quality Control program for surveillance inspection over Canonic's implementation of their QA program commitments is provided by the completed FIP's, IR's, NCR's, Bechtel QA audit reports and Canonic inspection reports; all of which are on file at the jobsite.

Documentary evidence that the Construction Quality Control program for inspection of soil compaction performed by Bechtel is similarly provided by the completed FIP's, IR's, DR's, NCR's and Bechtel QA audit reports; all of which are on file at the jobsite.

B. Since there is no variance, the question of generic application is not relevant.

C. The remedial action taken by Project Engineering in revising the specification requirements for proctor curves, lift thickness, density testing, etc., will be reflected in changes to the inspection criteria contained in the QCI's.

D. Except for changes in the inspection criteria referenced in the QCI's to reflect Project Engineering changes to the specifications, no other changes in the Construction Quality Control program are needed for corrective action.

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APPENDIX B

CATEGORY NO. 6

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DESCRIPTION FILL NOT PLACED ADEQUATELY

PAGE ____ OF ____

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
≠(9) pec. 7220-C-211 Revs 0-5, Para 5.2.2 states The uncompacted lift thickness of backfill aterial shall be determined by field ersonnel after evaluation of the proposed ompaction equipment. However, in no case hall the uncompacted lift thickness exceed 2 inches". ≠(10) IP C-211-1, Revs. 0-2 address lift thickness a task No. 3.20 or 2.30 which references pec C-211, Para 5.2.2 and requires an Inspect" (I) point to assure lifts do not xceed that determined by the Field Engineer. CI C-1.02, Rev. 2 has the same callout in xt 2.2.4 but with a surveillance [S(V)] code.	Contrary to Program Requirement No: 9. There are no records available to indicat that the various types of compaction equipment used for structural backfill where evaluated by Field Personnel and exceptable lift thickness established for each type of equipment. 9,10 Quality Control signatures on Inspection Plans and Records indicate lifts did not exceed the limits established by the Field Engineer after evaluation of the proposed equipment even though there are no records to verify the evaluations. NOTE: The stated 12 inch maximum lift thickness was used as a limit by Field Personnel and Inspection Personnel

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CATEGORY NO. 6

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DESCRIPTION FILL NOT ~~[illegible]~~ PLACED ADEQUATELY

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DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
(9) THIS ITEM IS NOT CONSIDERED GENERIC TO OTHER AREAS AS THIS TYPE OF EQUIPMENT QUALIFICATION IS UNIQUE TO SOILS OPERATIONS AND THE FIELD ~~[illegible]~~ USED WHAT THEY FELT IS AN ACCEPTABLE AITERNATE METHOD OF VERIFICATION OF THE CAPABILITY OF THE EQUIPMENT. EACH GENERIC TYPE OF EQUIPMENT USED WAS EVALUATED ALONG WITH LIFT THICKNESS FOR THIS EQUIPMENT BY VERIFYING BY ACTUAL INPLACE TESTING.	~~[illegible]~~ TEST PADS WILL BE RUN TO QUALIFY EQUIPMENT AND ESTABLISH LIFT THICKNESSES ~~[illegible]~~ FOR COHISIVE AND COHESIONLESS SOILS. THIS OPERATION WILL BE DIRECTED BY BECHTEL GEO-TECH AND WILL BE COMPLETED BY _____.

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CATEGORY NO. 6 DATE

DESCRIPTION FILL NOT PLACED ADEQUATELY PAGE OF

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
(9,10) SEE ATTACHED	NONE REQUIRED

SD121516

2. Variance 6, Items 7 and 8 (NEW NOS. 9 AND 10)

A. There is no variance to the Bechtel QA program requirements for construction quality control based upon the following evidence:

1) Evaluations of motorized compaction equipment did occur and are recorded in the following memorandas:

Buchanan to Jeffers of 9/18/73
Dragicevic to Church of 10/5/73
Jeffers to Valenzano of 11/16/73

The motorized equipment described in the above correspondence was used by both Canonie and Bechtel for compaction work. Evaluation of hand held equipment was accomplished on initial use based upon satisfactory compaction reports. Formal evaluation reports were not required by specification nor provided by Field Engineering. The documented telephone conversation between Grote and Rixford on 9/18/74 should also be noted as it clearly indicates that Project Engineering's position was that equipment capacity is not important provided the main objective of obtaining acceptable compaction test results is achieved.

2) The completed Quality Control Inspection Plans and Inspection Records on file at the jobsite provide documentary evidence that lift thicknesses did not exceed the 12 inch limit. No changes to the maximum lift thickness were made by Field Engineering, and the inspection records show that the specification requirements were met.

B. Since there is no variance, the question of generic application is not relevant.

C. Same as for 1C above.

D. Same as for 1D above. If it is now believed that formal documentation for reporting equipment evaluation is necessary, this requirement should be added to the Project Engineering specification.

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 7

DATE 4-6-79

DESCRIPTION SOIL MOISTURE NOT TESTED AT SPECIFIED TIME

PAGE ___ OF ___

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
ecification 7220-C-210, Rev 2-6, Para. 13.6 quires moisture control for plant fill to be accordance with Para 12.6. 12.6 states inpart - "The water content ring compaction shall not be more than 2 rcent - age points below optimum moisture ntent and shall not be more than 2 percent- points above optimum moisture content...." also states inpart "After placement of se material on the fill, the moisture con- nt shall be further adjusted as necessary bring such material within the moisture ntent limits required for compaction."	Contrary to Program Requirement No: 1, 2 Prior to 1978 moisture content was controlled by taken tests after compaction. No test were taken on the fill prior to compaction to verify adherence to the technical requirements of specification 7220-C-210 Para. 12.6. (See attached chart).
(3) ality Control Inspection Plans or Instructs called for QC surveillance to assure pper moisture content and reference ecification 7220-C-210 paragraphs 13.6 and 6. These documents include: •FIP C-210-4 •QCIR C-102 •QCIR SC-1.10 ypical example of this inspection callout •QCIR C-1.02 Rev I dated 8/2/77 ACT 2.3.3.3: "Fackfill material shall be conditioned to the required moisture content through the use of approved procedures. 2.3.3.3 references spec 7220-C-210, a 13.6 and 12.6 and has an inspection code S(V).	3-4 Quality Control surveillance did not identify the lack of testing to verify moisture content even after issuance of QAR SD-40. NOTE: THERE HAS BEEN CONTINUED CONFUSION AND CHANGING INTERPETATIONS AS TO THE PROPER TIMING OF MOISTURE TESTS.
(4) e: Quality Assurance issued QAR SD-40 on 7/22/77 to identify this problem. Project Engineering's response was that tests to control mositure should be taken prior to compaction.	

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BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 7

DATE 4-6-79

DESCRIPTION Soil Moisture Not Tested at Specified Time

PAGE ___ OF ___

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
This is not a generic problem since soils is the only material in which moisture is taken. Prior to 1978, Sect. 126 of Spec. C-210 was interpreted by the field as follows: "During compaction" was interpreted as the entire process of placing, compacting, and testing fill. The moisture content was taken during the density test which was taken immediately after compaction. Therefore, by field interpretation, the moisture content was taken after compaction, the fill was not tested in its loose state. Any reconditioning was therefore done after testing. Note: The method stated above is basically the same as SCN No. C-210-9001 presently requires.	Follow SCN No. C-210-9001 dated 3-29-79 and BEBC-2835 dated 4-4-79.

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 7

DATE 4-2-79

DESCRIPTION SOIL MOISTURE NOT TESTED AT SPECIFIED TIME

PAGE ____ OF ____

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
3, 4 SEE ATTACHED IOM, page 5	NONE REQUIRED

SB121520

3. Variance 7, Items 4 and 5 (New 3 and 4)

A. There is no variance to the Bechtel QA program requirements for construction quality control based upon the following evidence:

1) Construction Quality Control through their surveillance of U. S. Testing did in fact identify the lack of moisture testing. As illustrated in the following listed documents, it is apparent that not only QC, but Construction, Project Engineering and QA were all aware of the lack of testing:

NCR-55 of 2/4/74
NCR-324 of 8/6/75
NCR-421 of 5/16/76
QAR SD-40 of 7/22/77
Memo Newgen to Castleberry of 8/15/77
Memo Castleberry to Newgen to 9/30/77
Telecon Hook to Rea of 10/10/77
Telecon Hook to Rea of 10/13/77
NCR-1005 of 10/26/77
Memo Newgen to Castleberry of 11/18/77
Memo Castleberry to Newgen of 12/15/77
Memo Newgen to Richardson of 12/21/77
Telecon Dean/Osborn to Rea of 4/7/78

2) Following the issuance of QAR SD-40, U. S. Testing did perform moisture tests in the borrow area and they maintained an informal moisture log for this activity starting 8/1/77.

A review of this log by CPCO - QA in January 1978 revealed some inconsistency in reporting dates and moisture contents. As a result, Bechtel QC added a formal review of the U. S. Testing Log to the current inspection plan QCI C-1.02 on 2/13/78 - and this log is now being retained in the QC vault.

B. Same as 1B.

C. No remedial action is needed.

D. No corrective action is needed.

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 8

DATE 4-6-79

DESCRIPTION POSSIBLE DEFICIENCIES IN SOIL TEST RESULTS

PAGE 1 OF

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
ec 7220-C-208, Rev. 15, Dated 2-5-79 revious rev. same) Para. 9.0 describes tests r soils. These tests include: °ASTM-D-1557 - Compaction °ASTM-D-2049 - Relative Density °ASTM-D-1556, Field Density	Contrary to Program Requirement No: (1) A review of soils test conducted by Geo-tech indicates there are errors and inconsistencies in some of the tests performed by US Testing. The attached report (to be attached later) summarizes these problems.
/PSP G-1.1, Rev. 3, 9-13-78 para 3.5.9 states nsite Construction Quality Control responsi- lities for the Midland project are as llows: 5) Provide technical direction over on-site material testing laboratories and nondestructive examination subcontractors."	(2,3,4) Technical direction, surveillance and test report reviews by Quality Control failed to identify these problems.
ality Control Inspection Plans and Instruc- ons provided for test (T) of surveillance ints (S) for testing and review (R) points r test results as indicated below: Plan No. / Test / Review FIP-C-210-4 / T / R FIP-C-211-1 / T / R QCI-C-1.02 / TorS or S(v) / R QCI-SC-1.10 / SI / R e T & S Points for testing reference the plicable paragraphs of each specification r types of tests.	
I C-1.02, Rev. 2, dated 8/2/77 ACT 3.1 ates: Review and sign laboratory test reports erifying: a. Proper test method b. Proper test frequency c. Technical Adequacy T 3.1 Inspection Code is an "R" and ferences are made to: Spec / Para °C-208 / 9.0	(4) Para 5.6 of Spec 7220-C-211, Rev. 5 is not reference in QCI C-1.02, Rev. 2. This is the appropriate paragraph to establish proper test frequency.

SB121522

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 8

DATE 4-6-29

DESCRIPTION POSSIBLE DEFICIENCIES IN SOIL TEST RESULTS

PAGE 2 OF

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
c 7220-C-208, Revs 2-15, Table 9-1 ablishes test frequencies for soils as lows: •Field density, moisture content - one per every 500 cubic yards of fill •Compaction, grainsize, specific gravity - one per every 10,000 cubic yards of fill. c 7220-C-211, Revs 0-5, Para 5.6.2 ablishes test frequencie to be as in section of spec 7220-C-208 except frequency for l density will be as follows: •Large area - 1/500 c.y. •Confined area - varies from 1/10 c.y. to 1/100 c.y. as determined by the Field Engineer.	Contrary to Program Requirement No: (4,5,6) There are no records to validate the QC signoffs on QCIR's/FIP's to verify proper test frequencies were maintained for fill and structural backfill for each period covered by each individual QCIR or Inspection Plans. (6) Soil Tests were normally called for by the labor foreman. It appears that the Field Engineer was not determining the test frequency for confined areas.

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 8

DATE 4-6-79

DESCRIPTION Possible Deficiencies in Soil Test Results

PAGE ____ OF ____

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
Relative to program requirement 6: Prior to starting compaction in an area, the Field Engineer would determine the test frequency required and instruct the labor foreman. This review and the ensuing instructions were not documented. This particular deficiency is not considered to have generic implications since in other areas of construction which require testing, the specifications are more specific with regard to testing frequency.	Bechtel Project Management has stopped all permanent fill operations until a qualified Soils Engineer is on site to monitor soils operations.

SB 21524

BECHTEL POWER CORPORATION — ATTACHMENT 5

PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

CATEGORY NO. 8 — DATE 4-6-79

DESCRIPTION: POSSIBLE DEFICIENCIES — PAGE ____ OF ____

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
This item identifies inconsistencies in the operations performed by the test laboratory subcontractor and is considered to be possibly generic to other testing performed by this subcontractor. It is not considered generic to tests performed by Bechtel or the NOE subcontractor as is indicated by recent monitors and audits as follows: list of audits	AN INDEPTH REVIEW OF TESTING AND TEST RESULTS IS BEING CONDUCTED BY BECHTEL WITH THEIR GEO-TECH GROUP LEADING THE INVESTIGATION. THIS INVESTIGATION WILL INCLUDE: • BORINGS TAKEN IN AREA PLACED THROUGOUT CONSTRUCTION • TEST PITS • LAB TESTS ON SAMPLES FROM BORINGS AND TEST PITS • COMPUTER ANALYSIS OF PAST TEST RESULTS • OVERLAY PLOTS OF ALL TESTS THIS WILL BE COMPLETED BY ____. AN INDEPTH QA AND ENGINEERIN AUDIT OF U.S. TESTING OPERATION. COVERING TESTING AND IMPLEMENTATION OF THEIR QA PROGRA WILL BE CONDUCTED IN LATE APRIL OR EARLY MAY. THIS AUDI WILL UTILIZE GENERIC ELEMENT RESULTING FROM THE INVESTIGATION.

SB121525

No. 8
ATTACHMENT

POTENTIAL ERRORS IN TEST RESULTS
(PRELIMINARY)
(REPORT TO BE ATTACHED LATER)

Described below are potential problems and errors relating to tests performed by U.S. Testing Company.

- As indicated in the chart below certain laboratory standard compaction test were used many times more than would be expected considering that lab standards should be developed approximately once for every 20 field tests - many test results were over 105% - many tests plot outside the appropriate zero air voids curve.

Soil Classification Standard	Times Referenced	% over 105%	Highest Valve %	% Outside Zero Air-Voids
RD-61	574	15	137	-
RD-24	196	9	131	-
RD-55	491	51	142	-
BMP-270	210	4	-	30
BMP-271	135	2	-	30
BMP-269	217	1	-	12
BMP-277	148	11	-	49
BMP-278	81	22	-	51

- Time span over which standards were used have been found to be as long as 24 months.

- Retesting of failing tests may have improperly used different standards with lower maximum densities and resulted in passing tests. Example: Test MD-858 originally failed at 66% compaction using lab standard RD-49 (132.4 pcf; this test was cleared at 110% compaction using Lab Standard RD-41 (106.7 pcf

- Certain errors in actual calculations have been discovered (details not available).

- There is some evidence that "proctor" curves that do not represent the materials may have been selected in error by U.S. Testing technicians. Reference to:
  - Administration Building footing settlement
  - Report of test in response to Bechtel NCR 55.

SB121523

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 9

DATE 9-6-79

DESCRIPTION LACK OF SUBCONTRACTOR SOIL TEST PROCEDURES

PAGE ____ OF ____

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
	Contrary to Program Requirement No:
ecification 7220-C-208, Revs 2-15, Table 9-1 requency of test procedures" establishes the llowing test frequencies: °Field Density -1/500 YDS^3 Moisture Content °Compaction - 1/10,000 YDS^3	1,2 U.S. Testing's approved QA Program Rev. , dated does not provide procedures or instructions for testing of soils in the following areas: °Developing and updating the family of "proctor" curves. °Visual selection of the proper "proctor" curve. °Developing additional proctor curves for changing materials occuring between normal frequency curves. °Alternate methods of determining the proper laboratory maximum density where visual comparison is not adequate.
Specification 7220-G-22, Rev. 1, Dated 2/73 is an attachment to Spec 7220-C-208 and vides for U.S. Testing's QA Program. a 3.1 (5) requires this program to provide tructions, procedures and drawings.	
6.11, Rev. 0 Sect. 4.1, states inpart fore a purchase order is awarded, Engineer- is responsible for determining if the plier's Quality Assurance Program is able of meeting the specified requirements. ineering may delegate this function.... ineering is still ultimately responsible determining the acceptability of the plier's QA Program..."	3,4 [redacted] Project Engineering [redacted] reviews of U.S. Testing QA Manual failed to identify this lack of procedures.
6.11, Rev. 0, Part II, Sect. 2.1, states, art, "Upon receipt of the Supplier's posed quality assurance program document(s), cognizant engineer may either evaluate submitted program or forward it to the for review...."	

