Bechtel Associates Professional Corporation

Inter-office Memorandum

To T.E. Johnson

Date December 27, 1979

Subject Problem Alert
Large Settlements Due to
Incorrectly Placed Backfill

From E. Rumbaugh

Of Engineering

Copies to K. Wiedner
J. Milandin

At Ann Arbor

It appears that K. Buchert's TPO Problem Alert will delete a lot of the substance from your draft and may not fully cover us in future backfill operations.

I suggest that we do the following:

1. Try to get the TPO Standard Specs. revised to cover future work similar to your draft problem alert and appropriate new TPO Specs. issued (See Section V of your draft).

2. Use the TPO Problem Alert and your draft problem alert as commentary with the TPO Standard Spec. so anyone in this office will have benefit when using the TPO Specs. in the future.

SB 03501

E. Rumbaugh

ER/emp

CIVIL ENGINEERING - POWER

Tel me →
Talk
Maybe it's time for me to write Buchert me

Bechtel Power Corporation

Inter-office Memorandum

To E. A. Rumbaugh

Date November 28, 1979

Subject Problem Alert - Large Settlements Due to Incorrectly Placed Backfill

From J. Milandin

Of Quality Assurance

At Ann Arbor

Copies to

T. E. Johnson
G. A. Tuveson
S. I. Heisler
W. T. Kellermann
S. L. Blue

Lee
AAO. me

The subject Problem Alert was originated by Ted Johnson as a result of a meeting which we held on June 13, 1979. The Problem Alert was, in effect, issued to take advantage of the Midland problem by providing for certain revisions in our specifications and controls to preclude such a situation from recurring on another project. As you recall, I suggested the Problem Alert. Ted Johnson has been working very closely with me to insure that QA concerns were included. Ted issued the report to Ken Buchert on October 19 and received a reply, attached, from Ken Buchert, apparently incorrectly dated, on August 27, 1979.

Buchert's reply, in effect, deleted all the recommended corrective actions by the Ann Arbor Office and effectively stated corrective actions which are essentially the same as the present program. Without the AAO recommendations, the Problem Alert is truly incomplete. It will not prevent the problem from occurring again once this Problem Alert has been filed. The idea behind the recommended action of the Ann Arbor Office was to perserve these experiences by revising generic specifications and control procedures which govern the placement of backfill.

It is requested that you look into this matter to determine why the San Francisco Power Division Civil Structural Chief rejected the corrective actions proposed by the Ann Arbor Office. Each of those actions, which were proposed, were tied back to problems which were identified during the course of the investigation and were carefully developed to preclude the recurrence of such a situation in the future. Therefore, as the situation now stands, if the office follows through on the Buchert August 27 letter, new projects may fall into the same situation as Midland did when memories dim.

Please respond by 12/12/79. Please advise whether you consider this a matter to be handled by an MCAR.

J. Milandin

JM/le
JM-79-122
File: AAO-QAR-79-66

SB 03502

Inter-office Memorandum

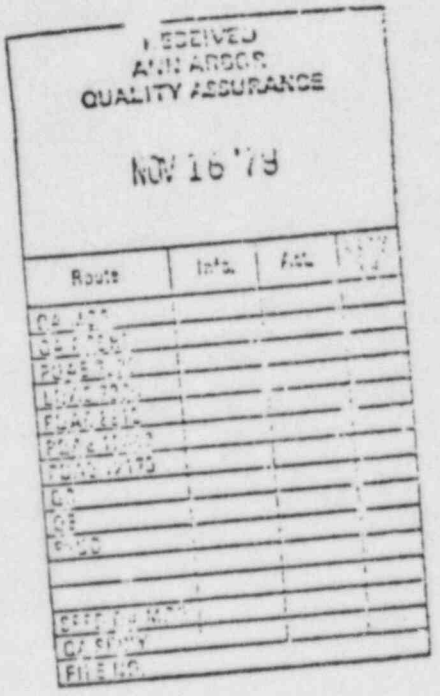
To	J. Milandin	Date	November 16, 1979
Subject	Problem Alert Large Settlements Due to Incorrectly Placed Backfill	From	T. E. Johnson
		Of	Civil/Structural
Copies to	File: 502	At	Ann Arbor Office

Attached for your information is a copy of the TPO response to the proposed problem alert on incorrectly placed backfill submitted for review by my IOM dated October 19, 1979.

G. Tuveson for
T. E. Johnson

TEJ/GT/wh

Attachment



SB 03503

Bechtel Power Corporation

Interoffice Memorandum

To: Distribution

Subject: Soil Fills, Bechtel Generic Position

File No. 2.0, 2.2

Date: August 27, 1979

From: K. P. Buchert

Of: SFPD - Civil/Structural

At: MET/34/B9 Ext. 0552

Copies to

The following Bechtel Generic Position on soil fills has been finalized after coordination between Engineering and Construction.

1. See that soil report, PSAR, and specifications are in agreement on all projects. Test fills will be used on all projects.

2. Assign a Soils Field Engineer in Construction (Bechtel Construction or on a Subcontractor's staff) to oversee fill operations. Testing will normally be done by a testing laboratory.

3. QC will be responsible for surveillance of the work done by the testing laboratory. This will be done if Bechtel does the work or a subcontractor does the work. This will be in addition to that done in item 2.

4. Construction will prepare an inspection plan and it will be reviewed by Project Engineering with consulting by the Civil Chief's staff and by H&CF. Acceptance and rejection limits will be specified.

5. H&CF soils representative will make periodic visits to the site to make an overall review of entire operation to determine if performance criteria are met.

Please proceed with implementation.

K. P. Buchert

KPB:slh

Distribution

A. J. Arnold (GPD)
A. L. Cahn
J. A. Dunlap
H. B. Friend
R. F. Gibson
D. W. Halligan
~~T. E. Johnson~~ (AAO)
R. J. Kosiba (LAPD)
M. J. Mitchell
J. N. Mulay (MOO)
K. Wagstaffe (HAO)
Civil Supvs.
W. R. Ferris (H&CF)
R. A. Schnaible (H&CF)

SB 03504

Bechtel Associates Professional Corporation

Inter-office Memorandum

To K. P. Buchert

Date October 19, 1979

Subject Problem Alert
Large Settlements Due to
Incorrectly Place Backfill

From T. E. Johnson

Of Civil/Structural

At Ann Arbor

Copies to File: 502
A. J. Arnold
P. A. Becnel
R. J. Kosiba
J. Milandin
K. Wagstaff

Attached for your review is a copy of the problem alert on incorrectly placed backfill which occurred at the Midland jobsite. I strongly urge you to issue this as a TPO problem alert.

A copy has been coordinated with P. Becnel of San Francisco Legal, and his comments have been incorporated in the attached draft of the problem alert.

T. E. Johnson

TEJ/js

Attachment

SB 03505

Bechtel Associates Professional Corporation

Inter-office Memorandum

To K. P. Buchert

Subject Problem Alert
Large Settlements Due to
Incorrectly Place Backfill

Copies to File: 502
A. J. Arnold
P. A. Becnel
R. J. Kosiba
J. Milandin
K. Wagstaff

Date October 19, 1979

From T. E. Johnson

Of Civil/Structural

At Ann Arbor

Ted - Sections I, II, III generally okay. Delete Sections IV, V, VI, VII. Add my memo.

Attached for your review is a copy of the problem alert on incorrectly placed backfill which occurred at the Midland jobsite. I strongly urge you to issue this as a TPO problem alert.

A copy has been coordinated with P. Becnel of San Francisco Legal, and his comments have been incorporated in the attached draft of the problem alert.

T. E. Johnson

NOV 13 1979

CIVIL ENGINEERING

FILE 502

TEJ/js

Copied for: ~~T. E. Johnson~~
A. J. Arnold
K. Wagstaffe
R. J. Kosiba
P. Becnel
R. F. Gibson
A. L. Cahn
J. N. Mulay

~~TED~~ Sections I, II, III generally okay. Delete Sections IV, V, VI, VII. Add my memo.

KPB

Ed Salinas, please prepare TPO Problem Alert.

KPB

11/9/79

SB 03506

DISTRIBUTION OF THIS PROBLEM ALERT OUTSIDE OF BECHTEL REQUIRES WRITTEN APPROVAL FROM DIVISION ENGINEERING MANAGEMENT. INFORMATION FROM IT MAY BE USED IN DEVELOPING APPROPRIATE NOTIFICATION OR RECOMMENDATIONS TO CLIENTS, BUT PRIVILEGED OR OTHERWISE SENSITIVE INFORMATION SHALL NOT BE EXTRACTED WITHOUT ABOVE APPROVAL.

Discipline: Civil Engineering Origin: Ann Arbor

Subject: Large Settlements Due to Incorrectly Placed Backfill

Discipline Problem Alert Number: _____

I. APPLICABILITY

These conditions are applicable to all projects where structures are supported fully or partially by compacted backfill material.

II. PROBLEM DESCRIPTION

Insufficiently compacted plant area backfill under the diesel generator building was discovered because of excessive settlement during construction. The settlement monitoring program, which is designed to detect such conditions, did alert the project to this problem. Further investigation by a soils boring program has indicated that both granular and cohesive soils were improperly compacted in other areas of plant fill as well as at the diesel generator building. This required extensive reanalysis and/or modifications of the diesel generator building, the service water structure, the feedwater isolation valve pits, and portions of the auxiliary building.

Based on a thorough investigation, the most probable causes for the resulting remedial work include the following.

A. All types of compaction equipment used for plant area backfill were not prequalified for lift thickness and number of passes. This was particularly true for the small hand-operated equipment. Except for the prequalified heavy earth-moving equipment used to construct the plant area dikes, reliance was placed on acceptance being established by end result ASTM acceptance tests.

B. A review of test results by the geotechnical soils group has shown that the testing laboratory failed to obtain meaningful and accurate results after performing the applicable ASTM acceptance tests. Some examples are the following.

1. More than one-half of the test results for relative density and percent compaction were outside the theoretical comparison limit.

2. Incorrect soil indentification and calculation errors were present.

3. Clearing of failed tests was improper or incomplete.

III. CORRECTIVE ACTION TAKEN WHERE PROBLEM OCCURRED

A. The structures are being modified to compensate for the in situ soil conditions using the following solutions:

1. Underpinning by the use of caissons or piles for portions of structures partially supported by fill

2. Reduction of residual settlement by surcharge loading the structure totally supported by fill

3. Elimination of the possibility of liquefaction of extensive sand backfill areas during a seismic event by installing a permanent dewatering system

B. The earthwork specification has been revised to provide more guidance to construction. The specification now requires compaction methods be established which include the number of passes for a given lift thickness for all approved equipment.

C. The quality control (QC) department has rewritten its inspection plans. Instead of essentially providing a surveillance program for the administrative aspects of the soils testing program, an inprocess, in-depth inspection program has been adopted. This program includes the verification of equipment qualifications for the placement methods adopted.

D. A resident geotechnical soils engineer has been assigned to the site to oversee the backfill operation.

E. The soils testing laboratory has been made aware of all testing discrepancies and has taken actions to prevent recurrence. Procedures to control testing activities are now being provided.

F. All of the construction equipment to be used for compacting the various types of soils at the site has been qualified to a maximum lift thickness with a specified number of passes.

IV. ACTION TO BE TAKEN BY BECHTEL PROJECTS

A. Each type of compaction equipment should be qualified at the jobsite for the respective type of soils to be compacted. This qualification includes lift thickness and number of passes, which adds a method criterion to the performance criteria for acceptance. However, the final acceptance criteria are still to be based on testing by the appropriate ASTM acceptance standard.

