50-329/330 OM, OL

Documents Produced by

T.R Thiruvengadam,

Staff Engineer with Consumers Power Co.

for Oral Deposition 12/11/80

03875.191

DISTRIBUTION:
J. Kane (3)
LHeller
F. Rinaldi (2)
A. Cappucci (2)
R. Gonzales
E. Gallagher (IE-RIII)

I

TODAY'S DATE 06/18/80 1414 02 Batl12c 215-020

CUSTOMER e2150 OPERATOR 020 07220 001 Je 215-020

50.54(F) CONE 015 7220-001-09/List of Commits/Je/6-18-80

DATE STORED 06/18/80 1413

WIDTH 124 DEPTH 60

Current

PRINT POSITION OF LINE 03

ccb/6-19-80 ordered bond-sheet #1

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

② Status codes are: 1 complete, verified.
2 complete, not yet verified
3 Due, but not complete
4 Insufficient evidence or documentation to establish or verify status.

③ Commitments with NRC has been referred as Ref A :- Letter from G.S. Keeley to J. A. Rutgers, Serial # 8548, 5/27/80

Ref B :- Commitments made in 3/80 meeting with NRC at Midland.

MIDLAND UNITS 1 AND 2

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

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
1-1	Perform a final review and update of PSAR commitment list	1-3		LS		800101	1	
1-2	Review sections of the FSAR determined to be inactive	1-4		LS		800901	4	See 21-44
1-3	Review EDP 4.22	1-4		QE		790629	1	
1-4	Audit action items 1-3	1-4		QA		791026	4	
1-5	Review specifications not included in the specificity study initially	1-5 1-7		QE		790629	4	
1-6	Complete review of the Dames and Moore report	1-6		GT		790629	1	
1-7	Complete review of pertinent portions of FSAR Sections 2.5 and 3.8	1-6		GT,CE		790629	1	
1-8	Correct settlement calculations and update FSAR	1-6		GT		791101	1	
1-9	Schedule audits of the geotech sections on a 6-month basis	1-7		QA		790504	1	
1-10	Review drawings for possible effect of vertical duct bank restrictions	1-7		CE		790106	1	
1-11	Complete actions in response to DBVCL audit	1-7/8		QE		790518	1	
1-12	Revise EDP 4-49 to incorporate clarifications and instructions for use of SCR	1-8		QE		790504	1	
1-13	Schedule audits of each design discipline calculations on a yearly basis	1-8/9		QA		790504	1	
1-14	Reevaluate construction equipment used for compaction	1-11		FE			1	
1-15	Assign field soils engineer and soils engineer from design section	1-11		FE		790501	1	See 21-20
1-16	Review construction specifications and procedures to identify equipment requiring qualification	1-11		FE		790629	1	See 1-8

9

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

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
1-17	Review field procedure FPG-3.00 to ensure clarity and completeness	I-11	A	FE		790531	1	
1-18	Review PQCI C-1.02 to provide inspection rather than surveillance and to record inspections	I-16		QC		800801	1	
1-19	Complete in-depth review of soil test results	I-17	Rev	GT		790731	1	
1-20	Perform in-depth audit of U.S. Testing	I-18		QA		790531	1	
1-21	Review all active QCI's for surveillance callouts	I-18		QC		790628	1	Completed
added 1-21A	Modify QCIs based on 1-21 findings as 4-25	N/A		QC		800901	1	See 1-21
1-22	Evaluate documentation callouts on QCIs	I-18		QC		790628	2	See 1-19
1-23	Incorporate scientific sampling plans for inspection	I-20		QC		791019	1	
1-24	Complete in-depth review of the Bechtel trend program	I-22		QA		790628	1	
1-25	Conduct QA training	I-22		QA		790601	1	
2.0	No action items							
3-1*	Clarify the Response to Question 362.12 in FSAR Revision 18	3-1	0	IS		790531	1	
4-1*	Provide criteria for permissible residual settlement	4-1	3	GT CE		791231	1	
4-2*	Provide details of treatment of loose sands	4-2	0	GT CE		790831	1	Closed by Rev 3
4-3	Take dynamic modular measurements upon removal of preloads for diesel generator building and other buildings	4-3	3	GT		791130	1	
4-4	Use data of Item 4-3 to evaluate the seismic response of the structures	4-3	3	CE		791130	1	Partial Requirement of Items 13-4, 13-5, 13-10 6 11 16
added 4-5	Prepare additional response to NRC for Items 4-1 and 4-2	(N/A)				790731	1	

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

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
4-6	Monitor the non-Seismic Category I condensate storage tanks	4-4	5	CT CE		801130	A	Load test is on going results will be evaluated by Geotech and Civil.
4-7	Remove unsuitable material in the tank farm and replace by compacted fill	4-3	3	CT		791130	A	
4-8	Fill the BWST with water to perform a full-scale test of subsurface material	4-3	3	CT CE		801130	A	Load test may be delayed due to modification of disturbed hardware
4-9	Fill the diesel fuel oil tank with water to perform a full-scale test of the foundation soil	4-2	0	CT			A	Closed by Rev 3
5-1	Monitor the settlement of the structures (which were subjected to preload) during the life of the plant to provide a record of performance	5-1	0	CT			A	Ongoing activity, requirements in Dwg C-994, Spec C-76
6-1	Construct and fill the borated water tank to make a full-scale test of the foundation soils	6-1	0	CT CE			A	Tracked by Item 4-7
6-2	Deleted							
6-3	Deleted Use settlement data Item 6-4 to allow construction piping connection design		0				A	
6-4	Delay the piping connections to the BWST until most of the settlement has taken place under the test load	6-1	0				A	Superseded in Rev 1
6-5	Evaluate the load test result of the diesel fuel oil tank and provide precise corrective measures if required	6-2	0	CT			A	Closed by Response to Question 33, Rev 5
6-6	Monitor the piping between the BWST and the auxiliary building	6-1	1	CE		8C0407	A	
6-6a	Evaluate the settlement from Item 6-6 in accordance with the procedure described in Question 17	6-1	1	PS			A	
6-7	Remove all unsuitable material in the tank farm area and replace with suitable compacted fill	6-1	3	CT			A	Tracked by Item 4-7
6-8	Monitor the non-Seismic Category I condensate storage tanks	6-2	3	CT			A	Tracked by Item 4-6

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

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
6-30 (4-9)	Determine long-term settlement based on the measured settlement of the loaded tanks	6-2	3	GT			4	~~Reached by Items 4-8, 4-9~~ Geotech to review load test and predict long term settlement based on 4-6, 4-8, 4-9
7-1*	Perform continuity check on duct banks after completion of preload program	7-3	3	FE		791130	2	
7-2	~~Included in Action Item 1~~ Make results of continuity checks and settlement surveys available						1	Included in Action Item 7-1
7-3	~~Included in Action Item 1~~ If further corrective action is required, determine corrective measures						1	Included in Action Item 7-1
8-1	Establish a requirement to realign diesel generators if manufacturer's tolerance for pitch and roll are exceeded	8-2	0	CE		800304	3	Requirement is shown in drawing C-1011, note 4
8-2	Monitor the diesel generator pedestal markers on a 60-day cycle throughout the construction phase.	8-2	0	CE		NA	4	Ongoing activity. Requirements in Dwg C-994, Spec C-76
8-3	Review and modify the monitoring frequency for the diesel generator pedestal markers after 1 year of operation	8-2	0	CPCo		Open	4	
12-1	Complete one additional boring in the middle of diesel fuel oil tank area	12-1	0	GT		790413	1	Closed by Rev 1
12-2	Complete three additional borings in the auxiliary building control tower area	12-1	0	GT		790511	1	Closed by Rev 1
12-3	Complete Table 12-1 for soils investigation and planned remedial measures; respond to NRC	Tbl 12-1	1	CE		790531	1	
12-4	Provide supporting soil condition for Seismic Category I utilities	Tbl 12-1	0	CE		790531	2	Closed by Rev 1
12-5	Pressure grouting of void below the mud mat of the control tower as required	Tbl 12-1	0	CE		801231	4	
12-6	Provide a detailed description of planned corrective actions in Interim Report 6 of MCAR 24	Tbl 12-1	1	CE		790630	1	Closed by Rev 2
12-7	Perform a continuity check on one conduit in each duct bank made with a hard-fiber rabbit prior to cable pulling	Tbl 12-1 Pg 4	1	FE		800630	4	on going activity see field procedure
9-0	No action item	NA						
10-0	No action item	NA						
11-0	No action item	NA						

(Handwritten beside items 12-1 to 12-7: "9", "(SAME)")

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

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
13-8	Reassure the gaps between embedded sleeves and pipes entering the service water valve pits when the surcharge is removed	TDI 12-1 Pg 5	3	CE			#2	Closed by Response to Question 19, Rev 5
13-1	Complete seismic reanalysis of diesel generator building to account for current lack of compaction	13-1	0	CE		791031	#1	Superseded by Items 13-6 and 13-7
13-2	Review diesel generator building design and Seismic Category I equipment piping, and electrical systems to the enveloped seismic responses			CE		791231	#1	Superseded by Items 13-8 through #10 13-14
13-3A	Conduct a seismic reanalysis to account for revised soil structure interaction of service water pump structure;	13-1	0	CE		791031	4	Superseded by Items 13-11 through #12 13-15
13-3B	Review structural design and Seismic Category I equipment, piping, and electrical systems and incorporate the seismic responses of the reanalysis for service water pump structure	13-1	0	CE		791231	#1	" " "
13-4A	If significant change of foundation properties of the auxiliary building result, conduct a seismic reanalysis;			CE		791231	#1	Superseded by Item 13-16 through #20 13-20
13-4B	Review structural design and Seismic Category I equipment, piping, and electrical systems and incorporate the seismic response of the reanalysis for auxiliary building.			CE		791231	#1	" " "
13-5	Underground utilities - Investigate the change in differential displacement separately for buildings founded on fill pending results of seismic reanalysis					791231	#1	Superseded by Item 13-21
13-6	Conduct a seismic reanalysis for the diesel generator building	13-2	0	CE	(Task Check)	801015	#4	[illegible]
13-7	Review structural design for seismic response from Item 13-6	13-2	0	CE		801231	4	" "
13-8	Review Seismic Category I equipment for seismic response from Item 13-6	13-2	0	CE		801231	4	[illegible]
13-9	Review piping system for seismic response from Item 13-6	13-2	0	PD		( )	4	To be combined with 0.2 9 review

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

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
13-10	Review electrical system for seismic response from Item 13-6	13-2	0	CE		8011[illegible]	A	See item [illegible]
13-11	Conduct a seismic reanalysis for the service water pump structure	13-2	0	CE		800[illegible]	A	[illegible]
13-12	Review structural design for seismic response from Item 13-[illegible]	13-2	0	CE		800831	A	[illegible]
13-13	Review Seismic Category I equipment for seismic response from Item 13-[illegible]	13-2	0	CE		8011[illegible]031	A	[illegible]
13-14	Review piping system for seismic response from Item 13-[illegible]	13-2	0	PD			A	To be combined with 0.2 g review
13-15	Review electrical system for seismic response i. e Item 13-[illegible]	13-2	0	CE		8011[illegible]031	A	See item [illegible]
13-16	Conduct a seismic reanalysis for the auxiliary building	13-3	0	CE		800815	A	[illegible]
13-17 (13-07)	Review structural design for seismic response from Item 13-16	13-3	0	CE		800930	A	[illegible]
13-18 (13-09)	Review Seismic Category I equipment for seismic response from Item 13-16	13-3	0	CE		801231	A	[illegible]
13-19 (13-08)	Review piping system for seismic response from Item 13-16	13-3	0	PD			A	To be combined with 0.2 g review
13-20 (13-01)	Review electrical system for seismic response from Item 13-16	13-3	0	CE		801231	A	
13-21 (13-51)	Investigate the effect on underground utilities for differential building displacement resulting from Items 13-6, 13-[illegible], 13-16	13-5	0	CE PS		810131	A	
14-1	Review the estimated settlement upon completion of the load test program of the BWST	14-1	5	CT		810131	A	See remarks for item 4-8
14-2	Analyze flexible buildings for differential settlement based on stiffness at the time of distortion. Evaluate forces due to arching or distortion according to Question 15	14-2	0	CE			XI	Superseded by Item 14-[illegible]6