SB121527

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 9

DATE 4-6-79

DESCRIPTION Lack of Subcontractor Soil Test Procedures

PAGE ____ OF ____

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
The only other test subcontractor on site is the NDE subcontractor who performs all tests to the ASME and SNT codes. Audits by CPCo, Bechtel and ASME have not identified any significant deficiencies in this area.	Family of curves and selection of proctor curves will no longer be a problem as each field density test will be accompanied by a separate lab standard compaction test which will provide a direct comparison. This has been directed by a letter to U S Testing. An indepth audit of the test lab subcontractor operations will be performed by Bechtel by early May. This audit will include verificati that necessary procedures exist.

SB121528

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 10

DATE 4-6-79

DESCRIPTION DUCT BANK INTERFERED WITH SETTLEMENT

PAGE ____ OF ____

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
) P 4.46, Rev. 3, Section 5.1, states, in part, he Discipline Group Supervisor is respons-le, but may delegate authority to the oup Leader, for: ...e. Coordination with her disciplines and departments, including eir design interfaces....") ordination of project design drawings E-502 d C-1001, Rev. 6 and C-1002, Rev. 6 re-lted in a 1 in. separation gap between the ct banks and DGB foundations to allow for fferential settlement.	Contrary to Program Requirement No: (1-2) The coordination done failed to identify a second electrical dwg. E-42, Sht 33, Rev. 4 which showed that the duct banks were stepped (i.e, had enlarged cross-sectional area) below the openings provided in the footings. Four vertical duct banks were designed, and constructed in the field, without sufficient clearance and restricted the settlement of the Diesel Generator Building.

SB121529

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 10

DATE 4-6-79

DESCRIPTION DUCT BANK INTERFERED WITH SETTLEMENT

PAGE ____ OF ____

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
Coordination efforts were made which resulted in design details that provided a clearance for settlement. In addition, recognizing the variability in duct bank size and configuration, the cognizant engineer went to the jobsite, measured the duct banks, and designed the openings in the footings accordingly. At the time of this jobsite visit the duct banks were covered, up to the elevation of the bottom of the footings, by backfill and mudmat and the engineer failed to identify the enlarged cross-sectional area of the duct bank below the footing. Hence, the design did not specify a vertical gap between the bottom of the footings and the enlarged duct bank section. Based on the coordination done in this case, we do not believe this error has any generic implication	P The openings in the footings have been enlarged to allow adequate movement between the building and the duct banks. P Areas having duct banks penetrating vertically will be investigated to determine the effect of possible duct bank enlargement. This investigation will be done by June 1, 1979. P Proper remedial measures will be taken if the investigation shows potential problems.

SB121530

DATE	WHO	LIMITS	RESULTS
3-24-94	AI		
6-13-94	AI		
9-19-94	AI		

[illegible]

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

2 [illegible]

No headings

SB121532

SB121533

[illegible]

[illegible]

[illegible]

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 11

DATE 4-6-79

DESCRIPTION CORRECTIVE ACTION NOT TIMELY

PAGE ____ OF ____

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
I) NSI N45.2-1977, Section 17 - "Corrective ction" states, inpart, "Measures shall be stablished and documented to assure that onditions adverse to quality, such as ailures, malfunctions, deficiencies, eviations, defective materials and equipment, nd nonconformances, are promptly identified nd corrected as soon as practicable.:	Contrary to Program Requirement No: 1. Bechtel NCR No. 1004 was issued on 10-26-77 and identified failing compactic tests that were taken in 1976 and not previously identified. 1. On 1/13/78 Project Engineering issued IOM BEBC-2045 requesting the field to take test borings to aid in evaluating the conditions identified in the NCR. These areas included material under the Diesel Generator Building. The borings had not been done when the unusua settlement of the diesel Gen. Bldg was first noted on 7-22-78.

SB121535

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 11

DATE 4-6-79

DESCRIPTION Corrective Action Not Timely

PAGE ____ OF ____

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
imely identification of nonconformances is he subject of CPCo Quality Finding, QF-199. ue to the level of the backfill, to take the orings requested by Project Engineering ould have required backfilling or a ramp nd subsequent re-excavation to resume onstruction. This was not practicable and he field requested that the borings be elayed until the areas were completed.	Each open CPCo and Bechtel NCR, QAR, or Audit Finding will be reviewed to identify the need for additional action for timely closeout. This review will be done by _____. If the results of this review indicate a need for further correctiv actions such as programatic changes, appropriate action will be taken by _____.

SB121536

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX _____

CATEGORY NO. 12

DATE 4-6-79

DESCRIPTION _____

PAGE _____ OF _____

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
/PSP G-3.2, Rev. 4, Job 7220, Para. 5.2.1 tes - "NCRs which show evidence that nstruction Quality Control committed an ror in the implementation of the QC Program all be transmitted by the PFQCE to the sponsible Lead Discipline Quality Control gineer for action to prevent recurrence of e error. ality Assurance Department Procedure No. 101, Rev. 1, Para. 1.0 states in part: his procedure provides a mechanism for entifying quality trends, and initiating rrective action to prevent recurrence...."	Contrary to Program Requirement No: [redacted] 1, 2 From 1974 on, there have been numerous nonconformances in the area of soils operations written that identify: °Failure to perform inspections on structural backfill. °Moisture content out of spec and not identified and corrected. °Compaction tests not calculated correctl °Lift thickness exceeded. °Gradation requirements not met. °Compaction tests failed but not identified and corrected. These NCRs include but are not limited to: QF-29; QF-52; QF-68; NCR 421; QF-120; QF-130; QF-147; QF-172; QF-174; QF-199; QF-203; Audit Findings F-77-21 and F-77-32; NCR 686; NCR 698; NCR 1005. The Corrective Actions taken in response to the Bechtel QC and QA Program requirements do not appear to have been effective in preventing repetative problems in the area of soils.

SB121537

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX _____

CATEGORY NO. 12

DATE 4-6-79

DESCRIPTION _____

PAGE _____ OF ____

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
Q.A CPCO AND BECHTEL BOTH IMPLEMENT TREND PROGRAMS TO ASSIST IN THE DETERMINATION OF WHERE ADDITION CORRECTIVE ACTIONS MAY BE NEEDED TO PRECLUDE REPETITION OF REPETATIVE PROBLEMS. THE REPETITIVE PROBLEMS WITH SOILS OPERATIONS WERE INCLUDED IN THIS PROGRAM BUT THE INDEVIDUALS RESPONSIBLE FOR REVIEW OF THE TREND PROGRAM OUTPUTS FAILED TO IDENTIFY THE NEED FOR CORRECTIVE ACTIONS IN ADDITION TO THOSE ALREADY TAKEN. THIS ITEM COULD BE GENERIC TO OTHER AREAS WHERE REPETATIVE NON-CONFORMANCES HAVE OCCURRED	AN INDEPTH REVIEW OF THE BECHTEL TREND PROGRAM WILL BE UNDERTAKEN BY BECHTEL QA MANAGEMENT TO ASSURE THERE ~~BE~~ ARE NO OTHER SIMULAR AREAS THAT HAVE BEEN OVERLOOKED IN PAST REVIE. THIS WILL BE COMPLETED BY ____ IF THE RESULTS OF THIS REVIE INDECATE A NEED FOR ADDITIO. AL CORRECTIVE ACTIONS THESE WILL BE TAKEN IN ~~RESPONSE~~ AS REQUIRED BY THE EXISTING PROGRAM. AN INDEPTH TRAINING SESSION WILL BE GIVEN TO ALL MIDLAND QA ENGINEERS (BECHTEL) BY BECHT QA STAFF COVERING THE SETTLE MENT PROBLEM AND METHODS TO IDENTIFY SIMULAR CONDITI IN THE FUTURE. THIS WILL BE COMPLETED BY _____.

SB:21538

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 13

DATE 4-6-79

DESCRIPTION AUDITS LACKED SUFFICIENT DEPTH

PAGE ____ OF ____

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
M Section VI, No 1, Rev 4-B Para. 1.0 states part is policy establishes a system for the duct of quality audits to verify implemen-ion and assess the effectiveness of the lity Assurance Program...."	Contrary to Program Requirement No: 1: The Bechtel Quality Assurance Audit and Monitor Program as written and implemente for Job 7220 failed to identify certain problems relating to soils and the Diesel Generator Building Settlement Problem. These problems include: °PSAR requirements not reflected in specifications °Engineer calculation errors °Conflicts in specification 7220-C-210 °Required compaction not obtained °Testing errors °Lack of testing procedures °Inadequate inspection °Conflicts in the FSAR. This lack of identification of problems by the audit program resulted in a conclusion that Soils Operations were adequately controlled.

SD 21539

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 13

DATE 4-6-79

DESCRIPTION Audits Lacked Sufficient Depth

PAGE ____ OF ____

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
This item is considered to have possible generic implications in other areas even though it is recognized that a audit program only samples completed work.	An in depth training session will be given to all Bechtel QA Auditors assigned to the Midland job which will cover the settleme problem and methods to identify similar conditions in the future. This will be completed by _____.

SBI21540

To P. A. Martinez

Date June 5, 1974

Subject Job 7220 Midland Project
Structural Backfill
Specification 7220-C-211
BCBE 319

From E. E. Felton

Of Construction

Copies to R. L. Rixford
J. H. Allen

At Midland, Michigan

During April, 1974, civil procedure C-301 was replaced by Specification 7220-C-211, Rev. 0. At this time the field requested that a finer cohesionless and free draining material than that specified be considered; i.e., a material with 95-100% passing the #40 sieve. Reasoning for this was that the finer material is locally available within five miles from the jobsite as compared to twenty miles or more for the material specified and is available at a much lower cost. Some concern existed on possible liquefaction of this material and because of the time needed to fully test and evaluate it, the finer material was denied.

The field would like to continue to pursue this material. Please inform us of the testing required.

Please contact R. Grote if any further information is required.

E. E. Felton

EEF/RAG/kt

SB121727

5024 (10-72)

NONCONFORMANCE REPORT

2. DRAWING/PART NO. See 7220-C-208	REV. 2	7. PROJECT NO. 7220	12. REPORTED BY P.C. Chen	DATE 4/17-74	23. DISPOSITION CONCURRED REWORK / REPAIR / USE AS IS
3. ITEM DESCRIPTION Embankment Zone 1 #2		8. ITEM LOCATION "Q" Lined Dikes	13. VALIDATED BY P.C. Chen	DATE 4-17-74	P.G.C. Engrg 5/31
4. SERIAL NUMBER N/A		9. STARTUP SYSTEM NO. N/A	15. REPLACEMENT PART NO. N/A	REV.	Bechtel Proj Engr 5/31
5. PURCHASE ORDER NO. Subcontract C-210 Rev 2		10. QC FIELD INSPECTION PLAN NO. C-210 17, 18, 24, 28, 31, 32, 33 + 34	16. REPLACEMENT SERIAL NO. N/A		C Connelly 5/31 Bechtel Proj Field QC Engineer
6. CONTRACTOR/LOCATION Carlyle Constr. Co. South Haven Mich.		11. ASME CODE ITEM ☐ YES ☒ NO	17. SOURCE Subcontract		AUTHORIZED INSPECTOR DATE

18. ROUTING INSTRUCTIONS: ☒ ROUTE TO FIELD ENGINEERING ☐ ROUTE TO MATERIAL SUPERVISOR

19. NONCONFORMING CONDITION: Spec 7220-C-208, Table 9-1, page 14a states in part: field densities, moisture content test frequ will be one per every 500 cubic yards of fill. Actual test taken was one per every 2300 cubic yards. Ref: NCR #C-26 & NCR #55 It was recommended by Project Engineering borings be taken to evaluate the in place density of affected areas. Approx. 500 samples were taken in areas as designated by Project Engineering (work done under subcontract FSC-60, Raymond Internation) Out of all samples taken 5% are actually failures.

20. ☐ FIELD DISPOSITION ☒ FIELD RECOMMENDATION/ROUTE TO PROJECT ENGINEERING

Disregard failures as they are widley spread out and not far out of spec. A large percentage of these failures are also in the top one to two feet of dike and would have to be reconditioned before placement of embankment anyway. We recommend leaving dike as is with reconditioning of top lift as required. P.C. Chen 4/19-74

21. FIELD DISPOSITION RESULTS:

RECEIVED
MAY 31 1974
BECHTEL POWER CORP
JOB 7220
FILE

22. ENGINEERING DISPOSITION

Based upon evaluation of data from the boring program initiated in response to NCR C-26, Engineering recommends the Plant Area fill be used-as-is. A summary of the results of the boring program is being completed and will be forwarded under separate cover. Earthwork may proceed on the plant Area Fill. RFR 4-30-74 JGH 4-30-74

24. IS DESIGN CHANGE REQUIRED ☒ NO ☐ YES, SEE ATTACHED:
DRAWING REV. DCN
SPEC. REV. ADD.

25. REJECTED MATERIAL DISPOSITION ☐ RETURN TO SUPPLIER ☐ SCRAP
REMARKS

SB121742

27. QC ACCEPTANCE C Connelly 5/31
QC ENGINEER DATE
AUTHORIZED INSPECTOR DATE

ORIGINAL

NONCONFORMANCE REPORT

SPEC. NO. C-208	REV. 2	7. PROJECT NO. 7220	12. INITIATED BY [illegible]	DATE 6-7-74	1. PAGE 1 OF 1
C-208		8. ITEM LOCATION Q Levee Dikes	13. VALIDATED BY [illegible]	DATE 6-7-74	14. REV. NO. 0
C-208 Rev 2		9. SYSTEM OR SYSTEM NO. N/A	14. DRAWING OR PART NO. N/A	REV.	15. DISPOSITION CONCURRENCE
		10. QC FIELD INSPECTION PLAN NO. FIP 2-48, 51, 52, 53, 54	15. CHEM. LABORATORY WORK NO. N/A		REMARKS / QC REP. / ENGR. / WELDING ENGR.
		11. ASME CODE ITEM	YES / NO	17. SOURCE Subcontractor	

☒ ROUTE TO FIELD ENGINEERING ☐ ROUTE TO MATERIAL DISPOSITION

DESCRIPTION OF NONCONFORMING CONDITION

Spec 7220-C-208, Table 9-1, page 11a states in part: Field densities, moisture content test frequ
will be one per every 500 cubic yards of fill. Actual test taken was one per every 2300 cubic yards. Ref: NCR C-26 &
R 455 It was recommended by Project Engineering borings be taken to evaluate the in place density of affected areas.
(60 samples were taken in areas as designated by Project Engineering. Work done under subcontract PSC-60
(Wood Internation) Out of all samples taken 5% are actually failure

☐ FIELD DISPOSITION ☒ FIELD RECOMMENDATION/ROUTE TO PROJECT ENGINEERING

21. FIELD DISPOSITION REASON (S)

Disregard failures as they are widley spread out and not far out of spec. A large percentage of these failures are also in the top one to two feet of dike and would have to be reconditioned before placement of embankment anyway. We recommend leaving dike as is with reconditioning of top lift as required. [illegible] 6-7-74

ENGINEERING DISPOSITION

23. ENGINEERING DISPOSITION REASON (S)

Based upon evaluation of data from the boring program initiated in response to NCR C-26, Engineering recommends the Plant Area fill be used-as-is. A summary of the results of the boring program is being completed and will be forwarded under separate cover. Earthwork may proceed on the plant area fill. RTE 6-20-74 Ltr 6-30-74

24. DESIGN CHANGE REQUIRED ☐ NO ☐ YES, SEE ATTACHED

DRAWING ____ REV. ____ DCN ____

DEV. ____ ADD. ____

25. REJECTED MATERIAL DISPOSITION ☐ RETURN TO SUPPLIER ☐ USE AS

REMARKS

SB121743

27. QC ACCEPTANCE

QC ENGINEER

AUTHORIZED INSPECTOR DATE

ORIGINAL

WEEKLY COMPACTED FILL DENSITY TEST REPORT

Lab. Insp. _____

PLANT FILL [C-210]

