Agenda
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July 27, 1979

RECONSTRUCTION OF PRESENTATION MADE BY T. E. JOHNSON

My name is T. E. Johnson from Bechtel Corporation Ann Arbor, Michigan. I will give a brief overview of the structural investigation, the seismic analyses, and the design criteria. I would like to define structural analysis as when the various loadings are applied to the structure as static loads and then the design forces are determined for sizing reinforcing steel. Whereas, seismic analysis is defined as the dynamic analysis that is used to determine structural response.

The first viewgraph shows what various items were reviewed in the structural investigation. For the diesel generator building, the original design was governed by tornado missile impact and a 3 psi vacuum loading. The seismic response for this structure was relatively small. As an indication, the calculated shear stress in the east-west direction was 40 psi and 25 psi in the north-south direction.

The new analyses that we are in the process of performing will involve using a finite element model to investigate the variable foundation properties. Up to now, the cracking observed in this structure has been approximately 30 mils and this occurred in the short walls from the vertical duct bank loadings during construction.

The structural investigation of the service water pump structure revealed in the following: The original design for this structure was governed by tornado missile impact and the 3 psi vacuum loading. Seismic response was relatively low with a calculated shear stress in the mrjor walls of about 20 psi. The new analyses that will be used for this structure will involve conventional techniques considering the walls and slabs with the piling that will be used to support the portion of the structure on top of fill. Cracking in this structure to date has not exceeded 20 mils. This cracking occurred in the walls and the roof. Up to now there has been no detectable settlement for this structure.

The structural investigation of the auxiliary building penetration areas revealed the following: The original design was governed by the safe shutdown earthquake and the pipe break. The original, analysis was conservative since it was based on a system of beams and columns to simulate the large walls and floors. As far as the seismic response, the structure was near capacity using this original model. A new analysis is being performed which will involve a finite element analysis of the structure, this will include the caissons which will be used for end support. In this structure the cracking as measured to date has not exceeded 15 mils. This has occurred in the walls and there has been no detectable settlement.

I would now like to review the seismic analyses, refer to viewgraph No. 2. A general review is as follows: The ground response spectra is presented in the FSAR and this is based on an OBE of .06 g's and an SSE of .12 g's. Stick mass models with foundation springs were used. Material damping values are presented in the FSAR; modal damping was limited to 10% except for rigid body modes. The analysis technique used both the spectrum response and the time history methods.

For the diesel generator building the original analysis used a shear wave velocity of 1,360 fps. One analysis was performed, and equipment response spectra was widened by ± 15 percent. A new analysis has been completed using a lower limit shear wave velocity of 500 fps. The new spectra will envelop both the 500 and the 1,360 fps analyses values.

Referring to viewgraph No. 3, the seismic anlaysis for the service water building involved an original analysis which used 1,360 fps as a base case. Then the foundation shear modulus was varied by ± 50 percent. These three analyses were used to generate equipment response spectra and the spectra used was the envelop of all three. A new seismic analysis is being done which will use a shear wave velocity of 1,360 fps. The piling will be modeled in this analyses, but only to resist loads in the vertical direction. Torsion will also be considered in this model. The equipment will then be reexamined for the response spectra from both the original and the new analyses.

For the auxiliary building, including the control tower and electrical penetration areas, the original analysis used composite foundation springs with the equipment response spectra widened by ± 15 percent. The composite springs were used to represent different foundation materials for various parts of the structure. A new analyses will be performed including the caissons under the electrical penetration areas. The equipment response spectra will be widened by 15 percent and equipment will be checked, if this response spectra is greater than the original in any frequency range.

I would like to discuss the different types of loads which are shown in viewgraph No. 4. The first types of loads are primary loads. This type of load results in stress. As an example, the most critical type of loads would be what are considered mechanical loads. Which would be dead load, pressure, wind, all these types of loads have a constantly applied force.

The next type of load, but of lesser severity, would be seismic inertia load, however these are of a short duration.

The third type of load of lesser severity would be missile impact or pipe rupture loads. These types of loads have a limited energy input.

The next classification of load would involve what is known as secondary loads. This term is quite common in ASME codes. This type of load merely results in strain. They can result from internal self-constraint. As an example, if a pressure vessel has the bottom restrained, bending moments would develop which would be secondary in nature because they are due to internal self-constraint.

Seismic displacements in piping systems would be of a secondary nature since different support points would only move a set amount relative to each other and induced strain. However, these types of loads can be cyclic in nature.

Another type of secondary load would be a thermal load, such as a thermal gradient through a wall. This type of load is also cyclic.

Settlement is the least effective type of secondary loading because it primarily has only one/half cycle of load with a limited input. Settlement is similar to forming materials which are also half cycle. Forming is used for manufacturing pressure vessels and steel piping. Pipes are rolled to a particular shape. They exceed yield in this process, however due to the low strain rates relative to ultimate, there is an undetectable reduction in the ultimate strength. It is also common to form reinforcing steel. As an example, in reinforced containments the major hoop bars are bent to shape and this involves a yielding of the steel. This also does not lead to any detectable reduction in strength, and of course hooks are commonly used in reinforcing steel.

Viewgraph No. 5 shows a summary of the Midland design criteria. The first category is what is in the FSAR. The first is primarily dead and live load, the second combines the small earthquake with live and dead, the third combines live and dead load plus wind, and the fourth combination involves dead load, live load plus the safe shutdown earthquake. The final load combination is dead load and live load and the tornado loading.

After discovering the settlement problems on the diesel generator building at the Midland jobsite, it was decided to add some additional criteria. As a reference, we used ACI 318-1977 and it is interesting to note that in this code they recognized the fact that settlement only affects serviceability. This means it would induce some additional cracking, which if then exposed to a corrosive environment, could result in corrosion of reinforcing steel. Therefore in ACI, settlement loads are only combined with normal operating type of loads such as live load and dead load. Using this as a base, we have created the additional criteria shown on viewgraph No.5. The first combination involves dead load, live load and settlement. The second combination considers 1.4 x dead load plus 1.4 x settlement. These are based on serviceability.

Since the design wind and the small earthquake are postulated to occur more than once at the site, we have also added two combinations as shown which include live load, dead load, settlement and either design wind or the operating basis earthquake.

In summary, I would like to present the following. We have either removed the source of load, or added additional supports for the various structures that are founded fully or partially on fill at the jobsite. For the diesel generator building, the duct banks have been cut loose, removing the source that caused the cracking. The service water pump structure will be supported by adding piling. In the auxiliary building electrical penetration areas, we will be adding caissons. So again, we have either removed the source of load or supplied additional support.

I would like to comment on the significance of what has happened to date, the cracking only affects serviceability, large cracks over 15 mils will be sealed in the future. As far as present and future actions are concerned, we are performing new seismic analyses, we will also be performing new static analyses checking the structural design. For the diesel generator building, we will analyze the building for variable foundation conditions. This will be the only building that will involve applying the additional criteria since we will investigate variable foundation properties.

In conclusion, the structures are box type, reinforced concrete, with high strength and good ductility. If it was not for the diesel generator building settlement the concrete cracking of the structures would probably not be of any concern, since all reinforced concrete structures do crack under service, and that is the reason why reinforcing steel is used. With the original FSAR criteria, and the additional criteria, together with the modifications, the structures will be able to safely resist all normal type of loads and postulated events.

That concludes my presentation.

STRUCTURAL INVESTIGATION

(1) ORIGINAL DESIGN

(2) SEISMIC RESPONSE

(3) NEW ANALYSES

SEISMIC ANALYSIS

GENERAL

(1) RESPONSE SPECTRA PRESENTED IN FSAR

(2) STICK MASS MODELS WITH FOUNDATION SPRINGS

(3) MATERIAL DAMPING VALUES PRESENTED IN FSAR (MODAL DAMPING LIMITED TO 10% EXCEPT RIGID BODY MODES)

(4) SPECTRUM RESPONSE AND TIME HISTORY MODAL ANALYSES

DIESEL GENERATOR BUILDING

(1) ORIGINAL (V_s = 1360 FPS) - ONE ANALYSIS EQUIPMENT SPECTRA WIDENED BY ± 15%

(2) NEW (V_s = 500 FPS) - NEW SPECTRA WILL ENVELOP BOTH V_s = 500 FPS AND 1360 FPS

SEISMIC ANALYSIS

SERVICE WATER BUILDING

(1) ORIGINAL (V_s = 1360 FPS BASE CASE) THEN G VARIED BY ± 50% - EQUIPMENT SPECTRA ENVELOP

(2) NEW (V_s = 1360 FPS) - PILING IS MODELED FOR VERTICAL DIRECTION AND TORSION IS CONSIDERED

AUXILIARY BUILDING (INCLUDE CONTROL TOWER AND ELECTRICAL PENETRATION AREAS

(1) ORIGINAL - ONE ANALYSIS USING COMPOSITE FOUNDATION SPRINGS WITH EQUIPMENT RESPONSE SPECTRA WIDENED BY ± 15%

(2) NEW - ONE ANALYSIS INCLUDING CAISSONS UNDER ELECTRICAL PENETRATION AREAS, EQUIPMENT RESPONSE SPECTRA WIDENED BY ± 15%

TYPES OF LOADS

PRIMARY

1. MECHANICAL (DEADLOAD, PRESSURE, WIND, ETC.)
2. SEISMIC INERTIA (BUT SHORT DURATION)
3. MISSILE IMPACT & PIPE RUPTURE (LIMITED ENERGY)

SECONDARY

1. INTERNAL SELF CONTRAINT
   - (A) SEISMIC DISPLACEMENT (CYCLIC)
   - (B) THERMAL (CYCLIC)
2. SETTLEMENT (1/2 CYCLE)
3. FORMING (1/2 CYCLE)

MIDLAND DESIGN CRITERIA

FSAR

(A) $1.4D + 1.7L$

(B) $1.4 (D + L + E_O) + \ldots$

(C) $1.25 (D + L + W) + \ldots$

(D) $1.0D + 1.0L + 1.0E_{SS} + \ldots$

(E) $1.0D + 1.0L + 1.0W_T + \ldots$

ADDITIONAL CRITERIA

(A) $1.05D + 1.28L + 1.05$ SET

(B) $1.4D + 1.4$ SET

(C) $1.0D + 1.0L + 1.0W + 1.0$ SET

(D) $1.0D + 1.0L + 1.0E_O + 1.0$ SET

D:	DEAD LOAD	E_{SS}:	(SSE) EARTHQUAKE
L:	LIVE LOAD	W_T:	TORNADO
E_O:	(OBE) EARTHQUAKE	SET:	SETTLEMENT
W:	DESIGN WIND		

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cycles were taken as 10 in the Seed and Silver analysis. Finn and Cyrne analysis was based on the recorded El-Centro earthquake. Acceleration level was taken as 0.12g for the SSE and 0.06g for the OBE. Thickness of the sands were based on the soil borings. Multi-directional shaking effects were counted for by multiplying the calculated uni-directional settlements by a factor of 2.5. The structure was accounted for as if it was a uniform surcharge.

Preliminary analysis based on these parameters indicated a settlement range of 1/2 inch to 1 inch for the diesel generator building area. It is noted that these estimates are conservative since they are based on the assumption that the sand is dry. Because the sand will be moist, the presence of capillary force will reduce actual settlements below those predicted.

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SOILS SUMMARY

The diesel generator building settlement noted in August of 1978 were larger than expected. An exploration program was initiated to investigate the seat of the settlement and Drs. Peck and Hendron were consulted to discuss the evaluations and corrective actions required. Based on the exploration and the consultants recommendations it was decided to surcharge the building and surrounding area with a load exceeding the operating load. Instrumentation was installed to evaluate rate of soil consolidation and settlements of the structure and supporting soils. The preload was completed to a height of 20 feet by late March 1979.

Figures 7 through 10 illustrate locations of the various instruments associated with the preload program. Figure 7 shows the locations of building survey

settlement markers and pedestal settlement rods. Figure 8 shows the location of surface settlement plates and borros anchors installed in the fill primarily at three different elevations to monitor the movement of the soil as a result of the surcharge. The figure also shows locations of 4 deep (elev. 535) borros anchors installed for use as reference points for the precise measurements during secondary compression where the movement has subsided to a very small rate. Figure 9 illustrates locations of piezometers installed primarily at three different elevations below the building to monitor the dissipation of pore water pressure during consolidation. Figure 10 illustrates the locations of Sondax instruments intended for measuring soil rebound in order to estimate the modulus of elasticity below the building to check the range used in dynamic analysis.

Figure 11 illustrates typical results of the settlement and pore water measurements for the building. It is seen that within a short time after the completion of the surcharge the settlements of both the soil and the building has subsided to a very low rate and the piezometer water levels have declined significantly. At present the piezometers indicate approximately the same water level as the general ground water level (elev. 627). This indicates essentially total dissipation of pore water pressure.

A preliminary plot of the building settlement during secondary compression based on survey measurements indicates that the residual settlement of the building should be less than 1.5 inches during its service life.

The exploration program below the diesel generator building has indicated that the fill is quite variable both in the material type and quality. Therefore, additional explorations were made in the remaining plant site fill

to evaluate its condition. The expanded exploration program indicated that although there was no settlement elsewhere, there were certain areas that the fill was of a quality requiring corrective action of the structure involved. These areas are the auxiliary building, electrical penetration rooms, valve pits, and the fill supported portion of the service water structure.

Figure 12^A and 12^B summarize the fill type (sand clay) below the structures and the planned remedial measures for the various strucutres supported on plant area.

Liquefaction evaluations based on published experience at sites where liquefaction did or did not occur showed that in certain areas of the sand fill, under the maximum ground water level of elevation 627 and the SSE of 0.12g, the factor of safety was less than the acceptable value of 1.5. These areas are primarily in the diesel generator building.

As a result of these evaluations consideration was given to grouting of the sands and also to permanent area dewatering. The latter approach of dewatering was proven most beneficial that it could be monitored simply.

Settlements of the sands following an SSE event would be on the order of 1/2 to 1 inch in the area of the diesel generator building.

Regarding the subject of estimated settlements for plant structures supported on fill, these settlements will be re-evaluated utilizing the following information:

1. Settlement of the own weight of the fill based on borros anchors installed in areas where no structures are involved

2. Measurements on existing structures and foundations

3. Soil boring information

4. Laboratory test information

5. Diesel Generator Building surcharge experience

These analyses will account for additional induced settlements due to dewatering. These evaluations will be made and reported in the FSAR as part of the current committment.

SSA/cf

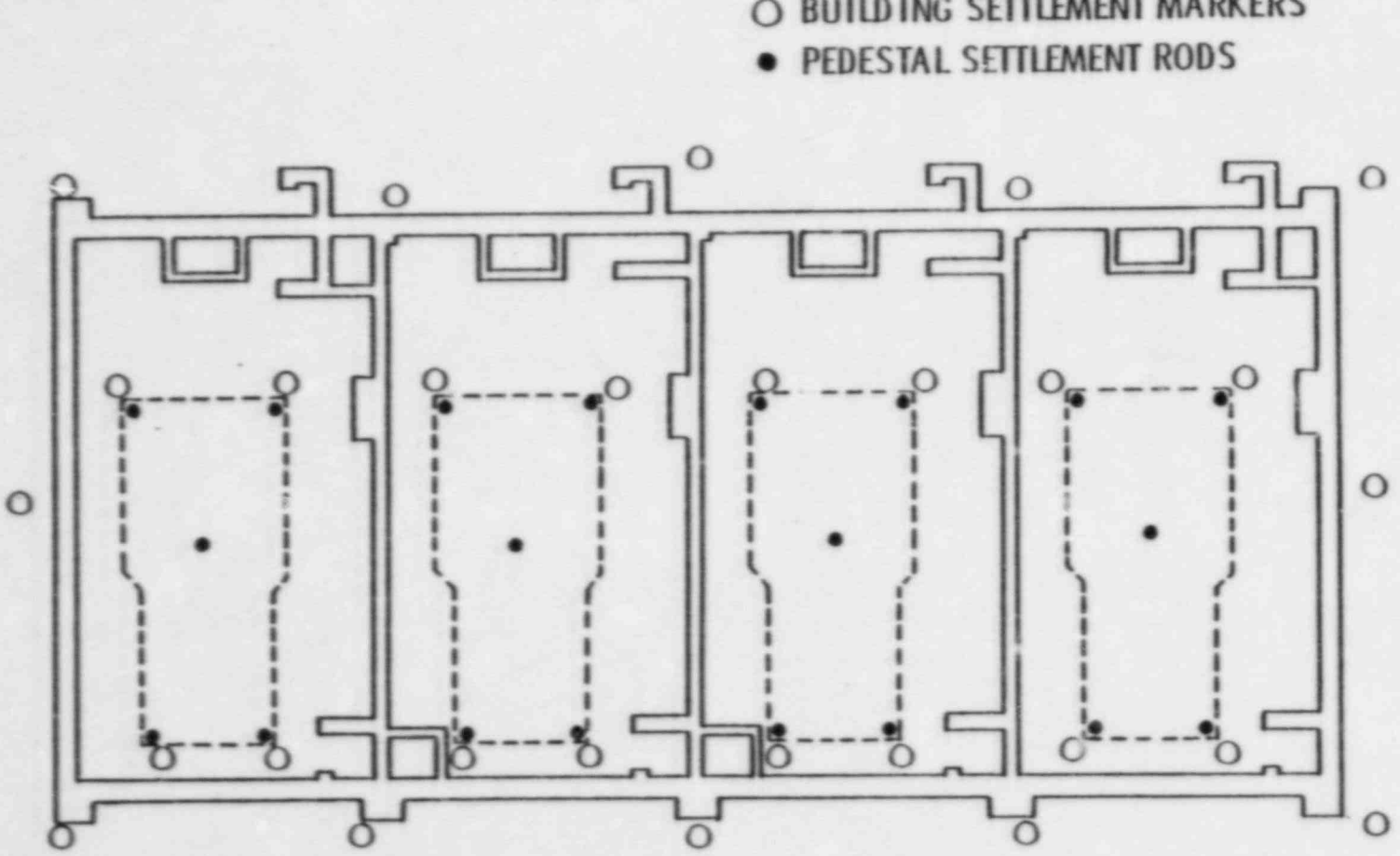


FIGURE 7 - BUILDING AND PEDESTAL MOVEMENT MONITORING EQUIPMENT DIESEL GENERATOR BUILDING

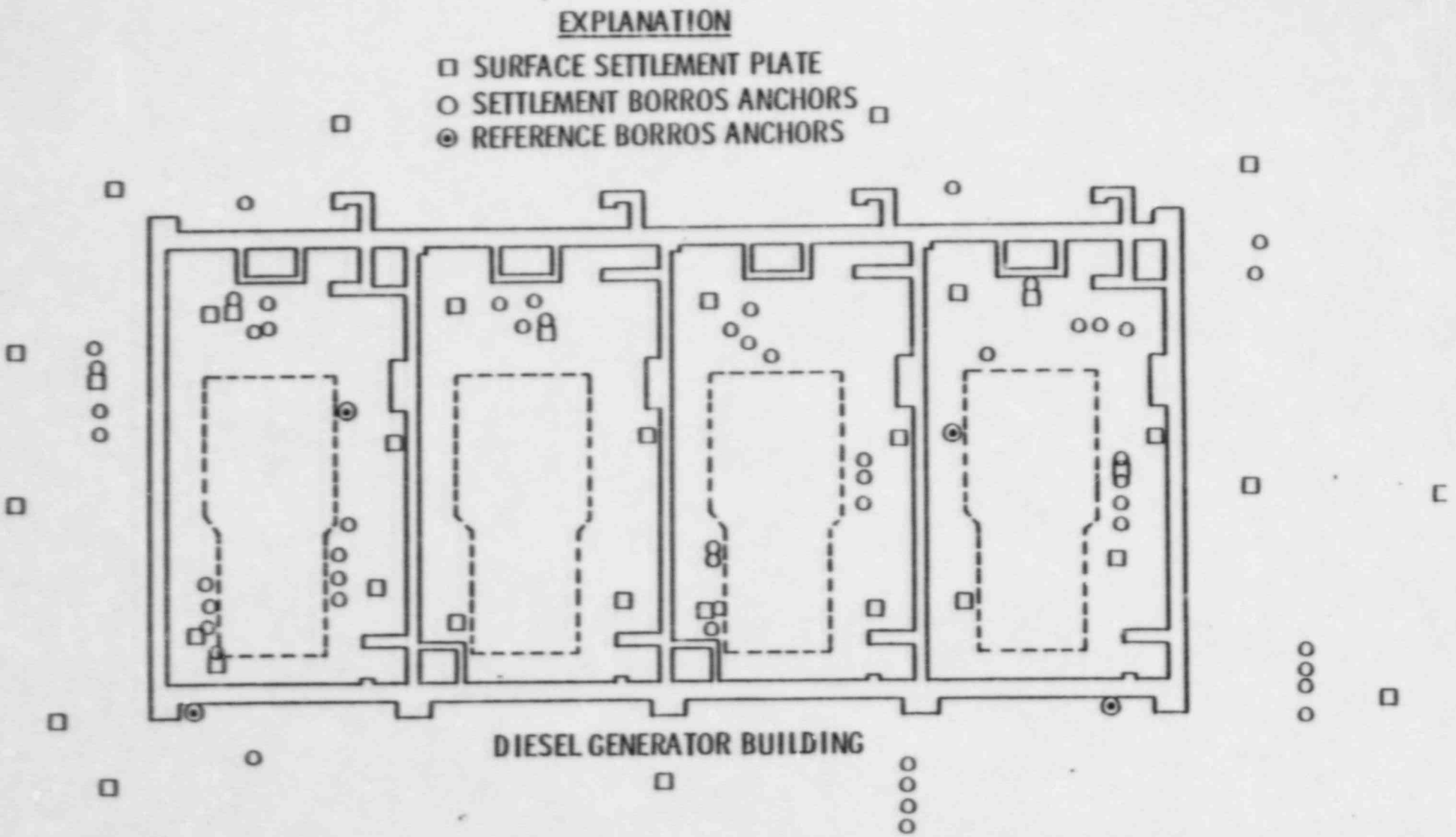


FIGURE 8 - SOIL SETTLEMENT MONITORING EQUIPMENT
DIESEL GENERATOR BUILDING

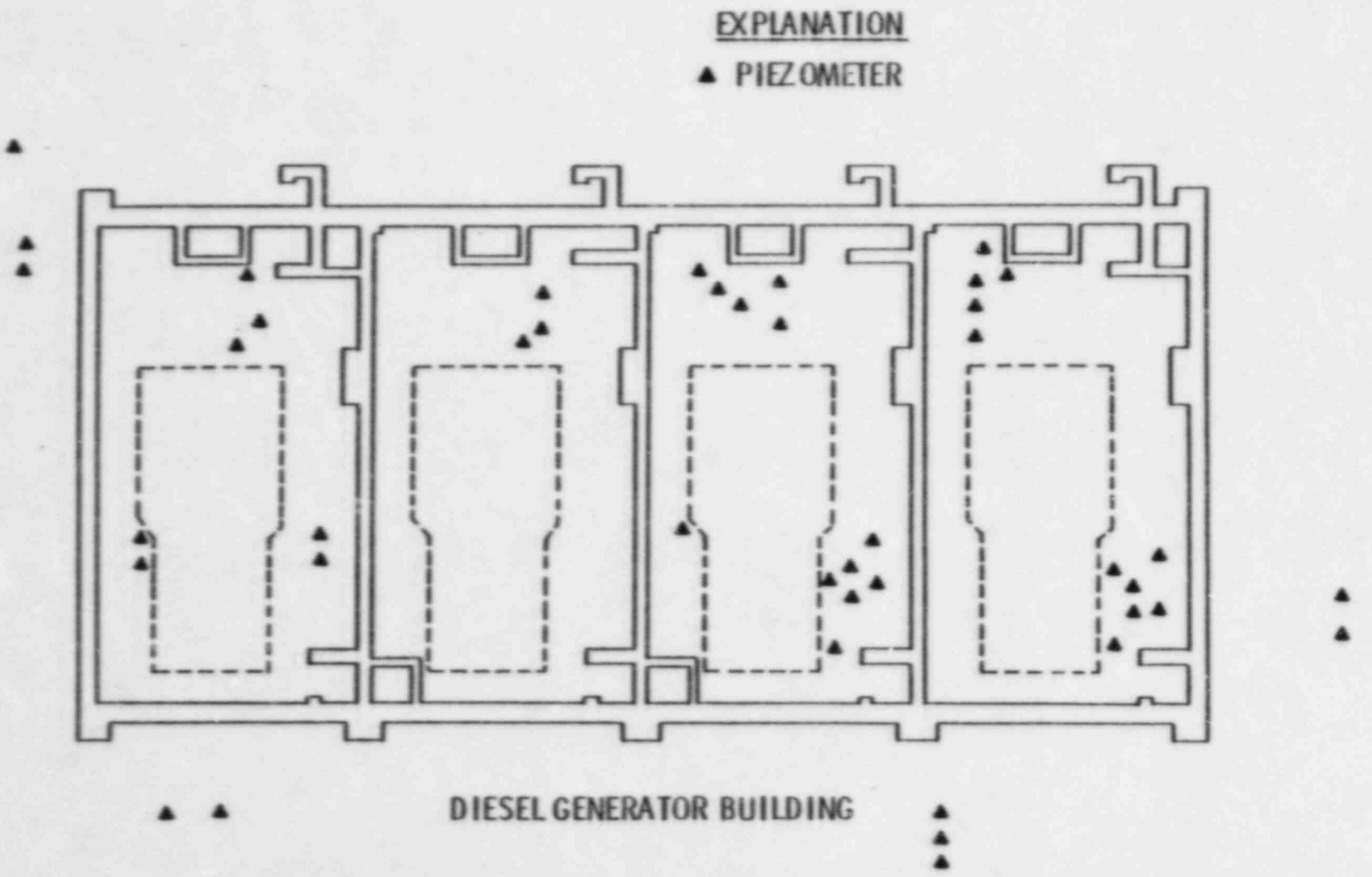
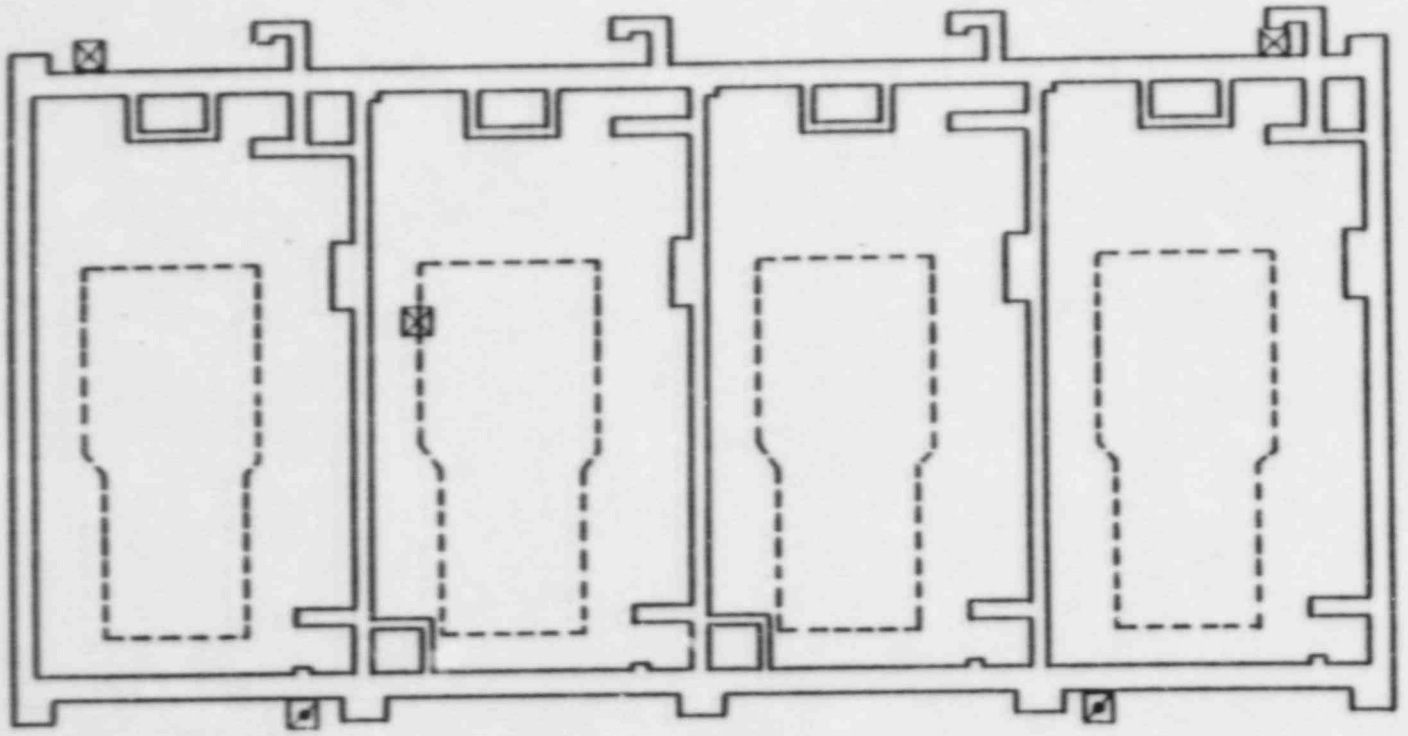