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

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
14-3	Map significant cracks in auxiliary building, feedwater isolation valve pits, and ring foundation for the BWSTs	14-3	0	CE		790630	1	Closed by Rev 3
14-4	Analyze buildings affected by differential settlement for observed differential settlement plus predicted differential settlement	14-4	0	CE		790831	N1	~~Deleted in Rev 5~~ Related requirement deleted see rationale in page 14-5 rev 5
14-5	Prepare additional response to the NRC					790851	N	
14-6	Analyze the diesel generator building for variable foundation properties by finite element model	14-2	3	CE		791231	N	Closed by Rev 5
14-7	Analyze the BWST foundation for variable foundation properties	14-2	5	CE		800831	A	
14-8	Compare allowable versus calculated forces and moments at critical sections for auxiliary building electrical penetration area and service water pump structure	14-5	5	CE		800831	A	
15-1	Evaluate the differential settlements in accordance with provisions of ACI 318-71 for Seismic Category I structures founded partially upon natural soil and partially upon fill material	15-1	0	CE		791231	N1	Rev 3 identified diesel generator building is the only affected structure, this item is same as Item 14-6
15-2	Expand the Midland project structural design criteria for Seismic Category I structures to include the differential settlement effect.	15-2	0	CE		800831	A	
15-3	Prepare additional response to the NRC					7912	A	
16-1	Perform soil borings in areas of buried pipes	16-1	0	CT		790831	1	~~Deleted in Rev 2~~ Requirement to perform borings is given in Item C- 7[illegible] commitment not deleted in rev 5
17-1	Evaluate impact of the failure of buried non-Seismic Category I piping on safety-related structures, foundations, and equipment	17-1	0	CE		790630	1	~~Deleted in Rev 2~~ Evaluation was not requested by NRC. Commitment was deleted in rev 2

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

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
17-2	If future profiles show any extreme conditions, analyze the piping system and make necessary repairs	17-3	0	CE			A	Superseded by Item 17-A-S
17-3	Prepare additional response to the NRC					790629	1	
17-4	Profile the buried water lines by optical means	17-1	2	CE			A	Tracked by Item 6-A-S
17-5	Analyze buried piping considering the probable ultimate settlement. Provide unique resolution for any unacceptable stress conditions for the portion of the system	17-3	5	PS		800801	3	
17-5	Investigate the excess rounding of profile data	Tbl 17-2	2	PS		800801	A	
18-1	Perform reexamination of the stresses in all Seismic Category I connecting piping between buildings as a normal iteration of design. Consider stresses induced by differential settlement after connecting pipe and anticipated future settlement	18-1	0	PS		800801	2A	
18-2	Perform final analyses to demonstrate the margin of acceptability for additional differential settlement beyond that expected for the life of the plant	18-2	5	PS		800801	A	
18-3	Design piping connecting from the diesel generator building to the pedestals which will accomodate the expected future settlement	18-2	5	PS		800801	A	
19-1	Profile pipes in the vicinity of diesel generator building after removal of preload and evaluate as described in the Response to Question 17	19-1	0	PS		800801	A	
19-2	Take additional gap measurements between embedded sleeves and pipes when surcharge is removed. Coordinate this information with the profile data	19-2	0	CE			A-L	Closed by Rev 5

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

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
19-3*	Perform a complete evaluation of safety-related piping after completion of the preload program	19-3	0	FS		800801	24	
20-1	Analytically check the Seismic Category I systems affected by settlement for pump and nozzle loadings and verify that they are within specified or vendor-accepted limits	20-1	5	FS		800801	24	
20-2	Verify piping support loads for systems subjected to settlement-induced loads	20-1	5	FS		800801	24	
20-3	Prepare additional response to the NCR					800801	24	24-1, 24-2
20-4	Evaluate active valves affected by settlement for imposed loads and reactions; compare to the allowable for operability	20-1	5	FS		800801	24	
22-1	Consultant reports other than Dames & Moore were considered in accordance with the guidelines provided in NRC Regulatory Guide 1.70, Revision 2. Consultant reports were not attached to the FSAR, but portions of consultant reports were extracted and incorporated into the FSAR text itself. Those portions incorporated into the FSAR become commitments. Therefore, disposition of recommendations in consulting reports has been adequately accounted for in the preparation of the FSAR.	22-1 thru 22-7	4	PE		790518	1	
	Verification that those portions of consultant reports determined to be commitments and incorporated into the FSAR have been adequately reflected in project design documents is being accomplished via the FSAR review program described in the response to Question 23, Part 2.							
	The two Bechtel QA audit findings reported in our April 24, 1979, response (Paragraph 8.1, Page 2-8) have been closed out.							

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

Item	Description	Page	Ref	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
23-2	On April 3, 1979, Midland project engineering group supervisors in all disciplines were reinstructed that the only procedurally correct methods of implementing specification changes are through the use of specification revisions or specification change notices. This was followed by an interoffice memorandum from the project engineer to all engineering group supervisors on April 12, 1979.	Q23, p8, 9 RR 11-14		PE		790312	1	
23-3	Engineering Department Project Instruction 4.49.1 was revised in Revision 2 to state, "Under no circumstances will interoffice memoranda, memoranda, telexes, TWIs, etc be used to change the requirements of a specification."	Q23, p8-9 RR 11-14		PE			1	
23-4	A review of interoffice memoranda, memoranda, telexes, TWIs, and other correspondence relating to specifications for construction and selected procurements of Q-listed items will be initiated.	Q23, p9, 9 11-9, 5		PE			1	

no split here

Sheet 10
6/16/80

tory Guide 1.70, Revision 2. Consultant reports were not attached to the FSAR, but portions of consultant reports were extracted and incorporated into the FSAR text itself. Those portions incorporated into the FSAR become commitments. Therefore, disposition of recommendations in consulting reports has been adequately accounted for in the preparation of the FSAR.

MASTER LIST OF COMMITMENTS TO NRC OR 10 C.F.R. 50.54(f) RESPONSES (Continued)

Item	Description	Page	Rev	Group Org	Responsible Engineer	Due Date	Status	Status Remarks
	The purpose of the review will be to identify any clarifications which might reasonably have been interpreted as modifying a specification requirement and for which the specification itself was not formally changed. An evaluation will be made to determine the effect on the technical acceptability, safety implications of the potential specification modification, and any work that has been or may be affected. If it is determined that the interpretation may have affected any completed work or future work, a formal change will be issued and remedial action necessary for product quality will be taken in accordance with approved procedures.							
	The foregoing procedure will be followed for all specifications applying to construction of Q-listed items.							
	For specifications concerning the procurement of Q-listed items, the foregoing procedure will be implemented on a random sampling basis. The sample size has been established and the specification selection has been made.							
(21)	Review and acceptance criteria for the specifications will be defined by March 14, 1980.	[redacted]				8003140		
(47)	The review of construction and selected procurement specifications is scheduled to be completed by October 1980.	[redacted]				8010		

Sheet 11
6/16/80

tory Guide 1.70, Revision 2. Consultant reports were not attached to the FSAR, but portions of consultant reports were extracted and incorporated into the FSAR text itself. Those portions incorporated into the FSAR become commitments. Therefore, disposition of recommendations in consulting reports has been adequately accounted for in the preparation of the FSAR.

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

Disp	Description	Part	Rev	Prog Grp	Responsible Engineer	Due Date	Status	Status Remarks
	If the acceptance criteria are not met, the review will be expanded to include other specifications for Q-listed items. At that time, a revised completion date will be established.							
22-5	A study was completed which examined current procedures and practices for the preparation and control of the FSAR in view of these experiences. Procedural changes will be initiated by the revision of or addition to the engineering department procedures. This action is scheduled to be completed by January 31, 1980.		5			800131	1	
22-6	An interoffice memorandum dated April 12, 1979, was issued by geotechnical services to alert personnel of the need to revise or annotate calculations to reflect current design status.		4	GT		790312	1	
22-7	Field Instruction FIC 1.100, Q-listed Soils placement Job Responsibilities Matrix, has been prepared and establishes responsibilities for performing soils placement and compaction.						1	
22-8	Construction specifications, instructions, and procedures were reviewed to identify any other equipment requiring qualification which had not yet been qualified. No such equipment was identified.		5	FE			1	

Sheet 12
6/16/80

tory Guide 1.70, Revision 2. Consultant reports were not attached to the FSAR, but portions of consultant reports were extracted and incorporated into the FSAR text itself. Those portions incorporated into the FSAR become commitments. Therefore, disposition of recommendations in consulting reports has been adequately accounted for in the preparation of the FSAR.

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

Item	Description	Part.	Rev	Keep Cur	Responsible Engineer	Due Date	Status	Status Remarks
23-9	A dimensional tolerance study was completed using the reactor building spray pump and auxiliary system as the study mechanism.	[illegible]		PE			1	
23-10	Engineering reviewed specifications not previously reviewed for the specificity or tolerance studies.	Q4vpl-					1	
23-11	A specific review of the FSAR and specification requirements for the qualification of electrical and mechanical components has been made as part of the corrective action relating to CPCo's 50.55(e) report on component qualification.	Q4yrl-					1	
23-12	Quality assurance will schedule yearly audits of the design calculational process for techniques and actual analysis in each of the design disciplines.	Q1.ql-					1	
23-13	Audits of ITT Grinnell hanger design and CPCo relay setting calculation have been conducted.	Q1.ql-		Q1			1	
23-14	Bechtel project engineering will review design drawings for cases where ducts penetrate vertically through foundations. The possibility of the duct being enlarged over the design requirements and the effect this enlargement may have upon the structure's behavior will be evaluated by June 1, 1979. Proper corrective measures will be taken if the investigation shows potential problems.	Q4.ql-7					1	

Sheet 13
6/16/80

tory Guide 1.70, Revision 2. Consultant reports were not attached to the FSAR, but portions of consultant reports were extracted and incorporated into the FSAR text itself. These portions incorporated into the FSAR become commitments. Therefore, disposition of recommendations or consultation [illegible] have been adequately accounted for in the preparation of the FSAR.

MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued) 16

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
23-15	An in-depth audit of N.S. Testing operations, covering testing and implementation of its QA program, will be conducted in late April or early May 1979, by Bechtel project QA and engineering.	Q23,pp1-11		QA			1	
23-16	An in-depth training session will be given to Bechtel QA engineers covering the settlement problem and methods to identify similar conditions in the future.	Q23, pp1-22	4	QA		7911?	1	
23-17	An in-depth training session will be given to all CPCo and Bechtel QA engineers and auditors to increase their awareness of the settlement problem and discuss auditing and monitoring techniques to increase audit effectiveness.	Q23, pp1-22	4	QA		8002	1	
23-18	An in-depth review of the Bechtel trend program data will be undertaken by Bechtel QA management to assure the identification of any other similar areas that were not analyzed in sufficient depth in the past reviews.	Q23, pp1-22	4	QA			1	
23-19	Quality control instructions will be evaluated to ensure that the documentation characteristics which are to be inspected (i.e., review callouts) are clearly specified.	Q23, pp1-18	4	QC			#1	
23-20	Field Instruction 1.100 will be supplemented by establishing requirements for demonstrating equipment capability, including responsibility for equipment approval, and providing records identifying this capability.	Q23, pp11-17	5	FI		791204	4	

23-19A Modify to include necessary revision to QCI resulting from review of procedures and review callouts and

To be completed when [illegible] 23-A1 is [illegible]

tory Guide 1.70, Revision 2. Consultant reports were not attached to the FSAR, but portions of consultant reports were extracted and incorporated into the FSAR text itself. Those portions incorporated into the FSAR become commitments. Therefore, disposition of recommendations in consulting reports has been adequately accounted for in the preparation of the FSAR.