Tested Week of _____

Sheet _____ of _____

Date Taken	Test No.	Unified No. Classification BMP RD CMC ZONE	Location	Elev. of Test	Depth Below Final Grade (ft.)	In Place Wet Density (lb/c.f.)	Water Content (%)	In Place Dry Density (lb/c.f.)	Max. Lab. Dry Density (lb/c.f.)	Percent compaction	Remarks
10/24/75	380	RD-38	S-5068 E-270	594		118.6	6.4	111.5	113.3	93	20% MIN
	381		S-5068 E-290	594		119.6	7.3	111.5	113.3	93	
	382		S-5071 E-314	594		118.1	7.9	109.5	113.3	85	
	383		S-5052 E-270	594		120.6	8.7	110.9	113.3	91	
	384		S-5052 E-240	594		119.4	9.6	108.9	113.3	83	
	386		S-5072 E-270	595		120.5	8.2	111.4	113.3	92	
	387		S-5072 E-225	595		123.9	10.4	112.2	113.3	96	
	388		S-5075 E-310	596		122.9	9.0	112.8	113.3	98	
10/31/75	401		S-5072 E-238	597		121.6	8.0	112.6	113.3	97	
	407		S-5062 E-260	597		121.3	8.3	112.0	113.3	95	
	409		S-5052 E-310	598.5		123.1	8.7	113.2	113.3	100	
	410		S-5077 E-276	598		120.2	9.8	109.5	113.3	85	
	411		S-5072 E-210	599		121.3	11.3	109.0	113.3	83	
	412		S-5049 E-315	600		122.9	5.1	116.9	113.3	86	
	413		S-5050 E-250	600		123.4	9.0	113.2	113.3	100	

$0121890

WEEKLY COMPACTED FILL DENSITY TEST REPORT

Lab. Insp. _____

Tested Week of _____

PLANT FILL (C-210)

Sheet _____ of _____

Date Tested	Test No.	Unified No. Classification (BMP RD CMC ZONE)	Location	Elev. of Test	Depth Below Final Grade (ft.)	In Place Wet Density (lb/c.f.)	Water Content (%)	In Place Dry Density (lb/c.f.)	Max. Lab. Dry Density (lb/c.f.)	Percent compaction	Remarks
10/21/75	415	RD-38	S-5064 E-315	601		120.6	8.6	111.0	113.3	91	
10/22/75	425	RD-30	S-5052 E-252	601		115.9	7.6	107.7	113.3	96	
	426	RD-30	S-5082 E-242	601		118.0	7.5	109.8	113.3	106	
	427	RD-36	S-5052 E-210	601		128.5	9.0	117.9	120.9	85	
	428	" "	S-5052 E-255	609		130.2	8.4	120.1	120.9	96	
	429	RD-38	S-5077 E-310	603		121.2	10.2	110.0	113.3	87	
	430	RD-39	S-5072 E-225	603		117.4	11.3	105.5	109.1	82	
	431	" "	S-5057 E-290	604		121.1	11.3	108.8	109.1	99	
	433	RD-38	S-5077 E-335	605		121.3	10.7	109.6	113.3	86	
	434	" "	S-5057 E-225	605		123.3	11.2	110.9	113.3	91	**
10/23/75	449	RD-37	S-5078 E-303	606		119.3	10.1	108.4	108.2	101	
	450	RD-36	S-5068 E-268	606		116.2	7.7	107.9	120.9	99	
	451	" "	S-5068 E-246	606		121.6	10.2	110.3	120.9	110	
11/6/75	500	(260) (10.6) 2	S-5104 E-308	609		139	18.6	123.5	129.8	95	SB12189
	504	" "	S-5074 E-[illegible]	612		143.5	12.4	127.7	129.8	98	

WEEKLY COMPACTED FILL DENSITY TEST REPORT

Lab. Insp. _____

Tested Week of _____

PLANT FILL (C-210)

Sheet _____ of _____

Date Tested	Test No.	Unified No. Classification BMP RD CMC ZONE	Location	Elev. of Test	Depth Below Final Grade (ft.)	In Place Wet Density (lb/c.f.)	Water Content (%)	In Place Dry Density (lb/c.f.)	Max. Lab. Dry Density (lb/c.f.)	Percent compaction	Remarks
10/31 75	493	(362) (11.8) (2)	S-5074 E-270	607		134.6	12.3	119.9	123.9	97	
7/8 76	671	RD-41	S-5050 E-212	607		121.6	8.8	111.8	108.7	113	
	761										
7/24 76	762	(355) (14.2)	S-5134 E-162	615.5		138.0	14.0	121.0	117.4	103	
4/18 77	1279	RD-55	S-5062 E-323	609		115.2	6.0	108.7	109.7	95.7	
4/19 77	1280	" "	S-5062 E-323	613		117.8	5.9	111.2	109.7	106.2	
↓	1281	" "	S-5062 E-323	611		117.5	5.9	111.0	109.7	105.4	
4/28 77	1294	" "	S-5072 E-250	608		122.2	4.7	116.7	109.7	127.7	
4/29 77	1296	" "	S-5057 E-283	610		114.8	6.4	107.9	109.7	92.3	
↓	1297	" "	S-5059 E-285	612		114.8	6.1	108.2	109.7	93.6	
5/2 77	1301	" "	S-5062 E-244	606		122.4	11.7	109.6	109.7	99.6	
	1302	" "	S-5064 E-220	606		118.2	9.5	107.9	109.7	92.3	
↓	1303	" "	S-5064 E-228	610		118.0	8.7	108.6	109.7	95.3	
5/3 77	1306	" "	S-5077 E-254	609		122.5	7.8	113.6	109.7	115.9	SB12189
↓	1307	" "	S-5071 E-229	611		122.3	6.8	114.5	109.7	119.4	

WEEKLY COMPACTED FILL DENSITY TEST REPORT

Lab. Insp. _____

Tested Week of _____

PLANT FILL (C-210)

Sheet _____ of _____

Date Tested	Test No.	Unified No. Classification (BMP RD OMC ZONE)	Location	Elev. of Test	Depth Below Final Grade (ft.)	In Place Wet Density (lb/c.f.)	Water Content (%)	In Place Dry Density (lb/c.f.)	Max. Lab. Dry Density (lb/c.f.)	Percent compaction	Remarks
5/3 77	1309	RP-55	S-5067 E-223	610		113.0	7.1	105.5	109.7	81.6	
↓	1310	" "	S-5064 E-263	613		120.5	5.8	113.9	109.7	117.1	
5/19 77	1343	" "	S-5082 E-328	612		111.0	5.6	105.1	109.7	79.8	
5/25 77	1353	" "	S-5072 E-285	618		110.3	4.8	105.2	109.7	80.2	
↓	1354	" "	S-5072 E-328	620.8		118.5	9.1	108.6	109.7	95.3	
6/10 77	1461	" "	S-5071 E-254	617		122.6	5.5	115.9	109.7	124.7	
6/14 77	1489	" "	S-5077 E-298	619		119.1	5.6	112.8	109.7	122.8	
	1490	" "	S-5077 E-208	619		120.1	6.9	112.3	109.7	110.7	
	1485	(262) (11.8) (1)	S-5106 E-241	615		131.0	10.8	118.2	123.9	95.4	
↓	1486	" "	S-5102 E-276	615		135.5	11.3	121.7	123.9	98.2	
6/17 77	1528	(262) (10.0) (1)	S-5086 E-208	617		141.5	9.9	128.7	127.3	101.3	
↓	1529	" "	S-5128 E-214	616		135.0	9.6	123.2	127.3	96.8	
7/1 77	1595	(262) (11.8) (1)	S-5100 E-320	625		131.0	10.1	119.0	123.9	96.0	
7/5 77	1603	RD-55	S-5054 E-261	614		119.9	7.7	111.3	109.7	106.6	
7/11 77	1649	(269) (10.0) (1)	S-5050 E-207	618		138.5	11.5	124.2	127.3	97.6	SB12189

WEEKLY COMPACTED FILL DENSITY TEST REPORT

Lab. Insp. _____

Tested Week of _____

PLANT FILL (C-210)

Sheet _____ of _____

Date Sampled	Test No.	Unified No. Classification BMP RD CMC ZONE	Location	Elev. of Test	Depth Below Final Grade (ft.)	In Place Wet Density (lb/c.f.)	Water Content (%)	In Place Dry Density (lb/c.f.)	Max. Lab. Dry Density (lb/c.f.)	Percent compaction	Remarks
7/29 77	1778	(269)(10.0)(1)	S-5105 E-280	624.5		141.5	10.5	128.0	127.3	100.5	
7/30 77	1798	" "	S-5122 E-298	627		144.0	9.9	131.0	127.3	102.9	
↓	1797	" "	S-5135 E-175	623		139.0	10.8	125.5	127.3	98.6	
8/2/77	1808	" "	S-5074 E-270	628		143.0	10.4	129.5	127.3	101.7	
8/27 77	2356	RD-55	S-5079 E-328	632.5		120.0	7.2	111.9	109.7	109.1	
8/4/77	2160	(277)(13.5)(1)	S-5122 E-295	629.5		142.0	11.8	127.2	121.0	105.1	

SB12189

Bechtel Power Corporation

Interoffice Memorandum

To: File

File No:

Subject: U. S. Testing 30 Day Evaluation
GLR-10-75-303

Date: October 26, 1976

From: G. L. Richardson

Of: Quality Assurance

Copies to: J. Klacking

At: Midland, MI Ext. 207
Job 7220

A meeting was held on Oct. 25, 1976, to discuss and evaluate the performance of U. S. Testing and to establish additional corrective action to increase the creditability of the test lab.

People in attendance were:

D. Edley	U. S. Testing
G. Skeede	U. S. Testing
J. Connolly	Q.C.
B. Cheek	Q.C.
T. Lieb	Q.C.
G. Yiesley	Q.C.
G. Richardson	Q.A.
J. Hook	Q.A.
J. Church	Subcontracts

Problems discussed were:

A. U. S. Testing Lab Chief spends most, if not all, of his time checking paper problems and there is little, or no, time left for supervising.

Corrective Action Planned:

Elevate Bob Brown from Technician to Asst. Lab Chief to help lighten the work load of the Lab Chief and to allow the Lab Chief to spend time with the Technicians for technical and organizational assistance. The Asst. Lab Chief will have a Level II certification.

B. There appeared to be a problem of communications between Bechtel and the Test Lab. This area includes planning and scheduling and coordination for concrete pours.

SB122267

File
GLR-10-76-303
Oct. 26, 1976

Corrective Action Planned:

Q.C. will be the soul interfaced with the Test Lab. The Concrete Engineer will have the next day's concrete schedule submitted at 1400 hours the previous day. This will allow ample time for planning the next day's work at the lab.

C. U. S. Testing had on some instances held-up concrete pours because they were not in the field.

Corrective Action Planned:

U. S. Testing will be set-up and ready to go 15 minutes before concrete is scheduled to commence.

D. To keep both the Test Lab and Q.C. abreast of current problems and potential problems a weekly meeting will be held to discuss these conditions that were found through out the week.

Areas of concern discussed at the meeting:

1. The PFQCE stated that the number of findings and problems that the lab is encountering must decrease. The lab must establish creditability in the work they performed.

2. Q.A. was concerned about the wide area in which the problems have occurred. There is no single area in which major problems have occurred only a wide spectrum of minor problems.

3. QCE was concerned that both the Asst. Lab Chief and the Lab Chief do not get bogged down in paper problems but correct the problems in the initial stages of performance.

All parties agreed that these concerns are valid as it was apparent that this newly assigned Asst. Lab. Chief would help curtail the problems that have plagued the Test Lab. Bechtel has stated that they are not looking for a zero defect program from U. S. Testing but is expecting marked improvement from the Test Lab.

Another meeting will be held at the end of 5 weeks. This will be the end of the 60 day stepped up activity in which a final discussion and evaluation will be made as to effectiveness of the corrective action taken.

SB122268

G. L. Richardson

GLR/JGH/sw

This is a tabulation of quality discrepancies against the test lab during the thirty (30) day monitoring period.

DOCUMENT	ISSUE DATE	CLASSIFICATION	DESCRIPTION
NCR-541	9-28-76	Lab	Concrete curing tank temp exceeded the max. allowable
CPCo NCR-127	10-7-76	Lab	Tests of ice water not performed for User's Tests
QADR-SD-4	10-8-76	Lab	User's Tests samples for concrete taken from the stockpile
QADR-SD-5	10-15-76	Lab	90 day cylinder breaks made at 88 days.
QADR-SD-6	10-21-76	Soils	Incoming structural backfill tests not performed.
CPCo NCR-132	10-20-76	Lab	Test lab did not report failing rebar test to Bechtel

TOTAL CONCRETE PLACED (from 9-29-76 to 10-22-76)	4483 c.y.
TOTAL Q LISTED	1162 c.y.

SBL22269

GEOTECH
ANN ARBOR

Telephone call

ROUTE

BY K. Bailey OF M.O.

TO WCP OF AAO

DATE 3/6/80 TIME 12:30

SUBJECT Ax-1 Clean out JOB NO 7220

Ax-1 is slowly sinking into the sunset as they are cleaning it out I checked the boring log and completion log and I don't see any reason for it. The bottom of the casing should be setting in V. dense sand. I told Kirk to go ahead and keep working on it. Another "Rain gauge"

LY

SB 23285

February 28, 1980 - Midland, Michigan

FOR YOUR FILES
JTA

Underpinning Wings of the Auxiliary Building and the Feedwater Valve Pits - C. Gould

A dewatering system has been installed to permit removal of backfill material down to undisturbed glacial till.

An access shaft will be excavated 34 feet deep from plant grade at El 634 down to abo El 600.

The valve pits will be temporarily supported from the surface. A drift will be advan below the lower slab at El 607 to the auxiliary building wings. Pre-grouting ahead o the face will be used where necessary for ground stability during excavation.

Caissons will be installed to supp: t the outer end of the auxiliary building wings. No more than 10 percent of the electrical penetration area will be exposed at anytime Jack piling or caissons will be installed along the south wall of the turbine buildin The choice has been left to the contractors preference.

The area beneath the valve pit will be excavated down to till and it will then be backfilled with lean concrete in controlled lifts. The first lift will be 2 feet and subsequent lifts will be about 5 feet. Dowels will be placed between lifts and into the electrical penetration area. The caissons supporting the end of the electrical penetrations were selected instead of jacked piles because the ground is heterogeneous and these can be advanced without loss of ground. A one foot plug will be maintained throughout the installation operation. There are concrete obstructions in the fill so that jacked piles will not work. A caisson is large enough so that obstructions can be removed. The caisson also permits inspection of the till to determine its suitability. Each caisson will be load tested to 1.5 times its design load. After 500 tons of capacity has been installed there will be random checking of the caissons to determine if the prestress put into stub piles to transfer load to the caissons is being maintained.

A long term test load of 1.5 times the design load will be maintained for 24 hours and two times to 30 hours will also be included. Full load is 4000 kips. A limit of 1/4 inch up and 1/2 inch down is required to prevent damage to structure. The jacks used to transfer the building load to the caissons will be calibrated to ensure that the load is known. There will also be redundancy in the gage system. Wedges are used as shown on the attached sheets. The gage on the jack will indicate when transfer is affected. Allowable bearing values have been assigned.

SJ 29289

Service Water Pump Structure - M. T. Davisson

The north end of the service water pump structure will be underpinned using piles. The load at this end of the structure will be transferred to the piles through a korbel. The piles will be driven at the locations shown, the korbel will be bolted to the wall and the bolts will be prestressed. The load will then be transferred to the piles in a manner similar to that for the caissons at the auxiliary building.

The piles selected are 14 inch diameter, 0.5 inch wall, pipe piles which will be driven to a nominal 100 ton capacity. Only 75 tons will be transferred. The load will be transferred in 25 percent increments (18.75 tons) for all piles and this will be kept going until 75 tons is transferred. A wedge system similar to the caissons at the auxiliary building will be used.

All piles will be driven with the hammer above the roof of the structure. The furnish length will be long enough to do this. There should be no field splices in the ground.

All piles will be predrilled and a 010 hammer will be used. This hammer has a driving capability of about 300 tons but only 200 tons will be required. Most of the capacity will be developed in the till.

A tall micarta aluminum cushion will be used and the piles will be driven to 20 blows to the inch (60 blows for the last 3 inches).
The load procedure and method of evaluation will be those given in Peck, Thornburn and Hanson (similar to that used at Bailly).
Inspection will be in accordance with the Corps of Engineers procedures (also used at Bailly).

SB 23290

Summary - by R. B. Peck

The investigations at the diesel generator building showed that the seat of settlement was in the very variable clay fill. It varied in water content, type and consistency. A surcharge solution was recommended and adopted. The instrumentation installed provided data on which to base a reliable settlement forecast. The procedure also proof tested the soil. It eliminated the need for further sampling, testing and calculations to predict settlements. If sampling and testing were carried out now it is probable that some areas of lower compaction would be disclosed. We have a positive, better way to predict what the settlement would be with the surcharge in place.