FIGURE 9 - PORE WATER PRESSURE MONITORING EQUIPMENT - DIESEL GENERATOR BUILDING

EXPLANATION

☑ SONDEX REBOUND INSTRUMENTS

☒ PROPOSED LOCATIONS OF REBOUND SONDEX



DIESEL GENERATOR BUILDING

FIGURE 10 - SOIL REBOUND MONITORING EQUIPMENT
DIESEL GENERATOR BUILDING

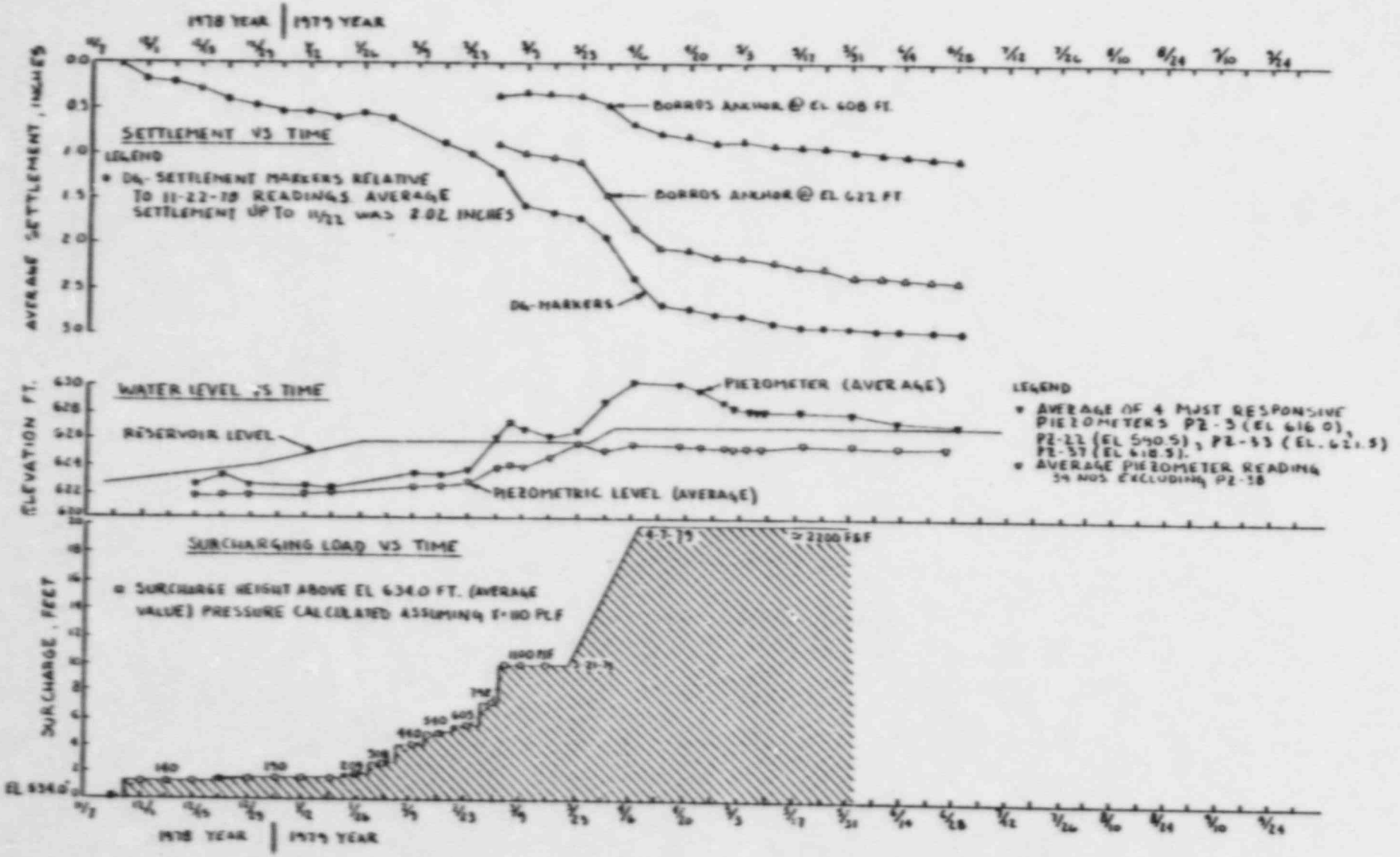


FIGURE 11 - DIESEL GENERATOR BUILDING: AVERAGE VALUE OF SETTLEMENT, SURCHARGE, AND WATER LEVEL VS. TIME

STRUCTURE	NO. of BORINGS	SUPPORTING FILL TYPE	PLANNED REMEDIAL MEASURES
A. AUXILIARY BUILDING			
1). CONTROL TOWER	3	SAND	NONE *
2). UNIT 1 ELECTRICAL PENETRATION AREA	2	SAND & CLAY	UNDERPINNING
3). UNIT 2 ELECTRICAL PENETRATION AREA	2	SAND & CLAY	UNDERPINNING
4). RAILROAD BAY	3	SAND	NONE
B. FEEDWATER ISOLATION VALVE PITS			
1). UNIT 1	2	SAND & CLAY	UNDERPINNING
2). UNIT 2	3	SAND & CLAY	UNDERPINNING
C. SERVICE WATER PUMP STRUCTURE - PORTION ON FILL	9	CLAY & SAND	UNDERPINNING

* GROUTING IS PLANNED BELOW MUD NOT AT AX - 9.

FIGURE 12A- SUMMARY OF FILL TYPE AND PLANNED REMEDIAL ACTION

STRUCTURE	NO. of BORINGS	SUPPORTING FILL TYPE	PLANNED REMEDIAL MEASURES
D. TANKS			
1). DIESEL FUEL OIL STORAGE TANKS	7	CLAY	NONE
2). BORATED WATER STORAGE TANKS	6	CLAY	NONE
E. DIESEL GENERATOR BUILDING	32	SAND & CLAY	SURCHARGE
F. UTILITIES			
1). PIPING	50	SAND & CLAY	NONE
2). DUCT BANKS	38	SAND & CLAY	NONE
3). VALVE PITS	2	SAND & CLAY	NONE

FIGURE 12B- SUMMARY OF FILL TYPE AND PLANNED REMEDIAL ACTION

Agenda Item 5.0

RBP

RALPH B. PECK CIVIL ENGINEER: GEOTECHNICS

23 July 1979
J958

Dr. Sherif S. Afifi
Bechtel Associates Professional Corporation
777 East Eisenhower Parkway
P. O. Box 1000
Ann Arbor, MI 48106

Dear Sherif:

Enclosed is a reconstruction of the remarks I made at our meeting with NRC on July 18.

Yours very sincerely,

Ralph

Ralph B. Peck

RBP/ajj

Enc.

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BECHTEL ASSOCIATES PROFESSIONAL CORPORATION
ANN ARBOR, MICHIGAN

EXHIBIT D

TECHNICAL SPECIFICATION

FOR

SUBCONTRACT FOR

UNDERPINNING, EXCAVATION, AND PLACING OF CONCRETE

FOR THE

CONSUMERS POWER COMPANY

MIDLAND PLANT UNITS 1 AND 2

MIDLAND, MICHIGAN

~~8405230044~~

No.	DATE	REVISIONS	BY	CH'K	APPR
0	6/2/83	Issued for Bids		BCH	

ORIGIN			JOB No. 7220	
BAPC	BECHTEL	CONSUMERS POWER COMPANY MIDLAND PLANT UNITS 1 AND 2 MIDLAND, MICHIGAN	SPEC DES GUIDE No	REV
			C-95(Q)	0

-6-100313

SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.
i	0	23	0	24	0								
ii	0	24	0	25	0								
iii	0	25	0										
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3	0	28	0										
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5	0												
6	0												
7	0												
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9	0	APPX.A											
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11	0	ATT.1											
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18	0	ATT.3	0										
19	0												
20	0	APPX.B											
21	0	22	0										
22	0	23	0										

NO.	DATE	REVISIONS	BY	CHK'D	APP'D	NO.	DATE	REVISIONS	BY	CHK'D	APP'D
0	8/2/79	ISSUE FOR BIDS									

BECHTEL

FACING SHEET

UNDERPINNING, EXCAVATION, AND PLACING OF CONCRETE
CONSUMERS POWER COMPANY
MIDLAND POWER PLANT UNITS 1 AND 2
MIDLAND, MICHIGAN

JOB No. 7220

C-95(Q)

REV. 0

TECHNICAL SPECIFICATION

FOR

UNDERPINNING, EXCAVATION, AND PLACING OF CONCRETE

CONTENTS

APPENDICES

1.0 SCOPE

1.1 ITEMS INCLUDED

The following work to be performed in accordance with this subcontract is located at Midland Plant Units 1 and 2. This specification includes Q-listed work where specifically noted and is to be performed in accordance with Subcontractor's QA program:

1.1.1 Underpinning the auxiliary building penetration rooms with caissons in the area indicated in the drawings

1.1.2 Removal of all unsuitable material as determined by Contractor and replacement of all removed material with concrete from under the feedwater valve pits

1.1.3 In addition, the following items are included under the scope of this subcontract:

a. Submit all drawings, calculations, and detailed procedures for a proposed type and method of underpinning which is best suited for the intended purpose and, as a minimum, meets all of the applicable criteria specified herein.

b. Furnish all labor, material, tools, equipment, supervision, design, and procedures to perform all operations and incidentals necessary to complete the work to the satisfaction of Contractor.

c. Provide (design, furnish, and install) local dewatering to remove and control all water which could cause soil movement.

d. Provide (design, furnish, and install) permanent support under the auxiliary building penetration rooms capable of withstanding approximately 4,000 kips vertical load at locations shown in the drawings without exceeding a 1/2-inch settlement (movement) of

the structure at points indicated in the drawings.

e. Provide (design, furnish, and install) permanent support under the turbine building along the K line to support the column and slab loads at columns 2.0, 2.5, and 3.0 for Unit 1 and 10.0, 10.5, and 11.0 for Unit 2, resulting from and including the temporary support of the valve pits as indicated in the drawings.

f. Provide hydraulic jacking capacity sufficient to simultaneously lift approximately 4,000 kips of structural load utilizing the permanent support as a reaction point.

g. Provide lateral support for the soil in the zone of influence resulting from excavation made during underpinning to prevent soil movement.

h. Place and cure lean concrete backfill under the designated buildings including encasement of the permanent caissons.

i. Provide positive contact between the underside of the building foundation and the lean concrete backfill by methods acceptable to Contractor.

j. Install styrofoam or similar material as indicated on the drawings.

k. Monitor the buildings for settlement.

1.2 ITEMS NOT INCLUDED BUT PERFORMED BY OTHERS

1.2.1 Area dewatering prior to underpinning and excavation

1.2.2 Temporary support (above the ground) of the feedwater valve pit for Units 1 and 2 as indicated in the drawings.

1.2.3 Disposing of the waste material from a stock pile to be located at the ground surface near Subcontractor's access shaft.

1.2.4 Furnishing and testing of lean concrete backfill

1.2.5 Furnishing and testing structural concrete

1.2.6 Furnishing reinforcing steel

1.2.7 Furnishing styrofoam

1.2.8 Soil testing

1.2.9 Monitoring the auxiliary building for cracks

2.0 ABBREVIATIONS

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ASTM	American Society of Testing Materials
AWS	American Welding Society

3.0 CODES, STANDARDS, AND REFERENCES

ACI 318-77	Building Code Requirements for Reinforced Concrete
ACI 543-74	Recommendation for Design, Manufacture, and Installation of Concrete Piles
AISC	Manual of Steel Construction, 7th Edition
ASTM A 36-77a	Specification for Structural Steel
ASTM A 53-77a	Specification for Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless Pipe
ASTM A 252-77a	Specification for Welded and Seamless Steel Pipe Piles

AWS D1.1-74 Structural Welding Code

Reference 1 Soft Ground Tunneling with Steel Supports, Commercial Shearing Inc., Proctor and White, Youngstown, Ohio, 1977 (used for definition of state and behavioral characteristics of soil)

4.0 DOCUMENTATION REQUIREMENTS

4.1 Engineering and quality verification documents shall be submitted to Contractor by the underpinning Subcontractor. Permission to proceed, based upon Contractor's review of the procedures, does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by Subcontractor and does not relieve Subcontractor from full compliance with contractual obligations. The submittal requirements are summarized in Form G-321-D attached. These requirements are augmented by detailed requirements in this specification.

4.2 As a minimum, Subcontractor shall submit the following procedures (in detail, including hold points and inspection points) to Contractor's satisfaction:

4.2.1 General Underpinning Procedure - This procedure shall include the overall concept of the work involved, including the interface of all the operations listed below.

4.2.2 Detection and Monitoring of Structural Movement Procedure

4.2.3 Local Dewatering Procedure

4.2.4 Support of Excavation, Bracing, and Lagging Procedure

4.2.5 Installation of Access Shafts Procedure

4.2.6 Permanent Support Procedure for approximately 4,000-Kip Caisson Capacity Installed Under Each Electrical Penetration Room

4.2.7 Pile and/or Caisson Installation, Cleaning, Concreting, and Testing Procedure

4.2.8 Lifting Procedure for Raising Ends of the Electrical Penetration Rooms Utilizing Approximately 4,000 Kips of Hydraulic Jacking Force

4.2.9 Mass Excavation and Removal of the Material Under the Structures Procedure

4.2.10 Installation of Styrofoam Procedure

4.2.11 Mass Concreting Procedure

4.2.12 Dry Packing/Pressure Grouting Procedure

4.2.13 Soil Grouting Procedure (Chemical and Cement)

4.2.14 Pump Tremie Procedure

4.2.15 Final Cleanup Procedure

4.2.16 Welding Procedures and Qualifications

5.0 MATERIAL REQUIREMENTS

Materials shall conform to the above standard specifications, and Subcontractor shall submit to Contractor certified copies of mill test reports of all material used as specified by the applicable ASTM specifications.

5.1 ASTM A 36: For structural steel and bearing plates

5.2 ASTM A 53: Types E or S, Grade B for piles and caissons

5.3 ASTM A 252: Grade 2 seamless for piles and caissons

6.0 DESIGN PARAMETERS

6.1 PILE AND CAISSON DESIGN

Piles or caissons may be used to underpin the turbine building along the K line adjacent to the valve pit structure. Only caissons shall be used to underpin the auxiliary building penetration rooms.

6.1.1 Piles shall be located at a minimum center-to-center spacing of 3.0 feet for 80-ton piles and 3.5 feet for 100-ton piles. The pile center to the edge of concrete shall be 1'3" for 80-ton piles and 1'6" for 100-ton piles.

6.1.2 Combination bearing/soldier piles shall penetrate a minimum of 5 feet into the till or natural dense sand strata as determined by the soil removed from the interior of the pile and the jacking resistance.

6.1.3 Maximum calculated soldier pile lateral deflection shall be limited to 0.25 inch due to bending under the combined axial and lateral loading.

6.1.4 Maximum calculated lagging member deflection due to bending shall be limited to 0.25 inch.

6.1.5 The lateral pressure diagram for soil pressure shall be trapezoidal with break points at 0.2 of the full excavated depth.

6.1.6 Bending stress reduction of lateral loads due to arching shall not be allowed.

6.1.7 Pile and caisson locations shall be taken into account in the support of the mudmat to prevent separation from the foundation.

6.1.8 A full water head shall be considered for lateral support from el 627' to the bottom of mass excavation under the structures.

6.1.9 Caissons shall extend at least 4.0 feet into the till or natural dense sand strata as evidenced by inspection of in situ material. The design bearing capacity shall be 20 ksf times the diameter squared (ft^2) of the caisson. If the caisson is belled, the capacity shall be calculated at 17.7 ksf times the plan area of the bell. No increase in capacity is allowed for additional embedment of the caisson in the bearing

strata.. Caissons acting as combination soldier and bearing elements are governed by the stress and deflection criteria from Sections 6.1.3 through 6.1.7.

6.1.10 The access shaft from el 634' to el 607' need not conform to Sections 6.1.3 to 6.1.8 but must be in accordance with acceptable industry practice.

6.1.11 For bearing plate design, the allowable bearing stress for concrete shall be 750 psi. Bearing stress for steel shall be 27,000 psi.

6.1.12 The design stresses shall not be greater than the allowable stress presented in AISC, ACI, or as specified herein. In the event of conflict, notify Contractor, who will determine the governing criteria.

6.2 DESIGN LOADS

6.2.1 Structure Loads

The load of each auxiliary building penetration room is equal to 8,300 kips (vertical). The center of gravity of the load is shown in the drawing. The allowable eccentricity of the underpinning support system during construction with respect to the east-west centroidal axis of the penetration room load is 3 feet.

Foundation pressure as well as local column loads for structures in the vicinity are shown in the drawings.

6.2.2 Soil Conditions

Soil conditions and interpretation of soil properties encountered are discussed below. In general, the backfill consists of heterogeneous mix of very loose to dense sand and very soft to hard clay fill. Details of soil information and boring logs are given in the foundation engineering sections of the PSAR and FSAR and are available from Contractor. The interpreted engineering properties of

backfill presented below are based upon the laboratory and field investigations performed in the vicinity of the diesel generator building.

a. Soft to stiff, silty, sandy clay fill (CL)

Total unit weight γt = 110 - 130 pcf

Dry unit weight γd = 93 - 116 pcf

Undrained shear strength = 150 - 3,000 psf

b. Loose to dense, silty, fine to medium sand (sm-sp)

Total unit weight γt = 110 - 130 pcf

Dry unit weight γd = 94 - 116 pcf

Angle of internal friction 28 - 32 degrees

c. In-Situ Fill

Total unit weight γt = 130 pcf

Average undrained shear strength
El 580-560' 6,000 psf

Below 560' 8,000 psf

6.2.3 The permanent support for each auxiliary building penetration room provided by underpinning shall have a vertical resistance capacity sufficient to produce a moment equal to or greater than 325,000 foot kips at column rows 5.3 and 7.8, respectively. This moment capacity is the major design criterion and shall be met by Subcontractor. The approximate value of 4,000 kips of installed capacity as referenced throughout this specification is an estimate of the actual caisson capacity. The exact capacity required is to be determined by Subcontractor. All pumps, jacks, gages, equipment, and other hardware shall be of sufficient capacity and number to install and

test, in accordance with this specification, the caissons that will produce a moment equal to or greater than 325,000 foot kips.

6.2.4 The permanent underpinning support for the turbine building shall be capable of safely resisting the column loads indicated in the drawings plus half the base slab pressure within the zone of influence. The zone of influence is defined by a slope of one horizontal to one vertical from the bottom of the excavation required for removal of the unsuitable material from under the valve pit structure. The permanent underpinning support for the turbine building shall take into account the 1,300 kips of force anticipated due to support of the valve pit structure.

7.0 PILE AND CAISSON LOAD TESTING

7.1 The vertical factor of safety established by in-place testing shall be not less than 1.5 for piles and caissons.

7.2 Test Method

7.2.1 The first caisson installed under each auxiliary building penetration room shall be load tested for 24 hours at 1.5 times the design load and 12 hours at 2.0 times the design load. The test load shall be applied in increments of 50%, 20%, 10%, 10%, and 10% of 1.5 times the design load at 1-hour intervals which are not included in the 24-hour period. At the completion of the 24-hour test at 1.5 times the design load, the load shall be increased to 2.0 times the design load in increments of 10% of the design load per hour. The load shall be maintained at 2.0 times the design load for 30 hours and then removed in decrements of 20% per hour to 80% of design load, then removed in decrements of 30%, and finally 50% at 1-hour intervals. This caisson selected for testing shall be representative of the majority of caissons to be installed.

7.2.2 All remaining caissons shall be loaded to 1.0 times the design load prior to concreting. This loading shall be referred to as the Empty Shell Test (EST). A satisfactory EST is defined as causing a caisson movement of less than 0.10 inch in a 5-minute period under a load equal to 1.0 times the design load.

7.2.3 After the EST and concreting of the caisson, the caisson shall be subjected to a Full Test Load (FTL). A satisfactory FTL is defined as causing a caisson movement of less than 0.05 inch in a continuous 1-hour period under a load equal to 1.5 times the design load. Extensometers (AMES) dial gages shall be calibrated to 0.001 inch per revolution and used to measure the movement of the caisson relative to the structure.

7.2.4 After installation of a group of caissons which constitute 500 design tons of underpinning resistance and prior to the completion of the caissons of the next group, one caisson in the previous group shall be chosen by Contractor for retesting. The caisson shall be tested for a period of 5 minutes at 1.5 times the design load. A satisfactory test shall be one where less than 0.010 inch of settlement occurs from the start of the test to the end of the test. If the test is satisfactory, the work on the next group may continue. If the test is not satisfactory, the caisson being tested shall be unloaded and retested in accordance with the requirements of FLT (Section 7.2.3). Then one more caisson in the group shall be subjected to the 5-minute and 0.01-inch settlement test. If the second caisson retested is satisfactory, the work on the next group may continue. If it is not satisfactory, repeat the procedure on caissons selected by Contractor until a satisfactory 5-minute and 0.01-inch settlement test is achieved before proceeding with the work.

After completion of the FLT (Section 7.3.2) or 5-minute retest, the caissons shall be locked off (wedged tight) at 1.5 times the design load.

7.2.5 During the period of the test performed in Section 7.2.1, neither jacking against the structure nor any work which causes vibrations or may otherwise affect the test results shall be permitted.

7.3 The test method for the piles and/or caissons under the turbine building adjacent to the valve pit structure shall be in accordance with Section 7.2.

8.0 UNDERPINNING AND SUPPORT OF STRUCTURES

8.1 GENERAL

Subcontractor shall provide the necessary underpinning and permanent support for the auxiliary building penetration rooms for Units 1 and 2 in accordance with the requirement of this specification and as shown in the drawings.

In addition to the underpinning work shown in the subcontract drawings, Subcontractor shall take all other action necessary to maintain the integrity of these buildings. Subcontractor shall be responsible for supporting structures and taking all necessary precautions to prevent the settlement (movement) greater than specified in this specification or cracking of the buildings, including slabs on grade, supported slabs, appendages, interior partitions, and other columns and walls.

8.2 RESPONSIBILITY

Subcontractor shall conform to the following.

8.2.1 Assume full responsibility for all underpinning and related operations. Take necessary precautions for protection of persons, and preclude damage to property, including structures which are underpinned or affected by underpinning work.

8.2.2 All underpinning operations shall conform to applicable codes and also meet requirements of other authorities having jurisdiction over the work involved.

8.2.3 The maximum settlement (movement) of the auxiliary building penetration rooms and the turbine building along the K line for Units 1 and 2 shall not exceed 1/2 inch.

8.3 TEMPORARY SUPPORT

Prior to underpinning for Unit 1 and 2 operations, the feedwater valve pits will be temporarily supported by Contractor as shown in the drawings. The feedwater valve pits shall not be subjected to any additional vertical loads or external forces by Subcontractor during the underpinning operation.

8.4 PILE AND CAISSON INSTALLATION

8.4.1 General

The piling or caisson shall consist of a concrete-filled steel pipe. The steel pipe shall be installed by jacking against the existing structure. The pipe shall be precut to a convenient length for jacking. The pipe segments shall be joined together by full penetration welds around the circumference as the pipes are advanced into the subsurface.

The pipe shall be installed open-ended to the depths specified. The pipe shall then be subjected to the EST (Section 7.2.2), cleaned, inspected, concreted, subjected to the FLT (Section 7.2.3), and wedged tight to the structure under a load equal to 1.5 times the design load.

8.4.2 Materials

Steel pipe shall conform to ASTM A 252, Grade 2 seamless or ASTM A 53, Types E or S, Grade B. It shall have a minimum wall thickness sufficient to sustain the design load of the pile or caisson calculated at f_a = 18,000 psi. All cutting of the pipe shall be done in such a manner that the cut edge shall be perpendicular to the longitudinal axis of the pipe. Flame cutting is permitted. Beveling of edges for welding shall be done in such a manner to ensure a true cut. Internal or external pipe couplings, whether mechanical or welded, are not permitted. The pipe tip shall be reinforced by a steel shoe or by increasing the wall thickness of the lowermost section of pipe. The reinforcement shall be sufficiently strong to sustain a static point load equal to the maximum jacking force without permanent deformation of the lowermost pipe section. The shoe diameter or outside diameter of the lowermost pipe section shall not exceed the diameter of the remaining pipe section by more than 1/4 inch. Steel friction breakers may be installed on the outside of the pipe by welding. Friction breakers will not extend more than 1/8 inch beyond the outside of the pipe.

8.4.3 Pile Installation

a. The plan location shall be established at the bottom of the concrete slab at el 607'±. The tolerance for the plan location shall be ±5 inches, but the algebraic aggregate of the deviations shall not exceed ±5 inches.

b. The allowable top-to-bottom plumbness of the pile shall be not more than 2% out over the entire length. If the plumbness is more than 2% over the entire length, Subcontractor shall reduce the

design load on the pile accordingly.

c. The maximum deviation for pile straightness shall be 1/2 inch in 10 feet and 1/2 inch in 20 feet.

d. If any criteria specified in Items a, b, or c of Section 8.4.3 are not satisfied, Subcontractor shall calculate the allowable reduced design capacity of the pile in accordance with generally acceptable methods. Calculations shall be submitted to Contractor for review. Subcontractor shall not be permitted to increase the load on other piles to compensate for the reduction caused by failure to achieve the requirements stated in Items a, b, or c of Section 8.4.3. All additional piles which shall be installed to compensate the loss of capacity shall be at the expense of Subcontractor.

e. The maximum jacking force shall be 1.50 times the design pile load or 0.85 fy prior to the reduction for L/r ratio or 0.70 fy as indicated in the certified material test report prior to reduction for L/r ratio. A commercial grade bentonite slurry may be injected between the pipe and the soil to minimize side wall friction.

f. Maintain a minimum of a 1-foot (vertical measurements) soil plug in the pile at all times unless an obstruction is encountered. If an obstruction is encountered, then maintain a liquid level inside the pile to within 5 feet of the bottom of the jacking pit, and limit the removal of material beyond the existing tip of the pile to less than 1 foot except by specific written instructions by Contractor.

g. No water jetting, slurry jetting, or air jetting for loosening or removal of material inside or in advance of the pile is permitted except by written permission from Contractor.

h. No airlifting or venturi principle lifting of the material in the pile or in advance of the pile is permitted within 5 feet of the pile tip except after final seating of the pile in the till. If air or venturi lifting is employed, Subcontractor shall maintain a liquid level in the pile at the bottom of the jacking pit during the entire operation. Contractor shall be notified in advance and in writing each time Subcontractor employs this procedure.

i. No impact or vibratory forces may be used for advancing the pile.

j. Inspection of piles prior to concreting shall be accomplished by visual inspection and measurements inside the pile. Subcontractor shall make a final cleaning of the pile and remove all water and deleterious matter from inside the pile. The pile will then be inspected by Contractor, who will give written permission to Subcontractor to place concrete in the pile. The maximum length of earth plug at the pile tip prior to concreting is 1'-6" of compact material.

k. The concrete for the pile shall be placed in such a manner that the concrete drops vertically from the top of the pile. Subcontractor shall take necessary measures to prevent segregation and voids in the concrete during placing.

1. Contractor reserves the right to direct Subcontractor to use the pumped tremie method for concreting the piles without employing the grout plug.