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

Item	Description	Date	Ref	Resp Sig	Responsible Engineer	Due Date	Status	Status Remarks
22-21	See Action Item 9		5	PE			1	
22-22	Guidelines for surveillance of testing operations will be developed and included in field instructions for the onsite soils engineer. Engineering/geotechnical services will develop the guidelines by November 30, 1979.	11-17	5	GT		800130	1	
22-23	Engineering will review Engineering Department Procedure 4.22 by December 1, 1978, to clarify that engineering personnel preparing the FSAR will follow the requirements of Regulatory Guide 1.70, Revision 2, Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (September 1975). Specifically, Regulatory Guide 1.70 (Pages iv and v of the Introduction) requires that such consultant reports only be referenced with the applicable conclusions and supporting information included in the text (third paragraph, Page vi). Such a requirement would preclude repetition of this circumstance.	11-7	5	PE		791130	1	
22-24	To preclude any future inconsistencies between the FSAR and specifications, Engineering Department Project Instruction 4.1.1 will be revised to state that all specification changes, rather than just "major changes," will be reviewed for consistency with the FSAR.	11-11	5	PE		791130	1	

Sheet 15
6/15/80

tory Guide 1.70, Revision 2. Consultant reports were not attached to the FSAR, but portions of consultant reports were extracted and incorporated into the FSAR text itself. Those portions incorporated into the FSAR become commitments. Therefore, disposition of recommendations in consulting reports has been adequately accounted for in the preparation of the FSAR.

INDEX LIST OF COMMITMENTS TO NRC OR 10 CFR 50.54(f) RESPONSES (Continued) 17

Item	Description	Page Ref	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
23-25	Quality assurance will issue a nuclear quality assurance manual amendment to clarify the requirement that procedures include measures for qualifying equipment under specified conditions.	Q23.p50 4.5-14	QA		800715	C	
23-26	In view of Action Item 6, geotechnical services will revise Procedure EP-4437 by December 31, 1979, to require that calculations be annotated to reflect concrete design status.	Q23.p51 5 4.5-15	GT			1	
23-27	Engineering Department Procedure 4.37 will also be revised by December 31, 1979, to require that calculations be annotated to reflect current design status.	Q23.p49 5 4.5-13	QA		791227	1	
23-28	Civil/structural Design Criteria 7220-C-501 will be modified to contain the requirements that a duct bank penetration shall be designed to eliminate the possibility of the unspecific size duct interacting with the structures.	Q23.p46 5 4.5-10	CE		800800	C	
23-29	The civil standard detail drawings will be revised to include a detail showing horizontal and vertical clearance requirements for duct bank penetrations. The detail will address any and not restrictions.	Q23.p45 5 4.5-9	CE		791231	1	re-key
23-30 (SSI)	Engineering will clarify specifications and construction will prepare procedures governing the soils compaction equipment to implement the requirements of the Nuclear Quality Assurance Manual as stated in Action Item 25	Q23.p48 5 4.5-12	CE/TE		800912	C	

Sheet 16
6/15/80

tory Guide 1.70, Revision 2. Consultant reports were not attached to the FSAR, but portions of consultant reports were extracted and incorporated into the FSAR text itself. These portions incorporated into the FSAR become commitments. Therefore, disposition of recommendations in consulting reports has been adequately accounted for in the preparation of the FSAR.

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

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
23-31	Design documents, instructions, and procedures for those activities requiring inprocess controls will be reviewed to assess the adequacy of existing procedural controls and technical direction. Engineering review is scheduled for completion by October 24, 1980.	~~Q1~~, p1-11 Q22, p20, 30-13-14, 10	5	PE		801024	~~S~~ Y	
23-32	Guidelines for surveillance of testing operations will be developed and included in field instructions for the site soils engineer. Engineering/geotechnical services will develop the guidelines by November 30, 1979, and field engineering will prepare the instructions by February 29, 1980.	Q22, p33 23-17	5	PE		8	1	
23-33	The quality assurance audit and monitoring program will be revised to emphasize and increase attention to the need for evaluating policy and procedural adequacy and assessment of product quality. A specialized audit training program will be developed and implemented to ensure guidance for this revised approach.	Q22, p35 23-15	5	QA		8C0912	~~S~~ Y	action completed except for developing audit training program.
23-34	Control Document SF/PSP C-6.1 will be revised to provide requirements for inspection planning specificity and for the utilization of scientific sampling rather than percentage sampling.	~~Q1~~, p1-20 Q22, p22, 24-21-22, 14	5	QC		800701	~~S~~ Y	New date from QC

Sheet 17
6/16/80

tory Guide 1.70, Revision 2. Consultant reports were not attached to the FSAR, but portions of consultant reports were extracted and incorporated into the FSAR text itself. Those portions incorporated into the FSAR become commitments. Therefore, disposition of recommendations in consulting reports has been adequately accounted for in the preparation of the FSAR.

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

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
23-35	Control Documents ? stet		5	QC		800701	3	
23-36	SF/pSF C-3.2 Control of Nonconforming Item	Q23,p22 23-13	5	QA/QC		791121	1	
23-36	QADP C-101, Project Quality Assurance Trend Analysis are in the process of being revised to provide an improved definition of implementing requirements for identifying repetitive nonconforming conditions.			QA				
23-37	Consistent with the intent of Action Item Numbers 35 and 36, quality assurance will review nonconformance reports which are open, or will become open between this time and ~~January 23, 1980~~. ~~This review will be to identify any repetitive nonconforming conditions pertaining to product type or activity, or pertaining to nonconformance cause.~~	Q23,p33 23-31	5	QA		8110	3	
23-38	A study was completed by October 31, 1979, to examine current procedures and practices for the preparation and control of the FSAR in view of these experiences. Procedural changes will be initiated by the revision of or addition to the engineering department procedures.	Q23,p44 23-11	5	LS		791130	1	
23-39 (30)	Engineering will clarify specifications and construction will prepare procedures (governing the soils compaction equipment) to implement the requirements of the Nuclear Quality Assurance Manual as stated in Action Item 25.	Q23,p48 23-18	5	FE		801017	3	

prior to implementation of the improved project quality assurance trend program as stated in action item 23-36

Sheet 16
6/16/80

tory Guide 1.70, Revision 2. Consultant reports were not attached to the FSAR, but portions of consultant reports were extracted and incorporated into the FSAR that itself. Those portions incorporated into the FSAR become commitments. Therefore, disposition of recommendations in consulting reports has been adequately accounted for in the preparation of the FSAR.

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

Item	Description	Page	Rev	Acct Org	Responsible Engineer	Due Date	Status	Status Remarks
23-40 Supp (31)	Design documents, instructions, and procedures for those activities requiring inprocess controls will be reviewed to assess the adequacy of existing procedural controls and technical direction. Engineering review is scheduled for completion by October 28, 1980, and field engineering and quality control review is scheduled for completion by November 28, 1980.	Q23, p22, 30 I-10,13 Q1, pI-11 I-18	4	FE,QC		801128	C	Project Engineering to provide list of design document to field engineering and QC to start this item.
23-41 1	QCIs in use will be revieved to ascertain that provisions have been included consistent with the revised control document, SF/PSP G-6.1, Quality Control Inspection Plans.	Q1, pI-11 Q23, p22, I-18	5	QE		800901	C	
23-42 2 (31) (40)	Design documents, instructions, and procedures for those activities requiring inprocess controls will be reviewed to assess the adequacy of existing procedural controls and technical direction. Engineering review is scheduled for completion by October 28, 1980, and field engineering and quality control review is scheduled for completion by November 28, 1980. Any revisions required will be completed by January 23, 1981.	Q1, pI-11 Q23, p20, 30 I-10,13	4	FE,FE, QC		810123	C	
23-43 3	The impact of Action Item 41 on completed work will be evaluated, and appropriate actions will be taken as necessary.	Q23, p22,25 I-11,16	4	QC		801101	C	
23-44 4	FSAR sections are being rereviewed as discussed in the Response to Question 23, Part (2).	Q23,p7, 11- I-7,11	4	PE		8609	C	

Sheet 19
6/16/80

tory Guide 1.70, Revision 2. Consultant reports were not attached to the FSAR, but portions of consultant reports were extracted and incorporated into the FSAR text itself. Those portions incorporated into the FSAR become commitments. Therefore, disposition of recommendations in consulting reports has been adequately accounted for in the preparation of the FSAR.

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

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
23-4	U.S. Testing will be required to demonstrate to the cognizant engineering representative that testing procedures, equipment, and personnel used for quality verification testing (for other than HDE and soils) were, and are, capable of providing accurate test results in accordance with the requirements of applicable design documents.	Q1, p1-18, Q23, p27, 31, 15-17, 31	5	CE		801001	Y	
23-5	A sampling of U.S. Testing's test reports (for other than HDE and soils) will be reviewed by the cognizant engineering representative to ascertain that results evidence conformance to testing requirements and design document limits.	Q23, p28, 31, 21-29, 31	5	CE		801001	Y	
23-6	See Action Item 4	11-9, 15, Q23, p29, 26	4	PE		801000		
23-8	CPCo will implement overinspection for soils placement, utilizing a specific overinspection plan.	Q1, p1-11, 1-16	4	CPCo-QA			4 Complete on going activity.	
23-9	CPCo will perform overinspection of the U.S. Testing soils testing activities and reports, utilizing a specific overinspection plan.	Q1, p1-17	4	CPCo-QA		BA	Y " "	
23-10	CPCo project management and QA review field procedures (new and revised) and CPCo QA reviews QCIs (new and revised) in line with Bechtel before release.	Q1, p1-19	4	QC		BA	Y " "	

Sheet 20
6/16/80

tory Guide 1.70, Revision 2. Consultant reports were not attached to the FSAR, but portions of consultant reports were extracted and incorporated into the FSAR text itself. Those portions incorporated into the FSAR become commitments. Therefore, disposition of recommendations in consulting reports has been adequately accounted for in the preparation of the FSAR.

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

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
23-~~5~~51	In 1978, CPCo implemented an overinspection plan to independently verify the adequacy of construction and the Bechtel inspection process, with the exception of civil activities. Reinforcing steel and embeds were covered in the overinspection.	~~QT~~, 1-19	4	CPCo-QA		NA	4	Ongoing activity.
23-~~6~~52	CPCo reviews onsite subcontractor QA manuals and covers their work in the audit process.	~~QT~~, 1-19	4	CPCo-QA		NA	4	
23-~~9~~49	An ongoing effort is improving the "surveillance" mode called for in the QCIs by causing more specific accountability as to what characteristics are inspected on what specific hardware and in some cases changing "surveillance" to "inspection."	~~QT~~, 1-19	4	CC		NA	4	
24-1	Determine final number of observation wells	24-21	5	GT		811031	4	
24-2	Develop frequency for monitoring the observation wells	24-21	5	GT		810131	4	
24-3	Develop system and schedule for monitoring sand removal	24-22	5	GT		810131	4	
24-4	Evaluate results of temporary dewatering system to verify design bases	24-E	5	GT		801031	4	
25-1	Revise seismic analysis for diesel generator building using the soil properties determined by the recent investigation and any foundation modifications	25-3	5	CE			1	Tracked by Item 13-6

tory Guide 1.70, Revision 2. Consultant reports were not attached to the FSAR, but portions of consultant reports were extracted and incorporated into the FSAR text itself. Those portions incorporated into the FSAR become commitments. Therefore, disposition of recommendations in consulting reports has been adequately accounted for in the preparation of the FSAR.