Excess pore pressures were found to be small and the final settlement readings were linear on a semi-logarithmic plot. Even the upper bound settlements predicted with the surcharge considered to be in-place for the life of the the plant were still found to be acceptable in the structural analysis.

The preloading is ineffective in improving conditions with regard to liquefaction in loose zones of saturated sand. Grouting was considered but it was considered to be too difficult to satisfy everyone that all critical areas had been grouted. It would be a piecemeal solution. Therefore it was recommended that a permanent dewatering system should be installed. This is positive for the diesel generator building and the other Category I structures within the powerblock. One of the advantages of the dewatering is that it can be monitored easily. It was also clear that there would be a time lag which would give sufficient time for corrective action to be carried out if something went wrong. The pumping tests confirmed this. Furthermore the pumps would not have to survive the SSE.

Dewatering tends to reduce seismic shakedown settlements due to the apparent cohesion caused by surface tension. Current methods for evaluating this involve dry or saturated sands and estimates based on that procedure will be upper bound.

Nowhere is there a preceden for preloading plus permanent dewatering for a nuclear plant but each of these methods has precedents. The precedent for loading inside a building was the Auditorium in Chicago in 1885. Permanent dewatering is not new. A simple system was used in an ore yard in Ohio (Republic Steel). It is easy to monitor and it worked.

Each of the problems at the Midland site has had a tailor made solution developed. The solutions don't require an unreasonable amount of maintenance or difficulty in monitoring.

The investigations have now disclosed all of the significant problems and there is now a suitable solution for each.

SB 23292

[illegible]

[illegible]

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

The water table at the time of preloading is significant. The pond was raised to try to saturate as much of the fill as was feasible. The pond level came to within 2 to 4 feet of the bottom of the building footings. In this zone clays would consolidate but sands may not. However, during the permanent dewatering capillarity will be preserved in the sands. Item 2 of the NRC letter requires "additional studies to get an independent prediction of settlement". However, the requirements of drilling and sampling cannot be carried out without sample disturbance so that laboratory tests will indicate compressibilities that are too large and predicted settlements will consequently also be much too large. Also because of sample disturbance a large amount of scatter will be found in the test data and the scatter and high amounts of settlement will be difficult to analyse. The preload program carried out at the diesel generator building has resolved all of this. In fact, if studies had been made prior to preloading based on laboratory tests of the fill it is arguable that it would not have been decided to preload the area anyway in order to get meaningful answers. It should also be noted that there has been no settlement in the past since

SBS12661

[illegible] to clearly state that we [illegible] trend of settlements so that our predictions are reliable and indeed much more reliable than could be determined by testing.

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

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

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

Based on his extensive experience, R. B. Peck stated that he was absolutely

[illegible] present qualification, based on preloading, is satisfactory, it is [illegible] it can be checked again during construction and it is the most reliable [illegible] prediction of settlement that can be made.

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

The Corps of Engineers has commented on the raising of the cooling pond however, this raising was complete at the time the maximum preload surcharge was reached and the pond level and surcharge were maintained constant during the period of maximum preload. The purpose of raising the pond level was to eliminate as much capillarity as possible. The second reason was to ensure that the piezometers would react and would not be influenced by air-water pore pressures. The raising of the pond reduced the surcharge load by 3 or 4 feet of bouyancy. The actual effective stress profile will be worked out in detail for the conditions during surcharging and after the building is in operation so that it will be clear what the influence of this small reduction in surcharge is. It should be pointed out that, based on the design criteria, it appears that the equipment live load is 300 psf but in reality it is much less than this and this will be considered in the effective stress computations. We need to know these profiles precisely in order to better understand the implications of the loss of surcharge due to 3 to 4 feet of bouyancy and the trade-off that was made in order to reduce capillarity.

[illegible] the pond might have softened large lenses of soil under [illegible]

SS013663

[illegible] there is [illegible] therefore in the prediction of [illegible] considering that the settlement trend will change in the future, therefore, extrapolation is possible.

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

We can now be quite confident, from the preload surcharging, settlement and

[illegible] measurements, that refine my [illegible] the [illegible]. Due to [illegible] with the several [illegible] that will still [illegible] required before the work is complete.

Corps and NRC Comments on Settlement Evaluation

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

The NRC and Corps concerns are:

1. What will the settlement be doing to dewatering?

2. What is the ultimate bearing capacity?

3. What is the overall settlement?

The first item can be answered by dewatering and monitoring the settlement. The second can be evaluated from load tests. The interpretation of the overall settlement cannot be addressed more reliably than it already has. The procedures required by the Corps of Engineers, sampling and testing are not

[illegible] to provide adequate strength, be reliable on the present [illegible].

[illegible] [illegible] [illegible]

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

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

Retaining Wall Stability and Settlement

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

Building Load Redistribution

The Corps is interested because a failure of the arrangement could affect [illegible]

SLS123 86

0852 FACSIMILE TRANSMISSION AND SILLING

TO Bechtel Power Corp.

COMPANY

Ann Arbor, Michigan

CITY AND STATE

DATE 8/14/82

FACSIMILE PHONE 313-994-7909

ATTENTION L. L. Aljic

NO. OF PAGES 8

FROM: BECHTEL-SAN FRANCISCO, CA 415-768-6000

SENDER W. R. Lewis

LOCATION 45/51/B37

EXTENSION 7204

DEPARTMENT OR DIVISION H&CF-Engr

ORGANIZATION CODE OR OVERHEAD 7HE-213

CHARGE #1 7220-10

M. Zafiriou SUBMITTED BY

FOR Walter R. Lewis AUTHORIZED BY

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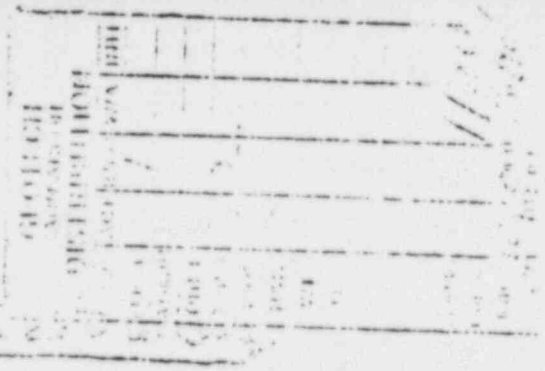

No doubt that the fill beneath the D.A. building does not meet the control properties of density and degree of compaction. These properties are much more variable than they should be. Anyway, the only property that counts is the compressibility of the fill and this has been greatly improved to the extent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

The water table at the time of preloading is significant. A pond was raised to try to saturate as much of the fill as was feasible. The pond level came to within 2 to 4 feet of the bottom of the building footings. In this zone clays would consolidate but sands may not. However during the permanent dewatering capillarity will be preserved in the sands. Item 2 of the NRC letter requires "additional studies to get an independent prediction of settlement." However the requirements of drilling and sampling additional borings cannot be carried out without sample disturbance so that laboratory tests will indicate compressibilities that are too large and predicted settlements will consequently also be too large. The presence of the sample disturbance, a large amount of scatter will be found in the test data and the scatter and high amounts of settlement will be difficult to explain. The preload program carried out at the D.A. building has produced a lot of data. In fact a number of studies (one by Lambe) have been made based on laboratory tests of the fill

It is conceivable that it would have been desirable to preload the area anyway in order to get meaningful measures. It should also be noted that there has been no settlement in the year since the preload fill was removed. Since the present foundation pressures are now very close to the final pressures it therefore is clear that the predictions provided by our analyses are conservative. It can therefore be clearly stated that we do now know how the building will perform and the trend of settlements so that our predictions are reliable and indeed much more reliable than could be determined by testing.

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

The concept of not relying on drilling and testing but rather relying on field performance is not new. It has been used successfully before at the Kewaunee nuclear plant. In that case the initial studies were made based on laboratory testing of good quality samples and the predicted settlement were determined to be 15 inches. However there was evidence of preconsolidation of the site soils. Based on upper limit values an estimate of the minimum preconsolidation pressure was made and using this a prediction of 4 inches of settlement was determined. By continuing the foundation work on segments and then not connecting the segments at

SE 5126 70

were 90 percent of the load was in place. [illegible]

In the Geonicetas test a similar procedure was used. A load test was carried out by drawing down the water table. The induced pore pressures in the soil and the resulting settlement as the pore pressures dissipated were measured and the properties of the foundation soils were back figured.

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

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

The Corps of Engineers has commented on the raising of the cooling pond however this raising was complete at the time that the maximum preload surcharge was reached and the pond level and surcharge were maintained constant during the [illegible] period of maximum preload. The purpose of raising the pond level was to eliminate as much capillarity as possible. The second reason was to ensure that the properties would react and would not be influenced

by air-water pressure. Although the raising of the pond reduced the surcharge load by 3 or 4 feet of seepage. The actual effective stress profile will be worked out in detail for the conditions during and surcharging and after the building is in operation so that it will be clear what the influence of this small reduction in surcharge is. It should be pointed out that, based on the design criteria, it appears that the equipment live load is 300 psf but in reality it is much less than this and this will be conservative in the effective stress computations. We need to know these profiles precisely in order to better understand the implications of the loss of surcharge due to 3 to 4 feet of buoyancy and the trade off that was made in order to reduce capillarity.

The raising of the pond would have softened deep lumps of soil which were potential subsidence voids. If this had happened it would have resulted in time lag and creep. The records show that this did not happen and even if this is some of what present it is in the foundation rebound settlement and heave in the production as secondary settlement. It is no basis for considering that the settlement trend will change in the future, though extrapolation is possible.

Bolton Tongue

What will be the effect on strength of consolidation of material not at optimum? The present data indicate some small rebound following removal of the surcharge, therefore the foundation contact pressure is less than under the surcharged condition. The factor of safety must be at least one and is clearly greater than this. There is experience (Fargo grain elevator) that even on stiff materials there is non-linear behavior at loads above about 80 percent of the ultimate. Therefore the factor of safety is clearly significantly larger than one since non-linear behavior has not been recorded. The factor of safety beneath the greater pedestals will be even greater because the contact pressure is less beneath them. The settlement below looks right. The stress in the ground during the preload surcharging ~~process~~ decreases slightly with depth. Dewatering will induce a load that increases with depth. When the dewatering load the lower materials will be stressed the most and because that material is softer only to the same depth as it will compress more than the upper materials. Additional settlement due to drawdown, if any, will be small. Even if the stress at depth exceeds the preload apparent stresses induced by the pedestals

surcharge, the settlement will have taken place during the underpinning operations at the auxiliary building so that it will be quite clear from the record.
We can now be quite confident, from the pulsed surcharging, that settlement and pore pressure measurements that primary consolidation occurs in about 2 weeks. The underpinning will take several months so that any settlement will have occurred before the work is completed.

Corps and NRC Comments on Settlement Evaluation

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

1. What will the settlement be due to dewatering?
2. What is the ultimate bearing capacity?

2. What is the overall settlement.

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

Auxiliary Building Underpinning

It is not clear what benefit additional borings will provide at the auxiliary building. The underpinning caissons will be carried into the till and each will be load tested to 1½ times design load. Only vertical load is carried by the caissons. The till at the base of each caisson can be examined for acceptance that it is satisfactory. The caissons are designed for end bearing. The Corps agreed that their comment on lateral loading only applies if the NRC structural people agree that it is required.

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

Retaining Wall Stability and Settlement

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

Cooling Pond Embankment

The Corps is interested because a failure of the embankment could influence recreational facilities. Failure might also influence Category I systems so that is possible that portions of the dike should be Category I. They require borings to demonstrate that the embankment has properties as good as what were indicated on the design parameters.

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

The dikes were built with a different specification which ~~required~~ specified the equipment and certain procedures.

[illegible] ERS POWER CORP.

MIDLAND PROJECT

QUALITY ASSURANCE PROGRAM

EMBANKMENTS, PLANT AREA EXCAVATION, OUTLET STRUCTURE,

AND DROP STRUCTURE

INDEX

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SS 9145555

1.1 GENERAL

1.1 These general instructions are for quality control of civil-structural components for the plant foundation excavation, the Cooling Pond Dikes, the Outlet Structure, the railway embankment; and other facilities which are required for the cooling pond at the Midland Power Plant for the Consumers Power Company.

1.2 Field Engineers shall, through progressive inspection, verify the proper fabrication, erection, installation, and construction of civil-structural components. Inspection and testing of all civil work at the site shall be such that the requirements of both the specification and the design report are completely satisfied.

1.3 All field inspection will be under the direct supervision of Field Engineers who will execute a reliable means of quality control.

SBS1255

2.0 INVESTIGATIONS DURING CONSTRUCTION

2.1 Prior to construction, investigation programs for design information were carried out to determine the nature of the foundations for the plant and embankments and to evaluate the availability and properties of materials suitable for use in the embankments.

Copies of the reports submitted by Michigan Drilling, and Dames and Moore, who performed the field and laboratory investigations, are available at the site for reference during construction. Prior to the commencement of work in any particular area, the applicable section of the soil reports, together with the borehole data shown on the drawings, should be studied to obtain advance information regarding the nature of the foundations to be excavated and the properties of the construction materials to be worked.

2.2 As construction proceeds, further information will be obtained:

2.2.1 From observations of foundation materials exposed by the required excavation in the Plant Area and the Cooling Pond.

2.2.2 From observations of material removed and exposed by excavations for the foundation of the embankments, particularly the excavation for the cut-off trenches.

2.2.3 From observations and tests carried out during the excavation and placement of the various construction materials required for the embankments.

Additional information may be required as the work progresses, in which case further drilling, test-pitting, and testing will be necessary. The extent and nature of these investigations will depend on the conditions encountered, available data and type of information required.

2.3 Particular care is necessary to assure that no pervious layers of material extend across the embankment foundation that would provide a means by which water can be lost from the pond. If there is any indication that pervious layers or lenses extend beneath what is considered acceptable foundation, then a drilling program must be carried out to define the depth and horizontal extent of these layers. The results of the investigation will be forwarded to the design office for review.

2.4 The decision regarding whether or not a slurry trench is to be installed, shall be based on preliminary exploration information, together with any additional information obtained by further investigations. Borehole information, test pit information, observations made in and

SBS12557

adjacent to the inspection trench, the elevation of the local water table, anticipated dewatering problems, etc., must be considered. The slurry trench should be installed only if a comprehensive review of the data definitely indicates that a trench is the most practical solution. Wherever possible, a positive cut-off should be made by excavating the inspection trench through the pervious material, and a minimum of two feet into the underlying impervious foundation. When water is encountered in a pervious stratum, excavation of a cut-off trench by conventional means rather than a slurry trench may require an extensive and complex method of dewatering.

2.5 Throughout the construction period all work must be reviewed and considered bearing in mind the fact that the site overlies a subterranean aquifer from which potable water is drawn. On no account shall this aquifer be contaminated as a result of the installation. In particular, special care is necessary to assure that there is no possibility of significant flows from the cooling pond finding their way into the aquifer. When excavation has been completed in the Cooling Pond Area, there must be at least 20 feet of material, designated as "impervious", overlying any continuous pervious deposits in the foundation. On the project, "impervious" material is defined as material graded such that not less than 20 percent passes the No. 200 U.S. Standard Series Sieve.

2.6 All boreholes which penetrate into an aquifer, or are estimated to end within 20 feet of the top of an aquifer, shall be sealed off with grout.

SDS12358

3.0 DEWATERING EMBANKMENT

3.1 Check the procedure the Subcontractor intends to use to dewater the embankment foundations, paying particular attention to sump and drain locations, anticipated ground water levels and pump capacities.

3.2 Check the effectiveness of the dewatering procedure and assure that at the time material is placed on any prepared embankment foundation it is free of surface water.

3.3 Check that at all times the water table is being maintained a minimum distance of 4 feet below the level of the completed embankment. During the placement of the first 4 feet of embankment material, the water table must be maintained below the foundation surface.

3.4 Check that all local runoff from adjoining areas is diverted clear of the embankment being constructed.

3.5 Check that all springs in the foundation are adequately dealt with so that water is led away from them for the period during which construction activities are being carried out in the area. Flows from springs may be piped clear of the foundation and the pipe installation grouted when the completed fill level has been raised to a suitable elevation. The location of all springs, together with details of any permanent installations made to control the flow of seepage water, must be recorded on as-built drawings.

SB51259

4.0 DEWATERING PLANT AREA

4.1 Check the procedure the subcontractor intends to use to dewater the Plant Area, paying particular attention to pump and sump capacities and locations, and anticipated effects on the water table.

4.2 Check that local runoff is kept away from the excavation and that water from rain falling on the excavation is pumped clear of the work.