8.4.4 Caisson Installation

a. The plan location shall be established at the bottom of the concrete slab at elevation 607'±. The allowable deviation from the plan location shall be ±5 inches, but the algebraic aggregate of the deviation shall not exceed ±5 inches.

b. The allowable top-to-bottom plumbness of the caisson shall be not more than 2% out over the entire length. If the plumbness is more than 2% over the entire length, Subcontractor shall reduce the design load on the caisson accordingly.

c. The maximum deviation for caisson straightness shall be 1 inch in 10 feet and 1 inch in 20 feet.

d. If any criteria specified in Items a, b, or c of Section 8.4.4 are not satisfied, Subcontractor shall calculate the reduced allowable design capacity of the caisson in accordance with generally acceptable methods. Calculations will be submitted to Contractor. Subcontractor shall not be permitted to increase the load on other caissons to compensate for the reduction caused by failure to achieve the requirements stated in Items a, b, and c of Section 8.4.4. All additional caissons shall be at the expense of Subcontractor.

e. The maximum jacking force shall be 0.85 fy prior to the reduction for the L/r ratio or 0.70 fy as indicated in the certified material test report for the steel shell (prior to reduction for L/r

ration) or 800 kips, whichever is less. A commercial grade bentonite slurry may be injected between the pipe and the soil to minimize side wall friction.

f. No water jetting, slurry jetting, or air jetting for loosening or removal of material inside or in advance of the caisson is permitted except by written permission from Contractor.

g. No airlifting or venturi principle lifting of the material in the caisson or in advance of the caisson is permitted within 5 feet of the caisson tip except after final seating of the caisson in the till. If air or venturi lifting is employed, Subcontractor shall obtain written permission from Contractor, and then maintain a liquid level in the caisson at the bottom of the jacking pit during the entire operation.

h. Caisson linings shall be of adequate thickness to ensure safe working conditions within the caissons.

i. The straight-shafted portion of the metal-lined caissons shall be limited in plan area to 16 square feet.

j. Metal-lined caissons with belled or wedge-shaped bottoms shall not have the top bell started until the shaft has penetrated only into the clay till a minimum of 2 feet.

k. The bell angle shall be a minimum of 60 degrees from the horizontal. The bell shall be lined for depths in excess of 4 feet below the straignt shaft. The annulus (void) between the straight shaft liner and the ground shall be grouted and cured for 24 hours prior to starting excavation of the bell.

l. If squeezing ground (as defined in Soft Ground Tunneling with Steel Supports by Proctor and White) is encountered, Subcontractor shall proceed in such a manner that no ground is lost. Methods acceptable for this operation are as follows:

   1. Jacking the lining past the squeezing zone without removal of material

   2. Drilling under bentonite slurry and jacking (Drilling cannot proceed in excess of 1 foot beyond end of lining.)

m. If running ground (as defined in Soft Ground Tunneling with Steel Supports by Proctor and White) is encountered, the following methods for advancing are acceptable.

   1. Jacking the lining past the running zone without removal of material

   2. Drilling under bentonite slurry and jacking (Drilling cannot proceed in excess of 1 foot beyond end of lining.)

   3. Grouting

n. If flowing ground (as defined in Soft Ground Tunneling with Steel Supports by Proctor and White) is encountered, stop excavation, fill caisson with water or slurry, give written notice of the condition to Contractor, and await written direction from Contractor prior to proceeding.

o. Concreting shall not be performed until Contractor has inspected the bottom and bell of the caisson and made measurements for plumbness, straightness, and location.

p. The concrete for the caisson shall be placed in such a manner that the concrete drops vertically from the top of the caisson. Subcontractor shall take necessary measures to prevent segregation and voids in the concrete during placing.

q. Contractor reserves the right to direct Subcontractor to use the pumped tremie method for concreting.

8.5 JACKING AND TESTING EQUIPMENT

8.5.1 The jacking and testing apparatus is to be actuated by hydraulic pressure generated by electrically or mechanically driven pumps. All high-pressure hydraulic apparatus shall be kept in a state of good maintenance.

8.5.2 All jacking and testing apparatus shall be equipped with two hydraulic pressure gages. The pressure gages for the production jacking equipment shall have a minimum face diameter of 2 inches. Testing equipment for the 24-hour load test (Section 7.2.1) shall have gages with a minimum 6-inch diameter face calibrated so that 270 degrees of dial movement covers the operating range of the equipment. Test equipment for the FLT (Section 7.2.3) shall have 4-inch diameter gage faces and be calibrated so the 270 degrees of dial movement cover the operating range of the equipment.

8.5.3 Subcontractor shall have the following hydraulic pressure gages at the job: three 8-inch face, three 6-inch face, and three 4-inch face gages calibrated with the specific rams intended to be used with each set of gages. The calibration shall be performed and certified by an independent laboratory which specializes in that type of work no earlier than 1 month prior to load testing. The calibration certificates shall be submitted to Contractor.

8.5.4 The gages and rams referred to in Section 8.5.3 shall hereafter be referred to as the master set. The master set shall not be used in the field operations except for the 24-hour load test. The master set shall be kept in a place suitable to Contractor and shall be used for calibrating all gages used in the field.

8.5.5 Subcontractor shall furnish a test manifold and test stand which will enable Subcontractor to field-calibrate four field gages simultaneously in the same hydraulic circuit as the respective three master gages and ram. Subcontractor shall notify Contractor in writing when field calibrating of gages will be done. Contractor will have a representative present during field calibration. The field gages shall be calibrated against a master set having a larger gage face. The results of the field calibration shall be forwarded to Contractor following the calibration.

8.5.6 Each field and master gage shall be assigned a unique identification number, and that number shall be engraved on the gage cover and also be painted on the gage back. In addition, a suitable calibration curve or tabulation for the particular gage shall be afixed to the back of the gage by means of a clear, sticky, celluloid cover. If gage face overlays are used, this is equally satisfactory.

8.5.7 Recalibration of the master sets is required at a minimum of every 3 months. This should be scheduled so there is at least one set of 6-inch or larger master gages on the project at all times. In addition, the master gages shall be recalibrated any time that one master gage varies by more than 5% of its calibrated rating as established by the other two master gages in the same master set. Field gages shall be recalibrated monthly or at any time when one gage is broken or damaged or when one gage varies by more

than 10% from its calibrated rating as established by its companion gage.

8.5.8 The field testing apparatus shall contain a snubber valve in the hydraulic circuit. The snubber valve shall be located on the high-pressure side between the tandem gages and the pump, and immediately behind the gages. For the FLT (Section 7.2.3), the snubber valves shall be closed when the ram attains the test load and shall stay closed until either the movement of the pile exceeds 0.05 inch, or when the FLT (Section 7.2.3) with less than 0.05 inch has occurred. Movement (not gage pressure) is the testing criterion for the FLT (Section 7.2.3). However, if the gage pressure drops by more than 10% during the FLT (Section 7.2.3), the test shall be restarted. For the 24-hour load test, the gage pressure required shall be maintained throughout the test period.

8.5.9 During the underpinning operation, Subcontractor shall have available at the site all rams, gages, pumps, hose, and fittings required to simultaneouly lift the auxiliary building penetration area at the location of the permanent support. The total lifting capacity required is approximately 4,000 kips, which is to be distributed equally as specified in Section 6.2.3.

8.6 DETECTION OF MOVEMENT

8.6.1 General

Subcontractor shall submit and implement to the satisfaction of Contractor a procedure to monitor each structure which might be affected by the underpinning operations.

8.6.2 Horizontal movement detection points shall be located at or near the top and at the ground level of the structures. Vertical movement detection points shall be located near the ground level of the structures.

8.6.3 Measurements shall be to the nearest 1/16 inch based upon survey observation.

8.6.4 Measurements shall be made daily during the underpinning operation, and Contractor shall be informed in writing if any movement is detected in excess of 1/16 inch of the previous reading or accumulated value of 1/8 inch.

9.0 WELDING

9.1 All welding shall be performed in accordance with AWS D1.1. Contractor shall approve all welding procedures.

9.2 All welders shall be qualified to the applicable welding procedures in accordance with AWS D1.1.

10.0 EXCAVATION

10.1 GENERAL

Subcontractor shall submit prior to excavation a detailed procedure describing the method of excavation. This procedure shall be to the satisfaction of Contractor and shall indicate coordination of the installation of lagging and bracing. The procedure shall also indicate the maximum amount of excavation below any previously installed lagging or structure. As a minimum, the excavation procedure shall include the following.

10.1.1 The location and dimension of each jacking pit

10.1.2 A flow diagram showing the excavation of all pits and the sequence of installation, testing, and locking off vertical support elements (caisson or jacked pile).

10.1.3 A table relating the information provided in Item 10.1.2 showing the following data with respect to each vertical support element:

a. Pile or caisson number

b. Pit number

c. Sequence number

d. Vertical capacity installed (kips)

e. Area undermined times 5.5 kips/ft (Note: The area undermined includes the disturbed but not excavated soil (influence zone) determined by a 1 horizontal to 3 vertical slope subtended from the bottom of the excavation prior to the installation of the lagging. Thus, a pit which is opened up to a depth of 6 feet prior to the installation of the lagging would have an influence zone which extended 2 feet beyond the edge of the excavation. If this same pit was subsequently (after installation of lagging) excavated to a greater depth, and lagging was installed as frequently as required by this specification, the influence zone would remain at 2 feet.)

f. Net overload (Item e) minus (Item d) (kips)

g. Percent net overload (Item f) times (100) divided by 8,300 kips

10.1.4 Sequence Control and Limits

In general, the objective is to install approximately 4,000 kips of underpinning resistance as close to the extreme end of the wings as possible. Subcontractor's plan shall be governed accordingly.

a. Piles which are adjacent to one another may be worked simultaneously provided the area of undermine is within allowable limits

b. Caissons which are adjacent to one another cannot be worked simultaneously. Where there are adjacent caissons, one must be excavated, concreted, tested, and stressed before work on any adjacent caisson can start. However, the first 7 feet below el 607' may be excavated in advance (if the space is required) for access to a nonadjacent caisson or pit.

10.2 Once an excavation is started, it must be worked continuously and without cessation until the lagging is in place and the lateral ground support restored.

10.3 Explosives shall not be used to dislocate and/or remove hardened material during excavation. Conventional tools, such as rock splitters and demolition tools, are acceptable.

10.4 Subcontractor shall submit the following procedure that is satisfactory to Contractor. This procedure shall describe in detail the measures, including hold points and inspection points, taken by Subcontractor to ensure slope stability and to prevent any movement of foundation material outside the excavation area.

10.5 Prior to excavation of material from under or within 7 feet from the foundations of the auxiliary or turbine buildings, the sand material shall be grouted. The pregrouted zone shall extend vertically from the underside of the existing foundation or mudmat to a depth of approximately 1 foot below the access excavation, or approximately 7 feet beyond the farthest lateral extent of the excavation.

10.6 The initial excavation below the bottom of the slab at el 607'± shall not exceed 7 feet in depth. In addition, in no case shall the jacking pit exceed 7 feet in depth.

10.7 The percent net overload as established by Section 10.1.3 shall not exceed 10% during installation of approximately 4,000 kips of permanent support capacity under each electrical penetration room.

10.8 Subcontractor shall advance the mass excavation under the valve pit structures to the depth determined by Contractor. The bottom surface shall then be prepared for concreting as follows.

10.8.1 The surface shall be flat but sloped to a minimum of 1/4 inch per foot draining toward a sump located in one corner.

10.8.2 Subcontractor shall dispose of all water in the sump to the satisfaction of Contractor.

10.9 LAGGING INSTALLATION

10.9.1 All lagging material that will remain in the ground shall be metal or concrete. Any wooden lagging used for jacking pit lining or any other purpose must be removed. If removal of the lagging exposes earth, which will not be excavated, then the unremoved soil shall be grouted prior to removal of the lagging. The object of the grouting is to ensure intimate contact between the soil and the structure, and where granular soil is involved, to ensure the material in the zone of influence is self-supporting.

10.9.2 The initial excavation, where the earth is not supported, shall not exceed a depth of 4 feet if it is within 6 feet of the K line. Otherwise, a maximum depth of 7 feet shall be used.

10.9.3 After initial excavation, the lagging shall be installed and back packed or grouted. The lagging along the K line located below el 600.0' shall be grouted.

10.9.4 The excavation shall not proceed to a depth greater than 3 feet below the previously grouted lagging.

10.9.5 The procedure for installation of the lagging below el 600' along the K line shall indicate the maximum vertical distance between unpacked lagging and the bottom of the excavation. This distance shall not exceed 16 inches.

10.9.6 If squeezing ground (as defined in Soft Ground Tunneling with Steel Supports by Proctor and White) is encountered below el 600', Subcontractor shall employ a Chicago lagging system (near vertical-driven lagging) for advancing. The advance shall be limited to a maximum of one-half the length of the lag. After advancing one-half a lag, the lower breasting member shall be installed and the lagging wedged.

10.9.7 If running ground (as defined in Soft Ground Tunneling with Steel Supports by Proctor and White) is encountered below el 600', the zone shall be grouted in advance of excavation. Spieling is not a satisfactory procedure for running ground.

10.9.8 If flowing ground (as defined in Soft Ground Tunneling with Steel Supports by Proctor and White) is encountered, Subcontractor shall immediately close the opening from which ground is flowing, dewater the area to the extent that the ground behavior is changed to a running condition, and then proceed in accordance with Section 10.9.7.

11.0 CONCRETING

11.1 GENERAL

Subcontractor shall submit to the satisfaction of Contractor a detailed procedure, including hold points and inspection points, describing the placing of concrete under the structure. As a minimum, the placing and consolidating of the concrete shall be in accordance with Articles 11.0 and 12.0 of Specification 7220-C-231, unless otherwise specified herein.

11.2 Pile, pit, and caisson procedures are specified elsewhere.

11.3 Mass concrete shall first be placed in the corner opposite the sump such that any water shall be driven to the sump as the concrete is placed.

11.4 The first lift shall not exceed 2 feet in thickness; all subsequent lifts shall not exceed 5 feet in thickness.

11.5 Successive lifts shall be doweled into the preceding lift by using #8 bars on 18-inch centers on a grit pattern. Dowels shall be located such that a minimum of 24 inches shall be embedded in both lifts.

Reinforcing steel will be furnished by Contractor.

11.6 The surface of the concrete lifts shall be horizontal within ±3 inches for the entire area.

11.7 The top lift shall be placed to within 6 inches of the bottom of the existing slab. The remaining void between the lean concrete backfill and the foundation slab shall be either dry pack grouted or pressure grouted using a nonshrink grout. Subcontractor, shall submit a procedure to the satisfaction of Contractor, including hold points and witness points, describing in detail the method of dry pack grouting or pressure grouting.

11.8 Each lift of concrete shall be water cured for a minimum of 48 hours in accordance with ACI 318-1977 before continuing the placement.

11.9 Contractor will perform slump, percent air content, temperature, unit weight, and compressive strength cylinders on the lean concrete placed, and perform a compressive strength test on the grout used.

Subcontractor shall assist contractor when performing all grout and concrete testing.

11.10 Preceding the placing of concrete, Subcontractor shall install 2-inch styrofoam along the containment structure and 3-inch styrofoam between the containment and auxiliary buildings. Subcontractor shall submit a procedure for installing the styrofoam to the satisfaction of Contractor.

12.0 CLEANING AND RESTORATION

Subcontractor shall restore the work area to the same condition that existed prior to the start of operation and to the satisfaction of Contractor.

Subcontractor shall also submit a procedure on final cleaning.

13.0 QUALITY ASSURANCE REQUIREMENTS

13.1 GENERAL

The following operations are to be controlled in accordance with Subcontractor's approved QA program (Subcontractor's QA program shall be in accordance with Specification 7220-G-23, Appendix A, Attachment 2):

13.1.1 The design, materials, installation, testing, concreting, grouting, and all other incidentals for the permanent underpinning (caissons) of the auxiliary building penetration rooms

13.1.2 The excavation, mass concreting, and grouting under the valve pit structures

13.1.3 As a minimum, the following sections of this specification are under the scope of Subcontractor's QA program: 5.0 , 6.1.4, 6.1.5, 6.1.6, 6.1.7, 6.1.8, 6.1.9, 6.1.11, 6.1.12, 6.2.1, 6.2.2, 6.2.3, 7.1, 7.2, 8.1, 8.2, 8.4.1, 8.4.2, 8.4.4, 8.5, 8.6, 9.0, 10.1, 10.4, 10.5, 10.6, 10.7, 10.9, and 11.0. These sections are applicable only with the work defined in Sections 13.1.1 and 13.1.2.

13.2 Because of the nature of the work, an independent overlay inspection will be performed by Contractor in accordance with this specification and Subcontractor's procedures.

14.0 MEASUREMENT OF PAYMENT

The measure of payment for this subcontract shall be in accordance with the pricing structure of the contract.

APPENDIX A

QUALITY ASSURANCE REQUIREMENTS FOR Q-LISTED ITEMS AND WORK

1.0 Subcontractor shall establish and maintain an effective quality assurance program which will meet the applicable requirements of Specification G-23 to ensure that all materials and workmanship furnished hereunder for Class I structures conform to the specifications.

2.0 Contractor shall have free access to all work and shall have the authority to stop work or reject shipment if the specification requirements, including those for documentation, have not been fulfilled.

3.0 Subcontractor shall furnish documentation in accordance with the specifications as summarized and directed by Form G-321-D. To complete Form G-321-D, Subcontractor shall check in column 8 which documents are being transmitted, and shall sign line 21. Subcontractor shall fill in lines 13 through 20 as applicable. Entries such as N/A or NA (not applicable) and "see attached sheets" are permissible. Form G321-D completed is then used for a cover sheet as directed on the back of the form.

Attachments:

1. Form G-321-D, Engineering and Quality Verification Document Requirements. Rev. 0

2. Specification 7220 G 23, General Requriements for Supplier Quality Assurance Programs, Rev. 7

3. Data Sheet 1, Quality Assurance Program Elements, Rev. 0

Appendix A
Attachment 1

READ INSTRUCTIONS ON BACK BEFORE FILLING IN FORM

These requirements for Engineering and Quality Verification Documents are to be fulfilled in accordance with the schedule set forth below. Supplier's failure to comply with these requirements may result in order cancellation or withholding of payment until compliance is established.

1. Document Category Number	2. Specification Paragraph Reference	3. Kind of Copies	ENGINEERING DOCUMENTS 4. Quantity Required Initial	4. Quantity Required Final	5. Prior Approval Required Yes	5. Prior Approval Required No	QUALITY VERIFICATION DOCUMENTS 6. Quantity Required for Release	7. Distribution Code	8. Supplier Conform Check	9. Inspection Release	10. Engineering Review	11. Field QCE Check In	12. Remarks
		Reproducible											
		Microfilm											
4.1E	4.2	Reproducible	1	1			N/A						For each procedure listed in par. 4.2
		Microfilm			X								
17.1	5.0	Reproducible		N/A			1	C					
		Microfilm				X							
8.0E	6.0	Reproducible	1	1			N/A						
		Microfilm			X								
1.1E	6.0	Reproducible	1	1			N/A						
		Microfilm			X								
25.0V	8.6.4	Reproducible		N/A			1	C					
		Microfilm				X							
12.0E	9.1, 9.2	Reproducible	1	1			N/A						
		Microfilm			X								
6.0E	13.0	Reproducible	1	1			1	C					A controlled copy to be sent to Q.C. and Engineering
		Microfilm			X								
		Reproducible											
		Microfilm											
		Reproducible											
		Microfilm											
		Reproducible											
		Microfilm											
		Reproducible											
		Microfilm											

13. Supplier's Order No.	14. Supplier's Part No.	15. Supplier's Part Name	16. Quantity
17. Buyer's Req. Item No.	18. Buyer's Line/Equip., Tag or Code No.	19. Buyer's Part Name	20. Traceability

21. Supplier's Conformance Statement — We certify that the listed work and required documents meet the requirements of the procuring documents. Supplier _____ Signature _____ Title _____ Date

22. Inspection Release Statement — Work was released based on satisfactory completion of inspection and review of documentation. Authorized Deviations ☐ YES, Noted under 12, Remarks ☐ NONE. Bechtel Inspector _____ Signature _____ Date

23. Engineering Review Statement — The Quality Verification Documents submitted to Engineering with this form have been reviewed for conformance to the specified requirements and are acceptable. Engineer _____ Signature _____ Date

24. QCE Check-in Statement — The form and the Quality Verification Documents referenced hereon have been received and their relationship to the hardware items verified. CONTROL NO. _____ FILE NO. _____ QCE _____ Signature _____ Date

After QCE Check-in Distribute to: Procurement Manager, Field Office Manager, Material Supervisor

G-321-0
AA REV 2
5/74

MIDLAND PLANTS - UNITS 1 & 2
CONSUMERS POWER COMPANY

JOB NO. 7220
P.O./SPEC. NUMBER C-950

ENGINEERING AND QUALITY VERIFICATION DOCUMENT REQUIREMENTS

SHEET 1 OF _ REV. 0

QUALITY VERIFICATION DOCUMENT TRANSMITTAL-REPRODUCE THIS SIDE ONLY

INSTRUCTIONS FOR PREPARING G-321-O

A. PURPOSE: This is a multi-purpose form to be used by Buyer/Contractor to specifically identify documents required of the supplier to satisfy specification requirements, and is to be used by the supplier as a cover sheet for Quality Verification Documents when submitting them to the Buyer/Contractor.

B. GENERAL INFORMATION: Engineering (E) and Quality Verification (V) Documents are identified by Category number and title in section H. below.

C. USE: A copy of the front of this form shall be completed by the supplier and provided to the Buyer's/Contractor's inspector along with the applicable Quality Verification Documents for his review prior to release of the unit(s).

D. DISTRIBUTION: All Engineering (E) Documents are to be sent to the Project Engineer at the address shown below (Code a).

When inspection release is completed, the Verification (V) Documents are to be distributed to the respective addresses shown below in accordance with the distribution code specified in Column 7. A copy of the completed Form G-321-O must accompany each "package" of Verification Documents to its destination. Also, a copy of completed Form G-321-O is to be included with the hardware shipment and a copy sent separately to the Project Field Quality Control Engineer at the jobsite.

Code a.
Bechtel Associates Proffessional Corp.
P. O. Box 1000
Ann Arbor, Michigan 48106
Attn: Project Engineer, Job 7220

Code b. With hardware shipment
Bechtel Power Corp.
3500 E. Miller Road
Midland, Michigan 48640

Code c.
Bechtel Power Corp.
P. O. Box 2167
Midland, Michigan 48640
Attn: Quality Control Engineer

E. DEFINITIONS OF TERMS (See also Document Category Definitions G-321-SUP A)

Supplier – This is a generic term and is synonymous with the terms seller, vendor, contractor, sub-contractor sub-supplier, etc.
Reproducible – can be legibly duplicated by either microreproduction or electrostatic dry process.
Microfilm – 35mm microfilm conforming to the requirements of the procurement documents. When not specified, supplier shall submit his standard for approval.
Prior Approval Required – Bechtel approval required prior to use of documents in the design, fabrication, installation, or other work process.
Initial – the first submittal of a document in accordance with the schedule mutually agreed to by the Buyer and the supplier.
Final – the submittal that reflects the resolution of review comments, or the complete submittal required. Both are to be accepted prior to rendering final payment. Drawings submitted as final must be full size reproducibles made from original document. Adjacent to the title block, each drawing must be certified and show Buyer's job title, job number, purchase order number, line, equipment, tag or code number and the manufacturer's serial number(s).
Certified – the dated Signature and Title of an authorized and responsible employee of the supplier.
N/A – Not applicable – can be used for individual entries, columns and lines by Project engineering, and for individual entries by the supplier.

F. BECHTEL ENTRY INSTRUCTIONS

Entry No.	Information Required
1	Enter Document Category Number.
2	Enter Specification paragraph reference.
3	Make no entry. Relates to kind of copies required.
4	Enter the number of each kind of copy for "initial" or "final" submittals of Engineering Documents.
5	Enter approval requirement by X under "Yes" or "No" column.
6	Enter the number of each kind of copy of Quality Verification Documents required for release of the item or installation.
7	Enter Quality Verification Document distribution code letter in accordance with paragraph D above.
8	Make no entry. For supplier use only.
9	Bechtel inspector to complete upon release. Sign on line 22.
10	Enter Bechtel Engineering review confirmation. Sign on line 23.
11	Bechtel QCE to complete check-in. Sign on line 24.
12	Enter remarks as appropriate.

G. SUPPLIER ENTRY INSTRUCTIONS

Entry No.	Information Required
8	Enter number of pages of each type of Quality Verification Documents being submitted for the unit(s) being released. Sign Statement of Conformance on line 21.
12	Enter remarks as appropriate. When a deviation has occurred, reference the deviation(s) and Buyer/Contractor's authorization in the column, and include the authorization documents) in the Verification Document Package.
13, 14, 15	Enter information as required.
16	Enter the numbers of units covered by the Quality Verification Documents being submitted. For each requisition item no. being released provide a separate copy of this completed form and the supporting Quality Verification Documents.
17, 18, 19	Enter information as required.
20	Enter identification number(s) traceable to the unit(s) being released, e.g. serial no., heat no. of major component, code reel no. or other unique designator.

H. DOCUMENT CATEGORY NUMBERS: Engineering (E) and Quality Verification (V) Document Requirements as entered in Column 1, and defined in G-321-SUP A Document Category Definitions. For details, see specification paragraph(s) referenced in Column 2.

1.0 DRAWINGS (E)
- 1.1 Outline Dimensions, Services and Foundation/Mounting Details
- 1.2 Assembly Drawings
- 1.3 Shop Detail Drawings
- 1.4 Wiring Diagrams
- 1.5 Control Logic Diagrams
- 1.6 P & IDs

2.0 PARTS LIST AND COST (E)
3.0 COMPLETED BECHTEL DATA SHEETS (E)
4.0 INSTRUCTIONS (E)
- 4.1 Erection/Installation
- 4.2 Operating
- 4.3 Maintenance
- 4.4 Site Storage and Handling

5.0 SCHEDULES: ENGINEERING AND FABRICATION/ERECTION(E)
6.0 QUALITY ASSURANCE MANUAL/PROCEDURES (E)
7.0 SEISMIC DATA REPORT (E)
8.0 ANALYSIS AND DESIGN REPORT (E)
9.0 ACOUSTIC DATA REPORT (E)
10.0 SAMPLES (E)
- 10.1 Typical Quality Verification Documents
- 10.2 Typical Material Used

11.0 MATERIAL DESCRIPTION (E)
12.0 WELDING PROCEDURES AND QUALIFICATIONS (E), AND VERIFICATION REPORTS (V)
13.0 WELD ROD CONTROL PROCEDURES (E), AND VERIFICATION REPORTS (V)
14.0 REPAIR PROCEDURES (E), AND MAJOR REPAIR VERIFICATION REPORTS (V)
15.0 CLEANING AND COATING PROCEDURES (E), AND VERIFICATION REPORTS (V)
16.0 HEAT TREATMENT PROCEDURES (E), AND VERIFICATION REPORTS (V)
17.0 CERTIFIED MATERIAL PROPERTY REPORTS (V)
- 17.1 MTR (Certified Material Test Reports)
- 17.2 Impact Test Data
- 17.3 Ferrite Data
- 17.4 Material Certificate of Compliance
- 17.5 Electrical Property Reports

18.0 CODE COMPLIANCE (V)
19.0 UT – ULTRASONIC EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V)
20.0 RT – RADIOGRAPHIC EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V)
21.0 MT – MAGNETIC PARTICLE EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V)
22.0 PT – LIQUID PENETRANT EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V)
23.0 EDDY CURRENT EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V)
24.0 PRESSURE TEST – HYDRO, AIR LEAK, BUBBLE OR VACUUM TEST PROCEDURE (E), AND VERIFICATION REPORTS (V)
25.0 INSPECTION PROCEDURE (E), AND VERIFICATION REPORTS (V)
26.0 PERFORMANCE TEST PROCEDURES (E), AND VERIFICATION REPORTS (V)
- 26.1 Mechanical Tests
- 26.2 Electrical Tests

27.0 PROTOTYPE TEST REPORT (E & V)
28.0 Personnel Qualification (E)
29.0 Supplier shipping preparation procedure (E)

DOCUMENT CATEGORY DEFINITIONS

(E) - Engineering Documents. This term comprises procedures, drawings, specifications, QA plans, prototype/qualification test procedures, reports and other similar documents that require Bechtel permission to proceed prior to fabrication, or prior to use of the document in the design, fabrication, installation, or other work process unless otherwise indicated. The term is also applied to price lists, and instructional documents for handling, storage, maintenance, etc., that are of informational interest only to project engineering.

(V) - Quality Verification Documents. This term comprises material test reports, heat treatment charts, welding records, NDE results, performance test reports, etc., which demonstrate or certify conformance to the technical or inspection requirements of the procurement documents.

1.0 DRAWINGS (E)

1.1 Outline Dimensions, Services and Foundation/Mounting Details - Drawings providing external envelope, including lugs, center line(s), location and size for electrical cable, conduit, fluid, and other service connections, isometrics, and details related to foundations and mountings.

1.2 Assembly Drawings - Detailed drawings indicating sufficient information to facilitate assembly of the component parts of an equipment item.

1.3 Shop Detail Drawings - Drawings which provide sufficient detail to facilitate the fabrication or manufacture of the equipment item. This includes but is not limited to, spool drawings, heat exchanger internal details, internal piping and wiring, cross-section details and architectural details.

1.4 Wiring Diagrams - Drawings which show the schematic wiring and connection information for electrical items.

1.5 Control Logic Diagrams - Drawings which show the paths which input signals must follow to accomplish the required responses.

1.6 P&IDs - Piping and Instrumentation Diagrams which show piping system details and the basic control elements.

2.0 PARTS LIST AND COST (E) - Exploded view with identified parts and recommended spare parts for one year's operation with unit cost.

3.0 COMPLETED BECHTEL DATA SHEETS (E) - Information provided by a supplier on data sheets furnished by Bechtel which states serial numbers, operating ranges, etc., of equipment that the supplier intends to deliver to satisfy the specification requirements.

4.0 INSTRUCTIONS (E)

4.1 Erection/Installation - Detailed written procedures, instructions, and drawings required to erect or install material or equipment.