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

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
25-2	Revise seismic analysis for auxiliary building using the soil properties determined by the recent investigation and any foundation modifications	25-3	5	CE			1	Tracked by Item 13-11
25-3	Revise seismic analysis for service water pump structure using soil properties determined by the recent investigation and any foundation modification	25-5	5	CE			1	Tracked by Item 13-6
26-1	Analyze the effect of differential settlement of the diesel generator building in accordance with ACI 349 as supplemented by Regulatory Guide 1.142	26-2	5	CE		800930	4	
26-2	Incorporate in the Midland project standard design criteria the effect of differential settlement of structures which are founded partially or totally on fill	26-1	5	CE			1	Tracked by Item 15-2
27-1	Prohibit final piping connection to the diesel generator building before 12/31/81	Fig 27-9	5	PD		8007	4	
31-1	Perform full-scale load test by filling the BWST with water	31-2	5	GT CE		801130		Tracked by Item 4-28
33-1	Fill the diesel fuel oil tanks with oil prior to preoperational testing	33-2	5	CE		8008	4	will be accomplished just prior to preoperational testing
S-1	Advise Pechtel to commence dewatering and underpinning activities	A		CPCo			4	after favorable SER
S-2	Develop settlement time rate criteria for all Seismic Category I structures	*		GT		810331	4	

TITLE

NEXT PAGE — LIST OF COMMITMENTS AND QUESTIONS

Sheet 22
6/16/80

tory Guide 1.70, Revision 2. Consultant reports were not attached to the FSAR, but portions of consultant reports were extracted and incorporated into the FSAR text itself. Those portions incorporated into the FSAR became commitments. Therefore, disposition of recommendations in consulting reports has been adequately accounted for in the preparation of the FSAR.

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

Item	Description	REF Page	Key	Resp Eng	Responsible Engineer	Due Date	Status	Status Remarks
S-3	Monitor concrete cracks for service water pump structure and auxiliary building mechanical penetration areas and the feedwater isolation valve pits before and after installation of piles and caissons	B		CE		801031	Y	One date is for incorporation of requirement into drawing
S-4	Monitor concrete cracks in the RWST valve pits and repair any observed crack exceeding the ACI code limits	B		CE		800630	Y	"
S-5	Grout the local gaps between diesel generator building footing and mud mat	B		CE		800407	Y	Grouting requirement is given in drawing # C-1147
S-6	Continue involvement of CPCo/Bechtel consultants for reviewing remedial actions	B					Y	
S-7	Monitor service water pump structure and pile displacement during jacking operation to verify pile dynamic stiffness used in seismic analysis	B		CE			Y	
S-8	Envelope pile stiffness for the seismic analysis of service water pump structure	B		CE			Y	Enveloping is completed in seismic model. See Item 13-11
S-9	Check the limited clearance between the service water pipe at the building penetration	B		ED CE		800731	Y	

REF
A. Letter from G.S. Keeley to J.H. Rutgers, Serial 858E, 3/27/80
B. Commitments made in 2/80 meeting with NRC at Midland site

tory Guide 1.70 Revision 2. Consultant reports were not attached to the FSAR, but portions of consultant reports were extracted and incorporated into the FSAR text itself. Those portions incorporated into the FSAR become commitments. Therefore, disposition of recommendations in consulting reports has been adequately accounted for in the preparation of the FSAR.

Bechtel Corporation
Engineers—Constructors

Fifty Beale Street
San Francisco, California 94119

August 22, 1969

Dames & Moore
309 West Jackson Blvd.
Chicago Illinois 60606

Attention: Mr. George D. Leal

Subject: Consumers Power Company
Midland Plant Units 1 & 2
Job No. 7220
Soils Investigation
File: 0120, 1700, C-1Y

Gentlemen:

Referring to your letter of July 8, 1969, on the subject of plant excavation slopes, we have the following comments on which we would appreciate your response:

It is our opinion that in accordance with normal practice, the minimum factor of safety during construction should not be less than 1.25 for conditions where failure could endanger life or cause considerable financial losses. However, stability analysis should be based on realistic, rather than on excessively conservative assumptions.

For the case 2a, "western soil profile", the reported factor of safety of only 1.1 is less than the minimum 1.25 which we consider acceptable, particularly as the slope may be standing for as long as a year. However, the assumption of phreatic surface extending to the surface of fill at elevation 634 is ultraconservative, and we see no reason for this to be higher than the existing water table assumed at elevation 604. On the other hand, a tension crack along which there is no contribution to the shearing resistance should be assumed in the cohesive fill. These two factors will have opposite effects on the stability.

Please comment on whether more realistic assumptions for stability analysis for the "western soil profile", may justify a lower phreatic surface (el. 604 instead of 634), but inclusion of a tension crack extending to a depth consistent with the assumed properties of the fill. If you agree with this, then please recalculate the factor of safety for these adjusted assumptions.

The text appended to your letter (Part 1 -"General Description") is a general method of stability analysis based on published literature. No indication is given of how the method was applied to the present problem. It would be useful for our review and for record purposes if you would submit an illustration showing the location of the slip circles analysed and the corresponding factors of safety, together with the assumptions made

in the analysis. This would assist us in forming a judgement on the significance of "minor sloughing" which, as you indicated, may take place.

Regarding the stability at the "eastern soil profile", you indicated that the factor of safety is dependent on the location of the phreatic surface. Please provide a description, more precise than that given in paragraph D-4 of your letter, of the minimum distances from the soil surfaces to the phreatic line. This is required in order that these distances can be included in the dewatering specification.

Itmay be assumed that the maximum rate of excavation could be about 500 cy/day applied to either of the reactor buildings or the auxiliary building.

In addition, as a separate subject, please advise your approximate charges and schedule for the following:

1. Furnishing to us complete details of calculations of total and differential settlements of the major plant structures. The maximum and minimum settlements should be stated. The estimated settlements should be given for the centers of the reactor and auxiliary buildings, such as required to determine the maximum and minimum differential settlements. The relatively small differential settlements were queried by the AEC. Information is required as to whether single or double drainage was assumed in the settlement analysis, details of rate of settlements, and whether artesian condition in underlying aquifer was allowed for.

   As you are aware, these analyses should be thorough and by methods which would be acceptable to AEC personnel and their consultants. It is important that the short term elastic and the long term consolidation type of settlement should be given separately and that the effects of the deep excavations and the area load to El. 634 be taken into account. The timing of these phases of unloading and loading should also be considered.

   We note that consolidation test results contained in the reports submitted to date do not include data on the time rate of consolidation such as coefficient of consolidations which normally are a part of consolidation test results. Will you please furnish this missing information as part of our original agreement.

2. Recommendations as to the criteria such as relative density of sand and strength of clay, or glacial till, which would determine what materials can be retained in foundations and what materials must be removed for stability under seismic conditions of Class I structures. (The operating Basis Earthquake is 0.05 g and the Design Basis Earthquake is 0.10 g).

3. Recommendations or comments on seismic stability of the dense clay till type soil which will be supporting the reactor and auxiliary buildings and in particular of silt and sand inclusions of this soil as indicated on the borehole logs.

4. The overconsolidation ratio of the soils supporting the reactor and auxiliary buildings.

5. Providing us full design, including plan, illustration, description, and specification, for the installation of the piezometer monitoring system around the plant excavation which you recommend in your July 17 letter.

We would appreciate receiving your initial response to this letter outlining anticipated charges for points 1, 2, 3, 4 and 5 by August 29, 1969.

Very truly yours,

J. H. Blasingame
Project Engineer
Bechtel Company

PAM:ea
(In dup.)
cc: Consumers Power Company (3)

SUPPLEMENT TO REPORT

FOUNDATION INVESTIGATION AND
PRELIMINARY EXPLORATIONS FOR BORROW MATERIALS
PROPOSED NUCLEAR POWER PLANT
MIDLAND, MICHIGAN

FOR

CONSUMERS POWER COMPANY

5697-004-07

DAMES & MOORE

CONSULTING ENGINEERS IN THE APPLIED EARTH SCIENCES

309 WEST JACKSON BOULEVARD · CHICAGO ILLINOIS 60606 · 312 922-1772 · TELEX 2-5227

PARTNERS JAMES B. THOMPSON · GEORGE D. LEAL

ASSOCIATE WILLIAM G. PARATORE

CHIEF ENGINEER JAMES V. TOTO

March 15, 1969

Bechtel Corporation
P.O. Box 3965
San Francisco, California 94119

Attention: Mr. J. H. Blasingame,
Project Engineer

Gentlemen:

This letter transmits fifteen copies of our "Supplement to Report, Foundation Investigation and Preliminary Explorations for Borrow Materials, Proposed Nuclear Power Plant, Midland, Michigan for Consumers Power Company," dated March 15, 1969.

The scope of this investigation was planned in collaboration with Messrs. Flach, Martinez, Kulesza and Cherrington of Bechtel Corporation.

The data and recommendations presented in this report are intended to supplement those presented in our "Report of Foundation Investigation, and Preliminary Explorations for Borrow Materials," dated June 28, 1968, and are considered appropriate for final plant design.

It has been a pleasure to be of service to Consumers Power Company and Bechtel Corporation on this project, and we trust that you will contact us if you should have any questions or comments.

Yours very truly,

DAMES & MOORE

George D Leal

George D. Leal

GDL:WWM:mf

SUPPLEMENT TO REPORT

FOUNDATION INVESTIGATION AND

PRLIMINARY EXPLORATIONS FOR BORROW MATERIALS

PROPOSED NUCLEAR POWER PLANT

MIDLAND, MICHIGAN

FOR

CONSUMERS POWER COMPANY

INTRODUCTION

This report presents the results of a supplementary foundation investigation performed at the site of the Proposed Nuclear Power Plant to be constructed in Midland, Michigan for Consumers Power Company.

An initial foundation investigation was performed by Dames & Moore and the results presented in our "Report, Foundation Investigation and Preliminary Explorations for Borrow Materials, Proposed Nuclear Power Plant, Midland, Michigan," dated June 28, 1968. Subsequent to the initial investigation, the plant structures were relocated 150 feet to the east and 60 feet to the north of the original location. Because of subsurface conditions encountered at the new location, the plant structures were relocated a second time to a position 40 feet south and 20 feet east of the original location. The data and recommendations presented in this supplementary report are appropriate for the final plant location.

SCOPE

The purpose of the supplementary foundation investigation was to develop data and recommendations appropriate for final plant design. The specific program discussed and agreed upon for investigating the site consisted of the drilling and sampling of exploration test borings, the performance of a limited number of supplementary laboratory tests, the performance of appropriate engineering analyses, and the preparation of final recommendations and substantiating data.

This report is intended to be supplementary in nature and does not repeat discussion of items covered in the initial report unless required. Emphasis is given to the following specific information:

1 - Modified site description as necessitated by the additional explorations.

2 - Soil boring logs which include information on ground water levels at the time of drilling.

3 - Results of supplementary laboratory tests.

4 - Final foundation design criteria, including:

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

b) Lateral earth pressure against structure walls as a function of depth. In developing these data, the maximum probable flood has been assumed at elevation 632 feet, and the top of plant fill has been assumed at elevation 634 feet. For normal conditions, the ground water level has been assumed at elevation 625 feet, the reservoir water surface elevation.

c) Recommended foundation type for the reactor buildings, the turbine building, and for the turbine generators. The estimated total settlement and maximum differential settlement are provided for recommended foundation types.

d) Recommended foundation type and estimated total settlement for the auxiliary building which is located between the two reactor buildings. Its structure and foundation will be separate from those of the adjacent three buildings to allow for possible differential settlement which must not exceed 3/4 inch.

e) Differential settlements between auxiliary building, reactor, and turbine buildings.