4.3 Check to determine that at the time structural concrete or other structural material is placed on any foundation, such foundation is satisfactorily dewatered and that any ponded water has been removed from the surface of the foundation.

4.4 Check that the ground water levels, indicated by the piezometric monitoring system installed around the plant excavation, are not higher than the maximum levels which calculations show ensure stability of the excavation. The limiting water level for each piezometer will be provided by Engineering.

4.5 If the piezometers indicate water levels which are higher than the calculated levels, ensure that immediate measures are taken to lower the level of the water table to acceptable values.

4.6 If it is found impossible to maintain the ground water levels lower than the acceptable levels Engineering should be notified at once, as redesign or protective measures may be required.

S.S12560

5.0 CLEARING AND GRUBBING

5.1 Check that all trees, brush, down timber and floatable material has been removed from the areas specified to be cleared. Check that disposal of the material by either burning or burying has been carried out satisfactorily in accordance with the specification. If buried, check that an earth cover having a minimum thickness of 3 feet is provided to assure that disposed material will not float or be uncovered when the pond is in operation.

5.2 Check that all fences and structures have been satisfactorily dismantled and removed from the site.

S.S12561

6.0 SEALING WELLS

6.1 Assure that before attempting to seal any artesian wells the Subcontractor stops all flow in the casing.

6.2 Check that the cement conforms to ASTM Designation C 150, Type III.

6.3 Check that the grout is proportioned, mixed and placed in accordance with the requirements of the manufacturer of the aluminum powder.

6.4 Check that each well is properly sealed off by the applicable procedure given in the specification. In this respect, note the differing requirements for wells with and without check valves and wells with obstructions.

6.5 Throughout construction, and particularly during the clearing and grubbing, stripping and excavation operations, maintain a vigilant watch for the possible occurrence of old boreholes or wells, additional to those shown on the construction drawings. Carefully investigate the occurrence of any old vertical pipes, and seepage flows emerging from the ground before or after excavation.

6.6 The importance of satisfactorily sealing off all applicable wells and boreholes, to prevent ingress of water from the Cooling Pond into the subterranean aquifer, when the plant is in operation, cannot be overstressed.

6.7 The location of all wells or boreholes, known to exist and designated for sealing not found during construction, shall be recorded in the job files.

SbS123382

7.0 EXCAVATION

7.1 Check that excavation is made strictly in accordance with the locations and depths shown on the drawings and described in the specifications.

7.2 Check that the Subcontractor's operations do not cause the unnecessary removal or disturbance of material beyond the specified limits of the excavation. If the Subcontractor disturbs or removes any material outside the limits of the required excavation, and the disturbed material forms an essential part of the foundation, check that all of the disturbed material is removed and/or replaced with compacted material in accordance with the requirements of the specification.

7.3 Check that the Subcontractor constructs the inspection trench to the specified minimum depth along the entire length of the embankment, and that once such trench has been excavated, the trench is inspected by a competent person qualified to interpret his observations and relate them to the requirements of the design and specification. The observation must be related to the satisfactory function and safety of the finally constructed embankment. Deposits of sand of uniform grain size and deposits of silt which have a density below that given in the Design Report are not acceptable in the embankment foundation and must be removed. Where, after excavation, there is a minimum thickness of impervious material of 20 feet overlying pervious deposits, such pervious deposits may be left in the foundation. Great care is necessary to determine the incidence, extent and continuity of sand lenses in the foundation and to assure that the finally constructed embankment forms a stable impervious water barrier with no lenses of pervious material passing across the foundation.

7.4 Check that excavation for the embankment is carried down to an acceptable foundation. Acceptable foundation for the Cooling Pond Dikes is firm undisturbed sandy silty clays or sandy silts with some clay. Generally it does not include uniform grain sand, silt deposits, or excessively wet material. However, uniform grain sand and silt deposits are acceptable if their in-place density is greater than the applicable density given in the Design Report. Acceptable foundation for the Baffle Dikes and railroad embankment is firm in-place material, free of humus and other organic material.

7.5 Inspect the material excavated from the required excavation and determine whether such material is suitable for use in the embankment. Check that all material unsuitable for use in the embankment is wasted within the areas designated for that purpose. Check that material wasted by placement within the Cooling Pond Area is compacted in

S.S12363

accordance with the specification and that the completed level is not higher than the design level for the bottom of the Cooling Pond, i.e., Elevation 615.

7.6 Assure that the borrow pits are sloped so that they drain. Check that the Subcontractor's borrow pit operations are such that pools of water do not pond in the borrow area, particularly on or adjacent to the areas being worked. If moisture conditioning is necessary, the Subcontractor should be encouraged to carry out any moisture content adjustments in the borrow area rather than on the fill. Check that the procedure adopted for moisture conditioning is such that at the time of compaction the material to be compacted has a uniform moisture content within the limits specified.

S.812564

8.0 SLURRY TRENCH

8.1 Check the applicability of the slurry trench and assure that the slurry trench is, in fact, the best means of providing an impervious cut-off over the proposed length. The principal field conditions which make the installation of the slurry trench a practical solution are:

8.1.1 Pervious material extending across the foundation which must be removed and replaced to form a suitable impervious barrier but which cannot be removed and replaced with rolled fill at a lower cost than the cost of constructing the slurry trench.

8.1.2 A water table at a level which precludes removal of the pervious deposits, without very extensive dewatering procedures.

A rolled fill cut-off constructed in a dewatered excavation is a preferable alternative to the slurry trench cut-off, because there is much more positive control and inspection of the construction. Check all available pertinent information such as borehole logs, test pit data, ground water levels, and observations in the adjacent excavation and inspection trenches. Refer to the criteria stated in the Design Report, Section 5.7, "Criteria for Depth of Impervious Cut-off", and to Section 5.8, "Slurry Trench Construction".

Check that sufficient subsurface data from boreholes and tests have been collected to ensure that the above criteria are satisfied, and carry out additional exploration and testing if required to define the conditions more clearly.

8.2 Check the Subcontractor's equipment to assure that it is adequate to carry out the work, i.e., excavation, mixing and cleaning the slurry and placing the backfill.

8.3 Check that the slurry trench excavation extends a minimum of 2 feet into the impervious foundation. Observe material being excavated to determine if impervious material has been reached. Correlate the observed excavation depths with the anticipated depths obtained from subsurface investigations.

8.4 Check that the excavated trench has a minimum width of 4 feet. The slurry trench should be excavated so that the width of the trench is not substantially greater than the minimum required. Provided the correct procedures and equipment are used, this situation should not arise. The excavated width will depend on the type of equipment used to make the excavation. If the trench is wider than 10 feet it may be

S.8123.65

necessary to revise the design or construction procedure to take precautions against the settlement which could result from this condition. Assure that the specified consistency and level of the slurry is maintained at all times while the slurry trench is open, including any stoppages of work.

8.5 If some sections of the slurry trench are wider than adjacent sections, check that the transition from the narrower to the wider section is not abrupt but flared in plan to form an angle not greater than 30 degrees to the axis of the trench.

8.6 Assure that slurry is introduced into the trench concurrently with the excavation so that it provides stability to the trench walls. Check the level of the slurry to assure that it is at least one foot above the water table.

8.7 Obtain samples, at least one for every 100 feet length, of the impervious material in the bottom of the trench. Take samples of the slurry to check its composition, viscosity, and density, at a suggested rate of at least 3 samples for every 100 feet of constructed slurry trench.

8.8 Using the applicable tests described in American Petroleum Institute Recommended Practice, "Standard Procedure for Testing Drilling Fluids", check the properties of the slurry.

8.9 Check that the type of bentonite being used is in accordance with the specification and that it conforms to the requirements of API Standard 13A, dated March 1965, Third Edition, "Specification for Oil-Well Drilling - Fluid Materials, (Tentative)". Check that peptizing or bulking agents are not used.

8.10 Check that the Subcontractor's equipment removes the slurry for cleaning from the bottom of the trench. Check that slurry cleaning is a continuous process whereby the coarse material is removed and wasted and the treated slurry returned to the trench.

8.11 Check that coarse particles have not accumulated on the bottom of the trench during excavation, during placement of backfill and during removal of slurry for cleaning. If such segregation occurs, check that it is corrected by removal of the coarse material.

S.S12366

8.12 Check that the excavated material, the imported backfill material, and the slurry have been thoroughly blended prior to placement in the trench as backfill. The backfill must contain at least 2 percent of bentonite. Check that before it is introduced into the trench the backfill has the consistency of wet concrete with a slump of about 6 inches.

8.13 Check that the gradation of the backfill for the slurry trench falls within the specified limits.

8.14 Check that the Subcontractor uses a clamshell bucket to place the initial backfill in the trench, and make sure that he starts by bringing the fill up to the final elevation at one end of the trench and progresses systematically with the construction along its length. Check that the material is not dropped freely through the slurry but that it is always introduced into the trench by building on a fill heading which advances along the length of the trench. Check that the Subcontractor adds or removes slurry as the work proceeds in order to balance excavation and placement of backfill, thus helping to keep the slurry level constant.

8.15 Check that after backfilling has been completed, the trench is covered with a surcharge in accordance with the specified requirements.

8.16 Check that the surface of the completed slurry trench and surcharge does not develop unusual cracking, subsidence or sinkholes. If such conditions are observed, the causes should be investigated by checking the density and gradation of the completed slurry trench cut-off by standard penetration tests and sampling. At least one borehole per one hundred feet of slurry trench cut-off is recommended. Re-excavation and reconstruction of the affected section of slurry trench may be necessary.

S0812367

9.0 FOUNDATION PREPARATION

9.1 Check that all subsurface drains, building foundations and other objects are removed from the embankment foundations.

9.2 Check that the dike foundation does not include any conditions which, if uncorrected, could leave weak spots or seepage channels below the dike.

9.3 Check that foundation preparation is not performed on any area until the foundation has been approved and is being satisfactorily dewatered in accordance with the requirements of the specification. Check that there are no pools or ponded water on the surface of the foundation being prepared to receive embankment material.

9.4 After the foundation has been approved, but prior to foundation preparation, there may have been some deterioration in the condition of the surface. Check that any unsuitable material in the foundation is either removed or moisture conditioned and compacted before the specified foundation preparation is carried out. Re-approval of the foundation may be necessary.

9.5 Check that the entire embankment foundation is given 4 complete passes with the specified roller before any material is placed thereon. If an equivalent roller is used, check that the necessary field tests with confirming density tests have been carried out to prove the suitability of the roller.

9.6 Check that proof rolling in the Plant Area is carried out in accordance with the specifications.

SJ812368

10.0 EMBANKMENT CONSTRUCTION

10.1 All material to be placed in the embankment must be inspected and tested with the specified tests to assure that the material conforms with the applicable gradings and moisture contents. If material from the required excavation is to be used in the embankment, check the quality and extent of the suitable material and make sure that the Subcontractor is aware of any limitations concerning the use of the material, i.e., in depth and/or extent. This applies both to areas specified as required excavation, but from which material suitable for use in embankment may be obtained, and to those areas designated for borrow only.

10.2 Check the survey layout to confirm that the embankments are being constructed on the alignments shown on the drawings and to the lines and grades shown. Permanent monuments and markers must be set up as reference points to provide data from which the layout of the work can be periodically checked. Check the layout of the impervious cut-off trench and the layout of the internal zones and check carefully that the minimum zone thicknesses, widths, and tolerances shown on the drawings and specified, are maintained in the field.

10.3 Check the suitability of the material to be used in the dikes with the soil tests listed below. Make sure that the test procedures adopted are those specified.

10.3.1 Gradation. The test shall be conducted in accordance with ASTM Designation D 422.

10.3.2 Specific Gravity. The test shall be conducted in accordance with ASTM Designation D 854.

10.3.3 Moisture Content. The test shall be conducted in accordance with ASTM Designation D 2216.

10.3.4 Shear Strength (fully drained), Zone 1A only, will be performed generally in accordance with Chapter XI of "Soil Testing for Engineers" by T. W. Lambe.

10.3.5 Laboratory Maximum Density and Optimum Moisture Content. The maximum dry density and optimum moisture content of cohesive material will be determined in accordance with ASTM Designation D 1557, Method D, provided that the sample is prepared in 4 layers, each compacted by 25 blows with a 10-pound hammer dropping 18 inches.

The maximum density of cohesionless soils will be determined in accordance with the applicable requirements of ASTM Designation D 2049.

S.S12563

10.4 Check the properties of the material placed in the embankment with the following tests:

10.4.1 Moisture Content. The test shall be conducted in accordance with ASTM Designation D 2216.

10.4.2 In-situ Density. The test shall be conducted in accordance with ASTM Designation D 1556 with the size of the hole selected in accordance with the requirements of the specification.

10.5 The frequency of control testing shall be sufficient to ensure that the material conforms to the requirements of the specification. The suggested minimum frequency of testing is given in the Design Report. The frequency of control testing may be reduced as the inspectors become more familiar with the visual and handling characteristics of materials suitable for use in the embankments.

10.6 Additional soil tests may be required for record purposes and to verify that the properties of the materials are in accordance with the criteria adopted for the design. The frequency of testing shall be in accordance with the design report. The tests are as follows:

10.6.1 Atterberg Limits. The test shall be conducted in accordance with ASTM Designations D 423 and D 424.

10.6.2 Shear Strength, fully drained. On materials for zones 1, 2, 3 and 4 to be performed generally in accordance with Chapter XI of "Soil Testing for Engineers" by T. W. Lambe.

10.6.3 Permeability. The tests shall be carried out in accordance with ASTM Designation D 2434.

10.7 Check that no embankment material is placed on frozen soil and that embankment construction utilizing material for which moisture conditioning is required is suspended when the ambient temperature is 32 degrees F and falling. Check that no frozen material is included in the embankments.

10.8 Assure that all embankment surfaces are brought up concurrently to form an approximately horizontal plane. If the Subcontractor wants to have differing elevations in the completed surface along the length of the embankment, the slopes between these differing elevations must conform to the requirements of the specification.

10.9 Check that the Subcontractor maintains the completed embankment surface so that it will readily drain.

S.S12370

10.10 Check that excessively wet or dry material, which can not be satisfactorily dried out or moistened on the fill, is not placed on the embankment. If excessively wet or dry material is placed, or develops on the embankment, such material must be either removed or, immediately prior to compaction, dried or moistened until such material falls within the moisture content limits.

10.11 Check that at the time of compaction any ruts in the surface of the material have been eliminated.

10.12 Check that each loose layer, placed on the embankment for compaction, is not thicker than the specified maximum.

10.13 Check that there are no pockets or patches of segregated, single-size, or gap-graded material placed in the fill. If such segregated material has been included in the embankment, check that it is completely replaced, or re-worked, before construction proceeds in that area, so that the gradation of the material in place conforms to the specification. Check that the grading of the riprap is consistent over the entire surface.

10.14 Check that riprap placement operations have not resulted in damage to the riprap bedding layer (zone 4). If such damage has taken place, check that the bedding layer has been rebuilt to the minimum thickness shown on drawings.

10.15 When placing those materials for which moisture content limits for compaction have been specified, check that the moisture content of the material is within the specified limits. If the moisture content of the material compacted on the fill is not within the acceptable limits specified, check that such material is reworked to bring it to an acceptable moisture content.

10.16 Make sure that the surface of the partially completed embankment is graded at all times so that surface water will drain away from zone 3.

10.17 Check that construction equipment crosses zone 3 only at specifically approved locations and that the number of such crossing points is the minimum required to perform the work. Ensure that zone 3 does not become contaminated, with fine material brought onto it by the wheels of the construction equipment, by unacceptable material falling from the hauling equipment, or by fines washed into the zone by surface run-off

S.S12371

10.18 Check that each layer to be compacted is rolled with the specified number of passes with the specified roller. If an alternative roller is to be used, check that the Subcontractor's procedure is such that the acceptable density is achieved on the fill.

10.19 Check that the compacted surface of any layer is not too smooth to bond with the next layer. If such layer is too smooth, ensure that prior to the placement of the next layer, the surface is disced or harrowed to break up the smooth surface. Occasionally, check the bonding between successive lifts by examining the appearance of the fill in a small test pit excavated for this purpose.

10.20 Where fill is not accessible to specified rollers, check that the material is placed and compacted in accordance with the specification. Great care is necessary to assure that the material placed against concrete surfaces is satisfactorily compacted.

10.21 If over a portion of the embankment, work is suspended, check that before there is further placement, any material which has deteriorated to below the acceptable standard for placed fill, is removed or re-worked until it conforms to the requirements of the specification. Particular attention must be given to the quality of the fill following winter shutdown and prior to commencement of fill placement in the spring.