B. A project soil engineer and a field soil engineer should be assigned to each major project. The project soil engineer is assigned by the geotechnical services department and reports to the head of the soils group in the engineering office. The field soil engineer is on the project construction staff and reports directly to the construction superintendent. The field soil engineer will be hired by Bechtel construction or retained through a subcontract with an outside organization specializing in soil engineering. Project engineering and the geotechnical services group will review the qualifications of the candidate for field soil engineering and monitor the adequacy of his technical performance. The project specifications should clearly establish the responsibilities of the project and field soil engineers. As a minimum, the project and field soil engineers will have the following duties.

1. The project soil engineer's responsibilities will include, as a minimum, the coordination of all project soil engineering activities, the continuous review of soil-related construction activities, and the monitoring of the technical performance of the field soil engineer.

2. The field soil engineer's responsibilities will include, as a minimum, the monitoring of fill placement activities, soil testing laboratory activities, foundation excavations and pile or cassion foundation installations. In addition, he will coordinate all soil-related activities between project engineering/geotechnical services and construction, and forward progress reports to project engineering.

3. In the event the soils and foundation work becomes minor, project engineering/geotechnical services may agree that a full-time field soil engineer may not be needed. The project soil engineer will then assume the responsibilities of the field soil engineer.

C. Quality assurance manuals and vendor procedure manuals for the soils laboratory testing should be reviewed by geotech as well as project engineering.

D. A maximum limit of the number of times a proctor curve may be used as representative of the material being placed should be established. The procedures manual should be reviewed by geotechnical services as well as quality engineering to ensure that proper controls are outlined.

E. To minimize errors in testing, the soils testing laboratory should include the following practices in its testing procedures manual.

1. Cohesive Soils - The moisture content associated with a given field density cannot fall outside the zero air voids curve for the respective specific gravity.

2. Granular Soils - The stockpiled material should be tested for relative density by both the wet and dry methods as defined in the ASTM standards to ensure that the maximum relative density attainable will be used in placement.

F. Backfill Under Structures

1. To ensure that proper compaction is obtained, the frequency of plotting proctor curves or maximum/minimum density tests should be increased.

2. Consideration should also be given to performing static plate bearing tests as defined in the ASTM standards. The project or field soil engineer should have the option of requesting this type of test when appropriate.

V. ACTION TO BE TAKEN BY THE TPO CHIEF CIVIL/STRUCTURAL ENGINEER

A. TPO Specifications C-441 Rev 6 and C-442 Rev 0 which are the materials testing services specifications for both nuclear power plants and fossil fuel power plants are to be revised to eliminate the soil laboratory testing section.

B. New TPO soil laboratory testing specifications are to be issued by February 1, 1980. In addition to the information presently in TPO Specifications C-441 and C-442, these specifications should be expanded to include the following items:

1. Establish a limit on the number of times a proctor curve may be used as representative of the material being placed.

2. Require a check to ensure that for cohesive soils the moisture content associated with a given field density does not fall outside the zero air voids curve.

3. Require stockpiled granular soils should always be tested for relative density by both the wet and dry methods as defined in the ASTM standards.

4. Require procedures to control testing methods.

C. Reevaluate and revise as necessary the soils sections of the following TPO Specifications by February 1, 1980.

C-033 Rev 1	Site Grading
C-052 Rev 0	Pressure Water Piping, Furnishing and Installing
C-053.2 Rev 1	Furnish and Installing Yard Fire Protection System
C-054 Rev 0	Storm Sewer, Furnishing and Installing
C056.1 Rev 1	Furnishing and Installing Culverts
C-058 Rev 2	Constructing a Sanitary Sewer
C-062.1 Rev 0	Circulating Water Pipe Installation (Steel)
C-062.2 Rev 0	Circulating Water Pipe Installation (Concrete)
C-314 Rev 0	Circulating Water Pipe Installation (Fiberglass)
C-234 Rev 2	Structural Excavation and Earthwork Construction

VI. FURTHER INFORMATION

For further information contact G. Tuveson, Ann Arbor office, (313) 994-7727.

VII. FURTHER COORDINATION

Reevaluation and modifications of the TPO specifications should be coordinated with the geotechnical services department of the H&CF division.

10/17/25

SB 03511

Midland

1. Question: With available information, provide the best estimate of the type and quantity of fill (i.e., lean concrete, sand, or clay) within the limits of E075 to E430 and S5225 to S5036. Also, provide plan and cross section sketch of such information.

Response: The engineering protrayal provided in the early cross section developed by Engineering provides the information requested above to the same level of accuracy which the field would provide if we were to generate a similar drawing. The only exception to the forgoing is the case of lean concrete where we note (via a review of personal records) that the attached amounts of lean concrete were placed.

SB 17596

DATE	LOCATION OF FILL	ELEV.	CUBIC YARDS
12/20/78	D/G BACKFILL @ DUCTBANK STUB BAY #4	628'	2
12/15/78	" " " " " "	"	3
12/13/78	D/G BACKFILL @ DUCTBANK STUBS BAYS 1, 2, & 3	628'	38
12/12/78	D/G BACKFILL @ DUCTBANK STUB BAY #4	628'	10
8/18/78	DUCTBANK MUDMAT S/E D/G	627'	2
8/17/78	DUCTBANK MUDMAT SE D/G	627'	12
8/7/78	DUCTBANK MUDMAT RUNS E-W S/W D/G	627'	29
8/1/78	" " S. D/G	627'	5
7/31/78	DUCTBANK MUDMAT RUNS E-W S/ D/G	627	11
7/14/78	MUDMAT S D/G	"	6
7/7/78	DUCTBANK MUDMAT SE D/G.	627	3
7/5/78	DUCTBANK MUDMAT SE D/G	627	26
4/18/78	DUCTBANK MUDMAT E D/G BLDG	630	1
4/14/78	SEWER ENCASEMENT SW D/G	-	9
12/20/77	BACKFILL BAY #2 @ SE	628	5
11/25/77	MUDMAT @ D/G		42
11/15/77	MUDMAT @ D/G		144
10/19/77	MUDMAT SE D/G FTGS		113
9/7/77	DUCTBANK MUDMAT @ D/G		18
8/18/77	MUDMAT @ D/G		57
6/10/76	BACKFILL @ S. T/B #1 (4.5-5.5 LINE)	603	16
			552

For Kane

MIDLAND SOILS

CHRONOLOGY AND SUMMARY

Soils placement on the Midland job is broken down between cooling pond dike construction and plant fill. This write-up will address the soils placement history for both areas, however, greater detail will be provided for the plant fill as that is the area where significant soils problems have been encountered.

A subcontractor (Cannonie, Inc.) constructed the dikes during the period of 1969-1950 and 1973-77. The original contract was let to Cannonie in 1968. The dike design is basically a clay berm with a sand core. The dike was designed to be constructed from on-site clay materials and imported sand. Shortly after work started, it was discovered that sufficient specified clay materials were not available on site. In response, Project Engineering revised the specification to allow greater fines (i.e., delete the requirement that not more than 60% pass the No. 200 sieve). Work continued and the emergency cooling water pond was essentially completed and some dike work completed prior to subcontract closeout in 1969. This subcontract closure was a part of project shutdown due to licensing problems.

The subcontract was rebid in 1973 upon project reactivation and was again awarded to Cannonie. The previous specification change on increased fines was omitted from the new subcontract specification and had to be added after award.

Cannonie continuously complained about the lack of "good soil" to build

haul roads. Even when well compacted by heavy earth moving equipment, the roads turned to quagmires when heavy rains fell. Cannonie also experienced continual problems with moisture control in the borrow and fill areas. In 1975 a contract change was negotiated for over $1,000,000 to compensate Cannonie for changed conditions.

Cannonie completed the pond dikes, the plant area dikes and the north plant fill during the 1973, 1974, 1975 (part thereof) and 1976 seasons. In 1977 Cannonie returned to the site to complete site fill south of the power block, part of which had been completed by Bechtel.

The specification for the dike construction required the use of mechanized equipment for fill placement and compaction. It also required this equipment and the maximum lift thicknesses for which the material was to be placed to be qualified. These qualification tests were run and documented.

In process acceptance of fill placement was based on the number of passes of the equipment, the minimum number to achieve compaction being determined in the aforementioned tests. Final acceptance of the clay fill was based on in place density and moisture tests taken within specified frequencies.

Cannonie's Quality Assurance program included an on site quality control engineer to provide a continuous overview and inspection of their work. His duties included verification of proper equipment selection and performance, material lift thickness, number of roller passes and maintenance of quality related documentation. The Bechtel Subcontracts

Group administered the subcontract for Bechtel while the Bechtel Quality Control Department provided a surveillance inspection over Cannonie's Q-listed work for the period of 1974 thru 1978. Bechtel's Geo-Technical Group provided an overview of Cannonie's work by a series of periodic site visits. These site visits were most frequent in the 1973-1974 work period. Bechtel's Quality Control Department was responsible for reviewing the in place moisture and density tests for final acceptance of dike material. There were Bechtel and Cannonie generated nonconformances over the dike work. These nonconformances have been resolved owing in part to borings taken to qualify questionable materials.

Plant area fill (which is essentially complete) has been placed by both a subcontractor (Cannonie, Inc.) and Bechtel. Cannonie's work was limited to placement of large, open plant fill areas with mechanical equipment, while Bechtel generally placed smaller areas inaccessible to mechanized equipment with "hands on" compactors. Bechtel has, however, placed some areas of plant fill with mechanized equipment. Placement of plant fill has extended from 1974 to present.

There are some noteworthy differences between the dike work and plant fill which should be examined. First, the Project Engineering call out for plant fill, including that under Q-listed structures on fill, consisted of random fill. Random fill, by definition, could consist of any site materials which were free of humus, organics, or other deleterious material that could be compacted to meet specification requirements. Concrete could be and was utilized as a random fill material at the

discretion of the field engineer. There were no specification directions prohibiting or specifying the use of different types of random fill materials in a common area. Layering of different random fill materials was allowed. Secondly, the acceptance of plant fill has been based upon meeting the specification compaction requirements as determined by taking tests within specified frequencies as opposed to a number of equipment passes. The specification did specify maximum lift thicknesses (12" for clay and sand) and required that qualification tests be run to verify that the compaction requirements could be met. Oualification tests were run, albeit, as production tests on fill placements.

The Project Engineering documents for compaction of clay materials used for plant fill have been contradictory in the past. The Dames and Moore soil report, which was a part of the PSAR, specified a compactive effort to yield 95% of the maximum density by ASTM 1557 Method D. The "Placement" section of the projection specification indicated that the material should be placed to meet the aforementioned criteria, however, the "Testing" section of the same specification called for the material to be tested to 95% of maximum density by the Bechtel Modified Proctor (BMP) (95% maximum density by the BMP is equivalent to approximately 90% maximum density by ASTM 1557 Method D). The project specification for the on site materials testing subcontractor (U. S. Testing, Inc.) also specified that the clay material be tested to 95% of maximum density by the BMP. Field Engineering questioned Project Engineering on this contradiction and were advised that 95% of maximum density by the BMP was to be used. Geo-Tech maintains that Project Engineering was in error in their position;

specifically, 95% of maximum density by ASTM 1557 Method D has always been and is still required. Project Engineering did revise the affected specifications recently to require 95% of maximum density by ASTM 1557 Method D, however, the field has only been able to qualify a single piece of hand held compaction equipment ("jumping jack") at a 4 inch lift thickness. All other hand held equipment has failed at the 4 inch lift thickness. Attempted qualification of a 25,000 pound dynamic force sheeps foot roller at an 8 inch lift thickness has also failed. It would appear from these qualification tests, that the on site clay material is suitable for dike construction using large equipment but is not suited for use as plant fill in the power block area where the work areas are small and generally inaccessible to mechanized equipment.