4.2 Operating - Detailed written instructions describing how an item or system should be operated.

4.3 Maintenance - Detailed written instructions required to disassemble, reassemble and maintain items or systems in an operating condition.

4.4 Site Storage and Handling - Detailed written instructions which define the requirements and time period, for lubrication, rotation, heating, lifting or other handling requirements to prevent damage or deterioration during storage and handling at jobsite. This includes return shipping instructions.

5.0 SCHEDULES: ENGINEERING AND FABRICATION/ERECTION (E) - Bar charts, critical path methods, etc., which chronologically detail the sequence of activities.

6.0 QUALITY ASSURANCE MANUAL/PROCEDURES (E) - The document(s) which describe(s) the planned and systematic measures that are used to assure that structures, systems, and components will meet the requirements of the procurement documents.

7.0 SEISMIC DATA REPORT (E) - The analytical or test data which provides physical response information on an item, material, component or system in relation to the conditions imposed by the stated seismic criteria.

8.0 ANALYSIS AND DESIGN REPORT (E) - The analytical data, (stress, electrical loading, fluid dynamics, etc.), which assures that an item satisfies specified requirements.

9.0 ACOUSTIC DATA REPORT (E) - The noise, sound and other vibration data required by specification which is in the audible range and above the seismic frequency.

10.0 SAMPLES (E)

10.1 A representative data package which will be submitted for the items purchased as required in the specification.

10.2 A representative example of the material to be used.

11.0 MATERIAL DESCRIPTION (E) - The technical data describing a material which a supplier proposes to use for a specific order. This usually applies to architectural items, e.g., metal siding, decking, doors, paints, coatings.

12.0 WELDING PROCEDURES AND QUALIFICATIONS (E), AND VERIFICATION REPORTS (V) - The welding procedures, specification and supporting qualification records required for welding, hard facing, overlay, brazing and soldering. A verification report of welds performed including the identification of the qualified welder(s), and the procedure(s) used, and certification that the welder(s) were qualified.

13.0 MATERIAL CONTROL PROCEDURES (E) - The procedures for controlling issuance, handling, storage, and traceability of material such as weld rod.

14.0 REPAIR PROCEDURES (E), AND MAJOR REPAIR VERIFICATION REPORTS (V) - The procedures for controlling material removal and replacement by welding, brazing, etc., subsequent thermal treatments and final acceptance inspection. Verification reports may include weld repair locations (maps), material test reports for filler metal, pre-and-post-weld heat treatment records, NDE records, etc. The resolution of whether a repair is major or not is a Bechtel responsibility.

15.0 CLEANING AND COATING PROCEDURES (E), AND VERIFICATION REPORTS (V) - The procedures for removal of dirt, grease or other surface contamination and includes application of protective coatings. Verification reports include certification of visual examination for surface preparation surface profile, materials, etc., humidity data, temperature data and coating thickness data as required by the procurement documents.

16.0 HEAT TREATMENT PROCEDURES (E), AND VERIFICATION REPORTS (V) - The procedures for controlling temperature, time at temperature as a function of thickness , furnace atmosphere, cooling rate and method, etc. Verification reports normally include furnace charts or similar records which identify and certify the item(s) treated, the procedure used, furnace atmosphere, time at temperature, cooling rate, etc. Verification data may be in either narrative or tabular form.

17.0 CERTIFIED MATERIAL PROPERTY REPORTS (V)

17.1 MTR (Certified Material Test Reports) - These reports include all chemical, physical, mechanical and electrical property test data required by the material specification and applicable codes. This is applicable to cement, concrete, metals, cable jacket materials, rebar, rebar splices, etc. The certified MTR shall include a statement of conformance that the material meets the specification requirements.

17.2 Impact Test Data - Results of all Charpy or drop weight tests including specimen configuration, test temperature and fracture data.

17.3 Ferrite Data - Report of the ferrite percentage for stainless steel materials used, including castings & welding filler metals as deposited.

17.4 Material Certificate of Compliance - Verification document which certifies conformance to the requirements of the applicable material specification.

17.5 Electrical Property Reports - Report of electrical characteristics, e.g., dielectric, impedance, resistance, flame test, corona, etc.

18.0 CODE COMPLIANCE (V) - Verifying documents (such as data Forms U-1, N-2, State, etc.), which are prepared by the manufacturer or installer and certified by the Authorized Code Inspector.

19.0 UT - ULTRASONIC EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V) - Method of detection and examination results of presence and certain characteristics of discontinuities and inclusions in materials by the use of high frequency acoustic energy.

20.0 RT - RADIOGRAPHIC EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V) - Method of detection and examination results of presence and certain characteristics of discontinuities and inclusions in materials by x-ray or gamma-ray exposure of photographic film.

21.0 MT - MAGNETIC PARTICLE EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V) - Method of detection and examination results of surface (or near surface) discontinuities in magnetic materials by distortion of an applied magnetic field.

22.0 PT - LIQUID PENETRANT EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V) - Method of detection and examination of surface discontinuities in materials by application of a penetrating liquid in conjunction with suitable development techniques.

23.0 EDDY CURRENT EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V) - Method for detection and examination results of discontinuities in material by distortion of an applied electromagnetic field.

24.0 PRESSURE TEST - HYDRO, AIR, LEAK, BUBBLE OR VACUUM TEST PROCEDURE (E), AND VERIFICATION REPORTS (V) - Method for evaluating the structural and mechanical adequacy or integrity by application of differential pressures, and report of the test results.

25.0 INSPECTION PROCEDURE (E), AND VERIFICATION REPORTS (V) - Organized process followed for the purpose of determining that specified requirements (dimensions, properties, performance results, etc.) are met. Documented findings resulting from an inspection are included in the verification report.

26.0 PERFORMANCE TEST PROCEDURES (E), AND VERIFICATION REPORTS (V) - Tests performed to demonstrate that functional design and operational parameters are met by each item produced and the report of the test results. Test results performed as verification of compliance to qualification requirements shall be submitted as engineering documents.

26.1 Mechanical Test, e.g., pump curves, valve stroking, load, temperature rise, calibration, environmental, etc.

26.2 Electrical Tests, e.g., load, impulse, overload, continuity, voltage, temperature rise, calibration, saturation, loss, etc.

27.0 PROTOTYPE/QUALIFICATION TEST PROCEDURES AND TEST REPORTS (E) - Report of a test which is performed on a standard or typical example of equipment, material or item, and is not required for each item produced in order to substantiate the acceptability of equal items. This normally includes tests which may, or could be expected to, result in damage to the item(s) tested.

28.0 PERSONNEL QUALIFICATION PROCEDURES (E) - Procedures for qualifying welders, inspectors and other special process personnel.

29.0 SUPPLIER SHIPPING PREPARATION PROCEDURE (E) - The procedure used by a supplier to prepare finished materials or equipment for shipment from his facility to the jobsite.

30.0 (OPEN)
31.0 (OPEN)
32.0 (OPEN)
33.0 (OPEN)
34.0 (OPEN)

GENERAL REQUIREMENTS

FOR

SUPPLIER QUALITY ASSURANCE PROGRAMS

FOR THE

MIDLAND PLANT

UNITS 1 AND 2

FOR

CONSUMERS POWER COMPANY

No	Date	Revisions	By	Ch'k	Appd
7	5-24-78	Added Paragraph 1.4, corrected Rev. No. on Exhibit A Corrected Sheet ii-Rev. 6-Block-Added clarification in Paragraph 2.2 , Exhibit B-revised	R.E.C.	CD	
6	6/23/77	Revised as noted to clarify and incorporate QA Reg. Guide Requirements Deleted APP. III	LAM		
5	[illegible]	Revised to Ref. Data Sheet 1 and Add Appendix III			
4	[illegible]	Revised to delete "Q" des. and add Appendix II			
3	4-15-74	Revised To Use Mandatory Form Per EDP 6.10 & to Clarify ANSI Ref.			

ORIGIN

GENERAL REQUIREMENTS FOR SUPPLIERS QUALITY ASSURANCE PROGRAMS

JOB No 7220
SPEC OR'S GUIDE No 7220-C-23
REV 7
Sheet 1

SHEET	REV	SHEET	REV	SHEET	REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV	SHEET	LATEST REV
i	7												
ii	7												
iii	7												
1	7												
2	7												
3	7												
4	7												
5	7												
6	7												
7	7												
8	7												
App I	6												
App II													
1	6												
2	6												
Exh A	7												
Exh B													
1	7												
2	7												

NO.	DATE	REVISIONS	BY	CHK'D	APP'D
6	6/21/77	Revised to clarify & incorp. Reg. Guides Delete APP. III	LAM	P.Z.L.	
5	2-7-74	Rev. to Ref. Data Sht and add Appendix III			
4	1-18-74	Rev. to delete "Q" des & add App. II			
3	3-29-74	Rev. to Change Form			
2	3-11-74	Rev. Per CPCo Comments			
1	1/18/74	Rev. Per CPCo comm.			
0	10/3/73	Initial Issue			

NO.	DATE	REVISIONS	BY	CHK'D	APP'D
7	5/24/78	Correct EXH A Rev. App III Deleted Rev. 6	P.Z.A	CD	

FACING SHEET

GENERAL REQUIREMENTS FOR SUPPLIERS QUALITY ASSURANCE PROGRAMS

JOB No 7220

Specification 7220-G-23

REV. 7

4-30-74-1C
3-11-58

GENERAL REQUIREMENTS

FOR

SUPPLIER QUALITY ASSURANCE PROGRAMS

FOR THE

MIDLAND PLANT

UNITS 1 & 2

FOR

CONSUMERS POWER COMPANY

TABLE OF CONTENTS

1.0 SCOPE

1.1 This specification provides the quality assurance requirements for the equipment, material, or services as specified in the purchase order, specifications, or material requisitions.

1.2 This specification does not delete or revise (but is in addition to) those requirements defined by the procurement documents. If a supplier believes that an inconsistency exists between this specification and the procurement documents and referenced codes and standards, he shall immediately notify Bechtel for resolution. 2

1.3 Definitions used herein are derived from ANSI N45.2.10-1973. If the supplier needs clarification, requests departure, or feels an inconsistency exists between this specification and the procurement documents, he shall immediately notify Bechtel for resolution. 6

1.4 For all activities within the scope of the ASME B&PV Code, the supplier shall maintain a quality program that is in compliance with current Code requirements. All revisions necessary to meet these requirements shall be submitted to the buyer within seven days after the supplier receives written acceptance by the authorized inspection agency. Evidence of Code acceptance shall accompany the submittal. 7

2.0 GENERAL PROGRAM REQUIREMENTS

2.1 The term supplier, as used herein, includes seller, vendor, contractor, and subcontractor.

2.2 The project quality assurance program is governed by NRC Regulation 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants." To satisfy this requirement, the supplier shall establish and implement a quality assurance program that conforms to the applicable provisions of ANSI N45.2-1971, "Quality Assurance Program Requirements for Nuclear Power Plants" as delineated on Data Sheet 1 (Exhibit A) and to the other codes and standards as cited in the contract documents. For commodities within the scope of the ASME 6 7

B&PV Code, the Code shall govern; for those items not within the scope of the Code, ANSI N45.2-1971 QA program requirements shall be applicable. These quality assurance requirements shall apply to all aspects of the work necessary for carrying out this contract, including design, procurement, fabrication, inspection, installation, and testing. (Data Sheet 1 is attached to this specification for reference only. This completed form is attached to the material requisition package.)

2.3 In the event a supplier does have a quality assurance program in accordance with Paragraph 2.2 and if the supplier's function is limited to placing the order with the actual manufacturer, the supplier shall be responsible for providing a controlled copy of the manufacturer's quality assurance program documents to Bechtel within 30 days after the award. The manufacturer's and supplier's quality assurance program documents must meet the requirements as outlined in this specification that pertain to the activities he performs. In no case will the supplier start activities without prior approval of the portions of the program applicable to the respect ve operation.

2.4 When audits are required the supplier shall implement a system of internal and external audits consistent with the requirements of ANSI N45.2.12, Draft 4, Rev. 1, dated November 1, 1974, "Requirements for Auditing of Quality Assurance Programs for Nuclear Power Plants."

2.5 When it becomes necessary for the supplier to procure materials, components, or services from a subsupplier(s), it is the suppliers responsibility to establish and implement a procurement control process consistent with the requirements and guidelines of ANSI N45.2.13, Draft 3 Rev. 3 dated June 1975, "Quality Assurance Requirements for Control of Procurement of Items and Services for Nuclear Power Plants."

2.6 Definitions utilized in the Supplier's Quality Assurance Program shall be consistent with ANSI N45.2.10-1973.

3.3 In order to comply with Subsection 50.55(e) of 10 CFR 50 Appendix B, the supplier, in less than 12 hours after detection, shall report to Bechtel Project Engineering each deficiency found in design, manufacturing, and/or construction, which, were it to have remained uncorrected, could have affected adversely the safety of operations of the nuclear power plant at any time throughout the expected lifetime of the plant, and which represents: 6

a. A significant breakdown in any portion of the quality assurance program conducted in accordance with the requirements of ANSI N45.2

b. A significant deficiency in final design as approved and released for manufacturing and/or construction such that the design does not conform to the criteria and bases stated in the specifications 2

c. A significant deficiency in manufacturing and/or construction of/or significant damage to a structure, system, or component which will require extensive evaluation, extensive redesign, or extensive repair to meet the criteria and bases stated in this specification or to otherwise establish the adequacy of the structure, system, or component to perform its intended safety functions

d. A significant deviation from performance specifications which will require extensive evaluation, extensive redesign, or extensive repair to establish the adequacy of a structure, system, or component to meet the criteria and bases stated in the specifications or to otherwise establish the adequacy of the structure, system, or component to perform its intended safety function.

e. Notification of reportable deficiencies as delineated above shall be by telephone or TWX, followed up by a completed SDDR form per instructions in Appendix II. 6

3.4 Any departure from the requirements of the procuring documents or Bechtel approved supplier technical documents which the supplier intends to incorporate in the completed item or service provided must be documented on a Supplier Deviation Disposition Request (SDDR). Deviation requests shall be submitted to the Bechtel project engineer with a copy to the Bechtel supplier quality representative if one is assigned within five working days after detection. Specific instructions are contained in Appendix II. The signature of the suppliers authorized representative in block number 17 of the SDDR form, signifies compliance with Paragraph 3.3. In addition, the supplier shall also maintain a status list of all nonconformances.

3.4.1 Definitions

a) Rework is defined as the process by which a nonconforming item is made to conform to a prior specified requirement by completion, remachining, reassembling, or other corrective means. Items classified as rework do not require submittal of the SDDR. 6

b) See sheet 2 of SDDR for difinition of repair.

3.5 Engineering and quality verification documents shall be submitted to Bechtel in accordance with the provisions of Form G-321-D. While in the supplier's facilities these and other records required by applicable codes and standards which are necessary to verify activities affecting quality, shall be maintained in facilities to protect contents from possible destruction by causes such as fire, flooding, tornadoes, insects, rodents, and from possible deterioration by a combination of extreme variations in temperature and humidity conditions. Storage systems shall provide for the accurate retrieval of information without undue delay. (Compliance to ANSI N45.2.9-1974, "Requirements for Collection, Storage, and Maintenance of Quality Assurance Records for Nuclear Power Plants" fulfills these requirements.) Quality assurance records are those records which

furnish documentary evidence of the quality of items and of activities affecting quality. Records become quality assurance records upon issuance for use.

3.5.1 Records shall not be stored loosely. They shall be firmly attached in binders or placed in folders or envelopes for storage on shelving in containers. Steel file cabinets are preferred.

3.5.2 An audit system shall be established to assure that the quality assurance records' storage system is effective. The following shall be performed as a minimum:

a. Periodic surveys to assure that records logged in are available and have been placed in their proper location within the files and to assure that the control system is adequate

b. Periodic audits to assure that the facilities are in good condition and that the temperature/humidity controls and protective devices are functioning properly

c. Periodic audits of the records to assure that the documents are not deteriorating due to improper storage practices or rough handling

d. The frequency of surveys and audits delineated above shall be determined by the supplier and addressed in the quality assurance program documents

3.6 All quality related records, procedures, and qualifications shall be available for examination by Bechtel or Bechtel's authorized agents.

3.7 The applicable quality assurance records shall be considered valid only if stamped, initialed, signed, or otherwise authenticated and dated by authorized personnel. These may be either the original or a high quality reproducible copy.

3.8 No quality related record shall be destroyed or otherwise disposed of without written permission of Bechtel (or their designee).

3.9 QUALIFICATIONS OF INSPECTION, EXAMINATION, AND TESTING PERSONNEL

3.9.1 The supplier's quality assurance program shall provide measures to assure that personnel performing safety-related inspections, examinations, and tests are qualified to perform these activities. Such measures include procedures for qualifications of personnel describing the minimum experience, training, and proficiency testing required for qualification. The measures shall also include requirements for records documenting qualifications for each of the suppliers' inspection, examination, and testing personnel. (Compliance to ANSI N45.2.6, "Qualifications of Inspection, Examination, and Testing Personnel for the Construction Phase of Nuclear Power Plants" fulfills these requirements.) 6

3.9.2 Nondestructive examination performed according to the quality requirements of Section III of the ASME Boiler and Pressure Vessel Code shall be performed by supplier personnel certified to SNT-TC-1A

3.9.3 Personnel qualification procedures will be reviewed by Bechtel prior to initiation of inspections, examinations, or tests.

4.0 QUALITY SURVEILLANCE

4.1 All designing, procuring, manufacturing, processing, assembling, testing, examination, and inspection operations performed by the supplier and his lower-tier suppliers are subject to surveillance by Bechtel or Bechtel's authorized agents. This surveillance shall in no way relieve the supplier of any contractual responsibilities. 2

NOTE: The term surveillance, here, may include inspection, survey, and/or audit.

4.2 The Bechtel supplier quality representative shall be given free access to the supplier's and his subsupplier's facilities to perform the necessary surveillance and report on the work in all phases of design, manufacturing, and testing.

4.3 The supplier shall give the Bechtel supplier quality representative at least five working days prior notice of all tests, and other check points in the manufacturing program specifically requested by the representative, after a joint review of supplier's work plan(s) and this specification.

4.4 If the requirements of this specification have not been fulfilled, the Bechtel supplier quality representative has the authority to refuse release for shipment.

APPENDIX I

PROPOSAL

(This sheet applies to the bid stage)

With his proposal, each bidder shall submit a summary description of the quality assurance program to be implemented in the performance of the work, or an uncontrolled copy of his quality assurance manual or procedure. This shall include information on the organization of the bidder, including the authority and responsibility of personnel performing QA/QC functions. It shall also explain administrative policies and procedures to be used in carrying out the program.

The bidder shall provide an adequate statement of justification if his quality assurance program does not need to contain all of the elements or portions thereof called for in Data Sheet 1 (Exhibit A). Any modifications agreed to by Bechtel will be identified in the procurement documents.

Bechtel will evaluate the description of the quality assurance program to determine its acceptability. An acceptable quality assurance program is a mandatory requirement for placing an order.

If a bidder is currently performing to or has completed a Bechtel order which invokes the requirements of this specification, he may, in lieu of submitting a copy of his manual, submit a letter listing the date of Bechtel acceptance, the controlled manual to be used and the revision that is currently in effect or was in effect, and a statement that it will apply for this proposed effort.

Bechtel reserves the right to survey/audit the bidder/supplier to determine the adequacy of his quality program as he proposed or is executing.

APPENDIX II

SDDR INSTRUCTIONS

DEVIATION - any departure from the requirements of the procuring documents, which the supplier intends to incorporate in the completed item or service provided.

1.0 The supplier shall be required to submit deviation requests to the Bechtel project engineer with a copy to the Bechtel supplier quality representative within five working days after detection. When this time limit cannot be met, notification by telephone, TWX, etc is acceptable; at that time, a revised submittal date shall be established. Any deviation is considered unacceptable until approval from Bechtel in writing is obtained.

2.0 SDDRs must be supported by technically valid information that is sufficient for project engineering evaluation. When necessary, the supplier shall attach supporting technical documents (of reproducible quality) to the SDDR. One copy of each attachment must also be supplied to the Bechtel (supplier quality representative), if assigned.

3.0 Detailed instructions for completion of the SDDR are shown on the attached form and instruction sheet, Exhibit B. It is required that all portions of the SDDR applicable to the supplier be completed prior to submittal to Bechtel including Block No. 10. If the entries are not completed, the SDDR will be returned to the supplier for inclusion of the pertinent information.

4.0 A copy of the SDDR, with the applicable attachment(s), is returned to the supplier after completion of Bechtel engineering actions.

5.0 For approved SDDRs, suppliers may be required by project engineering to change their engineering documents to reflect the "as-built" condition without extra cost to the Buyer.

A copy of the completed SDDR (including attachments) shall be included by the supplier in the QC data package for the item(s) to which it applies. The SDDR is considered complete when all entries are made including the appropriate verification signatures by the supplier and Bechtel supplier quality representative. If no representative is assigned for the order,

arrangements will be made by Bechtel engineering for verification of implementation.

6.0 A copy of the SDDR form shall be maintained as a QA record by the supplier after all entries have been completed.

EXHIBIT A TO
7220-G-23
Rev. 7

(DATA SHEET 1)

THE FOLLOWING ANSI N45.2-1971 QUALITY ASSURANCE PROGRAM ELEMENTS APPLY TO THIS SPECIFICATION.

TO BE COMPLETED BY BECHTEL		TO BE COMPLETED BY THE SUPPLIER
APPLICABLE		SUPPLIER DOCUMENT AND PARAGRAPH REFERENCES
[ ]	QUALITY ASSURANCE PROGRAM	
[ ]	ORGANIZATION	
[ ]	DESIGN CONTROL	
[ ]	PROCUREMENT DOCUMENT CONTROL	
[ ]	INSTRUCTIONS, PROCEDURES, AND DRAWINGS	
[ ]	DOCUMENT CONTROL	
[ ]	CONTROL OF PURCHASED MATL., EQUIP., & SERVICES	
[ ]	IDENT. & CONTROL OF MATLS., PARTS, COMPONENTS	
[ ]	CONTROL OF SPECIAL PROCESSES	
[ ]	INSPECTION	
[ ]	TEST CONTROL	
[ ]	CONTROL OF MEASURING AND TEST EQUIPMENT	
[ ]	HANDLING, STORAGE AND SHIPPING	
[ ]	INSPECTION, TEST AND OPERATING STATUS	
[ ]	NONCONFORMING ITEMS	
[ ]	CORRECTIVE ACTION	
[ ]	QUALITY ASSURANCE RECORDS	
[ ]	AUDITS	
[ ]	OTHERS	

NO.	DATE	REVISIONS	BY	CHECKED	APPROVED

7220-G-23		JOB NO.	
DATA SHEET 1	STATUS	DOCUMENT NO.	REV.

Supplier Deviation Disposition Request

Rev. 7

FOR SUPPLIER USE	
Supplier SDDR No.	Date Submitted

NOTE: The reverse side of this form contains the instructions for its preparation and use. Items marked with an asterisk (*) are for Bechtel entries only.

FOR BECHTEL USE	
*Bechtel SDDR No.	*Date Received

Supplier shall complete all blocks 1 through 18 with black ink or typewriter. Use NA for Not Applicable.

1. Supplier Name: _____ Address _____ City & State _____ Zip _____

2. Supplier's Order No.	3. Supplier's Part No.	4. Supplier's Part Name	5. Date Deviation Determined	6. Previous SDDR No. & Date
7. Bechtel P.O. No.	8. Bechtel Part No.	9. Bechtel Part Name	10. Bechtel Inspector Notified	11. Bechtel Eng. Notified

12. Qty or Serial No.	13. Deviation Description (Attach extra sheets, photographs, sketches, etc. as necessary)

14. Supplier's Disposition Classification: ☐ Use As Is ☐ Repair ☐ Modify Bechtel Requirement

15. Proposed Disposition and Technical Justification: (Attach extra sheets, sketches, etc. as necessary)

16. Associated Supplier Document Change (s):

17. Cost Effects:

18. Suppliers Authorized Representative

Signature: _____

Name: _____ Title: _____ Date: _____

*19. Bechtel Engrg. Action:

☐ Proposed Disposition Accepted ☐ Proposed Disposition Rejected

Engrg. Follow-up: ☐ Dwg Change ☐ Spec/Req. Change ☐ Other ☐ Other Suppliers Affected

*20. Bechtel Disposition Statement Including Justification (Attach extra sheets, sketches, etc. as necessary)

*21. Bechtel Acceptance	Date	Verification Signatures	Date
GS _____		22. Supplier _____	
PE _____		*23. Bechtel Supplier Quality Representative _____	
PQE _____			

AA-G-030678

INSTRUCTIONS FOR COMPLETING SDDR FORM

(Use Black Ink or Typewriter)

This form is used by a supplier to:

a) Notify Bechtel of deviations from approved technical requirements and document the supplier's proposed disposition, and with their technical justification
b) Record Bechtel's disposition of the SDDR.

A deviation is any departure from the technical requirements of the procuring documents which the supplier proposes to incorporate in the completed item or service provided. Deviation disposition can be classified as Repair, Use-As-Is, or Modify Requirement.

Repair is defined as the process of restoring a nonconforming characteristic to a condition such that the capability of an item to function reliably and safely is unimpaired, even though that item still may not conform to the original requirement. Repair includes alterations to the properties of the material through heat-treating, welding, metal deposition, chemical processing, etc. This form is not to be used for cases where Bechtel has previously provided authorization to proceed using an accepted repair procedure covering a specific type of repair; however, records must be maintained for each specific repair.

Bechtel's engineering action and disposition statement does not relieve the Supplier from responsibility for the accuracy, adequacy, or suitability of the item or service being provided as defined in the procuring documents, nor does it constitute waiver of the right to renegotiate the terms of the procuring documents.

NOTE: Items marked by an asterisk (*) are for Bechtel use only.

Block No.	Entry Information
1.	Supplier's name and address. List lower-tier Supplier's name and location (City and State) if applicable.
2.	Enter the Supplier's order number if one has been assigned.
3.	Enter Supplier's Part No. as applicable from the drawing, catalog, internal specification, etc. If the Deviation Request applies to all parts and additional space is needed, a list of parts to which the request applies may be attached.
4.	Enter Supplier's Part Name.
5.	Enter the date and the method (Spec. review, NDE, dielectric test, etc.) used to disclose the deviation.
6.	List any previous SDDR's and their dates that have been submitted for deviations requested on this Purchase Order.
7.	Enter the Bechtel Purchase Order Number.
8.	Enter the Bechtel Requisition item, part, tag or code number as it appears in the requisition. If additional space is needed, a separate sheet may be attached.
9.	Enter the Bechtel Part Name if one has been assigned.
10.	Enter the date and the method (TWX, letter, etc.) used to notify the Bechtel Supplier Quality Representative.
11.	Enter the date and the method (TWX, letter, etc.) used to notify Bechtel Engineering.
12.	As applicable, enter quantities or serial numbers of the items to which the deviation applies. If not serialized, record lot, batch, heat or other applicable identifying information.
13.	Describe the deviating characteristics and define the extent of the out-of-specification condition for each identified piece affected. Identify the location of the deviating characteristic by point coordinates or specific location, as applicable. Attach extra sheets, photographs, sketches, etc., as necessary.
14.	Identify disposition classification.
15.	Describe the proposed disposition and provide technical justification for Bechtel's evaluation. If the deviation is correctable by repair, submit a detailed repair procedure or reference the procedure previously accepted (Level 1) by Bechtel for use in similar situations. Provide Bechtel control number, supplier control number and procedure title.
16.	Identify the nature of changes that may result on associated supplier documents (drawings, specs., procedures, installation instructions, etc.).
17.	Enter the cost impact of the subject deviation.
18.	Enter the name (typed or printed), signature and title of the supplier representative authorizing the disposition request and date signed.
*19.	Enter an X in the applicable boxes.
*20.	Provide appropriate justification for the Bechtel actions(s) indicated in Block 19. When changes to drawings, specifications, requisitions, or other Bechtel documents are involved, each document should be identified and the associated change briefly described. If other suppliers are affected, indicate who they are and the document that initiated resolution of that involvement. "Other" follow-up action (e.g., the need for additional Bechtel calculations, additional drawings or sketches, input from a Project Engineering representative, etc.) should also be identified here.
*21.	GS – Signature of the responsible Discipline Group Supervisor accepting the Engineering action and the date signed. PE – Signature of the Bechtel Project Engineer and the date signed.
22.	Signature of the supplier's inspector or other representative authorized to verify that the accepted disposition was correctly accomplished.
*23.	Signature of the Bechtel Supplier Quality Representative or other representative verifying that the accepted disposition was correctly accomplished.

NOTE: A copy of the completed SDDR form shall be included by the supplier in the QC data package for each item to which it applies.