5 - Review of recommendations regarding site preparation and earthwork, as follows:

a) Recommended excavation slopes in natural soils and in plant fill.

b) Control of ground water in excavations for the reactor and turbine buildings.

c) Compaction requirements for the plant fill (I) beneath structures, and (II) adjacent to structures.

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

The results of our supplementary field explorations and laboratory tests are presented in the Appendix to this report.

DESIGN CONSIDERATIONS

Subsequent to the completion of the initial investigation, planned foundation elevations of all the major structures have been modified and more detailed structural design data has become available. A summary of pertinent structural data is given below.

The reactor building foundations will be established at elevation 582.5. They will be structurally separated from the adjacent auxiliary building, and the maximum allowable differential settlement between auxiliary building and reactor buildings has been established at three-quarters of an inch.

The auxiliary building plan dimensions will be 166 feet by 161 feet. This building abuts both of the reactor buildings and the turbine building. The central portion of the auxiliary building, 76 feet by 131 feet in plan dimensions, will be founded at elevation 562.0 feet; both parts of the auxiliary building abutting the reactor buildings will be founded at elevation 580. The remainder of the auxiliary building, located adjacent to the turbine building, and between it and the reactor buildings, will be founded at elevation 610.

Plan dimensions of the turbine building will be approximately 132 feet by 436 feet with a base elevation of 610. This building will house two turbine-generators supported on mat foundations established at approximately elevation 602 feet. The turbine-generator mat foundations will have plan dimensions of 145 feet by 45 feet and 185 feet by 45 feet.

Foundation loads imposed by the various structures under normal operating conditions and under seismic loading conditions are tabulated below.

STRUCTURE	FOUNDATION ELEVATION, FEET	FOUNDATION LOADING, LBS./SQ.FT. DEAD AND LIVE LOAD	DEAD, LIVE AND SEISMIC LOAD MAXIMUM	DEAD, LIVE AND SEISMIC LOAD MINIMUM
Reactor Building	582.5	8,000	16,000	0
Auxiliary Building	562.0	6,500	13,000	0
	580.0	5,000	10,000	0
	610.0	3,500	7,000	0
Turbine Building	610.0	3,000	5,000	1,000
Turbine Generator Mat Foundations	602.0	4,500	9,000	0

The locations and foundation loading data relative to the appurtenant structures have not been provided to us.

Final plant grade has been raised approximately six feet and will be established at approximately elevation 634. Normal ground water level as in the initial investigation, is assumed to be at the existing ground surface, approximately elevation 603. However, this may be a perched water level. The water level in the cooling pond reservoir will be at approximately elevation 625. The underdrainage system considered in the initial report has been eliminated; consequently, it is assumed that the ground water level in the plant area will rise concurrently to approximately elevation 625. The maximum probable flood level will remain at elevation 632.

SITE CONDITIONS

SUBSURFACE CONDITIONS

General geologic conditions, and surface conditions at the site have been discussed in our initial report.

The subsurface conditions at the site were further investigated by drilling 11 supplementary exploration test borings and 22 probings to depths ranging from 10 to 80 feet at the locations shown on Plate 2.

The supplementary borings and probings provided more detailed information regarding the sandy soils, which generally underlie the topsoil and/or organic silty soils. These sandy soils consist of brown and gray fine sands which grade from loose near the surface to very dense with increasing depth. Although there is little or no sand within the central part of the plant area, the sand stratum does extend to approximately elevation 585 feet at both the east and west ends of the turbine building. Similarly, the bottom of the sand stratum varies from approximately elevation 600 in the vicinity of the west reactor building area to approximately elevation 575 feet near the north-eastern edge of the east reactor building area and along a part of the northern edge of the auxiliary building area.

The presence of very stiff to hard cohesive soils, predominantly gray silty clay, underlying the surface sand deposits was confirmed by the supplementary boring program.

More detailed descriptions of the subsurface soil penetrated by the supplementary borings are presented on the Log of Borings in the Appendix to this report.

SURFACE WATER

The site is presently subjected to periodic flooding. We understand that maximum probable flood level has been estimated at elevation 632 feet, which is the same elevation assumed in our initial report.

GROUND WATER

Seepage water entered some of the borings through the sand stratum blanketing the site. Ground water observations in the supplementary borings were consistent with those discussed in the initial report. A perched water condition probably exists in the sandy surface soils, and it has been conservatively estimated that the perched ground water level is at or near the existing ground surface. The underlying silty clay soils are saturated, but the present ground water level in these impervious materials could not be determined during the short term of our field investigations.

LABORATORY TESTS

The results of the laboratory tests performed in connection with the supplemental investigation, together with a description of the test procedures, are presented in the Appendix to this report.

A summary of all laboratory strength tests, and moisture and density tests, performed on soil samples extracted from borings drilled in the power plant area are presented on Plate 5, Summary of Test Data.

DISCUSSION AND RECOMMENDATIONS

GENERAL:

The results of our supplementary investigation confirm that the site is suitable, from a foundation standpoint, for the support of the proposed plant structures. Initial recommendations regarding suitable foundation types for various structures are considered applicable. These recommendations are summarized below.

It is recommended that the reactor buildings and the lower portion of the auxiliary building be supported on mat foundations established at the planned elevations, in the very stiff to hard cohesive soils.

It is recommended that the turbine building, the higher south portion of the auxiliary building, and the turbine-generators be supported on mat foundations established in controlled compacted fill at the planned elevations. Prior to the placement of fill, it is recommended that all topsoil, loose sand and other unsuitable soils be excavated from the turbine building area and the south portion of the auxiliary building area. The exposed natural soils should be thoroughly proof-rolled prior to commencing filling operations.

It is recommended that appurtenant structures be supported on spread foundations established in the controlled compacted fill.

The more detailed structural design data and the additional subsurface data available at this time permit a final analysis of total and differential settlements. Foundation design data and the results of the settlement analysis are presented in subsequent sections of this report.

Recommendations regarding earthwork operations are presented in the following section.

EARTHWORK:

The supplementary investigation requires certain modifications in our initial recommendations regarding dewatering, excavating, filling and backfilling.

Dewatering - The supplementary investigation has indicated that more extensive dewatering operations will be required than originally anticipated due to the greater amount of sandy surface soils encountered in the immediate plant area.

Plant excavations will extend into sandy surface soil below the ground water level and into relatively impervious clay soils. The depth of the sandy surface soils in the vicinity of the plant structures ranges from 0 to approximately 35 feet, with the maximum depth of sand occurring near the south western corner of the turbine building. The maximum depth of excavation will be on the order of 40 feet, to elevation 562.0, for the auxiliary building.

Only minor water seepage is anticipated in the lower clay soils. However, dewatering operations will be required in connection with excavations into the upper sandy soils. The ground water level, presently assumed to be at approximately elevation 603, may vary during the construction period in response to rainfall, surface runoff conditions, and the water level in the adjacent Tittabawasse River.

We understand that a seepage cutoff wall will be installed which will minimize the flow of seepage water through the sandy soils into the plant excavations. The location of the seepage cut off wall is shown on Plate 2, Site Plan. In order to supplement ground water control in the excavations, it is recommended that the ground water level inside the seepage cutoff wall be lowered as required by a well-point or deep-well dewatering system.

The subsurface conditions at the site have been discussed with a representative of the Griffin Wellpoint Corporation, a qualified dewatering contractor. After having been familiarized with the soil conditions, the following schemes were proposed by the Griffin Wellpoint Corporation.

1 - A single stage well-point system would be installed to lower the water level in the sandy soils inside the seepage cutoff wall to approximately elevation 575. In areas where the depth of sandy soils exceeds approximately elevation 575, a second stage of well-points would be installed to lower the water level to approximately elevation 560. It is anticipated that well-points will have to be installed with vertical sand filter-wicks to maintain the required drainage and draw-down. A copy of correspondence from Griffin Wellpoint Corporation and their sketch of proposed locations of the upper and lower dewatering systems is attached to the Appendix of this report.

2 - As an alternative to the above, particularly in areas where the sandy soils extend to depths below the bottom of excavations, it may be more economical to install several peripheral wells to depths below the plant excavations. These deep wells should be designed and operated such that the ground water level in the vicinity of the plant excavations is maintained below the bottom of the excavations.

The dewatering schemes outlined above are considered suitable, but appropriate field pumping tests should be performed prior to selecting a dewatering contractor. The field pumping tests would provide data to allow the choice of the most suitable type of dewatering system (well-points or deep wells), and would provide additional data for contractor bidding purposes. We would be pleased to provide guide specifications and technical supervision during the performance of field pumping tests, if required.

The dewatering system should maintain the water level in the sandy soils at least three to five feet below exposed excavated surface. Piezometers should be installed and monitored to insure that the water level in the sandy soils is continuously maintained at the recommended level.

In peripheral areas where the sandy surface soils are shallow, and surface water is not intercepted by other means, it is recommended that a peripheral drainage trench system be installed around the outside of excavations. The perimeter drainage system should consist of trenches excavated through the sandy surface soils and graded to drain away from the plant area. The trenches should be backfilled with clean gravel or other pervious material. Inside the excavation it is recommended that ground water seepage be controlled by a system of shallow peripheral trenches and sumps. Pumps will be required to remove water which accumulates in the trench-sump system.

Excavating - This section presents recommendations pertaining to excavating operations required to attain the modified planned grades and to prepare soils for the support of foundations or fill materials.

The maximum depth of excavation will be on the order of 40 feet in the vicinity of the auxiliary building.

Providing stripping is carried out in the manner recommended in our previous report and stripped soils are wasted, all remaining soils to be excavated will be suitable for use as fill or backfill. Detailed recommendations for the use of these soils are given in a subsequent section.

In addition to the excavation required to attain foundation levels, it is recommended that all on-site sands be excavated from below foundation level in the reactor building and auxiliary building areas, and that these soils be replaced by either compacted sand or clay fill soils. Based on the results of our field explorations, we anticipate that only very minor amounts of in-situ sands may be encountered at the foundation level of these structures. Where over-excavation is required, subgrade preparation and the backfilling to attain foundation levels should be carried out in the manner outlined in subsequent sections.

All loose in-situ sands, soft or compressible clay soils, and organic soils should be excavated in the turbine building area. Based on the results of the supplementary field explorations, it is anticipated that the depth of excavation of unsuitable soils will vary from one to five feet with an average over the area of approximately three feet. The excavation of these unsuitable soils, and subsequent backfilling with controlled compacted fill where required, is necessary in order to provide uniform foundation support for the turbine building and turbine-generator foundations. The plan dimensions of the excavated area should include the "zone of influence" of the mat foundations established in the controlled compacted fill. For purposes of excavation and filling, the "zone of influence" of a foundation is defined as the zone within planes extending downward and outward from the bottom outside edge of a foundation at an angle of 45 degrees with the horizontal.

Engineering studies have been performed to evaluate the stability of slopes constructed through the upper dewatered sandy soils and the underlying very stiff to hard clay soils. Based on the results of these studies, it is recommended that the banks of excavations through the dewatered sandy soil be cut on a slope of one vertical to one and one-half horizontal or flatter. Banks of excavations cut through the clay soils may be cut on a slope of two vertical to one horizontal or flatter. Banks of temporary excavations within the clay soils which are not subject to surcharge loading may be cut vertically with an unsupported height of up to 15 feet. It is anticipated that localized sloughing and spalling of the banks of excavations will occur due to drying and shrinking of the banks and also due to the presence of discontinuous lenses and pockets of silt in the clay soils.