10.22 Check that the outer faces of the drain berms are not restricted by impervious material or debris.

S.S12372

11.0 CONCRETE AND REINFORCING STEEL

11.1 Check that all materials, i.e., cement, aggregate, reinforcing steel, etc., conform to the appropriate provisions of ASTM, AASHTO and MDSHSS as referenced in the specification.

11.2 Assure that all construction materials are stored in accordance with the applicable ASTM Designation and/or the ACI Manual of Concrete Inspection.

11.3 Check that concrete is designed, batched, mixed and furnished in accordance with MDSHSS and that the appropriate class and strength is placed in the appropriate locations shown on the drawings.

11.4 Check delivery tickets and assure that they state the location to which the concrete has been delivered.

11.5 Check that the concrete forms have been fabricated and erected in accordance with ACI 347. Check the strength, stability, surface smoothness and cleanliness of the forms. Check that form oil of the specified type and application has been used on the surface of those forms which will be in contact with the concrete. Check that immediately prior to concrete placement the forms are cleaned out. Check that temporary openings have been provided to facilitate cleaning. Check that wire form ties are not used.

11.6 Check the setting out of the forms, for position and verticality. Check that all embedded items and anchor bolts have been satisfactorily installed in the correct locations and fastened to prevent movement during concrete placing. It may be necessary to check the location and elevation of the anchor bolts immediately following the placement of the surrounding concrete.

11.7 Just prior to placing concrete, check all the reinforcement steel for size, position and cover. Check that fabrication and placement of the reinforcement is in accordance with MDSHSS, Paragraph 5.06.03, unless field fabrication is approved.

11.8 Check that other trades are notified in advance of all concrete placement so that they can assure that they have carried out any work which may be affected.

SBS12373

11.9 Check that the concrete is placed, finished and cured in accordance with MDSHSS, Paragraphs 5.01.03g through 5.01.03k. No special finishes are required. Check that, within 24 hours of removal of forms, any imperfections in the concrete surface are repaired in accordance with the specification.

11.10 Check that no forms or form supports are removed until the concrete has gained sufficient strength to support itself, and that no backfilling is made against concrete until it has gained sufficient strength to withstand the applied loads (usually 7 days).

11.11 Check that placement of the concrete conforms to the requirements of MDSHSS, Paragraphs 5.01.03g through 5.01.03k. Handling, curing and sampling shall be in accordance with ASTM Designation C 31 and C 39. Check that at least 4 cylinders are made for every 100 cubic yards of concrete poured

11.12 Check that fresh concrete is suitably protected from extremely hot and cold temperatures as required in the Standard Specification for Road and Bridge Construction for the Michigan Department of State Highways.

11.13 If the strength of concrete cylinders tested after 28 days indicate that the concrete does not meet strength requirements, core samples of that part of the concrete structure the tests represent, may have to be obtained and tested. If the tests show that the concrete does not meet strength requirements, the unsatisfactory material may have to be removed.

11.14 Check that grout is mixed in accordance with the requirements of the specification and that it is placed in its final location within 1/2 an hour after mixing commences.

SS8120574

12.0 CULVERTS

12.1 Check that the corrugated metal pipe, couplings and fittings conform to the requirements of AASHTO Designation M 36. Check that the 6-inch diameter pipes used in the drop structure are perforated in accordance with AASHTO Designation M 196 and coated as specified for Type C in AASHTO Designation M 190.

12.2 Check that damaged zinc coating and welds, both interior and exterior, are cleaned and painted with zinc coating repair material before backfill is placed against the culvert. Check that the surface preparation and application of the material is in accordance with the manufacturer's requirements.

12.3 Check the final alignment and elevations adopted for the culvert and confirm that such alignment and elevations conform with the design requirements and site conditions.

12.4 Check that the excavation for the culverts is carried out in accordance with the applicable requirements of the specification. Examine the foundation to assure that all soft or spongy material is removed and replaced with suitable backfill.

12.5 Check that the culverts are placed on the correct alignment and grade and that the pipes are firmly fastened together by means of the specified couplings. Check that the pipe is placed with the perforations in the correct position.

12.6 Check that the placement and backfill procedures are in accordance with the specification. It is particularly important that ground water and surface water be satisfactorily controlled and kept clear of the excavation during the installation of the culvert and placement of the contiguous backfill.

12.7 Check that there is sufficient depth between the top of the culvert and the road surface and that after the backfilling has been placed and compacted, the road surface is properly restored.

SBS123575

13.0 HEAVY DUTY SLUICE GATES

13.1 Fabrication.

Prior to the delivery of the gates check the manufacturers drawing to confirm that the gates are being constructed in accordance with the requirements of the specification.

13.2 Delivery.

Check that all of the components are delivered to the site in satisfactory condition and that they are in accordance with the vendor's drawings and the requirements of the specification.

13.3 Installation.

Check that the gates are installed and tested in accordance with the specification. Special care is necessary to check gate tolerances, seating face clearances, gate operator, the electrical installation and lubrication. Check that painting has been done in accordance with the specification.

13.4 Operation.

Once the gate has been installed check the operation of the gates through the entire gate cycle.

SS812576

14.0 REFERENCES

The following documents must be available for reference in performing the inspections and tests and should be kept in the Field Office Library. These may be ordered by the Project Field Engineer through the San Francisco Office.

14.1 American Society for Testing and Materials.

Most of the items listed below are contained in the following volumes which form part of the American Society for Testing and Materials annual publication.

Part 9	-	Cement Lime Gypsum
Part 10	-	Concrete and Mineral Aggregate
Part 11	-	Bituminous Materials; Soils; Skid Resistance

Designation	Title
A 36	Specification for Structural Steel
A 120	Specification for Black and Hot-dipped Zinc-coated (galvanized) Welded and Seamless Steel Pipe for Ordinary Uses.
A 123	Specification for Zinc (hot galvanized) Coatings on Products Fabricated From Rolled Pressed and Forged Steel Shapes, Plates, Bars, and Strip.
A 126	Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
A 153	Specification for Zinc Coating (hot dip) on Iron and Steel Hardware.
A 276	Specification for Stainless and Heat-resisting Steel Bars and Shapes.
A 436	Specification for Austenitic Gray Iron Castings.
A 525	Specification for General Requirements for Delivery of Zinc-coated (galvanized) Iron or Steel Sheets, Coils or Cut Lengths Coated by the Hot Dip Method.
A 582	Specification for Free Machining Stainless and Heat-resisting Bars, Hot Rolled or Cold Finished.
A 615	Specification for Deformed Billet Steel Bars for Concrete Reinforcement.
C 31	Making and Curing Concrete Compression and Flexure Test Specimens in the Field.
C 39	Test for Compressive Strength of Molded Concrete Cylinders.
C 76	Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

S.S12577

Designation	Title
C 150	Specification for Portland Cement (including tentative revision).
C 175	Specification for Air-entraining Portland Cement.
C 200	Specification for Extra Strength Clay, Pipe.
C 361	Specification for Reinforced Concrete Low-head Pressure Pipe.
D 422	Grain-size Analysis of Soils.
C 423	Test for Liquid Limit of Soils.
D 424	Test for Plastic Limit and Plasticity Index of Soils.
D 854	Test for Specific Gravity of Soils.
D 1556	Test for Density of Soil in Place by the Sand Cone Method.
D 1557	Test for Moisture-density Relations of Soils Using 10 lb. Hammer and 18 in. Drop.
D 1751	Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction. (Non-extruding and resilient non-bituminous types).
D 2049	Test for Relative Density of Cohesionless Soils.
D 2216	Laboratory Determination of Moisture Content of Soil.
D 2434	Test for Permeability of Granular Soils (constant head).

14.2 American Petroleum Institute:

Standard 13 B "Standard Procedure for Testing Drilling Fluids".

Standard 13 A "Specification for Oil-well Drilling - Fluid Materials (tentative)."

14.3 "Soil Testing for Engineers" by T. W. Lambe

14.4 American Institute of Steel Construction, Steel Construction Manual.

14.5 American Association of State Highway Officials.

Designation	Title
T 26	Standard Method of Test for Quality of Water to be Used in Concrete.
T 99	Standard Method of Test for the Moisture Density Relationships of Soils Using a 5.5 lb. Hammer and a 12 in. Drop.
M 36	Standard Specification for Corrugated Metal Pipe.
M 136	Standard Specification for Corrugated Metal Pipe Underdrains.

S.S12378

Designation	Title
M 190	Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.

Designations T 26, T 99, M 36, M 136, and M 190 are contained in Highway Materials Part I Specifications and Highway Material Part II Tests, published by the American Association of State Highway Officials.

14.6 American Welding Institute. "Code for Welding in Building Construction."

14.7 Michigan Department State Highway Standard Specification.

14.8 American Concrete Institute. Manual of Concrete Inspection 318.

SBS12379

LIST OF DOCUMENTS SUGGESTED FOR USE
TO RECORD THE QUALITY OF THE WORK CARRIED OUT

No.	Title	Type	Frequency	Content
	Earthwork	Report	Weekly	1. Foundation: a. Investigations; e.g.bore holes and/or test pits. b. Dewatering; e.g.difficulties, springs, encountered, etc. c. Inspection trench; e.g.unusual condi[illegible]as. d. Foundation preparation; e.g. areas prepared, foundation description,summary of foundation test. 2. Embankment: a. Unusual conditions; e.g.required removal or reworking of fill. b. Test summary table. c. Drwg.indicating location of field test. d. Test results.
	Slurry Trench	Report	Monthly	Description of location of trench, factors which necessitated installation, difficulties encountered, etc.
		Table	Monthly	Summary of test results.
	Concrete	Table	Bi-Weekly	1. Pour check
		Table	Bi-Weekly	1. Summary of concrete cylinder test results. 2. Mill cert. on rebar.
	QC Receiving Report	Form	As req'd	Inspection of items received at site.
	Equipment Installed/ Inspection	Form	As req'd	Report on condition of each piece of equipment after installation.
	Final Inspection	Form	As req'd	Report on condition of each facility after completion of work.

SS512C50

DRAFT

CONSUMERS POWER COMPANY

MIDLAND PLANT UNITS 1 AND 2

JOB 7220-001

INVESTIGATION OF SAND BELOW CLASS 1 COMPONENTS

1. General

The purpose of this investigation is to delineate the areas below Class 1 structures and components where the foundation soil consists of sand and to determine the in-situ density of the sand. This will be achieved by means of standard penetration tests carried out in boreholes.

2. Borehole Locations

The locations of boreholes are shown on appended drawing SK-C-247. Additional boreholes may be required to determine the lateral extent of sand under Class 1 components. Any additional boreholes will be requested by Engineering after analysis of data from the present boreholes.

3. Depth of Boreholes

All boreholes shall be terminated not higher than ten feet below the base elevations of Class 1 structures and components indicated on drawing SK-C-247. This minimum depth applies where sand is not encountered below the foundation level. Where sand extends below the foundation level, the borehole shall be continued to the bottom of the sand and 10 feet into cohesive soils underlying the sand, except that the borehole can be terminated where at least three successive tests resulted in a penetration resistance in excess of 50 blows per foot.

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4. Drilling and Sampling Equipment

The boreholes shall be performed with a drill capable of installing 4-inch casing and performing standard penetration tests. A hollow-stem augering machine is acceptable.

Sampling shall be performed by standard split spoon sampler described in ASTM 1586-64T. An ample supply of water-tight jars and sample identification labels shall be maintained at the site.

5. Sampling and Testing

Standard penetration tests will be carried out in accordance with ASTM 1586-64T. Special attention is essential to ensure that the free fall of the 140-lb. hammer does not deviate from 30 inches and that the sampler is not jarred upwards during the raising of the hammer. Where tests are performed below ground water table, the borehole casing must be nearly full of water during the test. Casing must be used in sand, but need not be used in cohesive soil such as clayey silt, clay and clayey till.

The frequency of standard penetration tests shall be as follows:

Above the foundation level of Class I structures indicated on the drawings: At 5-foot intervals.

Below the indicated elevations: At 2-1/2-foot intervals in the first 10 feet, and at 5-foot intervals thereafter, to the bottom of borehole determined in accordance with paragraph 3.

The soil recovered in the split spoon sampler shall be described on borehole logs in accordance with the Unified Soils Classification System. Representative portions of all samples, at least 3 to 4 inches long (where possible), shall be placed in water-tight jars sealed with tape and wax or equivalent sealing substance and labeled as to date of sampling, borehole

S.S12353

number, sample number and sample depth. All sample jars shall be retained in indoor storage until written notice is issued by Engineering that the samples can be disposed of. The samples shall be kept out of direct sunlight and heat at all times.

Engineering may issue additional instruction for retainment of certain bulk samples of material from specific locations.

6. Borehole Logs

All boreholes shall be fully logged on standard Bechtel log forms provided by Engineering. The soil data shall be plotted on the logs to scale with respect to depth. All the data spaces printed on the logs shall be filled out where applicable. In particular, the following information shall be included on the logs:

Borehole number

Borehole coordinates

Ground elevation at top of borehole

Dates of start and completion of borehole

Groundwater conditions

Sample number and depth

Soil description for each sample

Number of blows for each 6 inches of penetration

Number of inches of sample recovery

7. Presentation and Analysis of Results

Two copies of logs of completed boreholes shall be sent to Engineering on a weekly basis. At least one copy of logs shall be retained in the field office. Analysis of results and determination of relative density and of limits of sand to be removed shall be performed by Engineering.

S.S.12351

RICHARD D. WOODS
[illegible]
[illegible]
ANN ARBOR, MICHIGAN
48103
[illegible]

1 May 1974

Dr. S. T. Ariel
Bechtel Incorporated
P. O. Box 1089
Ann Arbor, Michigan 48106

SUBJECT: Midland - Vibratory Settlement of Diesel Pedestals

Dear Sherif:

Attached please find the revised report of Vibratory Settlement of Diesel Pedestals which replaces the previous report dated February 21, 1974.

Sincerely,

Richard D. Woods,
Ph.D., P.E.

RDW:ar
Attachments

VIBRATORY SETTLEMENT OF DIESEL PEDESTALS

for

BECHTEL CORPORATION
RICHARD D. WOODS

MAY 1, 1980

VIBRATORY SETTLEMENT OF DIESEL PEDESTALS

Diesel Generator Vibrations and Soil Conditions

Computations by Bechtel personnel (Tandyopadhyaya, 1977) estimated the maximum vibration motion of the diesel generator foundation system to be 0.00003 inch at an operating speed of 450 rpm. To be conservative, this displacement was rounded off to 0.0001 inch (peak). Then, at the operating speed of the diesel generator, the maximum acceleration would be about 0.0006 g.

The fill supporting the diesel generator building is highly variable, ranging from clays to sands. Only those portions of the supporting soil which consists of clean, loose sand are susceptible to vibratory settlement. Because of the variability of the soils at the diesel generator building, it is not possible to precisely describe a single soil profile which would be applicable to the entire site. Therefore, for conservatism the worst possible conditions based on loose sands observed only in limited zones are assumed to exist throughout the fill under the diesel generator pedestals; that is, the soil is assumed to consist of 30 feet of clean sand at a relative density (D_r) of about 45%.

Settlement Analysis

Most efforts to estimate settlement of sand due to vibratory loads have dealt either with accelerations greater than 1 g as for vibratory compaction or with ground motions of large shearing strain amplitude as for earthquakes. Neither of these conditions prevail in the case of the diesel generator pedestals.

Experience of the writer is that vibrations less than those which are perceptible by people (Richart et al, 1970) do not cause measurable settlement. At 450 rpm the level of vibration acceleration which is perceptible by people is about 0.001 g. Therefore, it is noted that the estimated diesel-generator acceleration is less than this threshold and vibration induced settlement would be imperceptible.

However, in an attempt to quantify the magnitude of imperceptible settlement, the results of laboratory experiment by Seed and Silver (1972) were employed. The clean quartz sand in the Seed and Silver tests were subject to multiple repetitions of shearing strains at an acceleration of 0.3 g. The sand was compacted to relative densities of 45% and 60% before starting the tests, and the vertical vibration compaction strain was measured for three magnitudes of cyclic shearing strain amplitude.