As stated previously, an overview of dike construction was provided by Geo-Tech (most notably) in the 1973-1974 period. The Dames and Moore soil report and a Project Engineering internal design criteria procedure required that all soils work on the Midland project including testing be performed under the continuous direction of a qualified soils engineer. Neither of these documents defined a qualified soils engineer nor did the project specification require the presence of this individual. (The field found out about this requirement during the NRC investigation of the "soils problem". Geo-Tech did not provide an overview on past soil placements for plant fill. The project specification has, however, been changed recently to require an on site Geotechnical Soils Engineer to provide technical direction over soils placement. Geo-Tech was not able to provide this individual so Construction retained the services of an individual with a masters degree in civil engineering (soils) and 3 years

consulting experience. This person was deemed to meet the requirements of being a qualified soils engineer.

All soils testing on the project has been performed by a subcontractor (U.S. Testing, Inc.). Their responsibilities include taking tests in accordance with ASTM Standards at locations specified by Bechtel or Cannonie, While not explicitly stated in their contract, in the past U. S. Testing also accepted the job of soils classification to facilitate testing. This has been changed in that the specification now requires U.S. Testing to run a proctor for each clay test and a relative density for each sand test.

Soils placement by Bechtel has been done in the past under the technical direction of Bechtel field engineers assigned to specific plant areas i. e., yard facilities, Auxiliary Building, etc. There was not a designated soils field engineer on the jobsite. Because they were assigned responsibilities in addition to soils placement (i. e., rebar and formwork inspection, material requisitioning, etc.) the field engineers were not always physically present during the fill placement. Labor forement were utilized to help call of soils tests under the direction of the field engineer. Technical acceptance of plant fill was based on satisfactory test results. As stated previously, the specification now requires that all fill be placed under the continuous direction of the on site Geotechnical Soils Engineer.

His responsibilities include in part:

1. Approval of all subgrade preparations.

2. Suitability of materials used for random fill.
3. Approving the use of different random fill materials in layers and zones so that the structural integrity of buried utilities and supported structures is not jeopardized.
4. Selection of lift thicknesses for the equipment used for compaction.
5. Maintaining moisture control during the placement.
6. Proper performance and application of compacting equipment. This includes speed, frequency, number of passes, proper overlap, and lift thickness.
7. Calling for soil tests within the required specification frequencies.
8. Reviewing the acceptability of all soil test reports.

Bechtel Field Quality Control Engineers performed surveillance inspection of Cannonie's placement of Q-listed plant fill. They also provided surveillance over Q-listed plant fill placed by Bechtel. In general, this meant that two to three times a day the Q. C. field engineer observed the fill placement and testing operations. Full time inspection was not implemented. Quality Control has now revised its inspection program to provide field and laboratory Q. C. Engineers to provide continuous surveillance over the placement and testing activities.

The settlement of the Diesel Generator Building was noted during routine construction survey work. Settlement markers were assigned and an extensive soil boring program was undertaken to ascertain the extent of the problem.

The results of the boring program which are included in MCAR 24 show material with highly variable properties in the first 15 feet under the structure. This fill which consists essentially of sand over the northern half of the building and clay over the southern half, was placed by Bechtel in 1977.

As a result of the problems with the Diesel Generator Building an extensive settlement monitoring and soil boring program was undertaken for the balance of the plant. This program included borings taken through building base slabs. The results of this investigation are included in MCAR 24. As a general rule, in those instances where "soft" fill was encountered the fill was placed by Bechtel using hand held equipment. It has been determined that remedial actions will be required to correct the discrepant soils conditions. The most noteworthy is a plan to provide a permanent plant dewatering system for the power block. It is felt that a draw down of the water table will eliminate the potential for liquefaction of sand fill under a seismic event. A summary of other remedial actions is provided below.

Structure	Proposed Remedial Action
Diesel Generator Building	Surcharge Program (In progress since 4/79)
Unit #1 Main Transformer Area	Surcharge program (In progress since 6/79)
Condensate Tank Area	Provide flexible pipe connections to tanks to accommodate anticipated settlement

Structure	Proposed Remedial Action
Service Water Structure (North Corner)	Piles and pile cap to provide vertical support
Diesel Generator Fuel Storage Tanks	Proof Load by filling with water (In progress since 3/79)
Borated Water Storage Tanks	Proof load by filling with water
Auxiliary Building Train Bay	None
Units 1 & 2 Feedwater Isolation Valve Pits	Remove and replace defective soil. Will require local dewatering
Units 1 & 2 Electrical Penetration Rooms	Remove and replace part or all of the defective material. Will require local dewatering and temporary underpinning

The above actions are described in more detail in Bechtel's response to the NRC's 50.54 (f) request for information.

As investigation into the soil problems on the Midland jobsite continues certain conclusions are being reached by individuals as to the probable cause. No single root cause has been identified; the general consensus is that several items combined to produce the problem. The items most prominently suggested are summarized below with the field's comments on them.

Item 1 - Far too great a reliance was placed on testing for acceptance of the fill. When combined with questionable test results (as observed by a detailed review of U. S. Testing operations and some 6,000 soil test reports) this could produce placements not meeting specification requirements without raising questions.

Field Comment - The acceptance of plant fill was based on acceptance of in place density tests by Project Engineering specification direction. All parties (Bechtel Field, Q. C. and Project Engineering and CPCO) participated in the selection of U. S. Testing as the on site testing laboratory and the eventual monitoring of their activities. No adverse trends were uncovered in audits of their soil testing activities.

Item 2 - The lift thicknesses at which the fill was placed were excessive. The required compaction could not be achieved using these thicknesses and the equipment that was used.

Field Comment - The lift thicknesses used were within the specification limits and were qualified by in place density production tests.

Item 3 - A "qualified" soils engineer was not on site to provide continuous technical direction over plant fill placement and associated testing. This individual would have identified that the testing was questionable and the lift thicknesses excessive.

Field Comment - Project Engineering's failure to include this requirement in the project specifications and Geo-Tech's failure to provide an overview of plant fill have been identified earlier in this report. The current On Site Geotechnical Soils Engineer who fills this requirement has a Masters Degree in Civil

Engineering (soils) and 3 years consulting experience. Without being specifically directed, the field would not have been expected to use someone with these qualifications as the field engineer assigned to soils placement.

Item 4 - If test pads had been run on the material for varying lift thicknesses, moisture content and equipment use, the field would have known that their placement techniques were improper.

Field Comment - This seems unlikely since the qualification tests were run and accepted, albeit, as part of production tests.

Item 5 - There was insufficient inspection of the fill placement and too much responsiblity and reliability was placed on the foreman of the soils crew.

Field Comment - The quality of soils placement, or any other activity, is not achieved by inspection. The techniques used by craftsmen, field engineers and supervision were the equivalent of those used previously and appeared to achieve satisfactory results when checked in accordance with specification requirements. (Note that specification relies on testing for acceptance.)

Item 6 - The nuclear densiometer (Troxler device) can give erroneously high moisture contents. This can lead to erroneous conclusions about compaction of clay soils.

Field Comment - It appears that this is a true statement. Although initial correlations with traditional techniques for moisture content determination were utilized to approve the use of the Troxler device, subsequent correlation checks were not made. Use of the Troxler device has been discontinued.

Item 7 - If clay is under compacted and is on the dry side of the optimum moisture content, the uncompacted clay lumps may soften when saturated by groundwater.

Field Comment - This appears logical, however, it is difficult to assess the actual moisture content at the time of placement in light of the reliability of the Troxler device.

Item 8 - Quality Assurance problems with reinforcing steel in the 1975-1977 time period detracted from the effort required to ensure a proper program for plant fill soils placement.

Field Comment - This is a highly subjective comment and if applicable was not a major cause. It could have been contributory, however, as rebar did take top civil priority during this time period.

General Field Comment - It appears that no one item will be traced which caused the "soil problem," however a series of probable causes could be put together as follows:

1. Site fill is designed as a "saturated area (il e., the impervious dike follows the site perimeter allowing free flow of cooling pond water into the site fill).

2. Random fill is specified for the plant fill which allows significant use of sand (around pipe, duct runs, buildings, general backfill, etc.) and concrete. The sand provides flow paths for water as do the interfaces between the various fill types (concrete/sand, concrete/clay, sand/clay).

3. Decrease in compaction requirements from 95% ASTM 1557-D to 95% BMP (about 90% ASTM 1557-D).

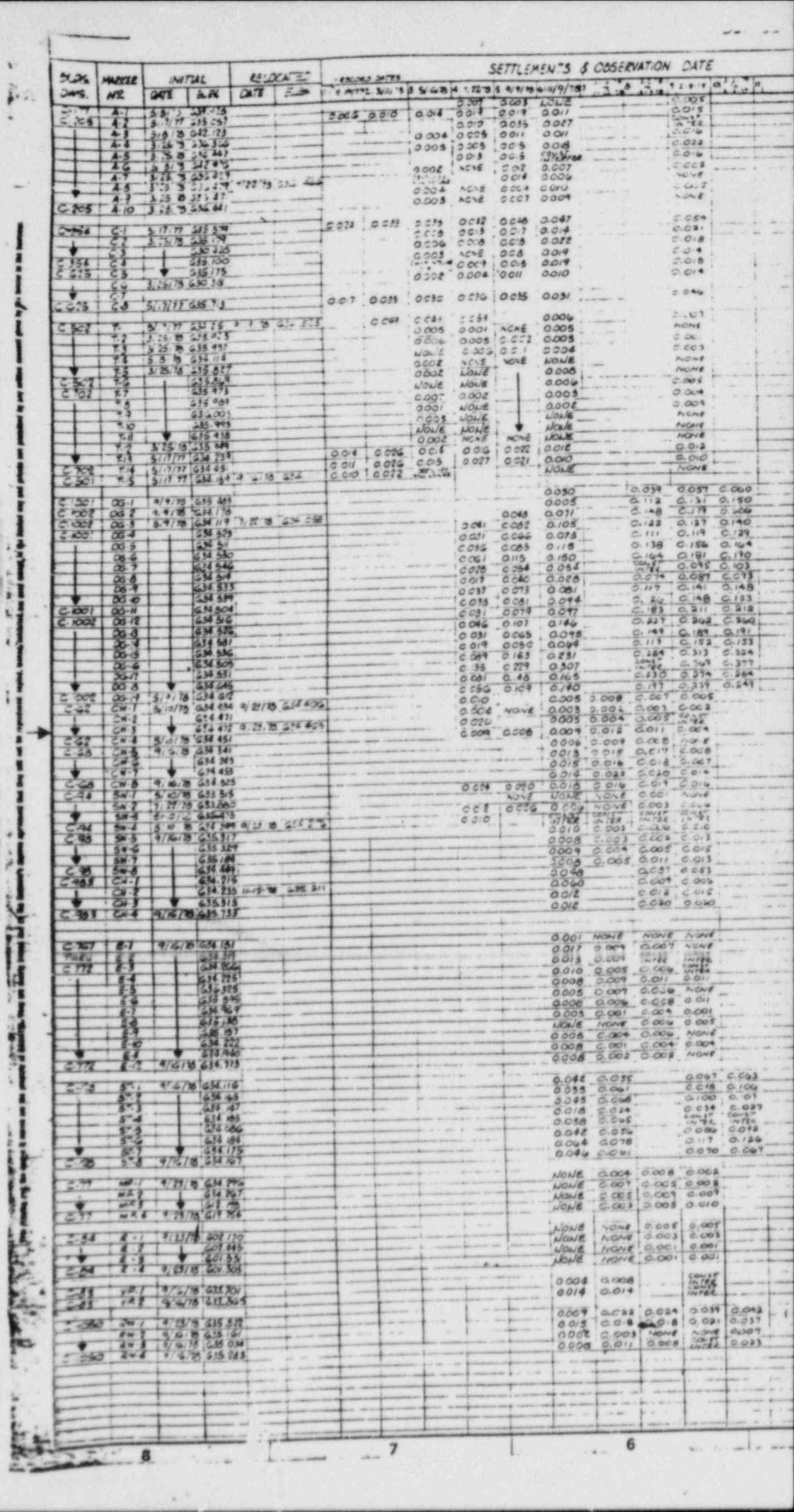
4. Design material was not available on site and a material containing significantly more fines was substituted. The substitute material was much more difficult to handle, particularly in terms of moisture control. Small, hand held equipment may not have been able to properly compact even though tests were OK. Also, this material was subject to "pumping" and breakdown when exposed to water flow, perhaps as seen at soil type boundaries.