QUALITY ASSURANCE PROGRAM ELEMENTS

(DATA SHEET 1)

THE FOLLOWING ANSI N45.2-1971 QUALITY ASSURANCE PROGRAM ELEMENTS APPLY TO THIS SPECIFICATION.

APPLICABLE		TO BE COMPLETED BY BECHTEL	TO BE COMPLETED BY THE SUPPLIER: SUPPLIER DOCUMENT AND PARAGRAPH REFERENCES
[X]	QUALITY ASSURANCE PROGRAM		
[X]	ORGANIZATION		
[X]	DESIGN CONTROL		
[X]	PROCUREMENT DOCUMENT CONTROL		
[X]	INSTRUCTIONS, PROCEDURES AND DRAWINGS		
[X]	DOCUMENT CONTROL		
[X]	CONTROL OF PURCHASED MATL, EQUIP, & SERVICES		
[X]	IDENT. & CONTROL OF MATLS, PARTS, COMPONENTS		
[ ]	CONTROL OF SPECIAL PROCESSES		
[X]	INSPECTION		
[X]	TEST CONTROL		
[X]	CONTROL OF MEASURING AND TEST EQUIPMENT		
[ ]	HANDLING, STORAGE AND SHIPPING		
[ ]	INSPECTION, TEST AND OPERATING STATUS		
[X]	NONCONFORMING ITEMS		
[X]	CORRECTIVE ACTION		
[X]	QUALITY ASSURANCE RECORDS		
[X]	AUDITS		
[X]	OTHERS	ANSI N45.2.1; N45.2.2; N45.2.10; N45.2.11; N45.2.12; N45.2.13; As defined in the procurement documents	

NO	DATE	REVISIONS	BY	CHECKED	APPROVED
0	8/2/79	ISSUED FOR BIDS	[illegible]	BCW	

BAPC	BECHTEL	CONSUMERS POWER COMPANY MIDLAND POWER PLANT UNITS 1&2 MIDLAND, MICHIGAN	JOB NO 7220 DOCUMENT NO C-95(Q)	REV 0

APPENDIX B
to
Specification 7220 C-95(Q)

11.0 CONVEYING AND PLACING

Conveying and depositing of concrete shall be in accordance with ACI 301, ACI 318, ACI Committee 304 Report "Placing Concrete by Pumping Methods", ACI 614, ASTM C-94 and as follows: An adequate communication system will be provided. No aluminum pipe or other conveying equipment containing aluminum, that will be in contact with the fresh concrete, shall be used for conveying concrete to point of placement. Steel pipe shall be used for concrete pumps or pneumatic placers. A piping arrangement utilizing a "Y" will be permitted provided a valve is installed at the branch point which will direct the flow into only one branch at any one time. The equipment shall be cleaned at the end of each operation.

11.1 Clean-up Preparation

Before depositing concrete, all placing equipment shall be cleaned. Debris, mud, snow, standing puddles of water, and ice shall be removed from spaces to receive concrete, and the reinforcement and other metal to be embedded shall be thoroughly cleaned of all coatings which might impair the bond. All compacted soil, rock or concrete surfaces to receive concrete shall be thoroughly saturated before placement.

11.2 Deposition

Critical structural concrete as designated on the drawings, shall be deposited in accordance with an approved schedule showing the number, size and sequence of concrete placements. Slabs shall be placed in a checkerboard pattern unless otherwise approved. A concrete placement checkout card shall be completed prior to concrete deposition. See Section 11.9 for procedures for large placements.

11.3 Time Between Adjacent Placements

Unless shown on the drawings or directed by Project Engineering, a minimum of 3 days shall elapse between the placing of concrete of adjacent horizontal sections of mass pours greater than 2- 1/2 feet in the least dimension.

11.4 Adequate provisions shall be made to protect the concrete from rain or snow during placement, and the exposed surfaces of fresh concrete after placement.

11.5 Segregation

Concrete shall not be dropped through dense reinforcing steel which might cause segregation of the coarse aggregate. In such cases spouts, flexible drop chutes, or other suitable means shall be used. In any event, concrete shall not be dropped free through a height of more than 6 feet, except as otherwise approved by Engineering.

On the bottom of formed beams and slabs, where the congestion of steel near the forms makes placing difficult, a layer of mortar, not to exceed one inch in depth shall be first deposited. The mortar shall have, as a minimum, the same cement-sand ratio as used in the concrete. Mortars of higher cement-sand ratios approved by Project Engineering may be used.

11.6 Placing Limitations

Concrete shall be deposited in horizontal layers of not greater depth than 24 inches so that satisfactory consolidation can be achieved with vibrators. Concrete shall not be allowed or caused to flow a distance within the mass of more than 5 feet from point of deposition.

11.7 Substitution of Mixes

With the exception of the containment exterior, non-pozzolan mixes may be substituted for mixes containing pozzolans, provided the concrete is 3 feet or less in the least dimension.

11.8 Additional Water

Concrete for Class I structures shall be rejected when the established water/cement ratio is exceeded. Water shall not be added to the concrete after it has been discharged from the batch plant.

11.9 Requirements for Planning Procedures for Large Placements (single item exceeding 600 cubic yards).

The proposed procedure shall be submitted to the Project Engineer at least two weeks in advance of the placement, and shall contain consideration of the following items:

11.9.1 The anticipated size and duration of the placement including both the maximum and average placing rates.

11.9.2 The proposed staffing over the anticipated duration of the placement, including curing, including a breakdown of the number of supervisory personnel, vibrator operators, finishers and laborers planned per shift.

11.9.3 The proposed conveyance system (i.e. the number of transit-mix trucks, the conveyor system, pumpcrete system and/or crane and bucket assemblies, chutes, and tremies) planned to accomplish the pour at the anticipated placing rate.

11.9.4 The planned sequence of the pour to achieve a monolithic slab and to insure against cold joints and the planned movements of the conveyance system (s) to accomplish this.

11.9.5 The checklist for approval of the pour including embedments.

11.9.6 The weather protection facilities proposed to prevent damage in the event of the inclement weather and in the case of planned cold weather placements the enclosure to accomplish the heating requirements for the necessary 7 days. Include the specifics on the heaters.

11.9.7 The procedures to follow in the case of emergencies (i.e. batch plant breakdown with a resultant requirement for an unplanned construction joint).

12.0 CONSOLIDATION OF CONCRETE

Methods for consolidating concrete shall conform with the recommended practices of ACI 309. Concrete shall be consolidated, thoroughly worked around the reinforcement and embedded fixtures, and into corners of the forms by mechanical vibrating equipment. The vibrating equipment shall be of the internal type and shall at all times be adequate in number of units and power of each unit to properly consolidate all concrete. The frequency vibration shall be not less than 7000 cycles per minute. The duration of vibration shall be limited to the necessary time to produce satisfactory consolidation without causing objectionable segregation. In consolidating each layer of concrete, the vibrator shall be operated in a near vertical position, and the vibrating head shall be allowed to penetrate under the action of its own weight and revibrate the concrete in the upper portion of the underlying layer. Surface vibrators shall not be used unless specifically approved by Project Engineering.

Form vibrators may be used in areas of extreme congestion as approved by the Field Engineer. The form vibration shall conform with the recommended practice of ACI-309. Vibrators shall not be used to move or spread concrete. Sufficient spare vibrators shall be kept available for immediate use at the point of desposition . (Recommend one spare vibrator for each three in use.) Provisions shall be made for auxiliary power to provide continuity of vibration in case of power failure from the principal source. Experienced and competent operators shall be provided for each vibrator being used, and shall have received instructions in proper vibration procedures.

FORM OF PROPOSAL

SUBCONTRACT FOR

UNDERPINNING, EXCAVATION, AND PLACING OF CONCRETE

FOR

CONSUMERS POWER COMPANY

MIDLAND PLANT UNITS 1 AND 2

Name of Bidder _____

The following summary of pricing and other information is offered to Bechtel Associates Professional Corporation in response to the bid request covering the material requisition identified above. By execution of this form of proposal, the bidder agrees to furnish all items described in the bid request in compliance with the material requisition and general conditions without deviation or exception (except as may be specifically noted below) in accordance with the following.

1.0 MEASUREMENT OF PAYMENT

The payment for the work performed as described below shall be on a lump sum basis. A separate lump sum price shall be submitted for each of the items listed below.

1.1 MOBILIZATION

Mobilization includes payment as compensation for the work and expense of importing labor, equipment, materials, supplies, supervision, and setting up onsite utilities.

1.2 AUXILIARY BUILDING

This includes payment as compensation for the work and expense of designing, furnishing, installing, and testing of the underpinning for the auxiliary building penetration rooms for Units 1 and 2. Work includes, but is not limited to, caissons from the underside of the existing foundation or mudmat to el 575', excavation of the material which is required to install the caissons, placing concrete backfill in the area of excavation, and dry packing.

1.3 TURBINE BUILDING

This includes payment as compensation for the work and expense of designing, furnishing, installing, and testing of the underpinning for the turbine building for Units 1 and 2. Work includes, but is not limited to, caissons and/or piles for support of the turbine building and the temporary load from the valve pit structure from the underside of the existing concrete foundation or mudmat to el 575', excavation of the material which is required to install the caissons, placing concrete backfill in the area of excavation and dry packing.

1.4 VALVE PIT STRUCTURE

This includes payment as compensation for the work and expense of excavation of all material underlying the entire plan area of the valve pit structure for Units 1 and 2. It extends from the elevation of the underside of the existing concrete foundation or the mudmat to el 580', support of the excavation from the elevation of the underside of the existing concrete foundation or mudmat to the top of the ccess shaft foundation, or el 580', whichever occurs first, foundation preparation, concrete backfill, and dry packing.

1.5 ACCESS SHAFTS FOR UNITS 1 AND 2

Included is payment as compensation for the work and expense of designing, furnishing, and installing shafts to provide access to the work itemized in Sections 1.2, 1.3, and 1.4 above. This work includes, but is not limited to, support of excavation and backfill of the two access shafts from the ground surface to 7 feet below the elevation of the underside of the existing concrete foundation or mudmat of the isolation valve pit. If Subcontractor elects to salvage the support of excavation material, such savings shall be included herein.

1.6 MONITORING

Included is payment as compensation for the work and expense of monitoring the buildings for movement.

1.7 DEMOBILIZATION AND CLEANUP

Included is payment as compensation for the work and expense of demobilization, cleanup, and any such work and expense necessary for the complete performance of the work but not included in any other of the payments listed herein.

2.0 ADJUSTMENTS

The payment for the lump sum price work shall be adjusted for added and deleted work according to the following schedule of unit prices.

2.1 Additional or deleted piles and caissons as ordered by Contractor shall include, but not be limited to, designing, furnishing, installing, testing of piles and/or caissons from the elevation of the underside of the existing concrete foundation or mudmat to el 575', bearing plates, stub columns, excavation, support of excavation, and support of excavation and concrete backfill of the necessary work space.

Description (type)	Design Capacity (kips)	Price per Each Unit ($)
Caisson	_____	_____
Pile	_____	_____

2.2 The length of the caisson and/or pile deducted above or added below el 575' is as follows:

Description (type)	Design Capacity (kips)	Price per Each Unit ($)
Caisson	_____	_____
Pile	_____	_____

2.3 Mass excavation, deducted above or added below el 580' (price per cubic yard in the bank measure)

2.4 Mass concrete, deducted above or added below el 580' (price per cubic yard)

2.5 Support of mass excavation, deducted above or added below el 580' (price per square foot of exposed area)

3.0 ITEMS NOT INCLUDED IN LUMP SUM

Payment for the work listed below is specifically excluded from the lump sum items or the lump sum unit price adjustment items.

3.1 Installation of styrofoam (price per contact square foot of area covered)

3.2 Placing and inspecting Q-listed dry packing (price per square foot)

3.3 Placing of reinforcing steel (price per pound)

3.4 Placing pumped tremie concrete (price per cubic yard)

3.5 SOIL STABILIZATION - Grouting (excluding grouting indicated in Section 4.2 above), as in the following:

3.5.1 Cement grouting (price per 94-pound sack of cement)

3.5.2 Chemical grouting (price per gallon)

3.6 OBSTRUCTIONS

3.6.1 Jacked Piling - Crew cost per hour, including all special equipment for removing obstruction - An obstruction for jacked piling is defined as follows.

a. The pile fails to advance while subjected to the maximum jacking force when there is no plug at the tip (provided there is adequate lubrication between the pipe and the ground as evidenced by the jacking force just prior to encountering the obstruction). The material removed from within or in advance of the pipe contains rocks or concrete fragments greater than 2 inches in any flat plane dimension.

b. Wood or steel is considered an obstruction by definition. (Material cost per linear foot of pile is to be added to the above crew cost for lengths of pile installed while passing or removing an obstruction. The price per linear foot is to be deducted from Section 13.2 for lengths of pile installed while passing or removing an obstruction.)

3.6.2 Caissons - Crew cost per hour, including all special equipment for removing obstruction - An obstruction for caissons is defined as follows.

a. The caisson fails to advance while subjected to the maximum jacking force when there is no plug at the tip (provided there is adequate lubrication between the pipe and ground as evidenced by the jacking force just prior to encountering the obstruction). The material removed from within or in advance of the pipe contains rock or concrete fragments greater than 2 inches in any flat plane dimension.

b. Wood or steel is considered an obstruction by definition. (Material cost per linear foot of caisson is to be added to the above crew cost for lengths of pile installed while passing or removing an obstruction. The price per linear foot is to be deducted from Section 13.2 for lengths of pile installed while passing or removing an obstruction).

3.6.3 Mass Excavation - The demolition of obstructions to a size suitable for efficient handling will be paid on a cost plus basis. All other costs for removal of obstructions shall be paid in the unit price for mass excavation.

3.7 Furnishing approximately 4,000-kip jacking system

3.8 Installing and removing approximately 4,000-kip jacking system

3.9 Operating approximately 4,000-kip jacking system

3.10 Additional load test at 1.5 times the design load for 5 minutes (reference Section 6.3.2.d) (price per each)

3.11 Additional load test at 1.5 times the design load (price per hour)

4.0 OTHER

Payment for the work listed below which is specifically excluded from the lump sum price items or the lump sum unit adjustment items or added unit items shall be paid on a cost plus basis. Cost shall be based on direct jobsite union labor plus labor burden, 5% of direct jobsite union labor for small (nonpowered) tools and consumables, and the invoice cost of materials, supplies, and equipment not owned by Subcontractor. Subcontractor-owned equipment shall be based on current blue book rates. An allowance of 25% of all direct costs shall cover all markup (job overhead, profit, general expense and administration fees, interest, home office expense, executive and management payroll, and travel).

4.1 Design, furnish, install, operate, maintain, and remove a dewatering system to remove local pockets of trapped water.

Note: The cost of other lump sum or unit price operations such as caisson installation, mass excavation, support of excavation, and concreting are not included in the cost of the dewatering system, even though their efficiency and productivity may be affected by the presence of water or the dewatering system. Subcontractor shall include whatever cost allowances deemed necessary for such inefficiencies or lack of productivity caused by water or the dewatering in the lump sum price, wherein the affected operation is compensated for, and that the prorated portion of the lump sum payment is accepted as the total compensation for that work.

Company

Signature of Bidder

Title

Bidder's Reference Number

Date of Bid

EXHIBIT "E"

LIST OF DRAWINGS

EXHIBIT "E"

LIST OF DRAWINGS

Drawing No.	Title	Rev.
C-2010	Auxiliary Building Unit 1 [redacted] Plant Area Dewatering	1
C-2011	AUX. BUILDING UNIT 2 PLANT AREA DEWATERING	0

REFERENCE DRAWINGS

Yard Drawings
CIVIL

C-5	Detail Plan Area B	6
C-51	Circulating Water System - Plan & Sections	11
C-52	Circulating Water System - Misc. Details	8
[redacted]	[redacted]	[redacted]

MECHANICAL

M-166	Yard Piping Plan - Area B	3

ELECTRICAL

E-530-Sh.#1	Duct Bank Sections	12
E-530-Sh.#2	Duct Bank Sections	3
E-531-Sh.#1	Duct Bank Layout - Plant Area	18

Turbine Building - Unit 1 & 2

CIVIL

C-501	Concrete Foundation Mat at El 614'-0"	11
C-504	Foundation Mat Reinforcing Plan	5
C-506	Foundation Mat Sections & Details - Sh.#1	8
C-508	Foundation Mat Sections & Details - Sh.#3	7
C-701	Concrete Foundation Mat at El 614'-0"	14
C-704	Foundation Mat Reinforcing Plan	6
C-710	Concrete Sections & Details - Sh. #2	5

MECHANICAL

M-14	Equipment Location at El 614'-0"	7
M-17	Equipment Location at El 614'-0"	11
M-89	Piping Drawing - Area 5	1
M-97	Piping Drawing - Area 6	1
M-105	Piping Drawing - Area 7	5
M-113	Piping Drawing - Area 8	3

ELECTRICAL

E-543	Embedded Conduit & Grounding @ El 614'-0"	9
E-547	Embedded Conduit & Grounding @ El 614'-0"	14

Preliminary Draft Thru 2/7

QUESTION 27

Your response to Question 4 states that the preliminary estimate for the residual settlement for the diesel generator building is of the order of one inch for the 40 year life of the plant.

a) Does this settlement estimate include any contribution due to potential soil shakedown due to an earthquake? If not, what would be the total predicted settlement? In your response, describe your method of analysis of settlement, and clearly differentiate between the contribution of and methods for the static and shakedown conditions.

b) Quantify and describe the basis for the accuracy of your residual settlement estimate including any adjustment to this estimate as may result from part a above. State the possible upper bound of the structural settlement and relate this value to that which will be used in your revised structural analyses.

RESPONSE

The order of magnitude settlement given in Revision 4 of Question 4 did not include seismic shakedown settlement. The response to Question 4 has been modified to include the

settlement contribution from a) static residual 40-year settlement due to secondary compression, b) settlement due to permanent dewatering, c) settlement due to diesel engines' vibration (pedestal only), and d) settlement due to earthquake ground shaking.

The method of analysis, basis for accuracy, and upper bound settlements are discussed below.

A) Method of Settlement Analysis

1) Static 40-Year Secondary Compression

To accelerate the settlement of the fill under the diesel generator building, a full-scale preload program was carried out during 1979. The time versus settlement and piezometer data collected during the preload program were compiled, analyzed, and evaluated. The loading histories imposed by the building and surcharge are shown in Figure 27-1.

a) Theoretical Background - A typical time-settlement history of a point on a foundation or earth structure is illustrated schematically in Figure 27-2. It is useful to calculate

the settlement S as the sum of two components, as shown in the figure:

$$S = S_c + S_s$$

in which Sc is the consolidation settlement (including any immediate settlement) and Ss is the secondary compression settlement.

The distinction between consolidation and secondary compression settlements is made on the basis of the physical processes which control the time rate of settlement. In primary consolidation settlement, the time rate of settlement is controlled by the rate at which water can be expelled from the voids. In the case of secondary compression settlement, the speed of settlement is controlled largely by the rate at which the soil skeleton itself yields and compresses. The transition time between these two processes is conveniently identified as that time when excess pore water pressure becomes essentially zero. This time, denoted as t_{100} is shown in Figure 27-2.

It has been observed in many laboratory and field measurements that the relationsnip between the magnitude of secondary compression and time is approximately a straight line on a semi-logarithmic plot after the primary consolidation has been completed, as shown in Figure 27-2. Thus the settlement ΔH can be expressed approximately as:

$$\Delta H = - C_\alpha \log t_2 / t_1$$

where t_2 and t_1 are two specific time periods on the extrapolated secondary compression line.

b) Precompression to Reduce Settlements - In order to produce more rapid consolidation of compressible materials, one of the most effective approaches consists of increasing the load on soil above that which would result from the intended construction. If the effective stress can be increased sufficiently, post-construction settlement will be largely eliminated. A surcharge consisting of 20 feet of sand was placed within and around the building. The surcharge extended 20 feet around the building except for the north part

where it extended about 15 feet. The dead weight of the building was in place during surcharge. The building weight amounted to an average pressure of about 2.2 ksf.

c) Method of Prediction - Figure 27-3 depicts a typical plot of settlement versus time for a point on the diesel generator building in association with surcharge load history under the surcharge loading. The same data have also been replotted by settlement versus logarithmic of time as shown in Figure 27-4. By comparing Figure 27-2 to Figure 27-4, it is evident that the primary consolidation was accomplished quickly after the completion of placement of fill. This was further proved by observing that pore pressures were smaller than actually anticipated, and they dissipated rapidly as shown in Figures 27-5a and b. Thus, it is possible to forecast the settlement that would occur at any future time by simple extrapolation of the linear portion of the settlement curve on the assumption that the surcharge will remain in place.

Figure 27-4 also shows the straight line interpretation of the data along with the slope C_α of the straight line per log cycle of time. The predicted C_α values for each of the 32 data points on the diesel generator building and pedestals also include four deep borros anchors which were installed at elevation 535 feet to improve measurement accuracy after the building movement rate became relatively small as shown in Figure 27-6.

As depicted in Figure 27-7 the total settlement of the diesel generator building and pedestals consists of the following components:

S_0 = Measured settlement prior to surcharge program (between approximately 3/25/78 and 1/19/79); Figure 27-8

S_1 = Measured primary plus secondary compression settlement during surcharge program (between 1/26/79 and 8/10/79); Figure 27-9

S_2 = Estimated secondary compression settlement assuming surcharge remains (between 8/10/79 and 12/31/81); Figure 27-10

S_3 = Estimated residual secondary compression settlement during 40-year plant life assuming surcharge remains (between 12/31/81 and 12/31/2021); Figure 27-11

Note: 12/31/81 will be the date when pertinent piping and major equipment will be connected and installed.

The estimated settlements of S_2 and S_3 for each point were obtained by extrapolation (i.e., by multiplying C_α by the number of log cycles required.)

Based on Figure 27-11, the range as well as average predicted settlement during the 40-year plant life after major piping connections and equipment installation have been made (12/31/81) will be as follows (assuming the surcharge remains in place).

40-YEAR SETTLEMENT UNDER CONSTANT SURCHARGE (S_3)

Area	Range (inches)	Average (inches)
North Wall	0.70 - 0.90	0.78
Pedestal No. 1	0.80 - 1.17	0.97
Pedestal No. 2	0.82 - 0.91	0.85
Pedestal No. 3	0.85 - 1.46	1.09
Pedestal No. 4	0.76 - 1.43	1.13
South Wall	1.10 - 1.49	1.29

The data show that an upper bound of static 40-year settlement due to secondary compression can be conservatively selected to be 1.5 inches. (under constant surcharge)

2) Settlement Due to Permanent Dewatering

Because of elimination of liquefaction potential, a permanent dewatering system will be implemented at the plant area. ~~In these calculations~~, Results indicate that the settlement due to permanent dewatering was based on the conservative assumption that the existing ground water table (elevation 627) will be lowered to elevation 600 (+) (-). The appropriate soil compressibility parameters used were obtained from settlement and rebound data under the diesel generator surcharge program.

595

Results of these calculations indicated that the settlement of fill due to dewatering is on the order of 1/10 inch. For conservative purposes, an upper bound value of 1/4 inch will be used. Settlements will also occur below the fill; it is estimated that they are on the order of 1/3 inch and will be uniform.

3. Settlement Due to Diesel Engine Vibration (Pedestal Only)

From an analysis of the dynamic response of the diesel engine-generator-pedestal and soil system, it was estimated that the maximum vibration amplitude would be about 0.00008 inch under operating conditions. By rounding this number up to 0.0001 inch, the cyclic shearing strain amplitude directly under the pedestal was estimated to be 1.6×10^{-5}%. The cyclic shearing strain amplitude would actually decrease with distance from the bottom of the pedestal, but that decrease was ignored in this settlement estimate.

The test results for settlement of uniform, dry silica sand during earthquake excitation by Seed and Silver (1972) was used to determine the vertical strain under the pedestals. The soil under the pedestals was assumed to have a relative density of 45% for a depth of 30 feet, although the actual relative densities were variable and were higher, on the average, than 45%. The conditions of the Silver and Seed tests which were applied here were relative density 45%, cyclic acceleration 0.3 g, and vertical effective stress 350 psf. Based on

these test results, the cyclic shearing strain determined above, and assuming the diesel generator set ran continuously for one year (365 days), the vertical strain due to vibration was estimated to be 0.07%. For a 30-foot thick sand stratum, the estimated settlement amounts to 1/4 inch.

The assumptions used in this estimate of settlement are considered conservative for the following reasons:

a) The cyclic shearing strain amplitude under the pedestals was assumed to be uniform for 30 feet below the pedestals, but the actual cyclic shearing strain amplitude would reduce with depth.

b) Seed and Silver tests were for dry, uniform silica sand and the silty and/or clayey sands at the site would settle less due to vibration.

c) Seed and Silver tests were performed for an acceleration of 0.3 g while the acceleration due to the estimated diesel generator vibration directly under the pedestal would be 0.0006 g.

d) One year of continuous operation of the diesel-generator set is considered an upper bound.

4. Earthquake Ground Shaking - With elimination of liquefaction potential, the remaining factor to be considered is the settlement of sand due to ground shaking caused by earthquakes. Settlement calculations were performed based on the approach described by Seed and Silver (1972)[1] and the recommendations on multidirectional shaking by Pyke, Seed, and Chan (1975)[2].

In these computations, average relative densities were based on standard penetration tests using the Gibbs and Holtz (1957)[3] relationships and the loads from the structure were accounted for in the calculations. Results of these calculations are shown in Figure 27-12. The data are summarized below:

Location	Range (inches)	Average (inches)
Northwest quarter	0.17 - 0.29	0.24
Northeast quarter	0.01 - 0.53	0.21
Southwest quarter	0.0 - 0.09	0.05
Southeast quarter	0.0 - 0.19	0.06

It is seen from the above data that the average settlement is about 1/4 inch in the north part of the building and about zero in the south part of the building. For conservatism, the design will be based on a settlement of 1/2 inch.

C) Basis for Conservatism and Accuracy

1) Static 40-Year Secondary Compression

a) The surcharge and the completed portion of the diesel generator building produced stresses in the fill in excess of those that will prevail when the structure is operational. However, the prediction of residual settlement by linear extrapolation secondary consolidation was based upon the assumption that the surcharge will remain for 40 years.

Predicted and measured secondary compression settlements based on data available to date (1/16/80) are shown in Figure 27-13. It is seen that the measured secondary compression settlement at the 32 data points encompasses the period between surcharge removal (8/10/79) and the latest recorded data (1/16/80). Two sets of predicted secondary compression settlements values (Sp_1 and Sp_2) were obtained:

1. Sp_1: Calculated Settlement value assuming surcharge remains.

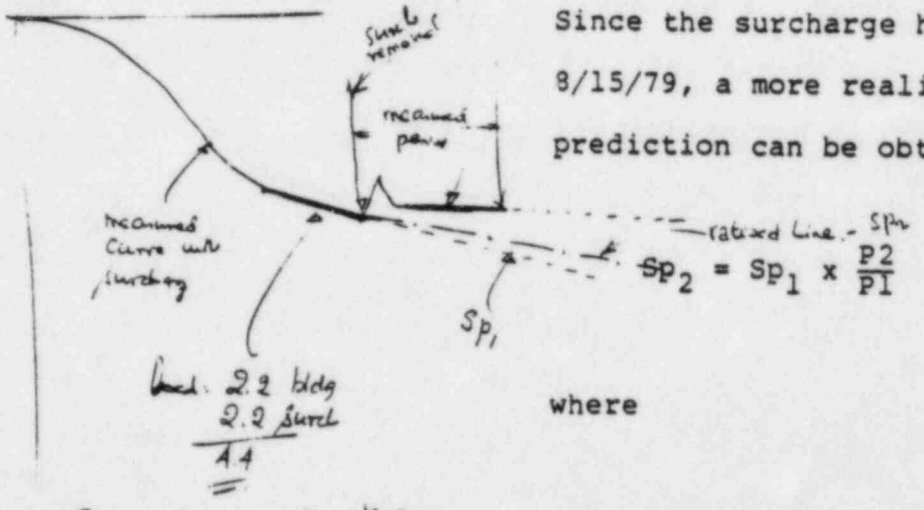
This was obtained by linear extrapolation of ~~Ox~~ values between time period of 8/10/79 and 1/16/80 as shown in Figure 27-7.

prior to 8/10/80

No surcharge as then

2. Sp_2: Settlement value accounting for surcharge removal.

bldg only = 2.2K/0'



Since the surcharge had been removed on 8/15/79, a more realistic settlement prediction can be obtained from:

$$Sp_2 = Sp_1 \times \frac{P2}{P1}$$

where

Sp_2 = predicted settlement values accounting for current level of imposed stress

Sp_1 = predicted settlement values assuming surcharge remains for 40-year life

Revision 5
2/80

P_1 = Average imposed stress during surcharge program (4.4 ksf-total of building plus surcharge)

P_2 = Average imposed building stress after surcharge removal (2.2 ksf)

It is seen from Figure 27-12 that both the predicted values of secondary compression settlement greatly exceed the measured values. Thus, it can be concluded with assurance that the rate of settlement for the 40-year plant life as shown in Figure 27-11 will be considerably less than the prediction.