To apply the Seed and Silver results to the diesel pedestal settlement analysis, the cyclic shearing strain in the sand supporting the pedestal was estimated as follows:

$$\gamma = \text{cyclic shearing strain amplitude} = \frac{A_{pp}}{D_s \times 5}$$

in which

A_{pp} = peak to peak vibration amplitude (in)

V_s = shear wave velocity in soil (ft/sec)
T_s = period of pedestal vibration (sec)

therefore,

$$\gamma = \frac{0.0002}{800 \times 12 \times 0.13} = 1.6 \times 10^{-7} \text{ or } 1.6 \times 10^{-5}\%$$

The Seed and Silver test results for relative density 45% and 60% were extrapolated to a shearing strain amplitude of $1.6 \times 10^{-5}\%$, see Figures 1 and 2. From these figures the vertical strains due to vibratory compaction were found for 2, 10, and 300 cycles of a shearing strain amplitude of $1.6 \times 10^{-5}\%$. These vertical strains were then plotted on Figure 3 and extrapolated to a number of cycles of shearing strain amplitude equivalent to one year of continuous operation of the diesel generators (450 rpm x 60 min/hr x 24 hr/da x 365 da) i.e. 230×10^8 cycles.

Because considerable extrapolation was required to arrive at the vertical strain vs number of cycles data, and because the data points for D_r = 45% and D_r = 60% were not significantly different, a single line was used to extrapolate vertical strain to 230×10^8 cycles in Figure 3. The vertical strain was found to be $100 \times 10^{-6}\%$ the settlement would amount to:

28 ft x 12 in/ft x 0.000001 = 0.0003 inch

This is clearly in the imperceptible range and confirms the writers previous experience.

Conclusions

Based on the preceding analysis, it is anticipated that the settlement of the diesel generator pedestals due to self-excitation will be imperceptible. However, because of the approximate nature of this analysis, the simplifying assumptions that were used, and the variability of the soil supporting the diesel pedestals, a settlement of 1/4 inch should be expected.

References

1. Bechtel Calculation No. 38, Civil Structure, Midland Units 1 & 2, 7220 File no. 50850-50999, dated May 13, 1977.

2. Seed, H. B. and Silver, M. L., 1972, "Settlement of Dry Sands During Earthquakes", Journal of Soil Mech. and Found. Div., ASCE, Vol. 98, No. SM4, April, pp. 381-397.

3. Richart, F. E., Jr., Hall, J. R., Jr., and Woods, R. D., 1970, Vibrations of Soils and Foundations, Prentice-Hall, Engelwood-Cliffs, N.J.

4. Woods, R. D., 1980, letter to S. C. Affel, February 21, 1980.

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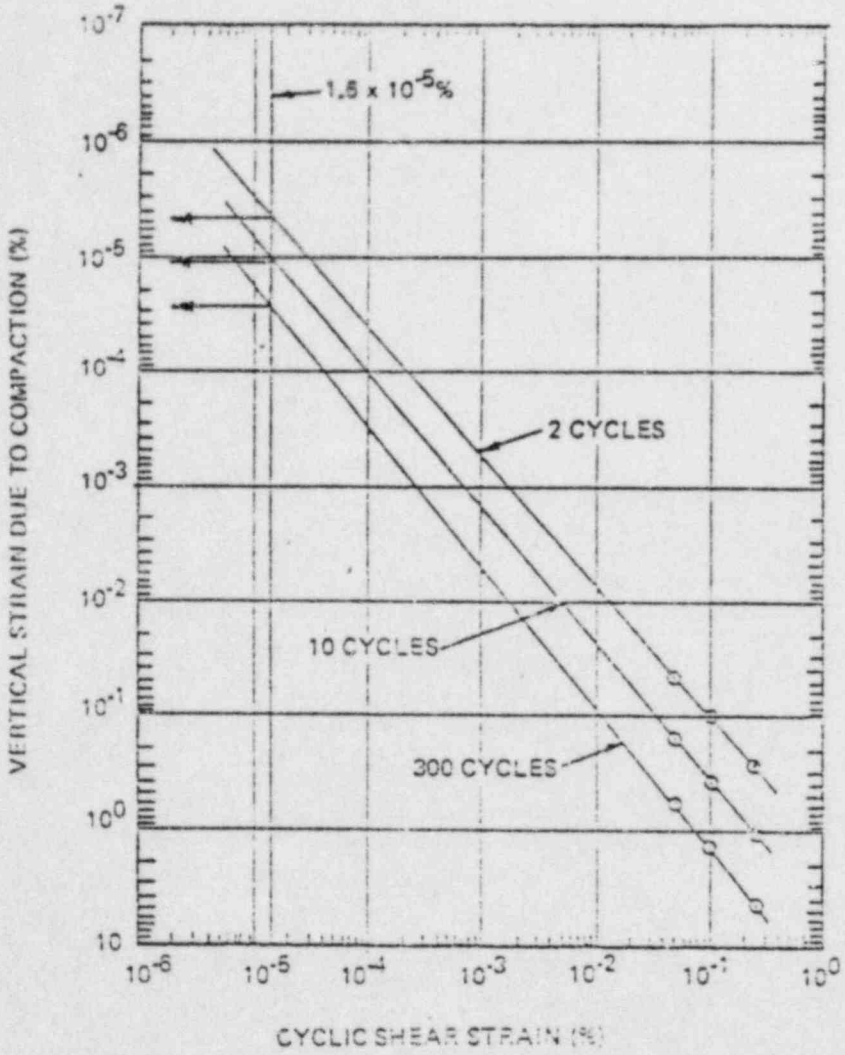


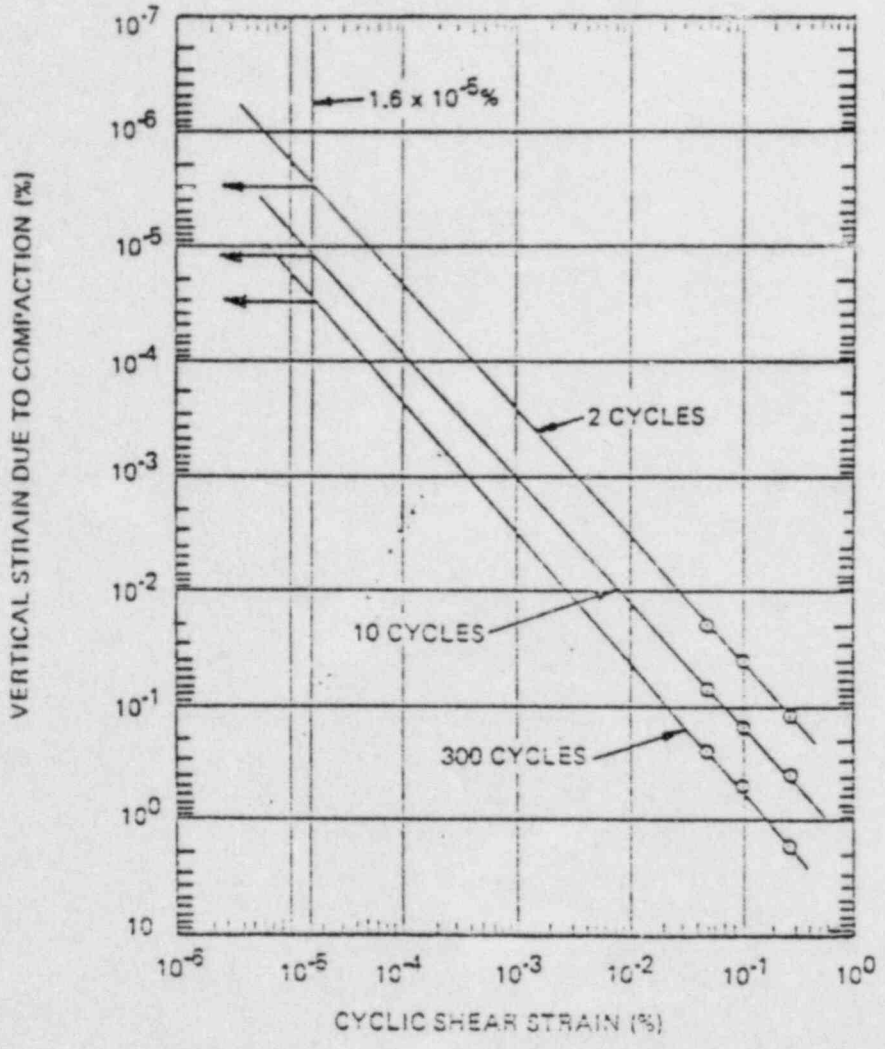
σ_v = 350 lb/ft^2

D_r = 45%

FIG. 1

VERTICAL STRAIN VS CYCLIC SHEAR STRAIN
(FROM SEED & SILVER, 1972)

SD0122.01



σ_v = 350 lb/ft^2

D_r = 60%

FIG. 2

VERTICAL STRAIN VS CYCLIC SHEAR STRAIN
(FROM SEED & SILVER, 1972)

8801210105

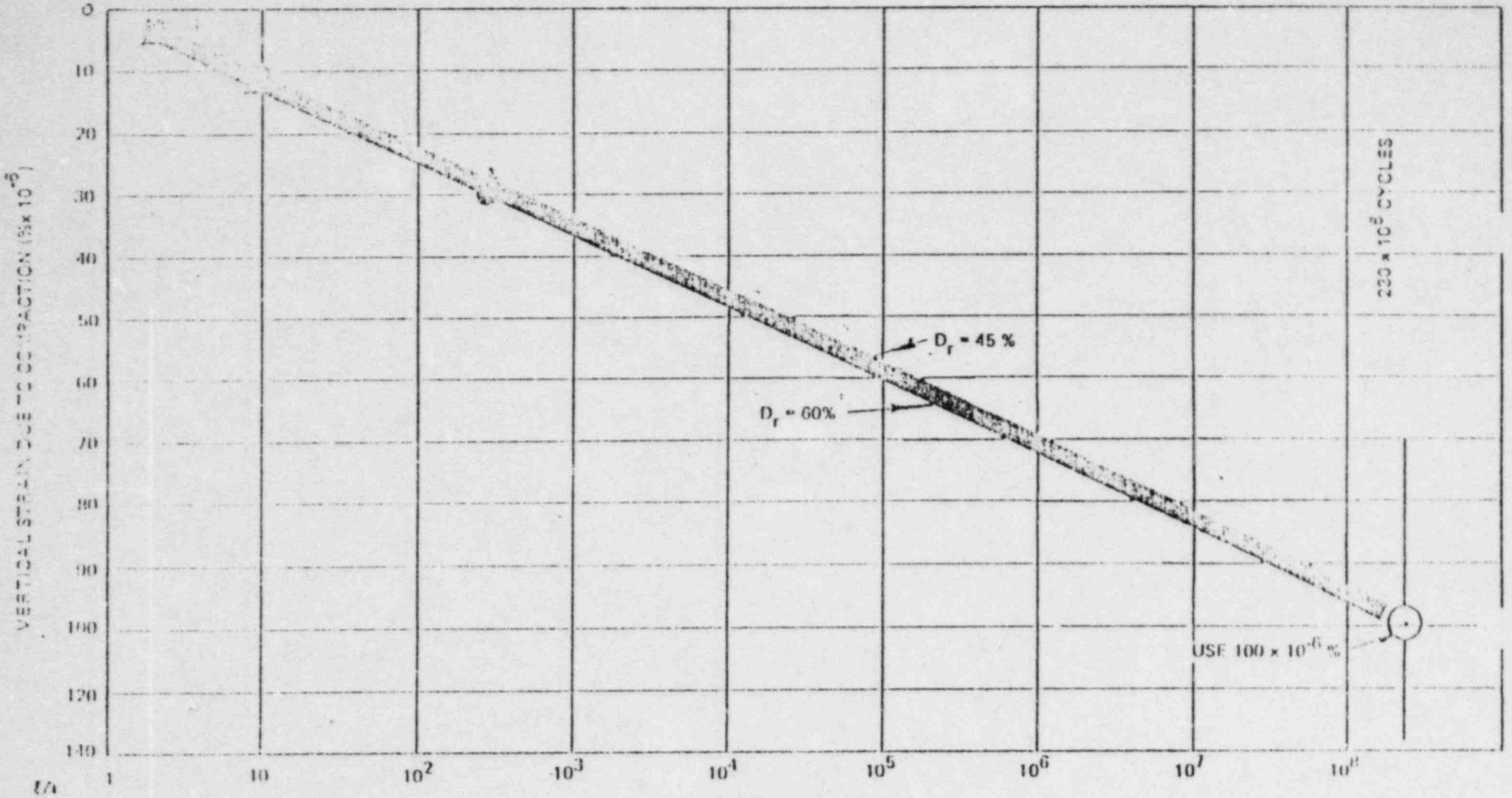


FIG. 3

VERTICAL STRAIN VS CYCLES OF SHEARING STRAIN

RICHARD D. WOODS
[illegible]
[illegible]
ANN ARBOR, MICHIGAN
48103
[illegible]

February 28, 1980

Dr. S.S. Afifi
Bechtel Incorporated
P.O. Box 1000
Ann Arbor, MI 48105

Dear Sherif,

Enclosed are five copies of my report on vibratory settlement of the Diesel-Generator Pedestals at the Midland Power Plant of the Consumer's Power Company.

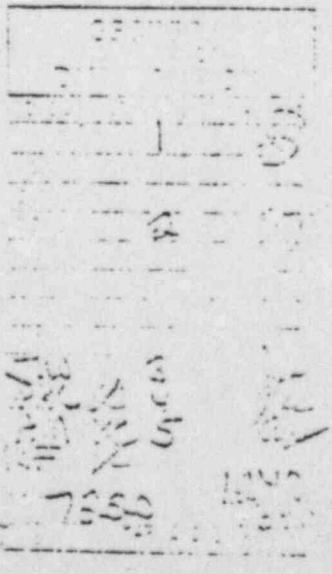
If you have any questions about this report, please contact me.

Sincerely,

Dick

Richard D. Woods, Ph.D., P.E.

5 encl.



VIBRATORY SETTLEMENT OF DIESEL PEDESTALS

for

Bechtel Corporation

Richard D. Woods

February 29, 1980

VIBRATORY SETTLEMENT OF DIESEL PEDESTALS

Diesel-Generator Vibrations and Soil Conditions

Computations by Bechtel personnel (Bandyopadhyaya, 1977) estimated the maximum vibration motion of the Diesel-Generator-Foundation system to be 0.00008 inch at an operating speed of 450 rpm. Increasing this displacement slightly to 0.0001 inch (peak), the maximum acceleration would be about 0.0006 g. The soil supporting the diesel-generator pedestal is assumed to consist of 30 feet of clean sand at a relative density (D_r) of 45%.

Settlement Analysis

Most efforts to estimate settlement of sand due to vibratory loads have dealt either with accelerations greater than 1 g as for vibratory compaction or with ground motions of large shearing strain amplitude as for earthquakes. Neither of these conditions prevail in the case of the diesel-generator pedestals.

Experience of the writer is that vibrations less than those which are perceptible by people* do not cause measureable settlement. At 450 rpm the level of vibration acceleration which is perceptible by people is about 0.001g. Therefore, it is noted that the estimated diesel-generator acceleration is less than this threashold and vibration induced settlement would be imperceptible.

However, in an attempt to quantify the magnitude of imperceptible settlement, the results of laboratory experiments by Seed & Silver (1972) were employed. The clean quartz sand in the Seed & Silver tests were subject to multiple repititions of shearing strains at an acceleration of 0.3 g. The sand was compacted to relative densities of 45% and 60% before starting the tests, and the vertical vibration compaction strain was measured for three magnitudes of cyclic shearing strain amplitude.

To apply the Seed & Silver results to the diesel pedestal settlement analysis, the cyclic shearing strain

*See Richart, Hall and Woods (1970)

SDC12199

in the sand supporting the pedestal was estimated as follows:

$$\gamma = \text{cyclic shearing strain amplitude} = \frac{A_{pp}}{V_s \times T_s}$$

in which

A_{pp} = peak to peak vibration amplitude (in)
V_s = shear wave velocity in soil (ft/sec)
T_s = period of pedestal vibration (sec)

therefore

$$\gamma = \frac{0.0002}{800 \times 12 \times 0.13} = 1.6 \times 10^{-7} \text{ or } 1.6 \times 10^{-5} \%$$

The Seed & Silver test results for relative density 45% and 60% were extrapolated to a shearing strain amplitude of 1.6×10^{-5}%, see Figs. 1 and 2. From these figures the vertical strains due to vibratory compaction were found for 2, 10 and 300 cycles of a shearing strain amplitude of 1.6×10^{-5}%. These vertical strains were then plotted on Fig. 3 and extrapolated to a number of cycles of shearing strain amplitude equivalent to one year of continuous operation of the diesel generators (450 rpm x 60 min/hr x 24 hr/da x 365 da) i.e. 230×10^6 cycles.

Using this approach, it was found that the vertical strain for a sand D_r of 60% was greater than that for D_r of 45% which does not agree with basic principles of soil mechanics. However, because considerable extrapolation was required to arrive at these vertical strains and because the magnitude of the vertical strain from this analysis was not greatly different for D_r=45% and D_r=60%, a single value of vertical strain equal to 10^{-4} % was selected as appropriate, see Fig. 3.