5. Soils testing apparently gave erroneous results both from the point of Troxler use and generally poor testing results and errors.

6. Inadequate Non-Manual control of the placement process to assimilate the various deviations from ideal and recognize the potential problem. This would include Field

Engineering Supervision and Field Quality Control, Quality Assurance, Project Engineering and Geo Tech were also contributory.

* Note as of 8-24-79 it has become necessary to abandon efforts to compact random fill to 95% ASTM 1557-D as we have not been able to consistently achieve such compaction with any hand held or motorized equipment (except jumping jacks inventoried earlier) available to the field.



BLDG DWG	MARKER NR.	INITIAL DATE	INITIAL EL.EV.	RELOCATED DATE	RELOCATED EL.EV.	SETTLEMENTS & OBSERVATION DATE
C-33	33-1	9/16/78	634.737			
	33-2		634.689			
	33-3		634.683			
C-33	33-4		634.1164			
C-34	34-5		633.021			
	34-6		634.42			
	34-7		633.026			
C-34	34-8	9/16/78	634.58			
C-34E	AD-1	9/6/78	634.278			
	AD-2		634.037			
	AD-3		633.527			
C-34E	AD-4	9/6/78	634.268			
C-27	TF-1	9/21/78	634.716			
	TF-2	9/21/78	634.666			
	TF-3					
	TF-4	11-6-78	634.648			
	TF-5	11-6-78	634.700			
	TF-6					
	TF-7	9/21/78	634.728			
	TF-8	9/21/78	634.725			
	TF-9	9/16/78	634.715			
	TF-10	11-6-78	634.561			
	TF-11	11-6-78	634.646			
	TF-12	11-6-78	634.550			
	TF-13	9/16/78	634.860			
	TF-14		634.931			
	TF-15		634.764			
	TF-16	9/16/78	634.811			
	TF-17					
C-27	TF-18	9/16/78	634.036			
C-21	XR-1	9/16/78	634.751			
	XR-2		634.668			
	XR-3		634.016			
	XR-4		634.155			
	XR-5		634-870			
	XR-6		634-892			
	XR-7		634.291			
	XR-8		634.211			
	XR-9		634.219			
	XR-10		634.276			
	XR-11		634.190			
	XR-12		634.118			
	XR-13		634.347			
	XR-14		634.217			
	XR-15		634.154			
	XR-16		634.193			
	XR-17		634.175			
	XR-18		634.231			
	XR-19		634.207			
	XR-20		634.237			
	XR-21		634.732			
	XR-22		634.91			
	XR-23		634.56			
C-21	XR-24	9/16/78	634.117			
C-36	CT-1	11-3-78	635.928			
	CT-2		635.906			
	CT-3		635.487			
	CT-4		635.118			
	CT-5	11-3-78	635.894			
C-36	CT-6					
C-78I	DT-1	11-3-78	634.730			
	DT-2		634.588			
	DT-3		634.464			
C-78I	DT-4	11-3-78	634.618			
C-100E	DQ-21	11-3-78	636.415			
C-100I	DQ-21		636.466			
	DQ-22		636.393			
	DQ-23		636.580			
	DQ-24		636.446			
C-100I	DQ-25		636.913			
C-100E	DQ-26		636.908			
	DQ-27		637.046			
	DQ-28		636.795			
C-100E	DQ-29	11-3-78	637.834			

NOTES

1. FOR GENERAL NOTES SEE [illegible]
2. FOR THE SETTLEMENT RECORD OF THE DIESEL GENERATOR BUILDING PRIOR TO THE INSTALLATION OF MARKERS 1 THROUGH 29, SEE FIG. 13 AND FIG. 14.
3. FIGURE 2 HAS BEEN UPDATED TO REFLECT CORRECTED READINGS AS OF 2-2-79.

MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

SETTLEMENT RECORD TABLE

FIGURE 2

SEC 4.5

TIME / RATE, SETTLEMENT OF DIESEL GENERATOR PEDESTA

DATES OF SETTLEMENT READINGS

SETTLEMENT IN INCHES

0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0

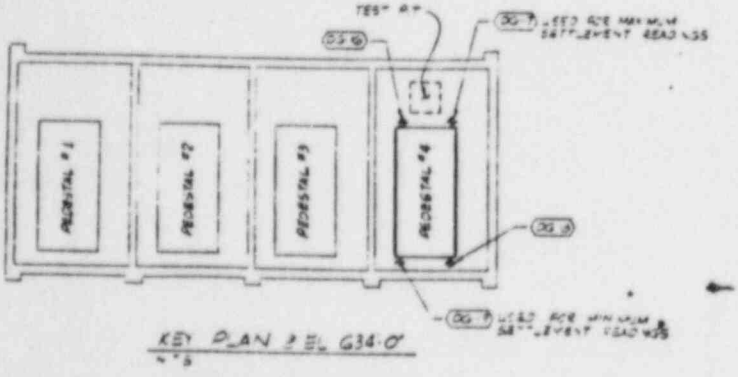
MINIMUM SETTLEMENT (DG 9)

AVERAGE SETTLEMENT

MAXIMUM SETTLEMENT (DG 17)

"TEST" D.F. DG
9.29.78

NORTH



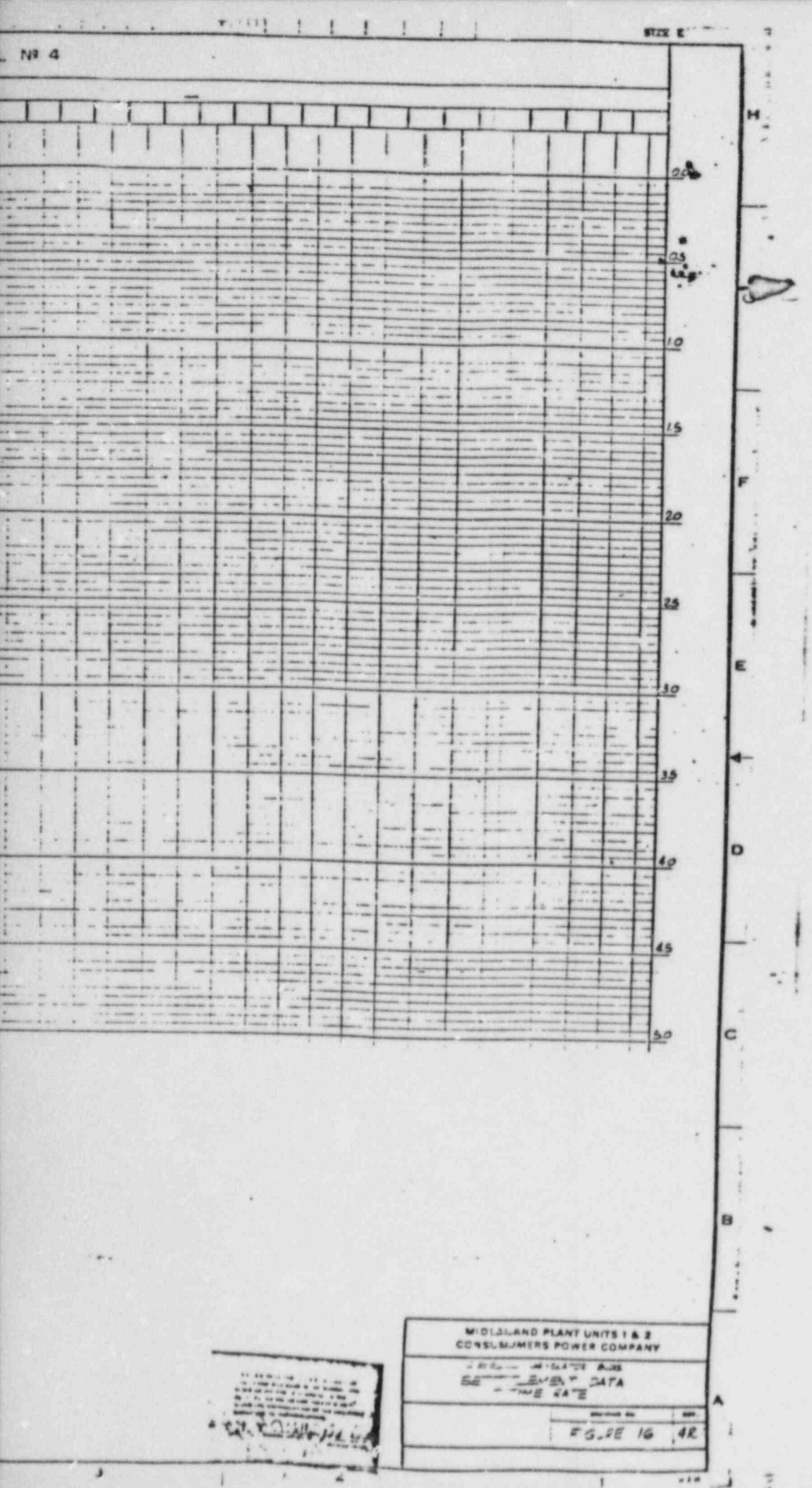
KEY PLAN @ EL 634'-0"