Subgrade Preparation - Following stripping and excavating it is recommended that the exposed surfaces be thoroughly proof-rolled under the supervision of a qualified soils engineer. Where practical both foundation and fill subgrades should be proof-rolled to compact the exposed surfaces and to detect any localized zones of soft soils. As a guide, the proof-rolling operation could be considered equivalent to making approximately two passes over the entire exposed subgrade with a 20-cubic yard capacity loaded motor scraper. In deep excavations or limited access areas, smaller equipment making more passes would be suitable for proof-rolling.

Zones of loose or soft soils delineated by proof-rolling should be compacted if possible or removed and replaced with controlled compacted fill.

Upon attainment of final foundation grade in each area, it is recommended that a working mat of lean concrete be poured. The installation of a lean concrete "mud mat" or similar protection should minimize disturbance of the subgrade soils due to water seepage and construction operations. The mud mat will not provide protection against freezing and thawing of the subgrade soils.

The clay soils are susceptible to loss of strength due to frost action, disturbance and/or the presence of water. If the construction schedule requires that foundation excavations be left open during the winter, it is recommended that excavating operations be performed such that at least three and one-half feet of natural soils or similar cover remain in place over the final subgrade or overlying the "mud mat." This layer of protective material is necessary to prevent the softening and disturbance of the subgrade soils due to frost action.

Mud mats or similar means of protection should also be installed on the banks of excavations which lie within the building areas. The mud mat will provide protection against drying and resaturation which could lead to weakening and spalling of slopes.

Filling and Backfilling - Fills up to approximately 35 feet in thickness will be required in the attainment of the final plant grade elevation 634. In addition, fills and backfills will be required below and adjacent to structures.

As previously mentioned, on-site excavated soils, both sands and clay soils are considered suitable fill materials. Provided either soil type is placed and compacted in accordance with the criteria recommended below, it is considered unnecessary, from performance considerations, to

specify the selective use of one or other of these soil types for any of the fills or backfills which will be required; however, as sands are more readily compacted with small equipment such as hand operated vibratory equipment it is recommended that sand fill be used in areas of limited access.

All fill and backfill materials should be placed at or near the optimum moisture content in nearly horizontal lifts approximately six to eight inches in loose thickness. Each lift should be compacted in accordance with the following criteria for the construction of controlled compacted fill and backfill.

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

Engineering studies have been performed to evaluate the stability of slopes constructed through the plant fill. Based on the results of these studies, it is recommended that the banks of temporary excavations through dewatered sand fill soils be cut on a slope of one vertical to one and one-half horizontal or flatter. Banks of temporary excavations through compacted clay fill soils which are not subject to surcharge loading may be cut vertically with an unsupported height of up to ten feet.

It is recommended that permanent slopes through granular compacted fill soils be constructed on slopes of one vertical to four horizontal or flatter. Permanent slopes through cohesive compacted fill soils may be constructed on slopes of one vertical to two horizontal.

Filling operations should be performed under the continuous technical supervision of a qualified soils engineer who would perform in-place density tests in the compacted fill to verify that all materials are placed and compacted in accordance with the recommended criteria.

	RECOMMENDED MINIMUM COMPACTION CRITERIA	
	ON-SITE SAND SOILS	ON-SITE CLAY SOILS
PURPOSE OF FILL	PERCENT RELATIVE DENSITY*	PERCENT OF MAXIMUM DENSITY**
Support of Structures	85	100
Adjacent to Structures	75	95
Areal Fill (Not supporting or adjacent to structures)	70	90

* Maximum and Minimum density of sand soils should be determined in accordance with A.S.T.M. Test Designation D-2049-64T.

** Maximum dry density and optimum moisture content should be determined in accordance with A.S.T.M. Test Designation D-698, modified to require 20,000 foot-pounds of compactive energy per cubic foot of soil.

FOUNDATION DESIGN DATA

General - Foundation design data presented in this section assumes that individual building areas will be prepared in the manner previously recommended. It is our opinion that the major plant structures may be satisfactorily supported on mat foundations established at the presently planned elevations. Similarly, shallow spread foundations founded on controlled compacted fill soils will provide satisfactory support for the appurtenant structures.

Mat Foundations - The ultimate bearing capacity of the supporting soils underlying each of the major structures has been re-evaluated to reflect modified foundation elevations. The results of these analyses are tabulated below:

UNIT	SUPPORTING SOILS	FOUNDATION ELEVATION (FEET)	ULTIMATE BEARING CAPACITY LBS./SQ.FT.
Reactor Building	Very stiff to hard natural clay soils	582.5	45,000
Auxiliary Building	Very stiff to hard natural clay soils	552.0 580.0	50,000 45,000
	Controlled compacted fill	610.0	30,000
Turbine Building	Controlled compacted fill	610.0	30,000
Turbine-Generators	Controlled compacted fill	602.0	30,000

The above tabulation assumes that fill will be composed of compacted clay soils; if compacted sand fill is used the ultimate bearing capacities listed above will be greater than the tabulated values. The tabulated ultimate bearing pressures are gross values; thus the weight of foundations should be included in computing the foundation loads. The effects of overburden to elevation 634, and the effects of ground water at elevation 625 have been considered in the bearing capacity analysis.

The following tabulation presents a summary of the factors of safety revised to reflect the modified loading conditions and ultimate bearing capacities for the various units:

UNIT	FACTOR OF SAFETY: DEAD AND LIVE LOADS	FACTOR OF SAFETY: DEAD, LIVE AND SEISMIC LOADS
Reactor Buildings	5.6	2.8
Auxiliary Building		
@ Elevation 562.0	7.7	3.8
@ Elevation 580	9.0	4.5
@ Elevation 610	8.6	4.3
Turbine Building	10.0	6.0
Turbine-Generators	6.7	3.3

Shallow Spread Foundations

The recommended bearing pressures for shallow spread foundations have been calculated assuming the ground water level to be at elevation 625 and assuming that the supporting compacted fill materials may be either clay or sand soils.

FOUNDATION WIDTH	ALLOWABLE NET BEARING PRESSURES (POUNDS PER SQUARE FOOT): CLAY SOILS	SAND SOILS
2	5,000	2,800
4	5,000	3,100
8	5,000	3,700
12	5,000	4,300

The factor of safety and allowable increase for seismic loads are the same as previously recommended.

SETTLEMENT

General - Settlement analyses are based on the results of consolidation tests performed on undisturbed and recompacted soil samples. Consolidation test data are presented in the Appendix of this report. The consolidation tests performed in connection with the supplemental investigation confirm that the very stiff to hard clay soils have been preconsolidated under overburden pressures of at least 15,000 to 20,000 pounds per square foot.

The settlement analyses consider the effects of lowering the ground water level, excavating, placement of areal fill, subsequent raising of ground water level and the associated time considerations.

Mat Foundations

The results of our settlement analyses for structures supported on mat foundations are tabulated below:

UNIT	ESTIMATED MAXIMUM SETTLEMENT INCHES	ESTIMATED MAXIMUM DIFFERENTIAL SETTLEMENT INCHES
Reactor Buildings	1 - 1½	¼ - ½
Auxiliary Building		
@ Elevation 562	½ - 1	¼ - ½
@ Elevation 580	½ - 1	¼ - ½
@ Elevation 610	1½ - 2	¼ - ½
Turbine Building	1½ - 2	¼ - ½
Turbine-Generator Mats	1½ - 2	¼ - ½

It has been further estimated that the maximum differential settlement which will occur between adjacent structures will be as follows:

ADJACENT UNITS	ESTIMATED MAXIMUM DIFFERENTIAL SETTLEMENTS BETWEEN STRUCTURES INCHES
Auxiliary @ Elevation 562 and @ Elevation 580	1/2
Auxiliary @ Elevation 562 and @ Elevation 610	1
Auxiliary @ Elevation 580 and Reactor	1/2
Auxiliary @ Elevation 610 and Reactor	3/4
Auxiliary @ Elevation 610 and Turbine Building	1/2
Turbine Building and Turbine Mat	1/2

The results of the dynamic settlement analysis presented in the initial report are considered applicable to the revised plant design and final location. Additional settlement under dynamic loading should not exceed one-quarter inch. The appropriate range of values for modulus of elasticity for dynamic settlement analysis is discussed in the Appendix to this report.

Appurtenant Structures - The total and differential settlements of buildings supported on shallow-spread foundations will depend on (1) the surface settlement of the areal fill and (2) the settlement caused by the individual foundations imposing bearing pressures on the order of the allowable bearing pressures previously recommended.

Neither building locations nor the individual column loads have been made available to us at this time. Analysis shows that the areal fill will undergo long term settlements on the order of 1½ to 2 inches. It is estimated that shallow spread foundations supporting a total design load of up to 30,000 pounds and proportioned utilizing the bearing pressures presented above will undergo settlement on the order of one-half inch or less.

If necessary, the long term total and differential settlement of each appurtenant structure will be analyzed when the locations and structural loads of these structures are known.

Time-Rate of Settlement - It is estimated that one-~~third~~ to one-half of the maximum settlements tabulated previously will occur, as elastic recompression, essentially simultaneously with the load application. The remaining one-half to two-thirds of the maximum settlements will occur in accordance with the time-rates estimated from consolidation test data and presented below.

APPROXIMATE PERCENT OF SETTLEMENT, AFTER RECOMPRESSION	TIME YEARS
20	2
50	10
90	50

Settlement of conventional spread foundations, established on an appreciable thickness of controlled compacted granular fill will occur essentially as the load is applied to the foundation.

LATERAL PRESSURES

The walls of structures below final plant grade, elevation 634, will be subjected to horizontal loads imposed by backfill materials, hydrostatic pressures, and the horizontal components of adjacent foundation loads. Excluding the horizontal components of adjacent foundation loads, it is recommended that long term lateral pressures against rigid and non-rigid walls be computed using the equivalent fluid unit weights tabulated below:

BACKFILL MATERIAL ADJACENT TO STRUCTURE	EQUIVALENT FLUID UNIT WEIGHT (LBS./CU.FT.) ABOVE WATER LEVEL	BELOW WATER LEVEL
NON-RIGID WALLS:		
Sand Soils	40	80
Clay Soils	50	90
RIGID WALLS:		
Sand Soils	60	100
Clay Soils	80	110

Lateral pressures developed adjacent to rigid walls immediately following placement and compaction of backfill materials may exceed the long term pressures in the portion of the wall near the ground surface. Therefore, we recommend that rigid walls be designed for the equivalent fluid unit weights presented above or a uniformly distributed pressure of 600 pounds per square foot, whichever is greater at any particular depth.

The above recommended equivalent fluid pressures assume backfill soils will be placed in a carefully controlled manner. The stiff to hard on-site clay soils should not be placed as layers of chunky soil which require excessive compactive effort to obtain a homogeneous compacted fill. Such a procedure would increase the equivalent fluid pressure on the order of 50 percent. The use of clay backfill in any areas of limited access is not recommended.

Substructure walls which are established below adjacent foundations should also be designed to resist the horizontal components of adjacent foundation loads. For preliminary analysis of lateral foundation pressures we suggest the method of analysis presented in Spangler and Mickle's* paper "Lateral Pressures on Retaining Walls Due to Backfill Surface Loads." For final analysis, after the final arrangement of facilities, type of backfill, and final loading conditions are known, it is suggested that horizontal components of foundation loads acting on adjacent walls be evaluated by finite element analysis.