For the 30 feet thick sand stratum undergoing a vertical strain of 10^{-4}%, the settlement amounts to:

30 ft x 12 in/ft x 10^{-6} = 0.0036 inch.

This is clearly in the imperceptible range and confirms the writers previous experience.

Conclusions

Based on the preceding analysis, it is anticipated that the settlment of the diesel-generator pedestals due to self-excitation will be imperceptible. However, because of the approximate nature of this analysis, the simplifying assumptions that were used, and the variability of the soil supporting the diesel pedestals, a settlement of 1/4 inch should be expected.

References

Bechtel calculation No. 33,
Civil Structure, Midland Units 1 & 2, 7220
File no. 50850-50999, dated 5-13-77

Seed, H.B. and Silver, M.L. (1972), "Settlement of Dry Sands During Earthquakes," Journ. of Soil Mech and Found. Div., ASCE, Vol. 98, No. SM 4, April, pp. 381-397.

Richart, F.E., Jr., Hall, J.R., Jr., and Woods, R.D. (1970), Vibrations of Soils and Foundations, Prentice-Hall, Engelwood-Cliffs, N.J.

Analysis and Computations Checked by:

Larry P. Tefela, P.E. Date

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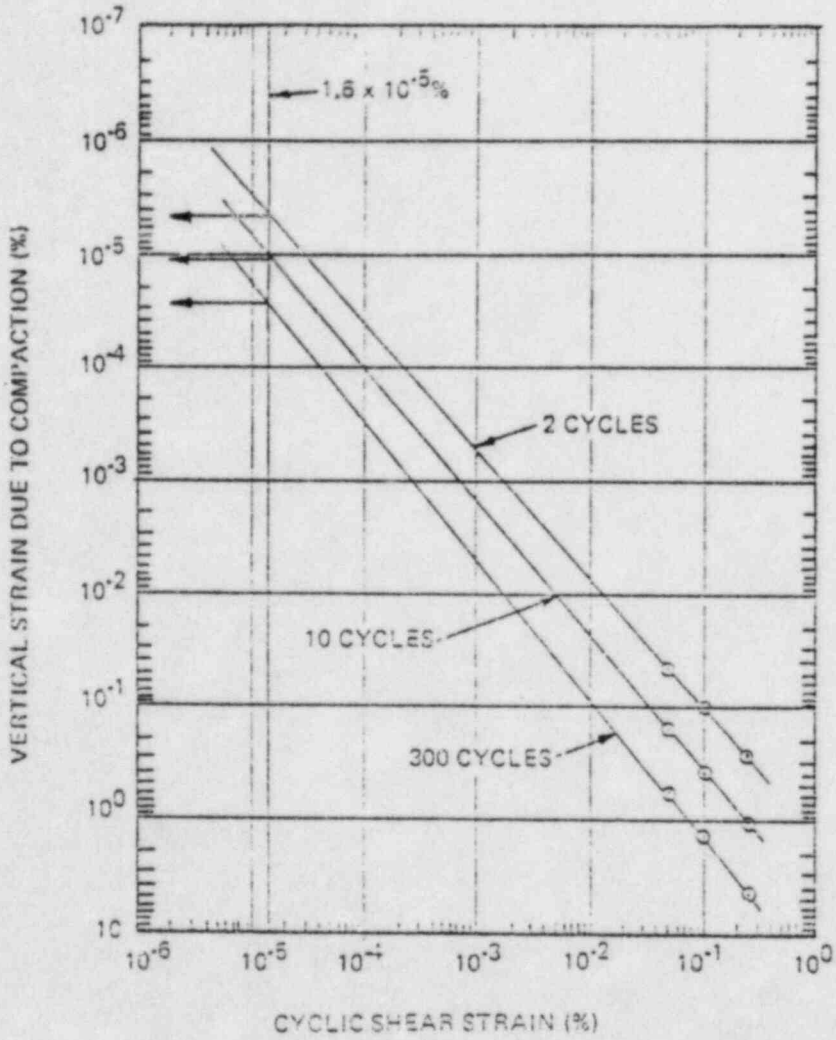

σ_v =350 lb/ft^2

D_r = 45%

FIG. 1

VERTICAL STRAIN VS CYCLIC SHEAR STRAIN
(FROM SEED & SILVER, 1972)

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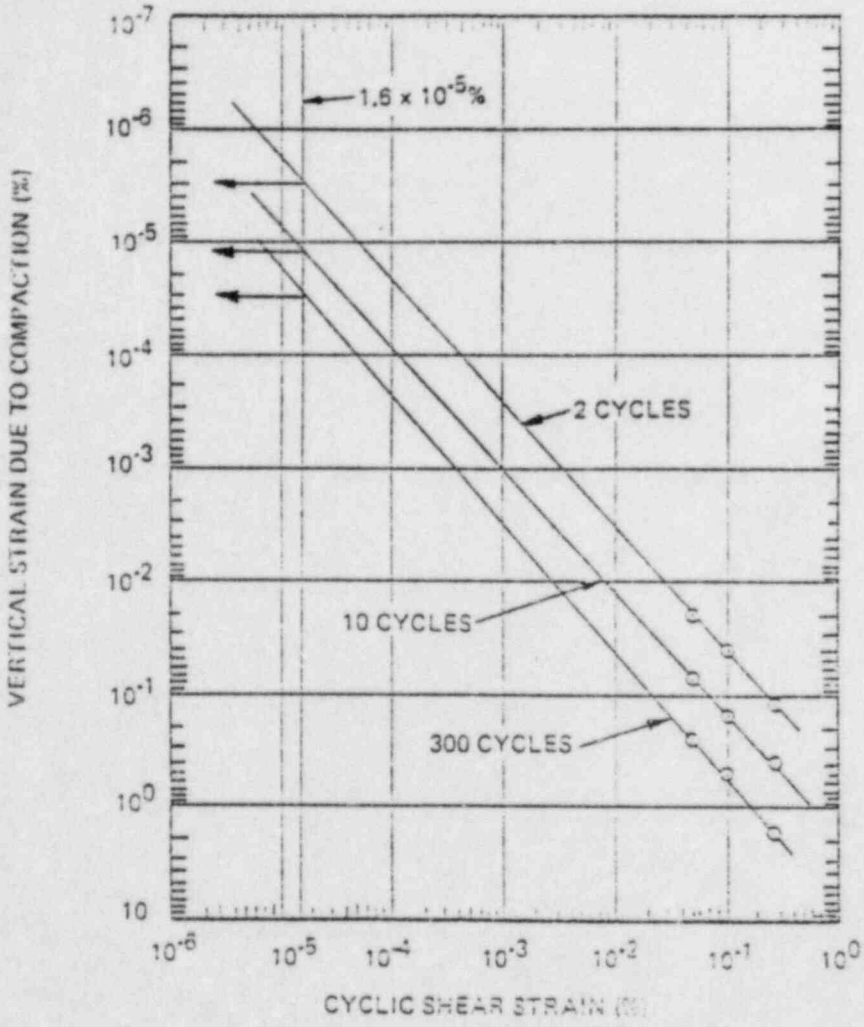

σ_v = 350 lb/ft^2

D_r = 60%

FIG. 2

VERTICAL STRAIN VS CYCLIC SHEAR STRAIN
(FROM SEED & SILVER, 1971)

SBE.2205

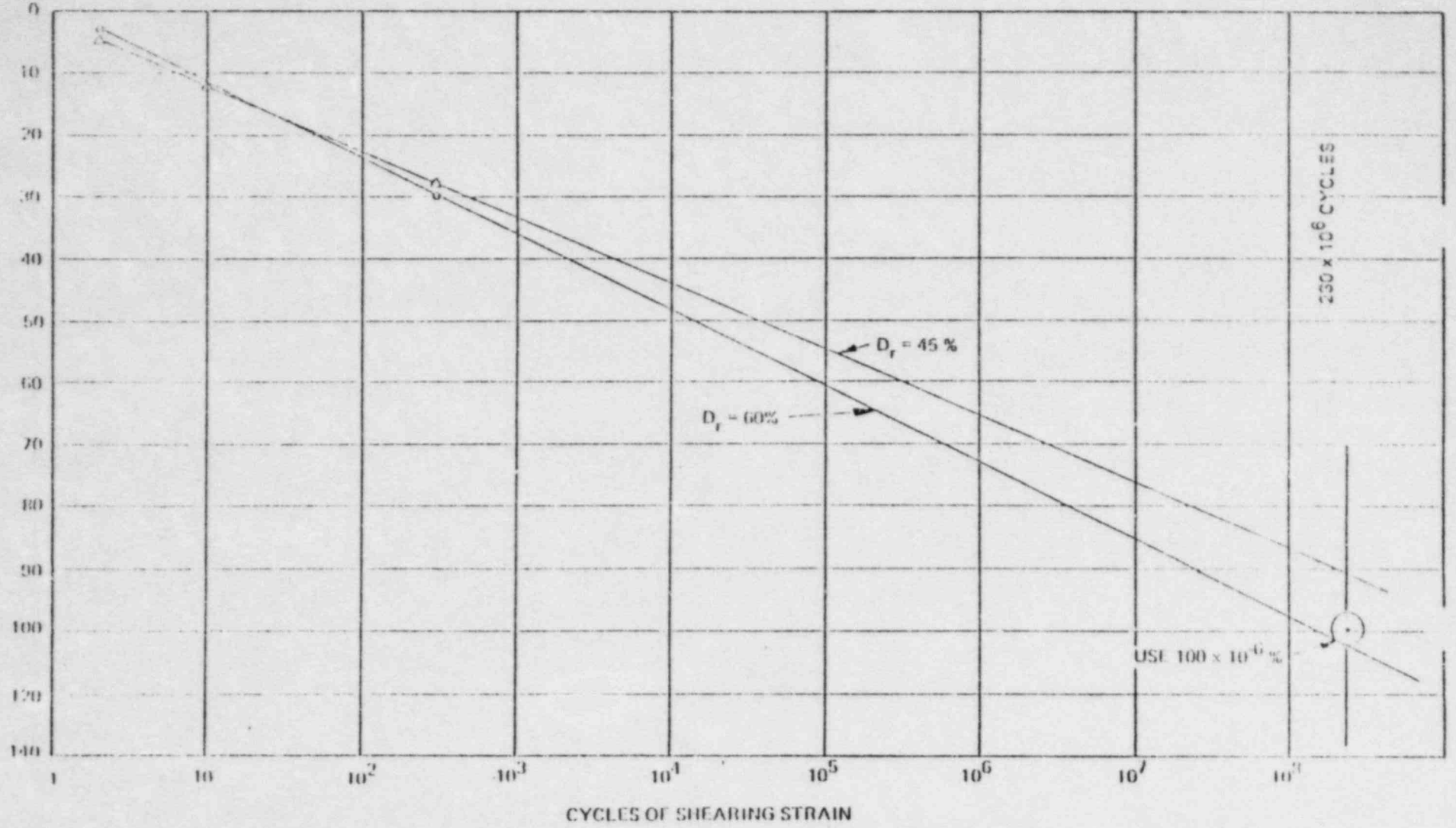

FIG. 3

VERTICAL STRAIN VS CYCLES OF SHEARING STRAIN

FORM S-6 100M

COPY

BECHTEL CORPORATION

bcc: T. Lynch w/att. ✓
W. Ferris w/att.
R. MacDonald w/att.

December 14, 1966

The Dow Chemical Company
256 Building
Midland, Michigan 48640

Attention: Mr. Robert E. Perry

Subject: Dow Chemical-Consumers Power
Energy Study
Bechtel Job 6397
Site Evaluation

Dear Bob:

Attached is an outline of our requirements for a preliminary soil mechanics site evaluation for the nuclear power study we are undertaking. This represents our minimum requirements for purposes of the feasibility study, to evaluate whether the foundation is adequate to support the loads and to determine the approximate magnitude of the settlements.

As Walter Ferris mentioned yesterday, we recommend that this investigation be carried out by Dames and Moore of 309 West Jackson Boulevard, Chicago, Illinois 60606. Mr. George Leal is the Supervising Partner there and he has told Walter that they would be able to undertake it.

I understand from Walter that you have no objection to this and that Dow would administer any contract. In order that there should be no delay in getting the work completed, could you please ask Dames and Moore to submit a proposal for the work. Their proposal should include an estimate of the total cost. Work of this type is commonly done on a time and materials basis and we would suggest that you ask Dames and Moore to submit an upper limit of cost which would not be exceeded without your prior approval.

In order to ensure that the work does not delay preparation of our report, we would require the Dames and Moore report to be submitted by not later than January 27, 1967.

Very truly yours,

J. H. Blasingame

WRF/mp
cc: R. C. Youngdahl, w/attach.
Consumers Power Co.

SB7C5095

Site Evaluation for
Dow Chemical Company and Consumers Power Company

An evaluation of a possible site near Midland, Michigan for a nuclear reactor and turbine installation is required for a feasibility study now being carried out by Bechtel Corporation, Power & Industrial Division, of San Francisco for Dow Chemical Company and Consumers Power Company. The work should consist of the following items:

Review of Regional and Areal Geology

This should be oriented towards evaluating the site with respect to its geologic characteristics including groundwater conditions, preconsolidation of soil strata or other factors that might influence the construction and performance of a nuclear facility at the proposed site.

Soil Explorations

This should consist of drilling two exploratory borings in soil at the locations of the reactor and turbine as shown on the attached sketch. At the reactor location the boring should be about 150 feet deep and at the turbine it should be about 60 feet deep. The overburden at the site consists mainly of glacial drift and it is reported that this contains some boulders. Undisturbed Shelby tube samples should be taken in clay strata and split spoon samples in sand strata. Drilling should be carried out with heavy rotary type drilling equipment capable of advancing to the required depth in glacial drift. The Dow Chemical Company can arrange necessary preparation for access to drilling locations and also for surveying the holes to determine location and elevation. The Dow Company will also allocate numbers to the holes. Field work should be under the direct supervision of a soil engineer.

Laboratory Testing

Moisture density tests should be made on all samples. In addition, a small number of Atterberg Limit and Gradation tests should be made on samples representative of the strata encountered. Consolidation and strength tests should be made on selected samples.

Site Evaluation Report

The site evaluation report should present preliminary data concerning sequence of strata, geology and groundwater. It should also present preliminary data pertaining to the foundation design of the proposed structures. These data should include an evaluation of the load bearing capacity of the

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foundation soils and suitable foundation types. It should also present preliminary data on settlements and differential settlements. To aid in this latter matter, it should be considered that the reactor containment structure is approximately 150 feet in diameter, loaded with a gross pressure of about 8 kips per square foot and with the foundation base at about 50 feet below plant grade. The turbine pedestal should be considered to be 40 feet wide and loaded with a gross pressure of about 3 kips per square foot and with its base about 20 feet below plant grade. Other structures would probably be on spread footings or mats at shallow depths. To protect the plant during flood stage in the river, about 25 feet of fill would have to be placed over the area. This will influence settlements and should be taken into consideration. The report should also present a discussion of construction operations. This would include construction of compacted fills, possible sources of suitable fill material, excavation and dewatering operations.

Because of the limited time available, the report should be completed not later than January 27, 1967.

SB7C5097

EDWARD C. EARLY — PRESIDENT
J. N. HARGRAVE-THOMAS — SUP. SOILS ENGR.
CARROLL O'KEEFE — SECRETARY

MICHIGAN DRILLING CO.
13911 PRAIRIE AVENUE
DETROIT 38, MICHIGAN
WEBSTER 3-8717

Job No. 57-147-A

The Dow Chemical Company
Midland, Michigan

May 3, 1957

Attention: Engineering Department
Mr. P.W. Millard

Subject: Soils Exploration
Proposed Sewer
Midland, Michigan

Bechtel Job 5005
For Ref. only

Gentlemen:

In accordance with the authorization contained in your Purchase Order No. 81677-X-FAE, we have made a soils exploration along the route of a proposed sewer at the Midland Plant of The Dow Chemical Company.

This consisted of five (5) soil test borings, four (4) of which were drilled to depths of twenty-five feet (25') each, and one (1) to a depth of thirty feet (30').

The results of this investigation, together with our recommendations, are to be found in the accompanying report.

Soil samples will be kept in our laboratory for a period of sixty days, they may be examined there, or will be sent to you, upon request.

Very truly yours,

MICHIGAN DRILLING COMPANY

JNHT/p

J.N. Hargrave-Thomas
J.N. Hargrave-Thomas

SB705101