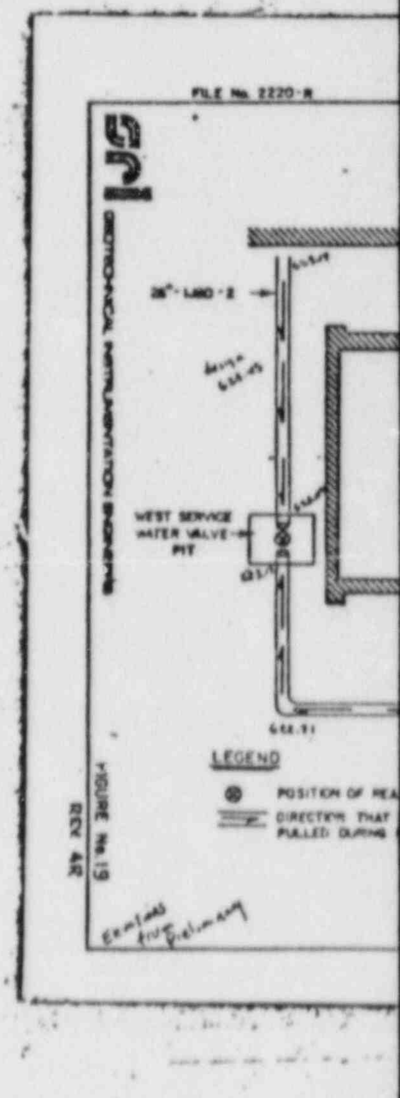
NOTES

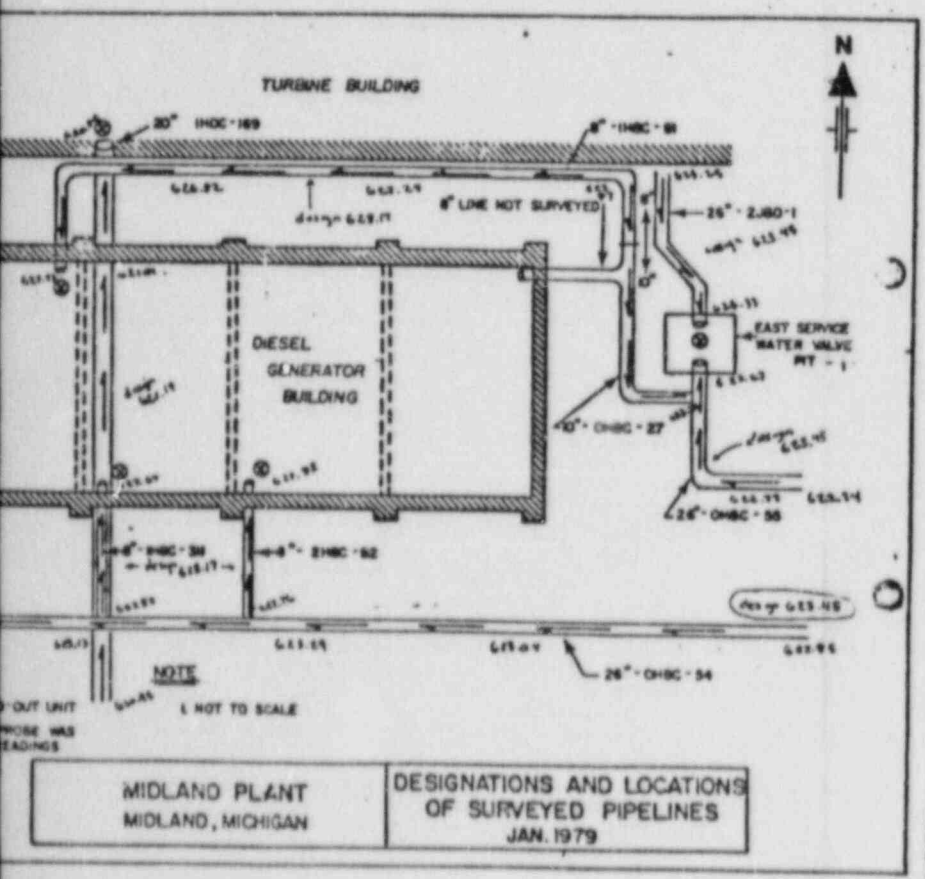
1) THE DG READINGS ON ALL PEDESTALS WERE RECORDED ON 5-7-78 THE FIRST READINGS WERE TAKEN ON 7-5-78

2) THE AVERAGE SETTLEMENT WAS DETERMINED USING VALUES DG 6, DG 17, DG 8 AND DG 14

8 7 6 5 4


SIZE E
Nº 4
H
F
E
D
C
B
A
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY
FSAR
FSAR FIG 16.4R

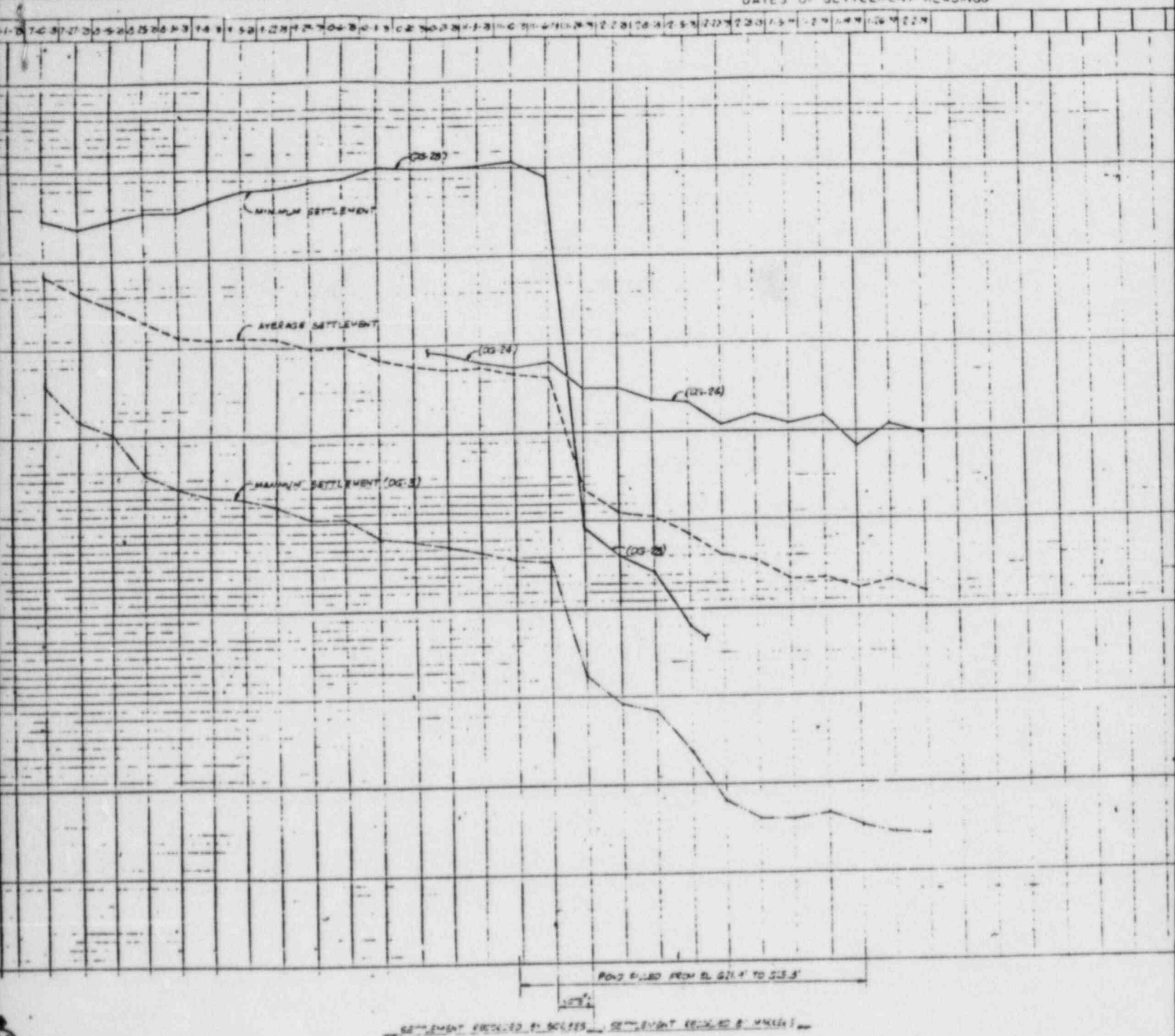

FILE No. 2220-R
GEOTECHNICAL INSTRUMENTATION ENGINEERS
WEST SERVICE
WATER VALVE
PIT
LEGEND
DIRECTION THAT
PULLED DURING
FIGURE No. 19
REV 4R

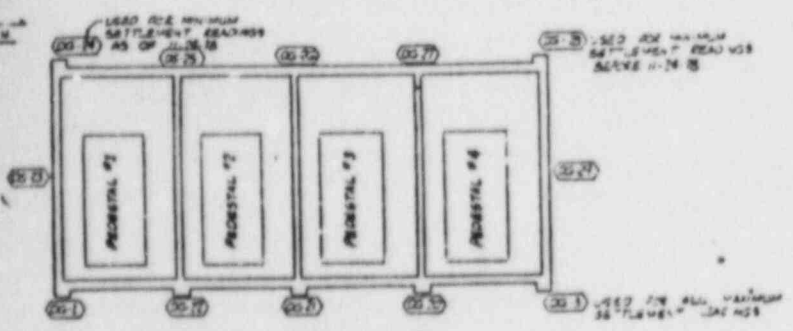


MIDLAND PLANT MIDLAND, MICHIGAN	DESIGNATIONS AND LOCATIONS OF SURVEYED PIPELINES JAN. 1979

19.