2) Earthquake Ground Shaking

It should be noted that the settlements computed by this procedure are conservative because it assumes that sand is dry. Because the sand will never dry, the presence of capillary action, as in the partially saturated sand, will reduce critical settlements below those predicted.

D) Structure Design Criteria

The possible total and differential settlements which will become the design bases for the diesel generator building are given in Table 4-1. It should be noted that they are divided into two parts, namely static and seismic.

The static total and differential settlements are time-dependent and will be experienced by the structure for the 40-year plant life. They are derived by super-position of three components contributed by a) static 40-year secondary compression after 12/31/81, b) permanent dewatering, and c) diesel engine pedestal vibration. The seismic total and differential settlements may be experienced by the structure and pedestals and they are not time-dependent.

To account for the two different types of settlement, the revised structural analysis will consist of ~~two independent parts:~~

~~1)~~ The building, pedestal, and utilities will be ~~designed~~ for the static + dynamic total and differential settlements as given in Table 4-1.

Revision 5
2/80

2) The building, pedestal and utilities will be designed for the seismic settlement by assuming northern half of the building and pedestal without soil support.

Revision 5
2/80

EXHIBIT "E"

LIST OF DRAWINGS

Drawing No.	Title	Rev.
Auxiliary Building		
CIVIL		
C-203	Floor Plan at El 599'-0"	5
C-204	Floor Plan at El 614'-0"	8
C-205	Floor Plan at El 634'-0"	12
C-213	Concrete Reinforcing Plan at El 614'-0"	6
C-274	Concrete Sections & Details - Sh. #5	7
C-275	Conceret Sections & Details - Sh. #6	8
MECHANICAL		
M-4	Equipment Location at El 614'-0"	11
M-63-Sh.#1	Piping Drawing - Area 3	2
M-63-Sh.#2	Piping Drawing - Area 3	2
ELECTRICAL		
E-532	Embedded Conduit & Grounding Switchgear Room At El 614'-0"	13
C-2005	AUX. BLDG & FEEDWATER ISOLATION VALVE PIT UNDERPINNING - UNIT #1	0
C-2006	AUX. BLDG & FEEDWATER ISOLATION VALVE PIT UNDERPINNING UNIT #2	0
C-2020	FEED WATER ISOLATION VALVE CHAMBER	1

DIESEL BUILDING & OTHER CIL. SETTLEMENT Calc

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

OCT

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, C-2645

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

Service Water Piping

Preliminary 2/5

QUESTION 34

Supplement your response to question 16 to address how underground seismic Category I piping and conduit are protected from excessive stress due to railraod tracks, construction cranes, and other such heavy vehicles during construction and operation.

RESPONSE

The seismic Category I piping (conduits) systems are protected against excessive stresses due to construction vehicular traffic, railroad traffic, etc, by using appropriate design and installation techniques. ~~Generally,~~ the pipes are installed in a trench condition with the bottom width of the trench approximately equal to the outside diameter of the pipe plus 12 to 24 inches on each side of the pipe. Select granular bedding material is placed and compacted all around the pipe to an elevation approximately 1 foot above the top of the pipe. In areas where it is impractical to use granular bedding material, concrete with a minimum strength of 2,000 psi is substituted. The rest of the trench is backfilled and compacted ~~with excavated material~~ upto grade.

The buried seismic Category I piping in the yard includes service water lines, borated water lines, and diesel oil fuel lines. The wall thicknesses for these pipes are primarily based on internal pressure to meet the appropriate ASME code requirements and are considered sound and conservative(2).

As a standard practice, the buried pipes are also analyzed for deflection caused by earth loads and superimposed loads such as construction vehicular traffic, railroads, cranes, etc. A deflection of 4% of the pipe diameter for externally coated pipes is considered as an acceptable limit (1,2). Deflection calculations are performed using a soil density of 120 lb/ft^3 for dead loads and Cooper's E-80 loads for live loads. (Cooper's E-80 loads, with an impact factor of 1.5, produces a maximum load of approximately 2,000 lb/ft^2 at a depth of 6 feet below the grade. The heaviest construction crane "Monitowoc-4100" induces a load of about 1,000 lb/ft^2, and HS-20 truck loading produces 200 lb/ft^2 at a depth of 6 feet below the grade.) Soil modulus values of 1,900 psi and 700 psi were used in the calculations and resulted in a deflection of less than 2% and 4% of the diameter, respectively. The soil moduli of 1,900 psi and 700 psi correspond to 85% and 75% compaction determined in accordance with AASHO T-99 specification(1). Deflections for bare steel pipes of up to 10% is considered safe, and a deflection of 20% is considered unacceptable(1).

True engineering properties of both steel pipe and the earth envelope enter directly into the deflection calculations. The analysis of underground conduits remain impractical. A precise knowledge of soil properties is difficult to obtain due to unmeasured variables in the field installation, backfilling and compaction(2).

The deflection calculations are based on Spangler's method[1]. The soil modulus was treated as a selective constant. The soil modulus is a measure of the passive resistance of the earth at the sides of the pipe on an elastic basis. The deflections of various pipes are found to be within the allowable limits even with a conservative soil modulus of 700 psi.

Although the bending resistance of pipes under an external load is relatively unimportant[2], structural calculations have been performed to determine the stresses in the pipe wall for informational purposes. The calculations considered Spangler's method for determining the lateral soil pressures on the pipes using a soil modulus of 700 psi and 1,900 psi. These soil moduli correspond to 75% and 85% compaction determined in accordance with AASHO T-99 specifications[1]. The results of this analysis are indicated on Table 34-1. The fact that the stresses are at or near yield point should not be a concern as proven by wide experience [4,5] and by laboratory tests[2]. Since the stresses due to internal pressure are minimal (about 8% of yield), the wall thicknessess of the buried Category I pipes are adequate to withstand the external loads.

Seismic Category I conduit used for electrical cables is embedded in concrete. Such conduit is designed as concrete structures to withstand appropriate loads.

REFERENCES:

1. Steel Plate Engineering Data, Volume 3, American Iron and Steel Institute (AISI), 1977

2. Steel Pipe Design and Installation, American Waterworks Association, Manual M-11, 1964

3. Spangler, Merlin G. and Richard L. Handy, Soil Engineering, 1973

4. "Design and Deflection Control of Buried Steel Pipe Supporting Earth Loads and Live Loads," Proceedings, American Society for Testing and Materials (ASTM), 57:1233, 1957

5. "Report on steel pipelines for underground water service," Special Investigation 888, Underwriter's Laboratory, Inc., Chicago, 1936

identify

TABLE 34-1

STRESS IN BURIED PIPES DUE TO DEADLOAD OF SOIL AND LIVE LOAD FROM COOPER'S E-80 LOADING

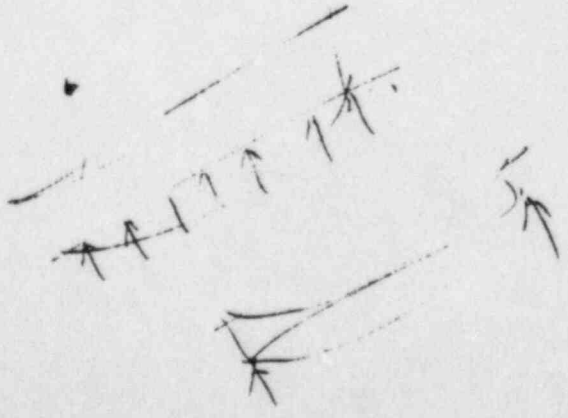
	Soil Modulus E'=700 psi (75% Compaction AASHO T-99 Specification)		Soil Modulus E'=1,900 psi (85% Compaction AASHO T-99 Specification)	
Pipe Diameter	36 in.	26 in.	36 in.	26 in.
Wall Thickness	3/8 in.	3/8 in.	3/8 in.	3/8 in.
~~Membrane~~ Stress (ksi)				
Internal pressure (uniform)	+3.1	+2.2	+3.1	+2.2
External loads (maximum)	-0.9	-0.3	-0.7	-0.4
~~Bending stress~~ (ksi)	±38*	±29.5	±26.9	±20.5
Vertical Displacement (% of Diameter)	2.9%	1.9%	1.4%	1.1%

*Maximum bending moment = 930 ~~in pounds~~ inch-pounds
Maximum membrane force = ±830 ~~in~~ pounds

Note: For a full plastic hinge at a moment of 930 ~~in~~ inch-pounds, the allowable membrane force = ~~7,850~~ pounds which is much more than ±830 pounds.

Allowable stress - ?

Note on → Allowable stresses



P

60

DIESEL BUILDING

Bechtel Specs: C-301
C-211
C-210
C-76

Drawings C-45
C-109
C-117
C-1001

ASTM

D 422-63
D 2049-69
D 2216-71
D 1557-70 (D)
D 1556-64
D 698
D 2167-66
D 1140-54
C-136
C-117

FSAR Table 2.5-14, Table 2.5-21,
Section 3.8.5.5, 2.5.21 - Compaction requirement.
Fig 2.5-14 Diesel Gen. Bldg.

Bechtel Quality Control Instruction C-1.02

Limitation on Crack : .013" (ACI 318, 1C 4)

Boring data: Sk-C-614 Rev A.

Reference to BMP: 1. C-208, Sect 9.1 - 95% BMR
2. C-210 12.4 - 95% (13.7 ?)
3. C-211 95% BMP

FCR C-302 (?)

Dutch Cone → Description, ASTM ? Reference ?

Civil Std: C-501.

Becht — C-301 → Modified Proctor Method.
Becht — C-211 → ✓ (ASTM 1557, Method D)
Becht — C-210 → Section 13.7

Spec C-76 Monitoring Settlement - Spec for.

ASTM. Material D 422-63 Gradation — ASTM C-136 } gradation
C-117 }
D 2049-69 Relative Density
D 2216-71 Moisture Content
D 1557-70 - Compaction (Method D) Laboratory
D 1556-64 (Field Tests)
D-698 ASTM D-2167-66
D 1140-54

Design Dwgs: C-45, C-109, C-117 & C-1001

Diesel Bldg:

① Get as drawings of the building, Foundations, etc.
② Drawings of their set up.
③ Settlement plots.
④ Original ground level vs fill etc
⑤ FSAR Commitments [2.5.4.10.3. Settlement]
⑥ Dams and Mine Report
⑦ Understand soil gradations.
⑧ In general to propose a cohesive report as backfill for Class I & Class II structures

79 1/2 (67)

Summary

1) BMP - 1557 Compaction | Confusion as to which method of test.
2) 6 to 8" Vs 12" layers → Dams & Moore Vs. practice.
3) Loose materials were found.
4) Borings showed sand lenses.
5) FSAR, PSAR, Commitments to clay etc, not met.
6) ~~Settlement~~ problem not a bearing problem & Fill settling in the dam weight - ?
7) 95% Vs 85% Vs 80%. What is FSAR's commitment.

2-14-80

QUESTION 31

Your reply to Question 6a does not provide the information requested. Your "full scale load test" proposed for the borated water storage tanks fails to provide any margin to account for additional loadings on the tank such as seismic forces, snow or ice packs, design and measurement uncertainties, etc. Your reply also fails to address the fact that the actual content of the tanks will be other than pure water. Consequently the test as currently proposed, will not produce conservative results and is unacceptable. Revise your proposed test to provide for worst case loadings or loading combinations, with allowances for uncertainties. Specify and describe the basis for the margins to be provided by revised test. Also define your minimum test duration. Describe the extent and type of measurements to be taken after completion of the load test to ascertain actual material properties.

RESPONSE

General

The 32-foot high and 52-foot diameter borated water storage tanks are designed to store fluid with a density of approximately the same as water (63 lb/ft³ at 40°F) and will be operated at above freezing temperatures by means of internal heaters. Each tank is constructed on sand fill within a spread footing type foundation ring. The maximum contact stress beneath

the ring wall due to dead load tank, live load, and wind load is 1.2 ksf. The maximum contact stress under the bottom plate of the tank due to weight of the fluid is approximatley 2 ksf. Soil borings within and around the borated water tanks show that conditions are satisfactory for the support of the tanks. Figure 31-1 shows boring locations in the tank farm area and Figures 31-2 through 31-7 show standard prediction blowcount results for the borings within and around the tanks. These blowcounts are also summarized in Table 31-1. Based on the blowcount information in Table 31-1, it is concluded that the condition of the fill is satisfactory for support of the tanks.

Settlement

Two plate load tests were conducted near the ring foundation of the east and west tanks at the location shown on Figure 31-8. The results of these tests are shown on Figure 31-9. Based on these results it is estimated that the immediate settlement of the tanks due to filling with water will be on the order of 3 inches.

A comparison between standard penetration test results for the borings within and around the tanks and the borings taken at the diesel generator building before preload shows that conditions at the tanks are better than those at the diesel generator building before preload. Based on the size of

the loaded areas occupied by the tanks and the more favorable conditions at the tanks, it is estimated that the residual settlement of the BWSTs will be less than the 40-year prediction for the diesel generator building. It is estimated that the residual settlement of the BWSTs will be on the order of 1 inch. The actual value will be determined based on the full-scale test to be performed by filling the tanks with water and monitoring them until the rate of movement becomes small, thus allowing prediction of residual settlement by extrapolation. The minimum duration of the test will be 4 months. No significant sand fill was encountered in the borings below and around the tank and, therefore, settlement due to earthquakes is not applicable in this case. As a result of plant area dewatering, the fill supporting the tanks will settle an estimated one-half inch due to consolidation of the fill material. The corresponding differential settlement will be on the order of 1/4 inch. In addition, small settlement will also occur in the natural soil below the fill. Thus, the total differential settlements are estimated to be as follows:

Structure

	Residual Settlement (inches)	
	Total	Differential
Borated water tanks	1 1/2	3/4

Shear Wave Velocity

Cross-hole shear wave velocity tests were conducted near the borated water tanks at the locations shown in Figure 31-8. The results are in Figure 35-1 along with results from other areas.

Bearing Capacity

Bearing capacity calculations were made for the borated water storage tanks using the shear strength data presented in Figure 35-2. The ultimate bearing capacity calculated is ? psf. This results in a factor of safety of (3) for dead and live loads and dead, live, and seismic loads, a factor of safety of two for respectively.

Based on the settlement, bearing capacity, and shear wave velocity information discussed above, it is concluded that the engineering properties of the fill are sufficient for support of the tanks and, therefore, preloading in excess of the tank pressures is not needed. The test to verify the predicted long-term settlement will be interpreted conservatively to account for any uncertainties in measurements. Inasmuch as the tanks are heated, any loading from snow and ice will be small and will not significantly affect settlement or bearing capacity. delete extra space

The capacity of the supporting fill to resist seismic

loading is accounted for by the ~~availability~~ factor of safety of (2) for this loading condition.

Engineering Input: Structural analysis of foundations to maintain differential settlement and respond to Heller's question during the 1/16/80 meeting.

~~what to do with this?~~ See insert

Q31

The borated water tank ring foundation will be analyzed for the predicted 40 years settlement and differential settlement condition. The loading combination will be consistent with the Midland Plant FSAR commitments as enumerated by the settlement criteria stated in Response 14. The stresses will be evaluated according to ACI 318-71 code.

NRC requested that the cracking for lean of support for this tank

SPEC FOR GROUTING (Draft copy)

DIESEL GENERATOR BLDG

1.0 SCOPE

1.1 ITEMS INCLUDED

The following items are included under the scope of this subcontract and involve the test grouting program and the grouting of material at various plant locations. This specification includes Q-listed work where specifically noted.

1.1.1 Submit all drawings, calculations, and detailed procedures for the proposal on the type and method of grouting which are best suited for the intended use and, as a minimum, meet all of the applicable criteria specified herein.

1.1.2 Furnish all equipment, supervision, design, and procedures to perform and operations and incidentals necessary to complete the work to the satisfaction of Contractor.

1.1.3 Subcontractor shall provide all design information and support which may be required for NRC licensing and which shall enable Buyer to submit and support changes to the Final Safety Analysis Report and any other licensing requirements which may be in effect prior to the issuance of an operating license. Subcontractor shall also submit the list of applicable codes, standards, and documents used.

Subcontractor shall be responsible for taking any action required by the U.S. Nuclear Regulatory Commission (NRC) to resolve written staff questions or positions which involve explanation or disclosure of design details.

Any criteria changes imposed by the NRC subsequent to the issue of the purchase order may constitute additional payment.

Subcontractor shall be responsible for all licensing documentation reproduction in sufficient copies to satisfy regulatory agency and Buyer requirements. The licensing report

Will be suitable for filing with the NRC, meeting the applicable portions of NRC requirements.

Upon request from Buyer, Subcontractor will attend all Buyer and NRC meetings related to the grouting operation.

1.2 ITEMS NOT INCLUDED

The following items will be provided by Contractor:

1.2.1 Labor

1.2.2 Material

1.2.3 Excavation

1.2.4 Fill

1.2.5 Core Drilling

2.0 ABBREVIATIONS

3.0 CODES AND STANDARDS

4.0 DOCUMENTATION REQUIREMENTS

4.1 Engineering and quality verification documents shall be submitted to Contractor by the grouting Subcontractor. Permission to proceed, based upon Contractor's review of the procedures, does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by Subcontractor and does not relieve Subcontractor from full compliance with contractual obligations. The submittal requirements are summarized in Form G-321-D attached. These requirements are augmented by detailed requirements in this specification.

4.2 As a minimum, Subcontractor shall submit the following procedure to Contractor's satisfaction.

4.2.1 Test Grouting Procedure

4.2.2 Grouting Procedures for the Diesel Generator Building

4.2.3 Grouting Procedures for the Auxiliary Building Train Bay

5.0 MATERIAL REQUIREMENTS

5.1 Chemical grouts shall be one or both of the following as directed.

5.1.1 A calibrated measure of sodium silicate base in combination with sodium aluminate, or sodium aluminate and a chemical with characteristics similar to formamide, or sodium aluminate in combination with formamide as used in "Siroc" or other similar approved product.

Brand name or what?

5.1.2 Acrylamide grout and associated chemicals or other similar approved product.

5.2 The viscosity of the chemical grouts shall remain constant throughout 80% of the injection and gelation time period. The final reaction shall produce a continuous irreversible and permanent gel at a chemical grout concentration as low as 1.0 pound per gallon of water.

5.3 Chemical grout materials shall be stored in accordance with the manufacturer's instructions.

5.4 Chemical grout materials shall be purchased in accordance with the requirements of Specification 7220-G-33(Q).

6.0 EQUIPMENT

6.1 GENERAL

Furnishing and delivery (including) freight to and from the jobsite (of equipment) in accordance with Section ____ for the duration of the grouting operations. Subcontractor shall set up performance criteria and develop and proof test such equipment to meet the technical requirements for the construction schedule of Contractor for the grouting operation.

Subcontractor shall be responsible for the proper functioning and quality of such equipment and shall make repairs as are necessary for the proper performance of the

equipment such that the schedule will be maintained. Contractor will maintain the equipment in accordance with Subcontractor's instructions.

6.2 Equipment shall consist of the following:

6.2.1 The pumping unit shall consist of two or more pumps with a combined discharge ranging from 2 to 20 gallons per minute when operating at a pressure at the grout hole connection of 150 psi.

6.2.2 The pumps in the pumping unit shall be so arranged that the two extremes in the discharge rate can be obtained while pumping without interrupting the flow of chemical grout into the hole.

6.2.3 Each pump shall be equipped with an accurate flowmeter or other approved device for measuring rate of flow of solution to the grout hole and shall be equipped with an accurate pressure gage at the pump and at the grout hole.

6.2.4 The storing and mixing capacity of the grout unit shall be such that a continuous uninterrupted flow of chemical grout at 20 gpm can be maintained.

6.2.5 All components (mixing tanks, storage tanks, pipe, fittings, and pump) shall be of noncorrosive metal.

6.2.6 The two chemical solutions shall be pumped through individual pipes or hoses which shall be joined at the injection point at the grout hole connection. The injection point shall be designed to prevent excess pressure in one supply line from affecting the other supply line.

7.0 CHEMICAL GROUT TEST PROGRAM

7.1 GENERAL

The work under this section consists of, but is not limited to, all work necessary to perform a chemical grout test program.

Subcontractor shall submit a detailed procedure describing the method of grouting employed prior to the start of work. This procedure will be to the satisfaction of Contractor.

Subcontractor shall provide the necessary equipment and supervision for the chemical grout test program in accordance with the requirements of this specification and as shown on the drawings.

7.2 The grout test is to be performed in the following manner.

7.2.1 Excavate a pit approximately 20 feet square and 15 feet deep. It is desirable to have the pit several feet below the water table.

7.2.2 Fill the pit with the two sands used at the site. The gradations and fill placement are shown in Figure 2. The sand should be end-dumped and leveled with a small dozer. No attempt at compaction is to be made.

7.3 ACCEPTANCE CRITERIA

Upon completion of the test grouting, the test pit shall be examined by Subcontractor using standard penetration tests (ASTM) and visual inspections.

Subcontractor shall develop acceptance criteria to ensure against liquefaction in the areas to be grouted. This acceptance criteria will be to the satisfaction of Contractor.

8.0 GROUTING OF STRUCTURES

8.1 GENERAL

The work under this section consists of, but is not limited to, all work necessary to grout the diesel generator building foundation and the auxiliary building railroad bay foundation.

Subcontractor shall submit a detailed procedure describing the method of grouting employed prior to the start of work. This procedure will be to the satisfaction of Contractor.

8.1.1 Subcontractor shall provide the necessary equipment and supervision for the grouting operation in accordance with the requirements of this specification and as shown on the drawings.

8.2 GROUTING UNDER DIESEL GENERATOR BUILDING

The work under the diesel generator building will include, but is not limited to, the sands under the northwest corner of the structure. A description of the soils is shown in the boring logs.

8.2.1 The grout holes for this work will vary from vertical to 45 degrees.

8.2.2 The grout holes are expected to be advanced into the fill for a depth of 15 feet.

8.2.3 The grouting will be performed from inside the structure through the foundation, and from outside adjacent to the structure.

8.3 GROUTING UNDER THE AUXILIARY BUILDING RAILROAD BAY

The work under the auxiliary building railroad bay will include, but is not limited to, the sand layers exibiting the following.

8.3.1 The grout holes for this work will vary from vertical to 45 degrees.

8.3.2 The grouting will include all areas where the blowcount is less than 15 blows per foot.

8.3.3 The grouting will be performed from inside the structure through the floor slab, and from the outside adjacent to the structure.

8.4 CORE DRILLING

Core drilling required to perform the grouting of these structures shall be in accordance with the requirements of Section 9.2 of Specification 7220-C-231(Q).

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CEPTANCE CRITERIA 470

ECORDS 470

A record of placing each grout pipe will be made, and information on location and driving the pipe will be recorded. A log of each hole grouted will be made, and information on chemicals used, pressures, gel times, grout types, and communications with other holes will be noted. All records and logs will be signed by the Bechtel Geotech representative on the site and by the Bechtel representative supervisor. 471 471 472 473 473 474 478

QUALITY ASSURANCE REQUIREMENTS 484

11.1 GENERAL 490

The grouting of the diesel generator building and the auxiliary building railroad bay are Q-listed operations and shall be controlled in accordance with this specification and Subcontractor's quality assurance program. Subcontractor's quality assurance program shall be in accordance with Specification 7220-G-23 (Appendix). 490 491 491 491 492 492 492 498 498 498

11.2 Because of the nature of the work, an independent overlay inspection will be performed by Contractor's inspection organization in accordance with this specification and Subcontractor's procedures. 499 499 503

12.0 MEASUREMENT FOR PAYMENT

15.0 CLEANING AND COATING PROCEDURES (E), AND VERIFICATION REPORTS (V) — The procedures for removal of dirt, grease or other surface contamination and includes application of protective coatings. Verification reports include certification of visual examination for surface preparation, surface profile, materials, etc., humidity data, temperature data and coating thickness data as required by the procurement documents.

16.0 HEAT TREATMENT PROCEDURES (E), AND VERIFICATION REPORTS (V) – The procedures for controlling temperature, time at temperature as a function of thickness, furnace atmosphere, cooling rate and method, etc. Verification reports normally include furnace charts or similar records which identify and certify the item(s) treated, the procedure used, furnace atmosphere, time at temperature, cooling rate, etc. Verification data may be in either narrative or tabular form.

17.0 CERTIFIED MATERIAL PROPERTY REPORTS (V)

17.1 MTR (Certified Material Test Reports) – These reports include all chemical, physical, mechanical and electrical property test data required by the material specification and applicable codes. This is applicable to cement, concrete, metals, cable jacket materials, rebar, rebar splices, etc. The certified MTR shall include a statement of conformance that the material meets the specification requirements.

17.2 Impact Test Data – Results of all Charpy or drop weight tests including specimen configuration, test temperature and fracture data.

17.3 Ferrite Data – Report of the ferrite percentage for stainless steel materials used, including castings & welding filler metals as deposited.

17.4 Material Certificate of Compliance – Verification document which certifies conformance to the requirements of the applicable material specification.

17.5 Electrical Property Reports – Report of electrical characteristics, e.g., dielectric, impedance, resistance, flame test, corona, etc.

18.0 CODE COMPLIANCE (V) – Verifying documents (such as data Forms U-1, N-2, State, etc.), which are prepared by the manufacturer or installer and certified by the Authorized Code Inspector.

19.0 UT – ULTRASONIC EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V) – Method of detection and examination results of presence and certain characteristics of discontinuities and inclusions in materials by the use of high frequency acoustic energy.

20.0 RT – RADIOGRAPHIC EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V) – Method of detection and examination results of presence and certain characteristics of discontinuities and inclusions in materials by x-ray or gamma-ray exposure of photographic film.

21.0 MT – MAGNETIC PARTICLE EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V) – Method of detection and examination results of surface (or near surface) discontinuities in magnetic materials by distortion of an applied magnetic field.

22.0 PT – LIQUID PENETRANT EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V) – Method of detection and examination results of surface discontinuities in materials by application of a penetrating liquid in conjunction with suitable developing techniques.

23.0 EDDY CURRENT EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V) – Method for detection and examination results of discontinuities in material by distortion of an applied electromagnetic field.

24.0 PRESSURE TEST – HYDRO, AIR, LEAK, BUBBLE OR VACUUM TEST PROCEDURE (E), AND VERIFICATION REPORTS (V) – Method for evaluating the structural and mechanical adequacy or integrity by application of differential pressures, and report of the test results.

25.0 INSPECTION PROCEDURE (E), AND VERIFICATION REPORTS (V) – Organized process followed for the purpose of determining that specified requirements (dimensions, properties, performance results, etc.) are met. Documented findings resulting from an inspection are included in the verification report.

26.0 PERFORMANCE TEST PROCEDURES (E), AND VERIFICATION REPORTS (V) – Tests performed to demonstrate that functional design and operational parameters are met and the report of the test results.

26.1 Mechanical Tests, e.g., pump curves, valve stroking, load, temperature rise, calibration, environmental, etc.

26.2 Electrical Tests, e.g., load, impulse, overload, continuity, voltage, temperature rise, calibration, saturation, loss, etc.

27.0 PROTOTYPE TEST REPORT (E & V) – Report of a test which is performed on a standard or typical example of equipment, material or item, and is not required for each item produced in order to substantiate the acceptability of equal items. This normally includes tests which may, or could be expected to, result in damage to the item(s) tested.

28.0 SUPPLIER SHIPPING PREPARATION PROCEDURE (E) – The procedure used by a supplier to prepare finished materials or equipment for shipment from his facility to the jobsite.

BECHTEL
ANN ARBOR

JUN 20 1979

MEMORANDUM

TO CHUCK HUNT - CRO LOCATION JACKSON MICHIGAN

FROM JON G. HOOK DATE MONDAY JUNE 18 19 79

SUBJECT UNDERPINNING SPECIFICATION JOB NO. 7220

FILE C-95

ATTACHED FOR YOUR REVIEW AND INFORMATION IS SPECIFICATION 7220-C-95 Q. THIS SPECIFICATION IS PRESENTLY BEING DEVELOPED.

SHOULD YOU HAVE ANY COMMENTS OR QUESTIONS, FEEL FREE TO CONTACT MYSELF OR BIMAL DHAR, BOTH AT EXT. 7068

Jon G Hook

1.0 SCOPE

CHUCK HUNT

1.1 ITEMS INCLUDED

The following items are included under the scope of this subcontract which involves the underpinning and removal of all unsuitable material and replacement of all unsuitable material with concrete from under the auxiliary building penetration rooms and feedwater valve pits of Midland Plant Units 1 and 2. This specification includes Q-listed work where specifically noted.

1.1.1 Submit all drawings, calculations, and detailed procedures for a proposed type and method of underpinning which is best suited for the intended purpose and meets all of the applicable criteria specified herein.