UPLIFT PRESSURES

Uplift loads will be resisted by the dead weight of the structures, the weight of the backfill materials, directly overlying the foundations, if any, and the frictional resistance between the structure and the adjacent backfill materials. The unit weight of the backfill materials may be taken as 120 pounds per cubic foot above the assumed ground water level, and 60 pounds per cubic foot below the assumed ground water level. The frictional resistance may be computed by assuming a coefficient of lateral earth pressure equal to 0.35 and a coefficient of friction between soil and concrete of 0.35.

These values apply to backfill soils composed of clean sand and pertain to ultimate frictional resistance to uplift. An appropriate factor of safety on the order of 1.5 for normal operating conditions and 1.2 for maximum probable flood conditions should be applied to the ultimate values.

---

* Spangler, M.G. and Jack L. Mickle, "Lateral Pressures on Retaining Walls Due to Backfill Surface Loads," Proceedings of the International Conference on Soil Mechanics and Foundation Engineering, Vol. 3, P. 155, 1936.

If clay backfill soils are used, the ultimate frictional resistance to uplift may be computed in a similar manner, except that the coefficient of friction between soil and concrete should be reduced to 0.25.

Floor slabs established below the design floor level should be designed for full hydrostatic pressure or should be provided with adequate drainage facilities.

--ooo--

The following Plates and Appendix are attached and complete this report:

Plate 2 - Site Plan (Revised Reservoir and Power Plant Areas)

Plate 3 - Plot Plan (Power Plant Area, Revised)

Plate 4B - Generalized Subsurface Section B-B (Revised)

Plate 5 - Summary of Test Data (Revised)

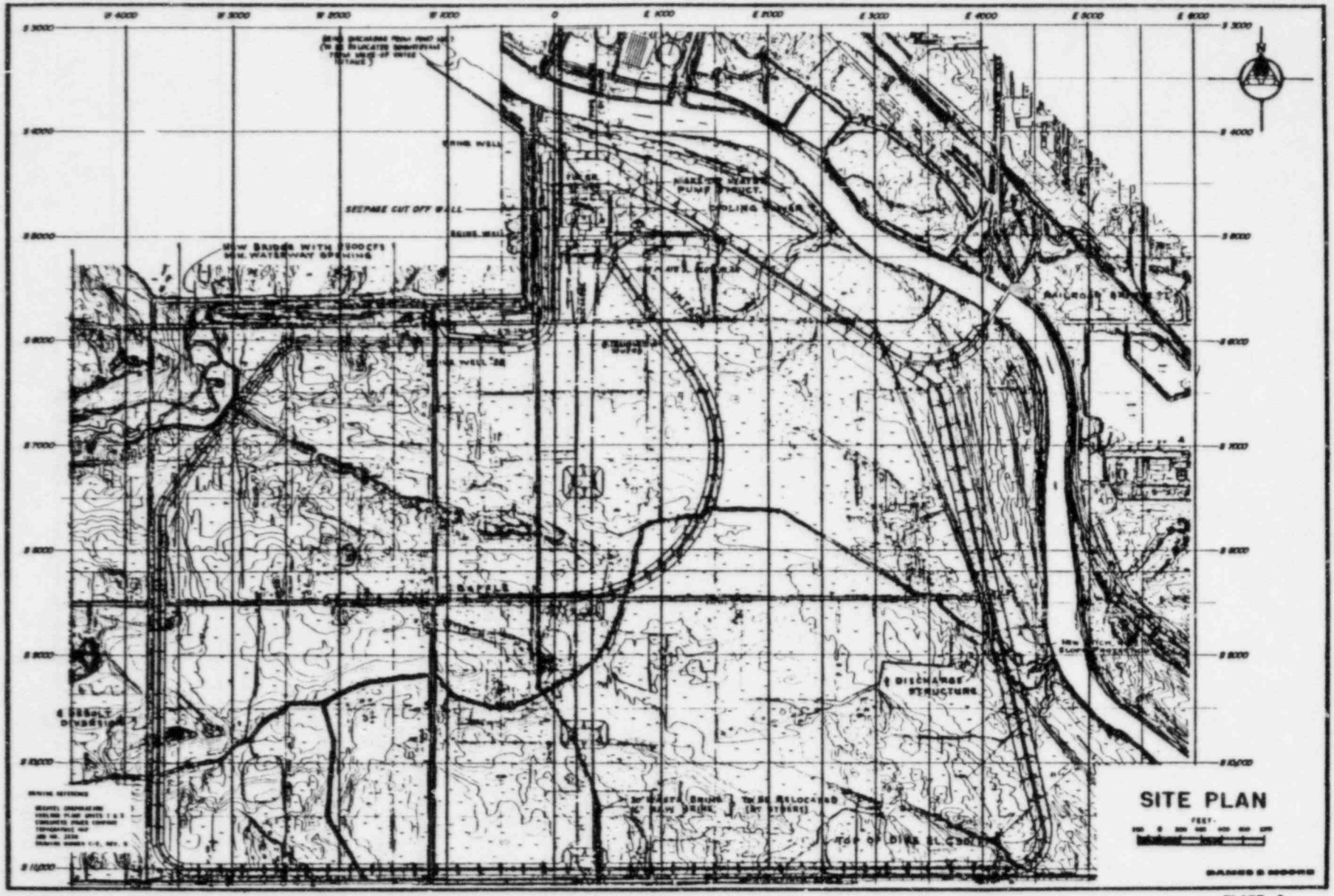
Appendix - Field Explorations and Laboratory Tests

Respectfully submitted,

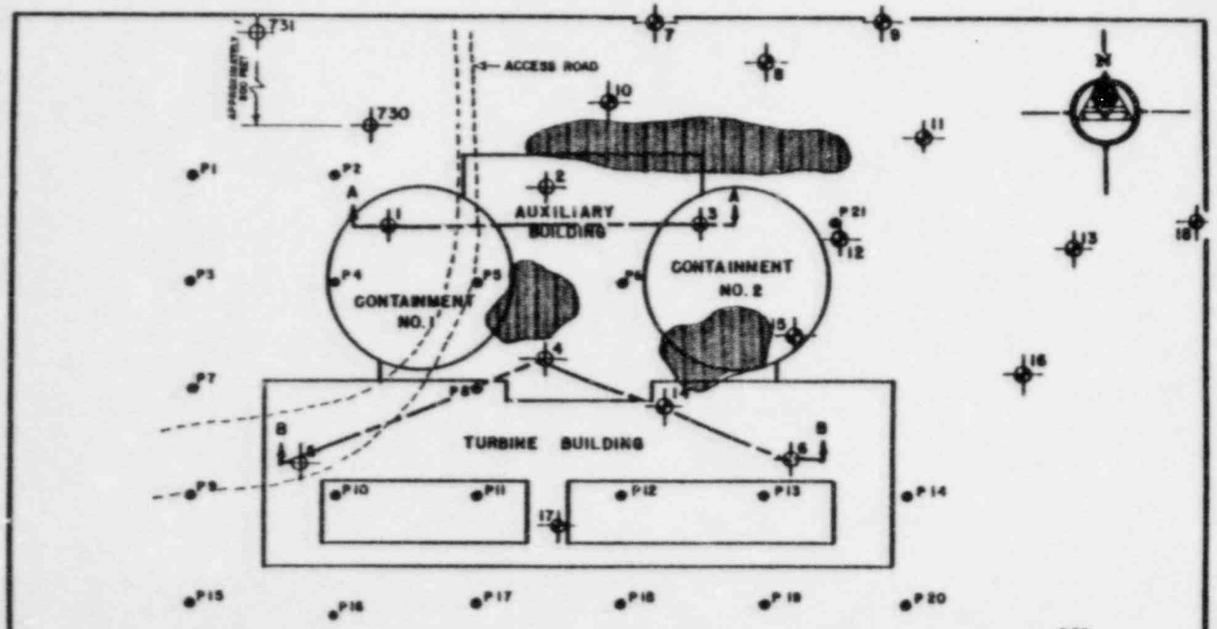
DAMES & MOORE

George D. Leal

George D. Leal
Registered Professional Engineer
State of Michigan
Certificate No. 17383


SEEPAGE CUT OFF WALL
BAFFLE
SITE PLAN
PLATE 2

BY RJH DATE 1-29-60
CHECKED BY _____ FILE 5697-004 REVISIONS BY _____ DATE _____



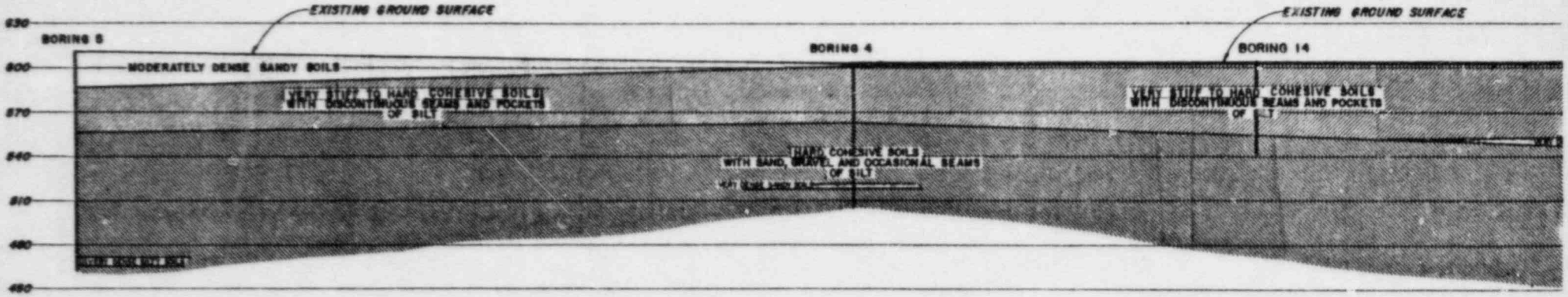
LEGEND:
- BORINGS DRILLED BY DAMES & MOORE
- BORINGS PREVIOUSLY DRILLED BY DAMES & MOORE
- PROBE BORINGS DRILLED BY DAMES & MOORE
- INDICATES APPROXIMATE LOCATION OF MARSHY AREAS

PLOT PLAN

SCALE: 1" = 80'