TIME / RATE SETTLEMENT OF DIESEL GENERATOR BUILDING



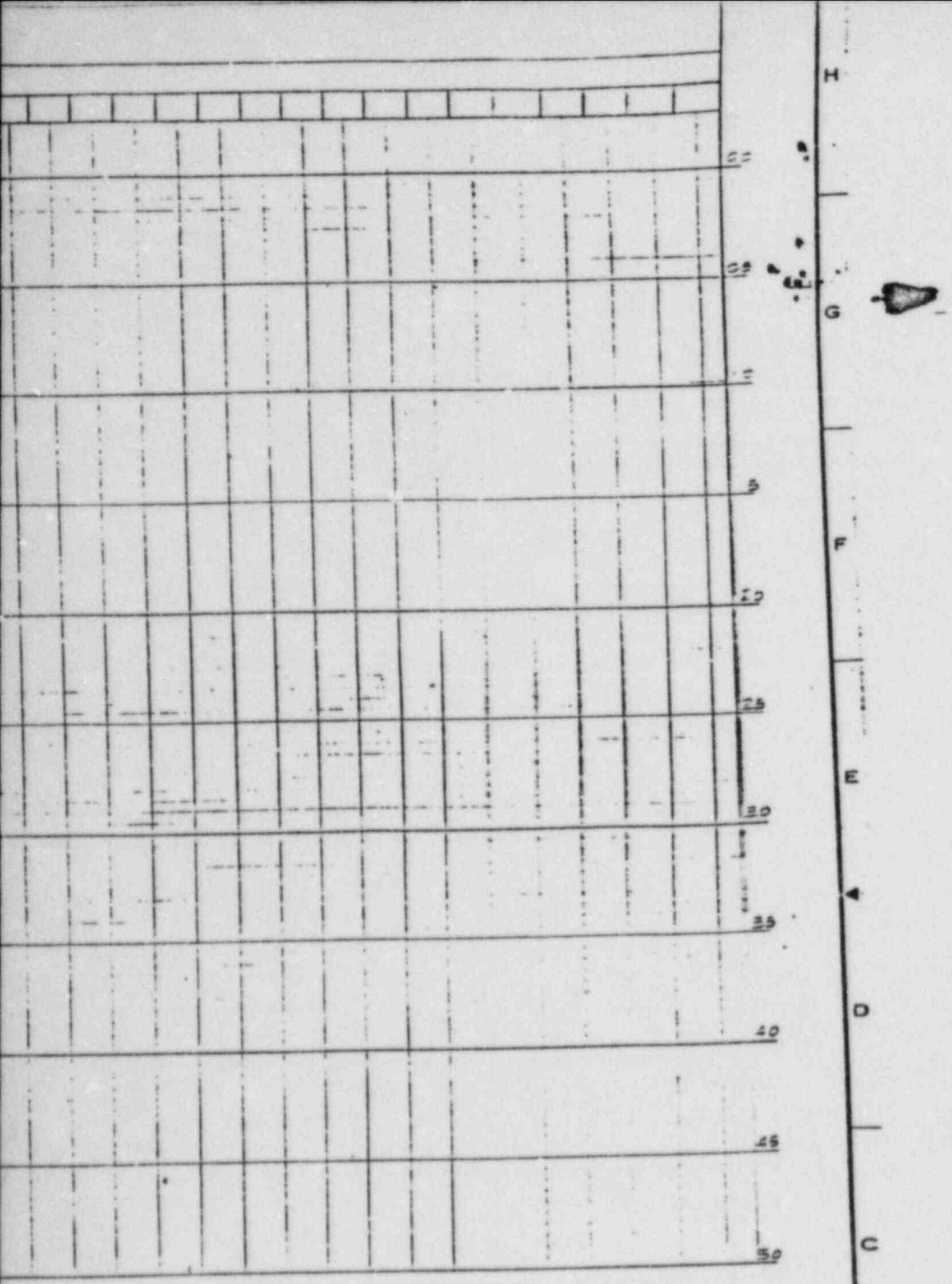


KEY PLAN @ EL 636.0'
NTS

NOTES

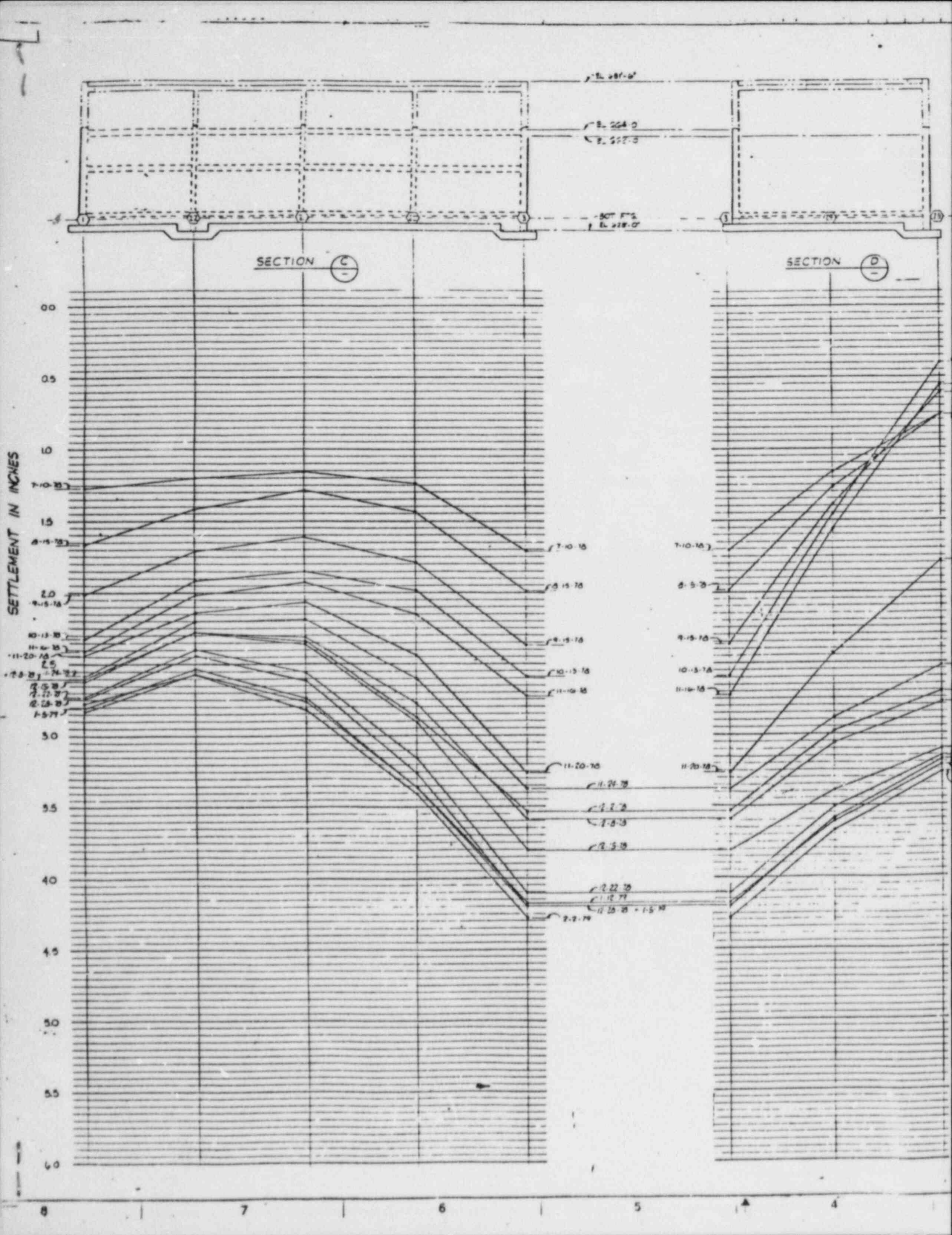
1. DUE TO GAPS ISOLATED BETWEEN 11-16-78 AND 11-24-78.
2. THE DG SETTLEMENT MARKERS ON THE OUTSIDE OF THE BLDG WERE INSTALLED IN 11-78. SETTLEMENT PRIOR TO THIS DATE WAS ESTIMATED FROM DATA USING CONST. SCALES INSTALLED ON OR ABOUT 8-1-78
3. THE AVERAGE SETTLEMENT WAS ESTABLISHED BY COMPARING DATA FROM BOTH THE CONST SCALES AND THE DG MARKERS SHOWN IN KEY PLAN

8 7 6 5 4

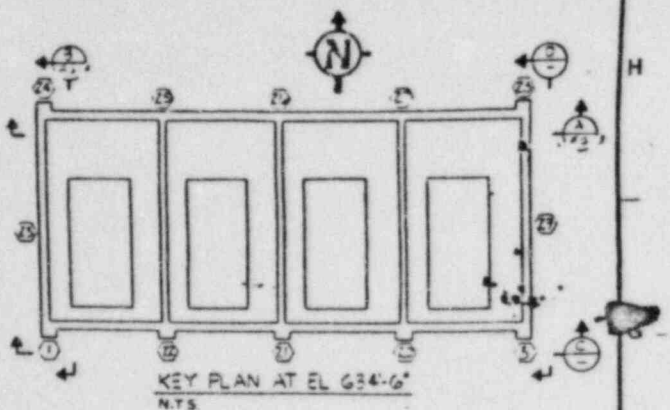


MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

3 1 2


SECTION C
SECTION D
SETTLEMENT IN INCHES
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
7-10-78
8-15-78
9-15-78
10-13-78
11-6-78
11-20-78
12-5-78
12-22-78
1-5-79
11-24-78
12-22-78
1-8-79
12-5-78
1-12-79
11-28-78 + 1-5-79
2-2-79
8-5-78
10-13-78
11-16-78
8
7
6
5
4

SIZE E



KEY PLAN AT EL 634'-6"
N.T.S.

NOTES

1. FOR NOTES SEE FIG. 3
2. THIS FIGURE SUPERCEDES FIGURE 4 SUBMITTED UNDER INTERIM REPORT #3

LEGEND

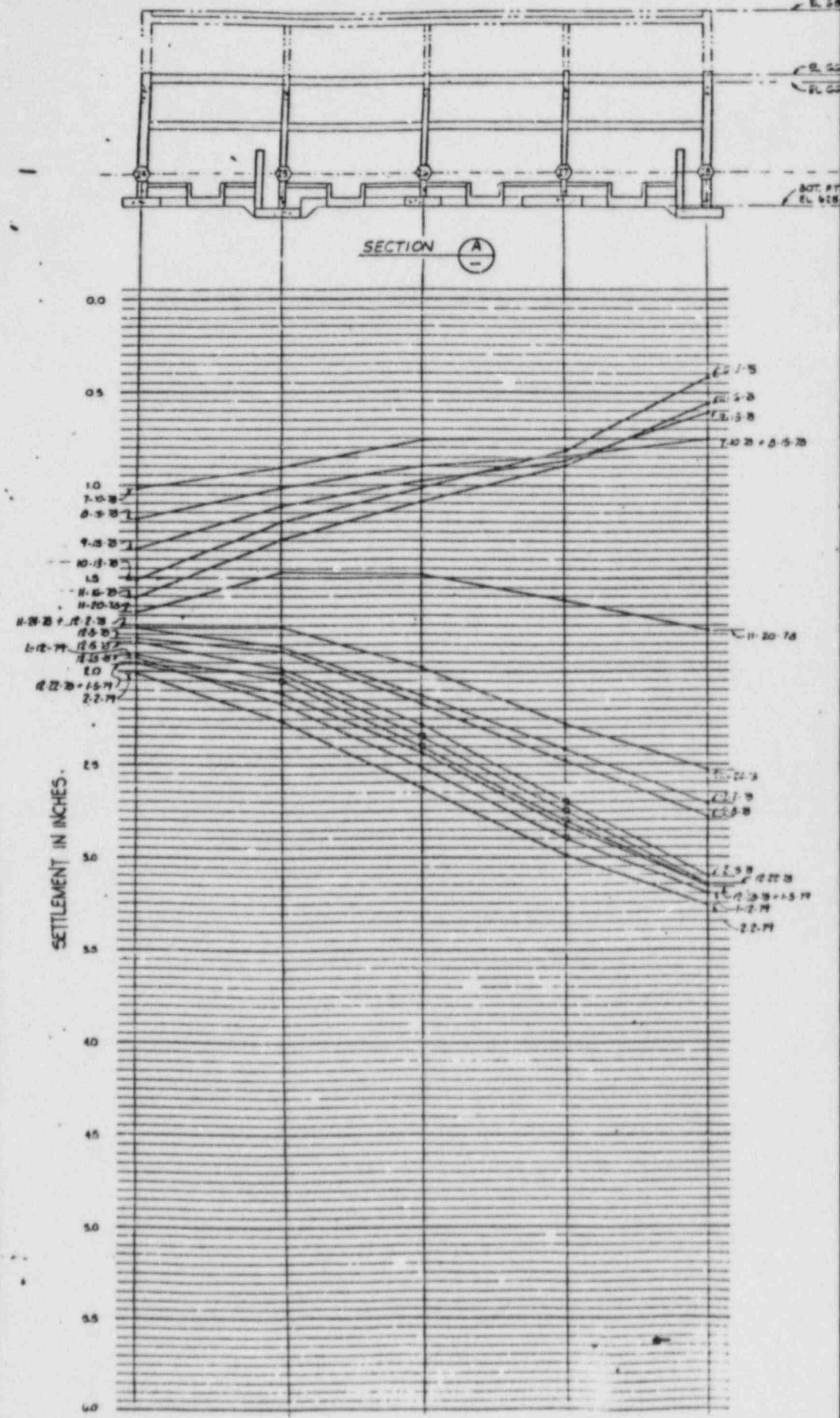
⊙ DENOTES SETTLEMENT MARKERS

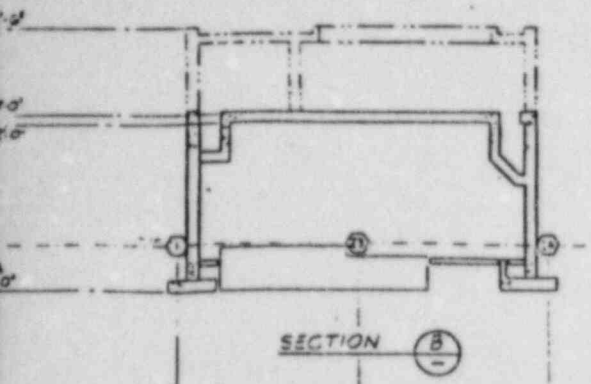
MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