1.1.2 Furnish all labor, material, tools, equipment, supervision, design, and procedures to perform all operations and incidentals necessary to complete the work to the satisfaction of Contractor.

1.1.3 Provide local dewatering to remove and control all water which could cause soil movement.

1.1.4 Provide (design and install) temporary support under the auxiliary building penetration rooms capable of withstanding 8,300 kips before undertaking mass removal of backfill material under the auxiliary building wings.

1.1.5 Provide (design and install) temporary support under the turbine building along the K line within the zone of influence as indicated on the drawings under the scope of excavation.

1.1.6 Excavate and remove all designated compacted backfill unier the auxiliary building penetration rooms and the feedwater valve pits to the satisfaction of Contractor. The extent of the soil removed shall be determined by Contractor.

1.1.7 Provide lateral support to the soil under the turbine building and control tower in the zone of influence being underpinned to prevent movement of these buildings during underpinning operations.

1.1.8 Place and cure 2,000 psi lean concrete backfill under the designated buildings.

1.1.9 Provide positive contact between the underside of the building foundation and the lean concrete backfill by methods acceptable to Contractor.

1.1.10 Furnish and install stryrofoam or similar material as indicated on the drawings.

1.1.11 Monitor the buildings for settlement.

1.2 ITEMS NOT INCLUDED BUT PERFORMED BY OTHERS

1.2.1 Area dewatering prior to underpinning and excavation

ASTM American Society of Testing Materials | 172

AWS American Welding Society

3.0 CODES AND STANDARDS 176

AWS D1.1-74 Structural Welding Code 180

ACI 318-71 Building Code Requirements for Reinforced 182
Concrete 183

ACI 543-74 Recommendation for Design, Manufacture, 185
and Installation of Concrete Piles 186

AISC 189

ASTM A 6-77b Specification for General Rolled | 190
Steel Plates, Shapes, Sheet Piling, | 191
and Bars for Structural Use | 192

ASTM A36-77a Specification for Structural Steel 194

ASTM A 252- Specification for Welded and Seamless 198
77a Steel Pipe Piles 199

4.0 DOCUMENTATION REQUIREMENTS

4.1 Engineering and quality verification documents shall be submitted to Contractor by the underpinning Subcontractor. Permission to proceed, based upon Contractor's review of the procedures, does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by Subcontractor and does not relieve Subcontractor from full compliance with contractual obligations. The submittal requirements are summarized in Form G-321-D attached. These requirements are augmented by detailed requirements in this specification.

4.2 As a minimum, Subcontractor shall submit the following procedures (in detail) to Contractor's satisfaction:

4.2.1 General Underpinning Procedure

(This procedure shall include the overall concept, including the interface of all the operations listed below.)

edge of concrete shall be 1'3" for 80-ton piles and 1'6" for 100-ton piles.

6.1.2 Combination bearing/soldier piles shall penetrate a minimum of 5 feet into the till or natural dense sand strata as determined by soil removed from the interior of the pile and the jacking resistance.

6.1.3 Maximum calculated soldier pile lateral deflection shall be limited to 0.25 inch due to bending under the combined axial and lateral loading.

6.1.4 Maximum calculated lagging member deflection due to bending shall be limited to 0.25 inch.

6.1.5 The lateral pressure diagram for soil pressure shall be trapezoidal with break points at 0.2 of the full excavated depth.

due to arching

6.1.6 Bending stress reduction ~~or skin friction due to~~ | 383
lateral loads shall not be allowed. | 383
~~Piles or lagging is to be allowed~~ 384

777

6.1.7 Pile and caisson location shall ... | 390
~~Consider~~ TAKE INTO ACCOUNT the support of the mudmat so | 390
that it does not separate from the | 390
foundation. | 390

Jon, "Locations" (places) can't "consider", only people can. So do the locations support?

6.1.8 A full water head shall be considered | 396
for lateral support from el 627' to the | 396
bottom of mass excavation under the | 396
structures. | 396

6.1.9 Caissons or pits shall extend at least | 402
4.0 feet into the till as evidenced by | 402
inspection of excavated material. ~~The~~ | 403
~~design bearing pressure shall be~~ 403
~~25 tons per square foot~~. Caissons 404
acting as combination soldier and 404
bearing elements are governed by the 404
stress and deflection criteria from 405
Sections 6.1.3 through 6.1.7. 405

6.1.10 The access shaft from el 634' to el 607' needs not conform to Sections 6.1.1 to 6.1.8 but must be in accordance with acceptable industry practice.

6.1.11 Bearing stress for concrete shall be 1,000 psi. Bearing stress for steel shall be 27,000 psi.

6.1.12 The design stresses shall not be greater than the allowable stress presented in AISC, ACI, or as specified herein. In the event of conflict, notify Contractor, who shall determine the governing criteria.

6.2 DESIGN LOADS

6.2.1 Structure Loads

The load of each auxiliary building penetration room is equal to 8,300 k (vertical). The center gravity of the load is shown on the drawing as well as the uniform pressure of the PENETRATION ROOMS. The allowable eccentricity of the

underpinning support system with | 445
respect to the centroid of the PENETRATION ROOM | 445
load is _____. Note: No supports | 446
shall be located between because of the | 446
presence of the underlying utility | 446
tunnel as shown in the drawings. | 446
~~utility tunnel.~~ 447

The 7.8 line and 15 feet east of the 1.8 line, or between the 5.3 line and 15 feet west of the 5.3 line

Foundation pressure as well as local | 452
column loads for structures in the | 452
vicinity are shown in the drawings. | 452

6.2.2 Soil ~~Values to be~~ 458

a. _ = _____ lb/cf 464

b. _ = _____ lb/cf 470

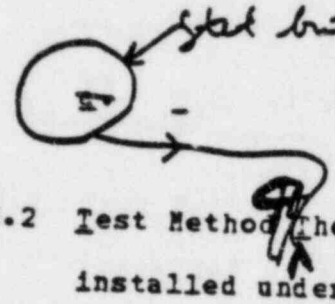
c. _ sand = _____ 476

d. _ clay above till = _____ 482

e. _ clay till = _____ 488

6.3 PILE AND CAISSON LOAD TESTING

6.3.1 The vertical factor of safety established by in-place testing shall be a minimum of 1.5 for piles and caissons under loads.



6.3.2 Test Method. The first pile or caisson installed under each auxiliary building penetration room shall be load tested for 24 hours at 1.5 times the design load and 12 hours at 2.0 times the design load. The test load shall be applied in increments and decrements of 50%, 20%, 10%, 10%, and 10% at 1-hour intervals which are not included in the 24-hour period. At the completion of the 24-hour test at 1.5 times the design load, the load shall be increased to 2.0 times the design load in increments of 10% per hour. The load shall be maintained at 2.0 times the design load for 12 hours and then removed in decrements of 10% per hour to 70% of design load, then removed in

decrements of 20%, and finally 50% at 1-hour intervals. This pile or caisson shall be representative of the majority of piles or caissons.

a.

(a.) At the completion of the 24-hour test at 1.5 times the design load, the load shall be increased to 2.0 times design load in increments of 10% per hour. The load shall be maintained at 2.0 times the design load for 12 hours and then removed in decrements of 10% per hour to 70% of design load, then removed in decrements of 20%, and finally 50% at 1-hour intervals. If no significant creep is detected as determined by Contractor, all remaining piles and caissons shall be load tested to 1.5 times the design load for such a period of time that less than 0.05 inch of settlement (excluding elastic compression and rebound) occurs in a continuous 1-hour period.

Measurement of movement shall be by extensometers (Ames) dial gages calibrated to 0.001 inch per revolution.

b.

At the completion of the 24-hour test at 1.5 times the design load, the load shall be increased to 2.0 times design load in increments of 10% per hour. The load shall be maintained at 2.0 times the design load for 12 hours and then removed in decrements of 10% per hour to 70% of design load, then removed in decrements of 20% and finally 10% at 1-hour intervals. After installation of a group of five load-bearing elements and prior to completion of the first element of the next group, one load-bearing element in the previous group of five shall be chosen by Contractor for retesting. The selected load bearing element shall be tested for a period of 5 minutes at 1.5 times design load.

A satisfactory test shall be one where less than 0.010 inch of settlement occurs from the start of the test to the end of the test. If the test is satisfactory, the work on the next group of five may continue. If the test is not satisfactory, the load-bearing element being tested shall be unloaded and retested for the criterion of a 0.05-inch settlement in a continuous 1-hour period. Then one more load-bearing element in the group of five shall be subjected to the 5-minute and 0.01-inch settlement test. If the second pile retested is satisfactory, the work on the next group of five may continue. If it is not satisfactory, repeat the procedure until a satisfactory 5-minute and 0.01-inch settlement test is achieved before proceeding with the work.

After completion of the 1-hour load test or 5-minute retest, the piles shall be locked off (wedge tight) at 1.5 times the design load.

c. If creep is detected on the 24-hour load test, Contractor shall modify the length of time required for testing the remaining piles.

d. During the period of long-term load testing, neither jacking against the structure nor any work which causes vibrations or may otherwise affect the test results shall be permitted.

7.0 UNDERPINNING AND SUPPORT OF STRUCTURES

7.1 GENERAL

Subcontractor shall provide the necessary underpinning and temporary support for the auxiliary building penetration room for Units 1 and 2 in accordance with the requirement of this specification and as shown on the drawings. In addition, Contractor shall furnish and install temporary support from ~~above~~ for the feedwater valve pit for Units 1 and 2. by shoring the top of the pit to the turbine building and the buttress access shaft.

7.1.1 In addition to the underpinning work shown on the ~~Subcontract~~ drawings, Subcontractor shall take ~~such~~ all other action ~~as deemed~~ necessary to maintain the integrity of these buildings. Subcontractor shall be responsible for ~~bracing excavation~~ supporting the structures temporary support and taking ~~any other~~ all necessary precautions to prevent the settlement or cracking of the ~~remaining portions of~~ the buildings, including ~~such as~~ slabs on grade, supported slabs, appendages, interior partitions, and other columns and walls.

7.1.2 Responsibility

Subcontractor shall conform to the following:

a. Assume full responsibility for all underpinning and related operations regardless of whether it is performed by Subcontractor or by others. Take necessary precautions for protection of persons, and ~~prevent~~ preclude damage to property, including structures ~~herein~~ which underpinned or affected by underpinning work.

b. All underpinning operations shall conform to applicable codes and also meet requirements of other authorities having jurisdiction over the work involved.

7.2 TEMPORARY SUPPORT

7.2.1 Prior to underpinning operations the feedwater valve pits will be temporarily supported ~~[illegible]~~ by contractor.

God?

The feedwater valve pits shall not be subjected to any vertical loads or external forces by Subcontractor during the underpinning operation.

7.3 PILE AND CAISSON INSTALLATION

7.3.1 GENERAL

The piling shall consist of a concrete-filled steel pipe. The steel pipe shall be installed by jacking against the resistance of the existing structure. The pipe shall be precut to

a convenient length for jacking. The | 678
pipe segments shall be joined together | 678
by welding as the pipe advances into | 678
the subsurface. | 678

The pipe shall be installed open-ended | 683
to the depths specified. The pile | 684
shall then be closed by a grout plug | 684
which is placed at the tip. After the | 685
plug cures, the pile shall be inspected | 685
and concreted. During of the concrete, | 686
the piles shall be load tested and | 686
stressed against the structures. | 686

7.3.2 MATERIALS | 692

Steel pipe shall conform to ASTM A 252, | 697 *
Grade II seamless. It shall have a | 698
minimum wall thickness of 0.375 inch. | 698
All cutting of the pipe shall be done | 699
in such a manner that the cut edge | 699
shall be perpendicular to the | 699
longitudinal axis of the pipe. Flame | 701
cutting is permitted. Beveling of | 702
edges for welding shall be done in such | 702
a manner to ensure a true cut. | 702
Internal or external pipe couplings, | 703

whether mechanical or welded, are not permitted. The pipe shall have no protuberances beyond the outside diameter of the pipe (except the negligible enlargement caused by the weld at each joint). The pile tip shall be reinforced by either a steel internal drive shoe with a minimum wall thickness of 1/2 inch, or increasing the wall thickness of the lowermost pipe segment to 1/2 inch.

7.3.3 Pile Installation

a. The plan location shall be established at the bottom of the concrete slab at el 607'±. The tolerance for the plan location shall be ±5 inches, but the algebraic aggregate of the deviations shall not exceed 5 inches.

b. The top-to-bottom out of plumbness shall be less than 2% of the length.

c. The maximum deviation for pile straightness shall be 1/2 inch in 10 feet and/or 1/2 inch in 20 feet.

d. The maximum jacking force shall be 1.50 times the design pile load or 0.85 f_y allowable prior to the reduction for L/r ratio, or 0.70 f_y certified prior to appropriate reduction for L/r.

e. Maintain a minimum of a 1-foot (vertical measurements) soil plug in the pile at all times unless an obstruction is encountered. If an obstruction is encountered, then maintain a liquid level inside the pile to within 5 feet of the bottom of the jacking pit, and limit the excavation beyond the existing tip of the pile to less than 1 foot except by specific

written instructions by Contractor.

f. No water jetting, slurry jetting, or air jetting for loosening or removal of material inside or in advance of the pile is permitted except by written permission from Contractor.

g. No airlifting or venturi principle lifting of the material in the pile or in advance of the pile is permitted within 5 feet of the pile tip except after final seating of the pile in the till. If air or venturi lifting is employed, Subcontractor shall maintain a liquid level in the pile at the bottom of the jacking pit during the entire operation. Contractor shall be notified in advance and in writing each time Subcontractor employs this procedure.

h. No impact or vibratory forces may be used for advancing the pile.

7.3.4 The combination soldier bearing piles shall not be seated prior to concreting. The pile shall be filled with water, and the soil plug in the pile tip removed. If the water level in the pile drops, it need not be maintained. Subcontractor shall then tremie grout with a sufficient quantity of grout (fc' = 5,000 psi) to fill the bottom 7 feet of the pile.

The hydraulic head shall remain on the pile for a minimum period of 24 hours. The pile shall then be dewatered and concrete placed in the dry. Loading of the pile may then proceed after the concrete has cured for 24 hours.

7.3.5 Inspection of pile prior to concreting shall be accomplished by visual inspection of measurements inside the pile. After Subcontractor has placed a grout plug in the bottom of the pile by tremie method, and ~~pr water~~ after the grout plug cures, Subcontractor shall

make a final cleaning of the pile and remove all water and deleterious matter from the inside the pile. The pile shall then be inspected by Contractor, who will give written permission to Subcontractor to place concrete in the pile.

7.3.6 The concrete for the pile shall be placed in such a manner that the concrete drops vertically from the top of the pile.

7.3.7 Contractor reserves the right to direct Subcontractor to use the pumped tremie method for concreting the piles without employing the grout-plug.

7.4 CAISSON INSTALLATION

7.4.1 The plan location shall be established at the bottom of the concrete slab at elevation 607'±. The tolerance for plan location shall be ±2 inches, but the algebraic aggregate of the deviations shall not exceed ±5 inches.

7.4.2 The top-to-bottom out of plumbness shall be less than 2% of the length.

7.4.3 The maximum deviation for caisson straightness shall be 1 inch in 10 feet and/or 1 inch in 20 feet.

7.4.4 The maximum jacking force shall be >> 0.85 f_y allowable or 0.75 f_y certified for the steel shell (prior to reduction for L/r) or 800 kips, whichever is less.

7.4.5 The maximum amount of open ground below the bottom of the caisson shall not exceed 16 inches. (Note: The squeezing ground condition takes precedence if that type of ground is encountered.) If a jacked casing is used, there shall be no open ground below the leading edge.

7.4.6 If liner plate is used, the annulus or void space between the liner plate and soil shall be grouted every 48 inches of vertical advancement, or every 18 hours, whichever occurs first.

7.4.7 No water, slurry, or air-jetting of the caisson shall be permitted except by written permission from Contractor.

7.4.8 For the caissons along the K line, the installation shall employ a metal lining for advancing the excavation inside the caisson.

7.4.9 Wooden lagging may be employed for lining caissons and/or pits in the interior of the excavation, except the ~~formed by the steel lined caissons.~~ wood lagging shall be removed prior to placing of mass concrete or shall be so located that it can be removed by subsequent excavation of pits or caissons within the excavation. When the subsequent excavation is made, all wood lagging that is inaccessible for subsequent removal shall be removed.

7.4.10 Wood-lined pits or caissons shall not be excavated until the metal-lined caisson work is complete, or until a 1.0 vertical to 1.5 horizontal influence line from the bottom

wood-lined pit lies within the completed portion of the metal-lined caisson.

7.4.11 Metal and wood caisson linings shall be of adequate thickness to ensure safe working conditions within the confines.

7.4.12 The straight-shafted portion of the metal-lined caissons shall be limited in plan size of 16 square feet. The wood-lined caissons or pits shall be limited in plan size to 24 square feet.

7.4.13 Metal-lined caissons with belled or wedged bottoms shall not have the bell started until the shaft has penetrated 2 feet into the clay till.

7.4.14 The bell angle shall be a minimum of 60 degrees from the horizontal. The bell shall be lined for depths in excess of 4 feet below the straight shaft. The annulus (void) between the straight shaft and the ground shall be grouted and cured for 24 hours prior to starting excavation of the bell.

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7.4.15 If squeezing ground is encountered, Subcontractor shall proceed in such a manner that no ground is lost. Methods acceptable for this operation are as follows:

Liner plate - Compressed air

Jack lining

a. Jacking lining past the squeezing zone without excavation

b. Drilling under bentonite slurry and jacking (Drilling cannot proceed in excess of 1 foot beyond end of lining.)

7.4.16 If running or flowing ground is encountered, the following methods for advancing are acceptable.

Liner plate - Grouting 955

Jack lining - 957

a. Jacking lining past the | 959
running or flowing zone without excavating | 959

b. Drilling under bentonite | 961
slurry and jacking (Drilling | 961
cannot proceed in excess of 962
1 foot beyond end of lining.) 962

c. Grouting 964

If running ground is encountered, stop | 969
excavation fill caisson with water or | 969
slurry and give written notice of the | 969
condition to Contractor. | 969

7.4.17 Concreting shall not be performed until | 975
Contractor has inspected the bottom and 975
bell of the caisson and made 975
measurements of plumb, straightness, 976
and location. 976

7.4.18 The concrete for the caisson shall be | 982
placed in such a manner that the | 982

concrete drops vertically from the top of the caisson.

7.4.19 Contractor reserves the right to direct Subcontractor to use the pumped tremie method for concreting.

1.0 SCOPE

1.1 ITEMS INCLUDED

The following items are included under the scope of this subcontract which involves the underpinning and removal of all unsuitable material and replacement of all unsuitable material with concrete from under the auxiliary building penetration rooms and feedwater valve pits of Midland Plant Units 1 and 2. This specification includes Q-listed work where specifically noted.

1.1.1 Submit all drawings, calculations, and detailed procedures for a proposed type and method of underpinning which is best suited for the intended purpose and meets all of the applicable criteria specified herein.

997

STET

7.6.2 All jacking and testing apparatus shall | 2341
be equipped with two hydraulic pressure | 2341
gages. The pressure gages for the | 2342
production jacking equipment shall have | 2342
a minimum face diameter of 2 inches. | 2342
Testing equipment for the 24-hour ~~load~~ load | 2343
test shall have gages with a minimum | 2343
6-inch diameter face calibrated so that | 2343
270° of dial movement covers the | 2344
operating range of the equipment. | 2344
Test equipment for the 1-hour load test | 2345
shall have 4-inch diameter gage faces | 2345
and be calibrated so the 270° of dial | 2345
movement covers the operating range of | 2346
the equipment. | 2346

STET

7.6.3 Subcontractor shall have the following gages: | 2352
3 to 8-inch face, 3 to 6-inch face and 3 to 4-inch | 2352
face gages calibrated with the specific | 2353
rams intended to be used with each set | 2353
of gages. The calibration shall be | 2355
performed and certified by an | 2355
independent laboratory which | 2355
specializes in that work. The | 2356
calibration certificates shall be | 2356
furnished to Contractor. | 2356

STET 7.3.4 This set of gages and rams shall | 2362
hereafter be referred to as the master | 2362
set. The master set shall not be used | 2363
in the field operations except for the | 2363
24-hour load test. The master set | 2364
shall be kept in a place suitable to | 2364
Contractor and shall be used for | 2364
calibrating all gages used in the | 2364
field. | 2365

STET 7.3.5 Subcontractor shall furnish a test | 2371
manifold and test stand which will | 2371
enable Subcontractor to field-calibrate | 2371
four field gages simultaneously in the | 2372
same hydraulic circuit as the | 2372
respective three master gages and ram. | 2372
Subcontractor shall notify Contractor | 2373
in writing when field calibrating of | 2373
gages will be done. Contractor shall | 2374
have a representative present during | 2374
field calibration. The field gages | 2375
shall be calibrated against a master | 2375
set having a gage face one site larger. | 2375
The results of the field calibration | 2376
shall be forwarded to Contractor | 2376
immediately following the calibration. | 2376

7.7.6 Each field and master gage shall be | 2382
assigned a unique identification | 2382
number, and that number shall be | 2382
engraved on the gage cover and also be | 2383
painted on the gage back. In addition, | 2384
a suitable calibration curve or | 2384
tabulation for the particular gage | 2384
shall be afixed to the back of the gage | 2385
by means of a clear, sticky, celluloid | 2385
cover. If gage face overlays are used, | 2386
this is equally satisfactory. | 2386

7.7.7 Recalibration of the master sets is | 2392
required at a minimum of every | 2392
3 months. (This should be scheduled so | 2393
there is at least one set of 6-inch or | 2393
larger master gages on the project at | 2393
all times.) In addition, the master | 2394
gages shall be recalibrated any time | 2394
that one gage varies by more than 5% of | 2394
its calibrated rating as established by | 2395
the other two master gages in the same | 2395
master set. Field gages shall be | 2396
recalibrated monthly or at any time when | 2396
one gage is broken or damaged or when | 2396
one gage varies by more than 10% from | 2397

its calibrated rating as established by | 2397
its companion gage. | 2397

7.3.8 The field testing apparatus shall | 2403
contain a snubber valve in the | 2403
hydraulic circuit. The snubber valve | 2404
shall be located on the high-pressure | 2404
side immediately ahead of the tandum | 2404
gages. For the 1-hour load test, the | 2405
snubber valve shall be closed when the | 2405
ram attains the test load and shall | 2405
stay closed until either the movement | 2406
of the piston exceeds 0.05 inches, or when the | 2406
1-hour period with less than 0.05 inches | 2406
has occurred. Movement (not gage | 2407
pressure) is the testing criterion for | 2407
the 1-hour test. However, if the gage | 2408
pressure drops by more than 10% during | 2408
the test, the test shall be restarted. | 2408
For the long-term load test, the gage | 2409
pressure required shall be maintained | 2409
throughout the test period. | 2409

7.9 DETECTION OF MOVEMENT 2415

7.9.1 General | 2421

Subcontractor shall submit and 2426
implement to the satisfaction of 2426
Contractor a procedure to monitor each 2426
structure which might be affected by | 2427
underpinning operations. | 2427

7.9.2 Horizontal movement detection points | 2433
shall be located at or near the top and at | 2433
the ground level of the structures. | 2433
Vertical movement detection points | 2434
shall be located near the ground level | 2434
of the structures. | 2434

7.9.3 Measurements shall be to the nearest | 2440
1/16 inch based upon visual | 2440
observation. | 2440

7.9.4 Measurements shall be made daily, and | 2446
Contractor shall be informed in writing | 2446
if any movement is detected in excess | 2446
of 1/16 inch of the previous reading or | 2447
accumulated value of 1/8 inch. 2447

8.0 WELDING 2451

8.1 All welding shall be performed in accordance with AWS D1.1. Contractor shall approve all welding procedures. 2457 2458 2458

8.2 All welders shall be qualified to the applicable welding procedures in accordance with AWS D1.1. 2464 2464 2465

8.3 Jacked piles used as soldier piles shall present a flush exterior from tip to butt. | 2471 | 2471

9.0 EXCAVATION 2475

9.1 GENERAL 2481

Subcontractor shall submit prior to excavation a detailed procedure describing the method of excavation employed. This procedure shall be to the satisfaction of Contractor and shall indicate coordination of the installation of lagging and bracing. The procedure shall also indicate the maximum amount of excavation below any previously installed lagging or structure. As a minimum, the excavation procedure shall include the following. | 2487 | 2487 | 2488 | 2489 2489 | 2490 | 2490 | 2490 | 2491 2491

9.1.1 The location and dimension of each jacking or caisson pit | 2497 2497

9.1.2 A flow diagram showing excavation of all pits relative to the sequence of installed, tested, and locked-off vertical support elements (caisson or jacked pile). | 2503 | 2503 | 2504 | 2504 | 2504

9.1.3 A table relating the information is provided in Item 9.1.2 showing the following data with respect to each vertical support element: | 2510 | 2510 | 2511 | 2511

a. Pile or caisson number | 2517

b. Pit number | 2523

c. Sequence number | 2529

d. Vertical capacity installed (kips) | 2535

e. Area undermined (do not include influence zone) times 5.5 kips/ft² | 2541 | 2541

f. Net overload (e-d) (kips) | 2547

g. Percent net overload ÷ 8,300 kips | 2553 *

9.2 Explosives shall not be used to dislocate and/or remove hardened material during excavation. Conventional tools, such as rock splitters and demolition tools, are acceptable. | 2559 | 2559 | 2560 | 2560 | 2560

9.3 Subcontractor shall submit to the satisfaction of Contractor a procedure describing in detail the measures, including hold points and inspection points, taken by Subcontractor to ensure slope stability and to prevent any movement of foundation material outside the excavation area. The work under this section is Q-listed and shall conform to the requirements of Section 11.0. 2566 2566 | 2567 | 2567 | 2567 | 2568 2569 2569 2569

9.4 The initial excavation below the bottom of the slab at el 607'± shall not exceed 7 feet in depth. | 2575 | 2575 | 2575

9.5 The net overload shall not exceed 10% during | 2581
installation of the initial 1,500 kips (design | 2581
load) of temporary support capacity under each | 2582
wing. The net overload for the remainder of | 2583
the operation shall not exceed 20%. | 2583

9.6 Subcontractor shall advance the mass | 2589
excavation to the depth determined by | 2589
Contractor. The bottom surface shall then be | 2590
prepared as follows. 2590

9.6.1 The surface shall be flat but sloped to | 2596
a minimum of 1/4 inch per foot draining | 2596
toward a sump located in one corner. 2597

9.6.2 Subcontractor shall dispose of all 2603
water in the sump to the satisfaction 2604
of Contractor. 2604

9.7 LAGGING INSTALLATION 2610

9.7.1 All lagging material remaining in the | 2616
ground shall be a nondeteriorating type. | 2616

9.7.2 The initial excavation, where the earth | 2622
is not supported, shall not exceed a | 2622
depth of 4 feet if it is within 6 feet | 2623
of the K line and 5.25 line. | 2623
Otherwise, a maximum depth of 6 feet | 2624
shall be used. | 2624

9.7.3 After initial excavation, the lagging | 2630
shall be installed and back packed. 2630
The lagging along the K line and | 2631
5.25 line located below el 600.0' shall | 2631
be grouted. | 2631

9.7.4 The excavation shall not proceed to a | 2637
depth greater than 3 feet below the | 2637
previously grouted lagging. | 2637

9.7.5 The procedure for installation of the | 2643
lagging below el 600', K line, and | 2643
5.25 line shall indicate the maximum | 2644
vertical distance between unpacked | 2644
lagging and the bottom of the | 2645
excavation. This distance shall not | 2646
exceed 16 inches. | 2646

9.7.6 If squeezing ground is encountered | 2652
below 600', Subcontractor shall employ | 2652
a Chicago lagging system for advancing. | 2653
The advance shall be limited to a | 2654
maximum of one-half the length of the | 2654
lag. After advancing one-half a lag, | 2655
the lower bracing member shall be | 2655
installed and the lagging wedged. | 2655

9.7.7 If running ground is encountered below | 2661
el 600', the zone shall be grouted in | 2661
advance of excavation. Spilling is not | 2662
a satisfactory procedure for running | 2662
ground. | 2662

10.0 CONCRETING 2666

10.1 GENERAL 2672

Subcontractor shall submit to the satisfaction 2678
of Contractor a detailed procedure, including 2679
hold points and inspection points, describing 2679
the placing of concrete under the structure. 2680
The work performed under this section is 2681
Q-listed and must conform to the requirements 2681
of Section 11.0. 2681

10.2 Pile, pit, and caisson procedures are specified elsewhere. | 2687 | 2687

10.3 Mass concrete shall first be placed in the corner opposite the sump such that any water shall be driven to the sump as the concrete is placed. | 2693 | 2693 | 2694 | 2694

10.4 The first lift shall not exceed 2 feet in thickness; all subsequent lifts shall not exceed 5 feet in thickness. | 2700 | 2700 | 2700

10.5 Successive lifts shall be doweled into the preceding lift by using #8 bars on 24-inch centers. Dowels shall be located such that a minimum of 24 inches will be embedded in both lifts. | 2706 | 2706 | 2707 | 2707 | 2707

Reinforcing steel will be furnished by Contractor. 2713 2713

10.6 The surface of the concrete lifts shall be horizontal within ±3 inches for the entire area. 2719 2719 2719

10.7 The top lift shall be placed to within 6 inches of the bottom of the existing slab. The remaining void between the lean concrete backfill and the foundation slab shall be either dry pack grouted or pressure grouted. Subcontractor shall submit a procedure to the satisfaction of Contractor, including hold points and witness points, describing in detail the method of dry pack grouting or pressure grouting. The grouting is a Q-listed item. | 2731

10.8 The concrete shall be placed and cured in accordance with ACI 318-1978.

10.9 Contractor will perform slump, percent air content, temperature, unit weight, and compressive strength cylinders on the lean concrete backfill, and perform a compressive strength test for the grout used.