SETTLEMENT DATA

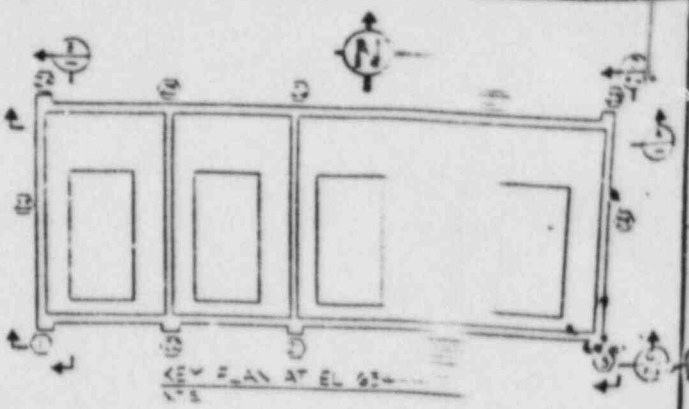
FIGURE 4 | 4R

3 2 1


SECTION A
SETTLEMENT IN INCHES.
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
11-20-78
2-2-79



SECTION B



KEY PLAN AT EL 62'-

SIGNIFICANT EVENTS

NO	EVENT	BM NO	DATE	REMARKS
1	SCATE ELEC DUCT BANKS	5	11-2-78	
		1	11-8-78	
		4	11-21-78	
		2	11-24-78	
2	PLACE UPPER 6' OF FROST PROTECTION			
3	PLACE MUDMAT FLOOR TO BLDG @EL 0"	6	12-7-78	
		3	12-9-78	
		1	12-20-78	
		2	12-29-78	

1. REMAINDER OF [illegible] STATOR BUILDING TO REPLACE [illegible] ECO WERE INSTALLED SCREWS ON [illegible] UNIT CONSTRUCTION

2. THE FINAL SE[illegible] READINGS FOR THE SCREWS [illegible] ON 11-24-78 AT THAT TIME [illegible]" ON BETWEEN THE SCREWS [illegible] EVENT VARIES HAS BEEN [illegible]

3. THIS FIGURE S[illegible] FIGURE 5 SUBMITTED U[illegible] REPORT #3

LEGEND

○ DENOTES SETTLEMENT [illegible]

MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

SETTLEMENT [illegible]

FIGURE 3 [illegible]

5 4 3 2

Stamnis X32

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

FEB 5 1982

Docket Nos: 50-329/330 OM, OL

APPLICANT: Consumers Power Company

FACILITY: Midland Plant, Units 1 and 2

SUBJECT: SUMMARY OF JANUARY 26, 1982 TELEPHONE DISCUSSION REGARDING SURCHARGE RESULTS FOR THE BWST FOUNDATIONS

On January 26, 1982, Messrs. J. Kane and D. Hood of the NRC staff received a telephone call from Consumers Power Company and Bechtel, to discuss the settlement measurements obtained since the valve pits for the Borated Water Storage Tank were filled with water on October 28, 1981. Participants in the call are listed by Enclosure 1. As a basis for this discussion, Enclosures 2 and 3 were delivered just prior to the call by Consumers' Bethesda Licensing Representative. These enclosures plot the settlement for one point on each of the two valve pits since the time of initial filling.

Consumer's discussion of the enclosures included the following points:

1. The criteria for maximum settlement is 0.5". Although the curve for marker D-41 on January 12, 1982 reads 0.5", Consumers does not consider this to be an accurate reading, as demonstrated by the January 18, 1982 reading which shows about 0.4".
2. Other measured points also show the dip which occurred on January 12, 1982. Consumers speculates that survey inaccuracies may be at fault for the January 12, 1982 readings.
3. Consumers feels the current data demonstrate that the fill beneath the BWST foundations is now in secondary consolidation. The secondary consolidation rate for the tanks has been estimated to be 1/2" per decade.

Mr. Kane replied that the settlement data for markers D-29 and D-41 do not clearly indicate that the foundation soils beneath the valve pit are in secondary consolidation. If the questionable readings of January 12, 1982 are excluded, and average smooth settlement curve through the plotted points could be drawn since November 24, 1981 (the date for placing the third and final surcharge load increment) which would indicate the foundation soils are still in primary consolidation. Mr. Kane requested that the settlement data for the other markers be provided for review.

Darl S. Hood, Project Manager
Licensing Branch No. 4
Division of Licensing

Enclosures:
As stated

cc: See next page

8202240292

ENCLOSURE 1

TELEPHONE CONFERENCE CALL PARTICIPANTS

January 26, 1982

Consumers Power Company

D. Budzik
J. Mesenheimer
J. Anderson

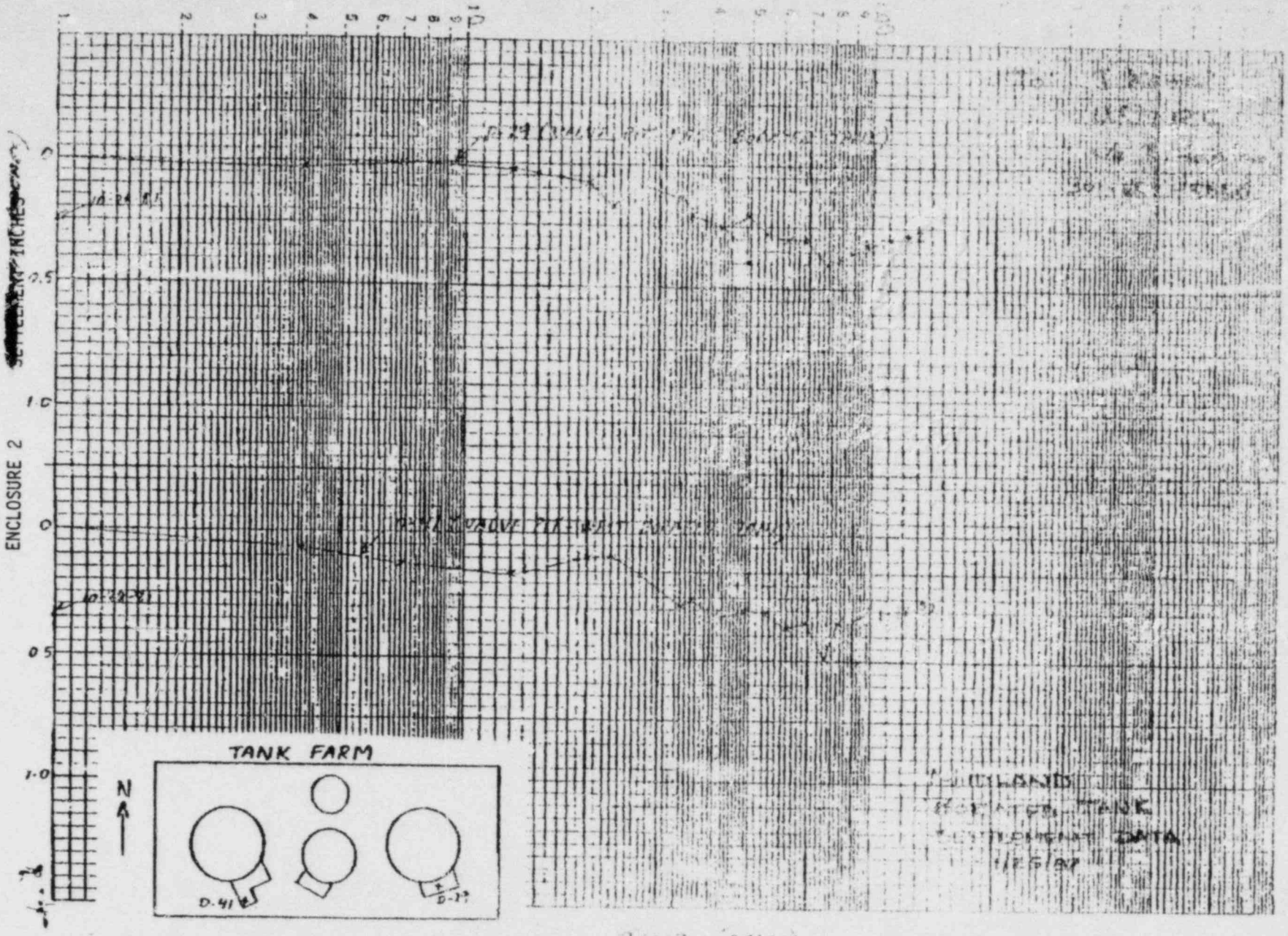
Bechtel

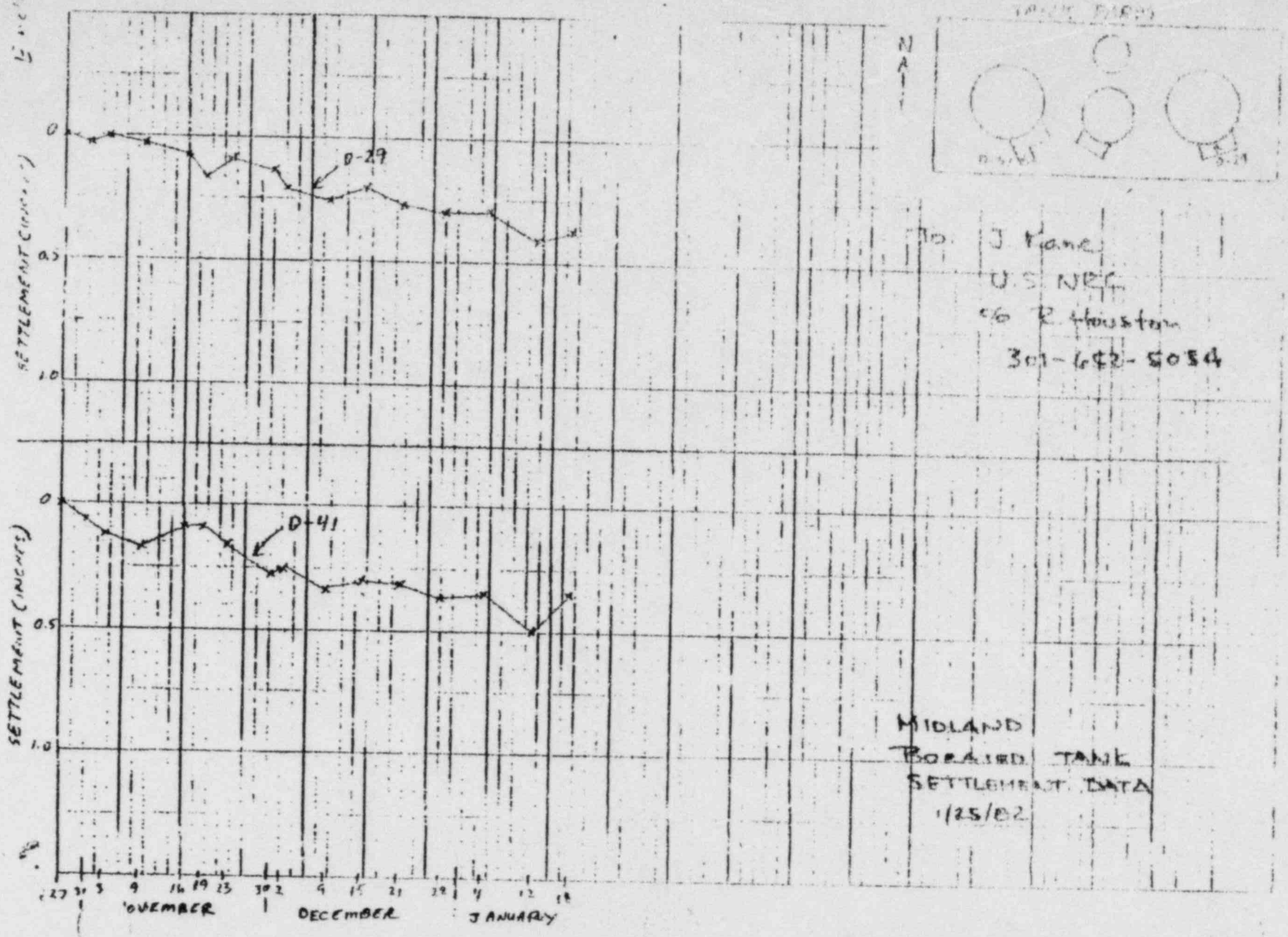
N., Swanberg
S. Lo
A. Boos

NRC

J. Kane
D. Hood

ENCLOSURE 2





D. J Kane
U.S. NRC
c/o R Houston
301-652-5054

MIDLAND
BORATED TANK
SETTLEMENT DATA
1/25/82

Consumers Exhibit #1
(Kane)

J. Kane

PROFESSIONAL QUALIFICATIONS AND EXPERIENCE

NAME: Joseph D. Kane

ADDRESS: 7421 Miller Fall Road
Derwood, MD 20855

EDUCATION:

B.S. Civil Engineering — 1961
Villanova University

M.S. Civil Engineering — 1973
Villanova University

Post-degree studies, Soils and Foundation Engineering
University of California — 1972
University of Maryland — 1978

PROFESSIONAL REGISTRATION:

Registered Professional Engineer (1966) - Pennsylvania 12032E

PROFESSIONAL SOCIETY:

American Society of Civil Engineers

EMPLOYMENT POSITIONS:

February 1980 - Present	Principal Geotechnical Engineer U.S. Nuclear Regulatory Commission
May 1977 - February 1980	Geotechnical Engineer U.S. Nuclear Regulatory Commission
October 1975 - May 1977	Soils Engineer - U.S. Nuclear Regulatory Commission
August 1973 - October 1975	Supervisory Civil Engineer Chief, Soils Design Section U.S. Army Corps of Engineers Philadelphia District
January 1963 - August 1973	Civil Engineer Soils Design Section U.S. Army Corps of Engineers Philadelphia District
January 1962 - January 1963	Design Engineer McCormick - Taylor Associates Philadelphia, Pa.

PROFESSIONAL EXPERIENCE SUMMARY:

1975 to Present

In NRC Division of Engineering, Geotechnical Engineering Section, Mr. Kane has specialized in soil mechanics and foundation engineering. Experiences in this position have included the following:

a. Evaluation of the foundation adequacy of proposed sites for nuclear facilities with respect to design and operational safety. This work has included evaluation of geotechnical, soils and rock mechanics, foundation and earthquake engineering related aspects. The results of this review effort are summarized in a safety evaluation report for each of the proposed facilities which have included nuclear power plants, nuclear fuel reprocessing plants and uranium mill tailings waste systems.

b. Serving as a technical adviser for soil and foundation engineering related aspects in the development of regulatory guides, acceptance and performance criteria that are intended to assure construction and operational safety of nuclear facilities.

c. Serving as a technical representative for the Office of Nuclear Reactor Regulation on the NRC Advisory Group concerned with federal dam safety.

d. Serving as an instructor for the Office of State Programs in the training of state personnel who are responsible for construction and operational inspections of uranium mill tailings embankment retention systems.

1963 to 1975

During this period Mr. Kane was employed with the U.S. Army Corps of Engineers, Philadelphia District and attained the position, Chief, Soils Design Section, Foundations and Materials Branch, in 1973. Professional experiences with the Corps of Engineers have included the following:

a. The embankment and foundation design of four large multi-purpose earth and rockfill dams with appurtenant structures (spillways, inlet and outlet structures, control towers, flood protection facilities, etc.). Responsibilities ranged from the initial planning of

subsurface investigations to select the most feasible sites through all design stages which were culminated in the final preparation of construction plans and specifications. This work included planning and evaluation of laboratory testing programs, studies on slope stability, seepage control and dewatering systems, settlement, bearing capacity, liquefaction embankment safety instrumentation and slope protection.

b. Served as a technical consultant to field offices charged with construction inspections for assuring completion of structures in compliance with design analysis and contract specifications. Participated in the development of needed modifications during construction whenever significant changed site conditions were uncovered.

c. Directed the efforts of engineers in the Soils Design Section in other fields of civil work projects that included the embankment and foundation design of levees, waterfront pile supported structures and disposal basins for the retention of hydraulic dredge waste.

1962 to 1963 — Served as design and project engineer for private consulting firm. This work included the design of large federally funded highways, a race track and various structures constructed to provide a Pennsylvania State park marina.

HONORS AND AWARDS:

High Quality Award	1972
Outstanding Performance Award	1978

CONSUMERS

EXHIBIT #6 - (KANE)

7/25/80

MIDLAND — Understanding of NRC Position (In Anticipation of Report)

Establish the following:

- The problems which have developed at the Midland site were not caused by NRC actions.
- These problems now require a more intense scrutiny & technical staff than is normally covered in our reviews. This increased level of staff review is needed to permit the staff to FULLY understand the proposed solutions and to be in a position where we can either defend acceptance of the solutions or CLEARLY identify our concerns so that they may be addressed & resolved.
- We suggest CPCo carefully consider the intent of our questions and request for information. If the information being requested is the type of information that CPCo's consultants or contractors must have originated and evaluated to come to a conclusion on adequacy or margin of safety, then there is no reasonable basis for CPCo to object to the staff's request for this information

COE [illegible] 5/27/80
DGB [illegible] COE-8, COE-13 1 of 4
SWS [illegible] COE-16
Retaining Wall COE-14
Auxiliary Bldg COE 17 & 18 (Consumers Exhibit #11 [illegible])

NRC Position -- Diesel Generator Building

Vu No. 1 CPCo Position No. 1

1. Let's look at the preload program completed at Midland:
   Plan view of DGB - Start w/ Vu No 1. Stress need to consider time element
   - Outline of structure, 4 bays **Vu No. 2**
   - Areal extent surcharge was placed
   - Extent of conduits & piping beneath DGB (Service water, Circulating water)
   - Location of sectional views A & B

   Sectional Views A & B **Vu No. 3 & 4** Point out depth of fill (30' ±) Point out level to which we feel GWT rose during surcharging

2. Discuss uniqueness of preloading program completed at Midland
   - Placed after structure & conduits had been placed. Effects.
   (Show working drawings Fig. 14 Settlement Data
   Note non-uniform, unusual settlement pattern
   Working Drawing Fig. 60 - Surveyed Pipelines * Stress concern is for differential settlement & overstressing of conduits
   - Concern of overstressing pipes. Difficulties in monitoring & evaluating future settlement of safety related piping

3. CPCo Position No. 2 concerning stresses produced in fill under surcharge **Vu No. 1** **Vu No. 5**

4. Staff Position - **Vu No. 6** Surcharge load apparently just meets DL+LL+ Effect of Dewatering. Does not allow for additional environmental loads. Normal practice in surcharge programs - Place a surcharge load that is 1.5 times final load to assure secondary consolidation is reached.

J. Kane
9/27/80
2 of 4

5. CPCo Position No.3 **Vu No.1** - Settlement Data
Vu No.7 Presented by Dr. Peck at Aug. 29, 1980 meeting
— Shows decrease in rate of settlement after 100 days. Rebound
— Time period where surcharge was imposed in secondary consolidation was approximately 90 days.
— Note that graph conveniently plots only settlement after surcharge was placed.

6. CPCo Position No.4 **Vu No.1** - Settlement & Piezometer Data
(1st Show **Vu No.8**) Presented by Dr. Peck at Aug. 29, 1980 meeting
— Cover info presented (Settlement - arithmetic scale, pond levels, PZ-30 behavior (particularly after removal) & surcharge load history
— Show disagreement with previously submitted data (**Vu No.9**) at critical time of surcharge removal for PZ-30.
— Show previously submitted Fig 27-5 (**Vu No.10**) where PZ-23 behavior at time of surcharge removal has been deleted & replaced w/ PZ-30 data but all other data (Settlement of DG-3, pond & surcharge) remains unchanged Show how PZ-23 supports our concern that secondary consolidation was not reached by observed behavior. Show other piezometers, PZ-36 **Vu No.11** and piezomter PZ-47 **Vu No.12**

7. CPCo Position No. 5 **Vu No.1** State of the art limitations
— thin samples - True. However in some respect we have better control to duplicate long term field conditions which did not develop during surcharging period.
— sample disturbance - Available methods for correction **Vu No.13**
— problems in selecting representative samples - a problem that a geotechnical engineer faces in nearly every aspect of our work. Knowing the problem exists should not prevent us from facing it, using experience & best judgement.

8. CPCo Position No. 6 **Vu No. 14**
   - Cite NRC experiences — Virgil C. Summer
   - Fact that Midland design used the present state-of-the-art approach (undisturbed sampling & consolidation testing) to show that the foundation glacial till materials were, in fact, preconsolidated under former glaciers. Here CPCo accepts the state-of-the-art because it does not cause them a problem
   - Show on **Vu No. 15** what we would accept (At depth testing & establishment of preconsolidation pressure.

9. CPCo Position No. 7 **Vu No. 14** Effect of temporary dewatering
   - Both NRC & COE anxiously await the details of the temporary dewatering now being conducted. The information that has been submitted to date is conceptual and does not permit us to reach an agreement on the adequacy of the temporary dewatering scheme. We do not know their specific plans for monitoring of the water table for both drawdown, and for further settlement. The ~~data~~ results from the temporary dewatering could provide additional important settlement data but it highly unlikely the zone of dewatering influence will resolve all our concerns with the DGB and the additional borings and lab testing will still be required

10. CPCo Position No. 8 **Vu No. 14** Future Monitoring
    Because of the known settlement problem & concern — Midland during plant operation will be required to have strict tech. specs on settlement monitoring, in much more detail than ~~Similar to~~ other plants. There are some very serious concerns on the adequacy of monitoring settlement on buried safety related piping & conduits. The requested laboratory testing is viewed by both

the COE & the DPC staff as a necessary approach to accurately predict the range of future settlements and satisfy ourselves that expected settlements will not exceed tolerable limits. Data and observations from the surcharge program pose questions as to its success because of the time it was imposed and the magnitude of the load. We view the additional testing as a reasonable way to resolve the concerns on the effectiveness of the preload program.

11. Summarize our concerns on the effectiveness of the Preload Program: we have concerns because
   a. Estimated settlement and piezometric levels made BEFORE the preloading were never reached. settlement vs "fit" - we are concerned that
   b. Not following the usual practice of requiring a surcharge load equal to 1.5 times the final load to assure reaching secondary consolidation
   c. The behavior of certain piezometers after surcharge removal to cause concern that secondary consolidation was not reached
— Support for our position for testing * Vu No. 15 statement on Peck's testimony

12. CPCo Position No. 9, 10 & 11 – Bearing Capacity
Vu No. 14

List of Vugraphs for Diesel Generator Building

No.	Subject
1	CPCo Position List - DGB
2	Plan - DGB Area
3	Section A - DGB
4	Section B - DGB
5	CPCo graph of stress vs. depth
6	COE graph of stress
7	CPCo Measured & Predicted Settlement
8	CPCo Typical Settlement & Piezometer Data
9	PZ-30 Data (not yet made - Fig. 27-32)
10	Settlement & Piezometer Data (not yet made - Fig. 27-3
11	PZ-36
12	PZ-47
13	Consolidation Test Report
14	CPCo Position list (cont.)
15	Page from "Foundation Engineering" textbook

4/Box 2

Records maintained by Joseph Kane in an unlabeled folder.