Contractor shall supervise Subcontractor when assisting in performing all grout and concrete testing.

10.10 Preceding the placing of concrete, | 2756
Subcontractor shall install 2-inch styrofoam | 2756
along the containment structure and turbine | 2756
structure. Subcontractor shall submit a | 2757
procedure for installing the styrofoam to the 2757
satisfaction of Contractor. 2757

11.0 CLEANING AND RESTORATION 2761

Subcontractor shall restore the work area to the same | 2767
condition prior to the start of operation and to the | 2768
satisfaction of Contractor. Subcontractor shall also 2769
submit a procedure on final cleaning. 2769

12.0 QUALITY ASSURANCE REQUIREMENTS 2773

11.1 GENERAL 2779

Excavation, concreting, and grouting are 2785
Q-listed and shall be controlled in accordance 2786
with this specification and Subcontractor's 2786
quality assurance program. Subcontractor's 2787
quality assurance program shall be in 2787
accordance with Specification 7220-G-23 2787
(Appendix __). 2787

12.2 Because of the nature of the work, an independent overlay inspection will be performed by Contractor's inspection organization in accordance with this specification and Subcontractor's procedures.

13.0 MEASUREMENT OF PAYMENT

1.0 MOBILIZATION AND DEMOBILIZATION WILL BE PAYED ON A FIXED (LUMP SUM) BASIS FOR EACH ON/OFF OCCURRANCE

2.0 THE DESIGN, FURNISHING AND INSTALLING THE TEMPORARY SUPPORTS UNDER THE AUXILIARY BUILDING PENETRATION ROOMS FOR UNITS 1 & 2 INCLUDING; PROCEDURES, LABOR, SUPERVISION, TOOLS, EQUIPMENT AND TESTING WILL BE PAID ON A FIXED (LUMP-SUM) BASIS. NOTE; THIS DOES NOT INCLUDE MASS EXCAVATION.

3.0 INADDITION TO THE ABOVE, THE FOLLOWING ITEMS WILL BE PAID ON A FIXED (LUMP-SUM) BASIS

3.1 ACCESS SHAFTS — ONE FOR EACH UNIT

3.2 MONITORING THE BUILDINGS FOR POSSIBLE SETTLEMENT

3.3 MONITORING THE BUILDINGS FOR CRACKS

4.0 INADDITION TO THE ABOVE, THE FOLLOWING ITEMS WILL BE PAID ON A UNIT PRICE BASIS.

4.1 MASS EXCAVATION UNDER THE AUXILIARY BUILDING PENETRATION ROOMS AND THE VALVE PIT STRUCTURE FOR UNITS 1 & 2 — PRICE PER CUBIC YARD.

4.2. DESIGN FURNISH AND INSTALL LATERAL SUPPORT FOR MASS EXCAVATION EXCLUDING LOAD BEARING MEMBERS I.E. CAISSONS. PRICE PER SQ. FT.

4.3. ADDITIONAL PILES OR CAISONS AS REQUIRED ~~PER~~ ~~PRICED~~ PER UNIT.

AND INSPECTION

4.4. THE PLACING ~~[illegible]~~ CURING OF Q-LISTED CONCRETE. PRICE PER CUBIC YARD.

4.5 THE INSTALLATION OF STYROFOAM. PRICE PER SQ. FT.

4.6 THE PLACING AND INSPECTION OF Q-LISTED DRY PACKING. PRICE PER SQ. FT.

4.7. THE PLACING AND ~~[illegible]~~ INSPECTION OF Q-LISTED PRESSURE GROUTING. PRICE PER CUBIC FOOT.

4.8 PLACING OF REINFORCING STEEL. PRICE PER lb.

4.9. PLACING PUMPED TREMIE CONCRETE. PRICE PER CUBIC YD.

4.10 SOIL STABILIZATION; GROUTING. EXCLUDING GROUTING INDICATED IN 4.2 ABOVE.
CEMENT GROUTING, PRICE PER CUBIC FOOT
CHEMICAL GROUTING, PRICE PER GALLON

4.11 ENCOUNTERING OBSTRUCTIONS.
- JACK PILING; WHEN THE PILE PENETRATION RATE FAILS TO ADVANCE AT MAXIMUM LOAD

- CAISONS; MATERIAL GREATER THAN 8" IN THE LEAST DIMENSION.

PRICE PER CREW/HR TO REMOVE OBSTRUCTION.

5.0 THE DESIGN, FURNISHING, INSTALLING, OPERATING AND MAINTAINING A DEWATERING SYSTEM TO REMOVE LOCAL POCKETS OF TRAPPED WATER WILL BE PAID ON A COST PLUS BASIS.

CALCULATION SHEET

CALC. NO. _____ REV. NO. _____

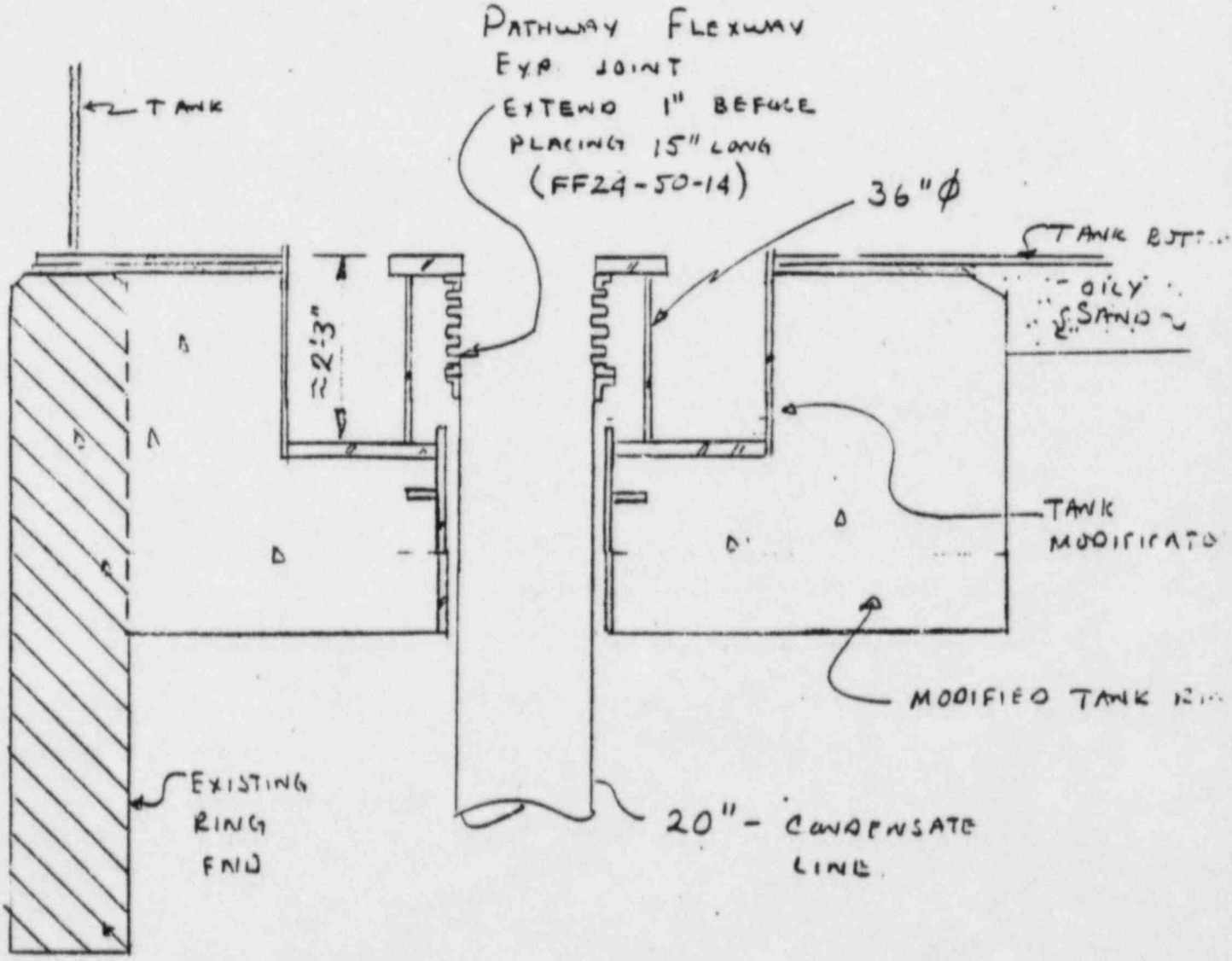
ORIGINATOR B C McConnell DATE 5-1-79 CHECKED _____ DATE _____

PROJECT Midland Unit 1&2 JOB NO. 7220-101

SUBJECT Condensate Tanks Joints SHEET NO. _____

SETTLEMENT CAPACITY 6.25"

ALT. I



ELEVATION

CALCULATION SHEET

CALC. NO. _____ REV. NO. _____

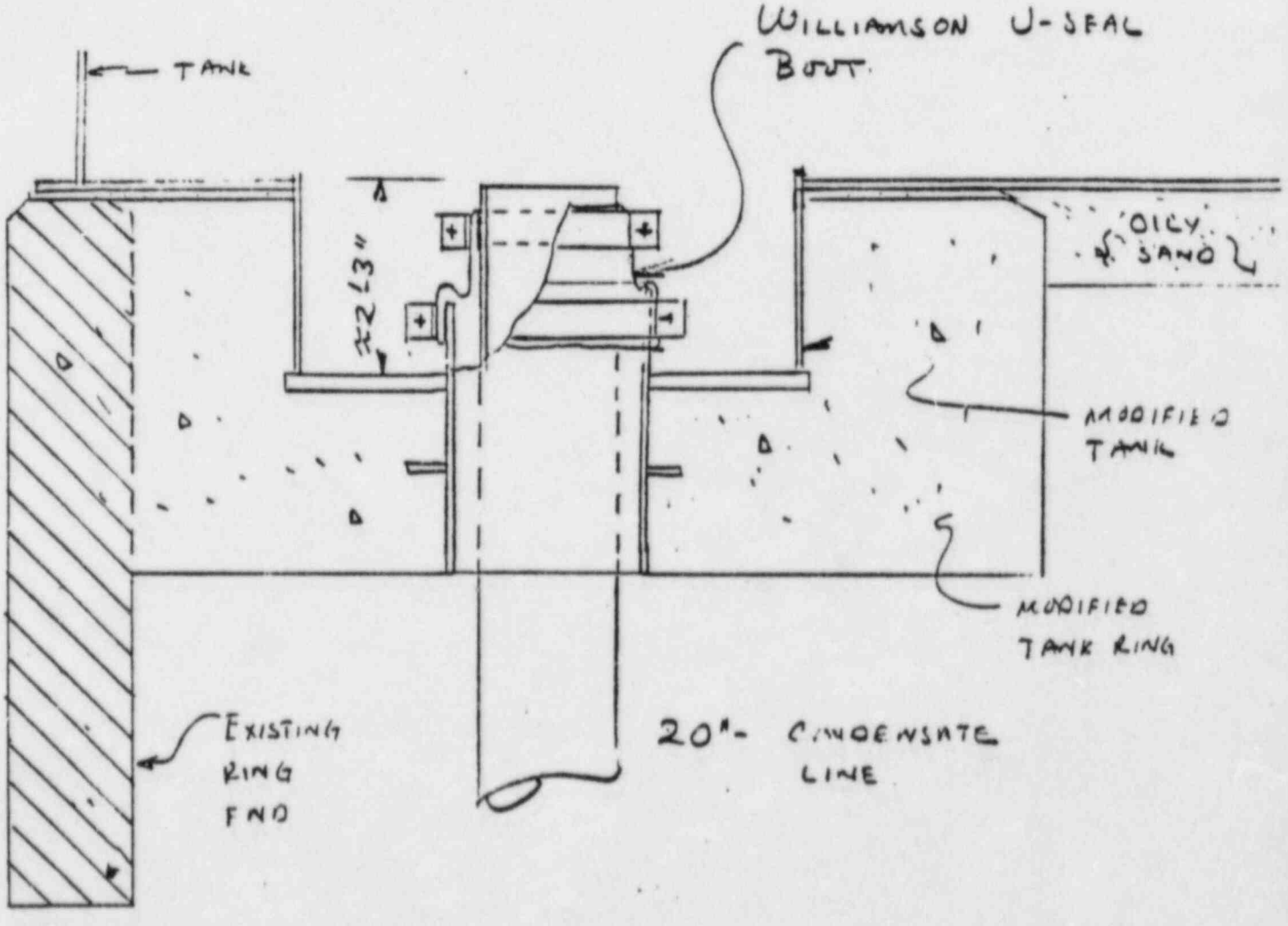
ORIGINATOR B C McConnell DATE 5-1-79 CHECKED _____ DATE _____

PROJECT Midland Unit 1 & 2 JOB NO. 7220-101

SUBJECT Condensate Tanks Joints SHEET NO. _____

Settlement Capacity Adjustable

Alt II



Elevation

Diesel Generator Bldg. Task Group

Monday, June 25, 1979

With Consultants: 2 9/16
Peck Hendron Lawsson + Chuck Gould —

Decorating Consultants — Dick Laughery).

Opinion of Kan C. → Gaithersburg.

Arnold Wanzek A-E/C. } 8
Tyler KC, T Johnson.
Al Rocs. PM
Cooke, Sibbald, Hord Thiru } 4

Wednesday 8:00 AM. with CPCo. with Early 16:30 leave for airport

Matrix - of all possibilities :- Adv + Dis.adv. cost. +.

Action items : Ref. meeting Note, 976 dt : 5.16.79.

1) Surveying the pipe line. Stamps kinks. - NRC - concern (July 10th meeting)
If the Kinks are existing dig out + find the problems.
Camera was not tracking the bug.
D. Rat - this kind of kinks impossible to exist.
Redo the profile + find out the kinks.

(2)

P. Hashing - changed the course of main towards Matrix

Diesel bldg:- underpinning)

RR bay — Liquefaction — 12% g. }
20% g. }

Natural sand deposits — 20% g

moist problem.
settlement of moist problem.

Shake DG Problem. (?)
— only Pedestal.

[ken Ware
Contact Manage
the Contractor.

Schedule for delivering DG. →

Sands around Containment — Structural sand ——.
Loose sand. test program — unreliable s/t of sand.

Adjacent str. RR bay - depend upon bearing
close to the containment. of it, supports another structure

Status of Contracts

(1) underpinning — bid out — bid will be here today.
(2) chem. Grouting —
(3) Decontaminating — can drill holes (subcontract)
(4) Piling - final review. (not critical timeframe.)
Lowest. week of 7/2. (AI*)

2nd review / Comment — 2 more weeks? to complete.
week of 22 of July

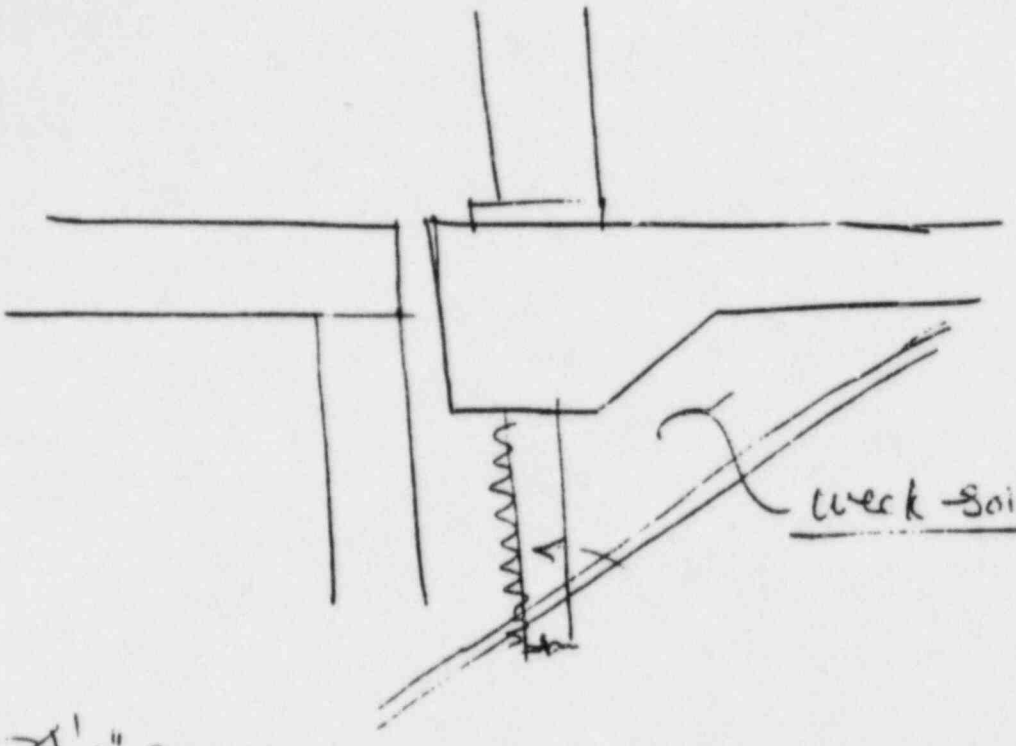
Before Denver

1. Could Bechtel contact Zimmer + Survey.

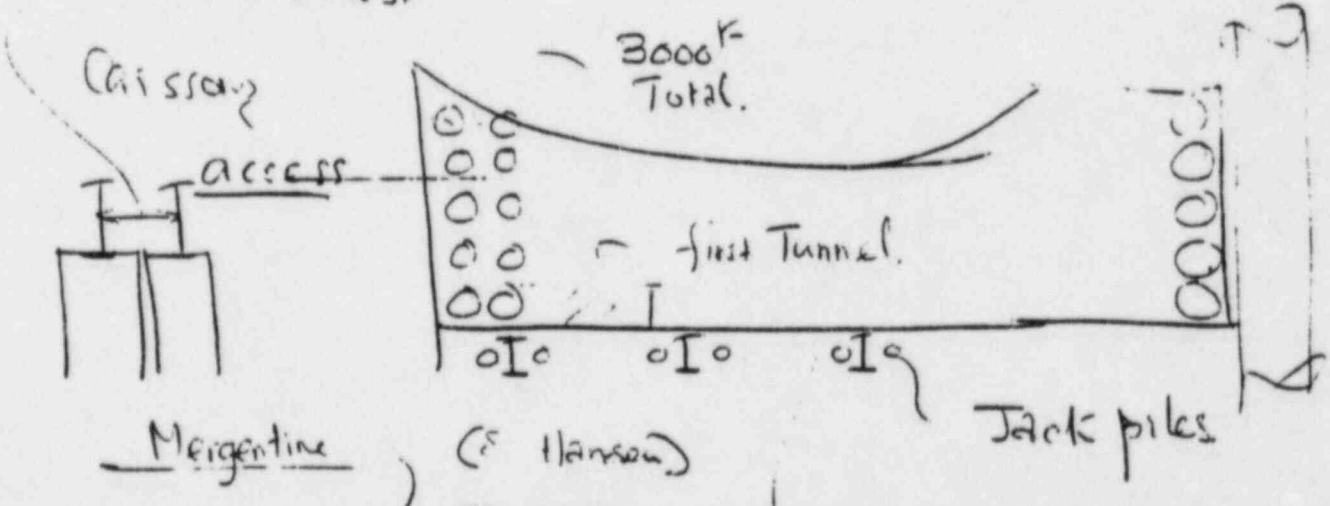
2. How Stine (Proj)

3. Reg. Guide (Dewatering)

4) Call VEPCO. for Survey.


wreck soil

4'-0" access


Caisson
access
3000 K-
Total.
first Tunnel.
Jack piles
Mergentine
(& Hanson)
Pits
no chance of
Main column
Revised underpinning
Scheme.

MATRIX

Comments due
Friday of next week

Option

(1) Excavating.

(2) ~~Decant~~ Underpinning and dewatering. (temporary)

(3) Permanent Dewatering System.
(Except Service water)

(4)

Two skyhooks — one:

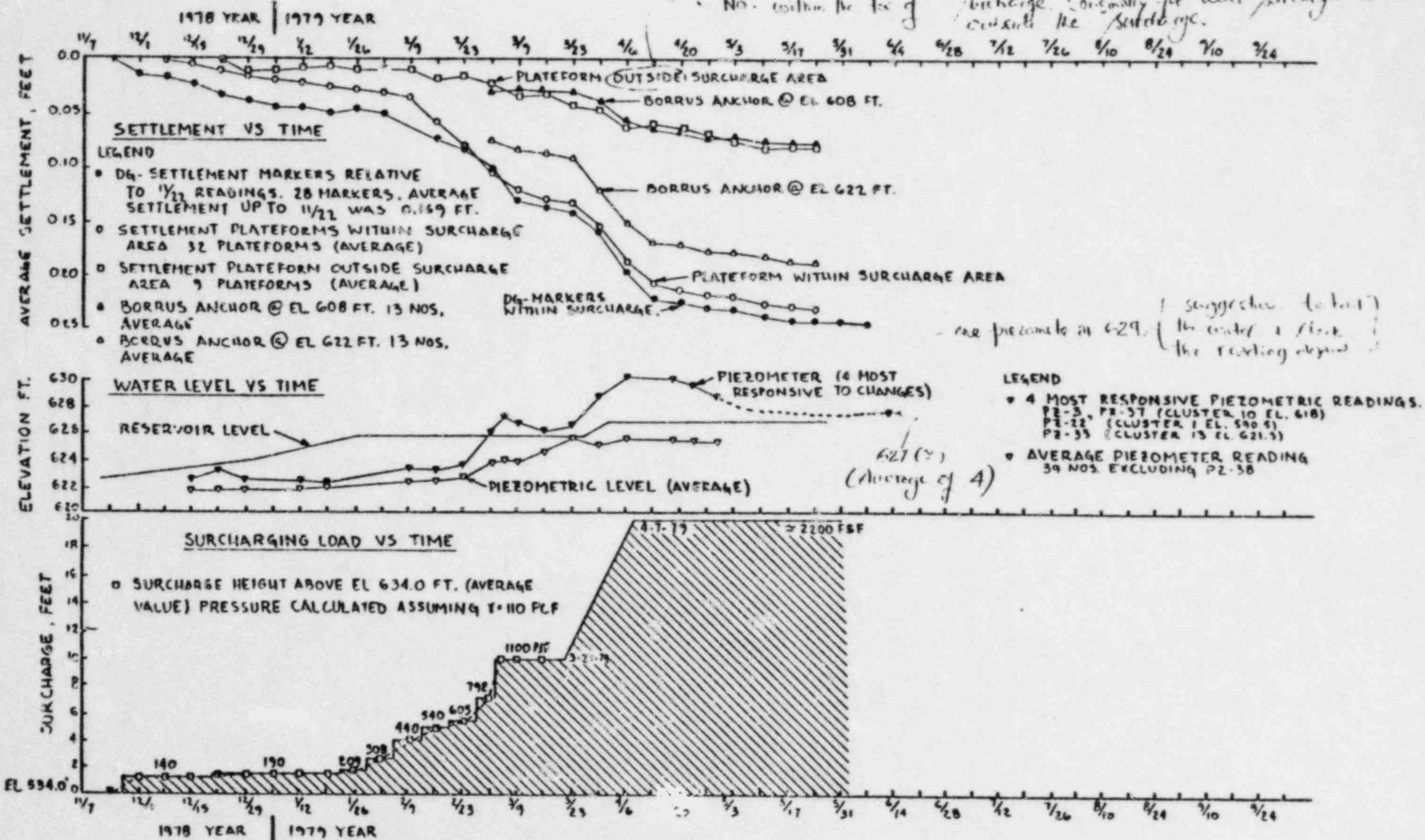
Schedule problems

CPCo $/25 ~~[illegible]~~ million/month. 7
Total Cost f. 8.22

	OPTION 1. (PLAN ADV & D.ADV) (~~Cost & Sch~~) SCH & COST IMP		OPTION 2	
D.G. BLDG	Preload and Chemical Grouting A) (1) No DEWATERING, (2) In Process. D) (1) Licensing, (2) EXTENT ~~[illegible]~~ (3) UTILITIES. S) DELAY SCHED (8/79) PRELOAD. 2 month C) $ ~~5~~ (B) + $ ~~[illegible]~~ 50 (CP)	10/79: 4 to 6 mo. slip. $ ~~7~~ (B) 150 + $ ~~[illegible]~~ (CP)	PRELOAD & U.P. for ~~loose sand area~~ A) LICENSING. D) (1) D.W. (2) EXTENT. (loose sands only) S) 8/79 Rmoval 1 mo. delay $ 7 (B) + $ ~~20~~ 25 (CP)	Grout UP S) 8/79 Rmoval 3 mo. delay $ 8 (B) + ~~[illegible]~~ 75 (CP)
ELEC. PENR & VALVE PITS	TEMP. LOCAL. D.W & UNDER PIN A). (1) IN-PROCESS (2) LICENSING (3) No IMPACT on SYST. POT. IMPACT D) (1) STRUCTURES No slip $ 3 (B) + 0 (CP)		TEMP. LOCAL. DW & UNDERPIN.	→
R.R. BAY	NOTHING UNLESS 'G' value change			
S.W. SK.	PILING			→
TOTAL COST.	$ 10 (B) + 50 (CP)	10 (B) + 150 (CP)	10 (B) + 25 (CP)	11 (B) + 75 (CP)
	[illegible]	[illegible]	35	86

	(3)	(4)	(5)
D.G BLDG	PRELOAD & PERM. D.W. STRT. (BLDG) (LOCAL) A) ① No Grouting ② No Mat. Removal ③ LICENSING D) ① PLANT OPER. 8/79. REMOVAL SUR | 10/79. REMOVAL SURCH. $8(B) + $0 (CP) + OPER. COST (CP) | $8(B) + $20 (CW) + OPER. COST (CP) 4 mo 16 million	REMOVE STRUCT & SOIL & REPLACE A) ① LICENSING. D) ① SCHEDULE 2/79 REMOVAL. 15 MO. SLIP $20 (B) + $ 550 (CP)	PRELOAD & PERM D.W. STRT. (PLANT) A) Eliminates Liquefaction problem D) ① LICENSING STRT. DESIGN & OPER ② EXTENT OF DEWAT ③ ADDL ANALYSIS. 2/79 Removal (Total Plant | 2/79 Removal $ 20 (B) | 32 (CP) 4 mo $2 mill. CP.
ELEC. PENS.	TEMP. LOCAL D.W. & UNDERPIN.	TEMP. LOCAL D.W. & UNDERPIN	PERM. D.W. STRT. (PLANT) and POSSIBLE CEMENT GROUT
VALVE PIT			① ① LICENSING (?) ② STR ANALYSIS REQ'D Grouting NO SCHED IMPACT. $1 (B) + $? (CW)
R.R. bay			PERM (D.W) STRT. (PLANT)
S.W. STR.			
TOTAL COST.	11 (B) + 0 (C) + 2 (CP) | 11 (B) + 25 (CP) + ? (C)	$ 23 (B) + 375 (CP)	21 (B) + ? (CP)

TPT Revised Figure 6.18.1979.



? No. within the toe of surcharge (originally for lower surcharge it was outside the surcharge.

I suggestion to test the water & check the reading depend — one piezometer at 629.

DIESEL GENERATOR BUILDING: AVERAGE VALUE OF SETTLEMENT, SURCHARGE, AND WATER LEVEL VS. TIME

MIDLAND UNITS 1 & 2
TAR: 7229

ANN ARBOR

JUN 15 1979

MEMORANDUM

TO DISTRIBUTION LOCATION

FROM JON HECK DATE JUNE 14 19 79

SUBJECT ACCESS DATABASING JOB NO. 7220

FILE C-88 PL

PER YOUR REQUEST AND INFORMATION, IS AN UNCONTROLLED COPY OF SPECIFICATION 7220 C-88Q REV.0. IF YOU HAVE ANY COMMENTS, PLEASE CONTACT MYSELF @ X 7068.

WE ANTICIPATE THE BIDS ON 6-22-79 WITH AWARD OF CONTRACT ON 6-29-79

Jon G Heck

DISTRIBUTION: B. NOWAK
R. SIMANEK
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