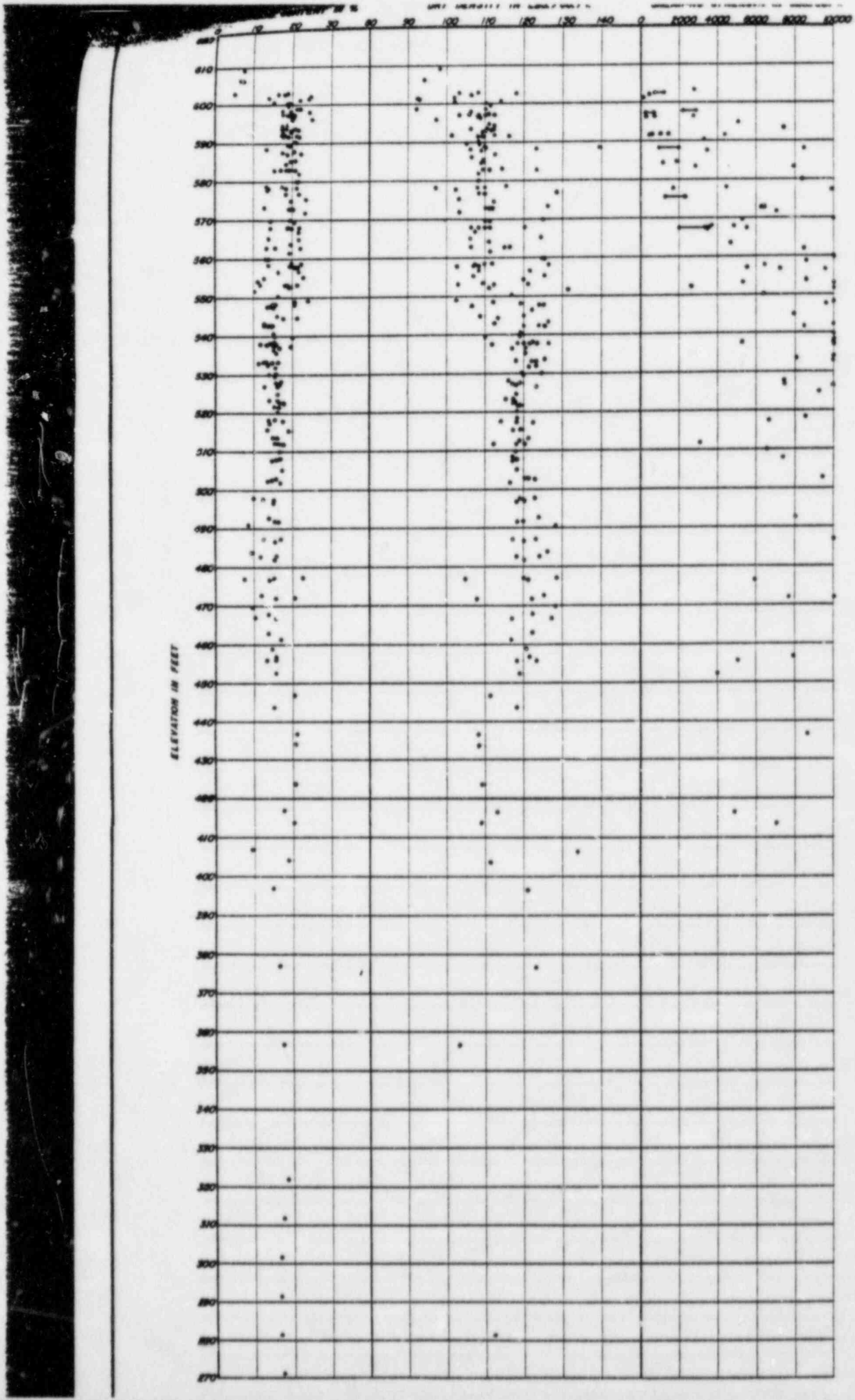
DRAWING REFERENCE:
BECHTEL CORPORATION
JOB NO. 7220
DRAWING NO. SK-C-99
REVISION A

ROUTE 52



GENERALIZED SUBSURFACE SECTION B-B

FEET


0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
0
2000
4000
6000
8000
10000
ELEVATION IN FEET

APPENDIX

FIELD EXPLORATIONS AND LABORATORY TESTS

FIELD EXPLORATIONS:

Power Plant Area - The subsurface conditions at the site of the Proposed Nuclear Power Plant were further investigated by drilling 11 additional four-inch diameter exploration test borings to depths ranging from approximately 40 feet to 80 feet below the existing ground surface utilizing truck-mounted rotary wash and rotary auger type drilling equipment. Exploration test borings 730 and 731 were drilled as part of a previous investigation. In addition to the exploration test borings, 24 probe holes were drilled to depths ranging from approximately 10 feet to 45 feet below the existing ground surface utilizing truck mounted rotary auger type drilling equipment.

The drilling operations were supervised by our field engineers who maintained logs of the borings, obtained undisturbed samples of the various soil strata penetrated utilizing Dames & Moore Soil Samplers and supervised the performance of Standard Penetration Tests. Graphical representations of the soils penetrated by the borings and probe holes are shown on Plates A-10 through A-10, Log of Borings. The method utilized in classifying the soils is defined on Plate A-2, Unified Soil Classification System.

Undisturbed samples of the soils penetrated by the exploration test borings were obtained in Dames & Moore Soil Samplers of the type illustrated on Plate A-3, Soil Sampler Type U. The Dames & Moore soil samplers were driven approximately 18 inches into the soil with a hammer weighing approximately 340 pounds falling approximately 24 inches. The

Standard Penetration Tests were performed utilizing a split spoon sampler having an outside diameter of two inches and an inside diameter of one and three-eighths of an inch. The split spoon sampler was driven 18 inches into the ground with a hammer weighing 140 pounds falling 30 inches. The number of blows required to drive the Dames & Moore soil samplers and the split spoon sampler for the second and third six inches of penetration are recorded on the Log of Borings.

The boring locations and the elevations of the ground surface were provided to us by a survey crew from the firm of Hunter, Whittier and Solberg located in Midland, Michigan. The ground surface elevation is shown above the log of each boring. These elevations refer to the U.S.G.S. Datum.

LABORATORY TESTS:

Strength Tests - Direct shear, unconfined compression and triaxial compression tests were performed on selected undisturbed samples to evaluate the strength characteristics of the various soils penetrated by the borings.

The direct shear tests were performed in the manner described on Plate A-4, Method of Performing Direct Shear and Friction Tests. Unconfined compression and triaxial compression tests were performed in the manner described on Plate A-5, Methods of Performing Unconfined and Triaxial Compression Tests. Stress-strain curves were plotted for each static strength test. For the direct shear tests, the shear strength is yield point strength or the strength at a deflection of one-tenth of an inch whichever occurs first. For the unconfined compression and triaxial compression tests, shearing strengths were chosen assuming that the angle of internal friction of the cohesive soils was equal to zero. The shear strengths presented are either peak strengths or the strengths at an axial deflection of ten percent

of the sample height, whichever occurred first. Determination of the moisture content and dry density were made in conjunction with each strength test. The results of the strength tests, together with the associated moisture-density determinations are presented to the left of the Log of Borings in the manner described by the Key to Test Data shown on Plate A-2.

Consolidation Tests - Consolidation tests were performed on representative undisturbed samples and a remolded sample of the soils penetrated by the borings to provide additional data for estimating settlements of fill and foundations. The results of the consolidation tests are presented on Plates A-7F through A-7H, Consolidation Test Data.

Moisture-Density Tests - Moisture-density tests were performed in conjunction with each strength and consolidation test. Additional moisture and/or density tests were performed on selected samples for correlation purposes. The results of the moisture and/or density tests are presented to the left of the Log of Borings in the manner described by the Key to Test Data shown on Plate A-2.

Grain Size Distribution - A determination of the grain size distribution of selected samples of sandy soils extracted from borings was made to facilitate classification of these soils. The results of the mechanical analyses performed to determine the grain size distribution are presented on Plate A-11 Grain Size Analyses.

DYNAMIC MODULUS OF ELASTICITY:

A revised derivation of appropriate values of dynamic modulus of elasticity (E) for the very stiff to hard clay soils underlying the site is as follows:

EARTHQUAKE ACCELERATION AT SURFACE	E @ 50 FEET DEPTH LBS./SQ.FT.
0.05g	30×10^6
0.10g	22×10^6
0.20g	17×10^6

Poisson's Ratio may be assumed equal to 0.4. The above modulus of elasticity values are approximate and it is recommended that they be varied by plus or minus 50 percent in analyses to evaluate their influence. It is anticipated that soil damping will be in the range of five to ten percent.

The above values are derived from the data of Idriss and Seed published in the December 1968 issue of the Bulletin of the Seismological Society of America.

--oOo--

The following Plates are attached and complete this Appendix:

Plate A-1D - Log of Borings (Boring 7)

Plate A-1E - Log of Borings (Boring 8)

Plate A-1F - Log of Borings (Boring 9)

Plate A-1G - Log of Borings (Boring 10)

Plate A-1H - Log of Borings (Boring 11)

Plate A-1I - Log of Borings (Boring 12)

Plate A-1J - Log of Borings (Boring 13)

Plate A-1K - Log of Borings (Boring 14)

Plate A-1L - Log of Borings (Boring 15)

Plate A-1M - Log of Borings (Boring 16)

Plate A-1N - Log of Borings (Boring 17)

Plate A-1O - Log of Borings (Boring 18)

Plate A-1P - Log of Borings (Boring 730)

Plate A-1Q - Log of Borings (Boring 731)

Plate A-1R - Log of Probe Borings (Probe Borings P1, P2, P3, P4, P5, P6)

Plate A-1S - Log of Probe Borings (Probe Borings P7, P8, P9, P10, P11)

Plate A-1T - Log of Probe Borings (Probe Borings P12, P13, P14, P15, P16, P17)

Plate A-1U - Log of Probe Borings (Probe Borings P18, P19, P20, P21, P22)

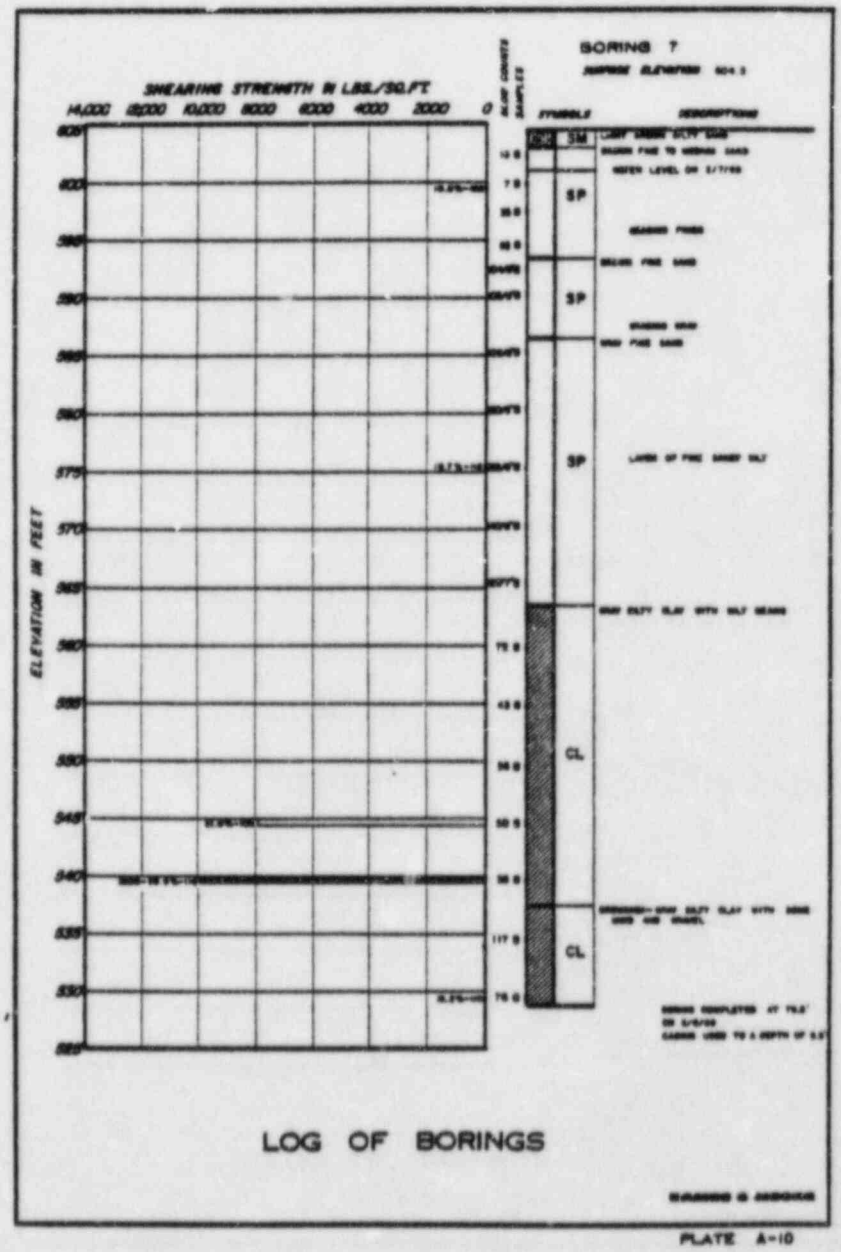
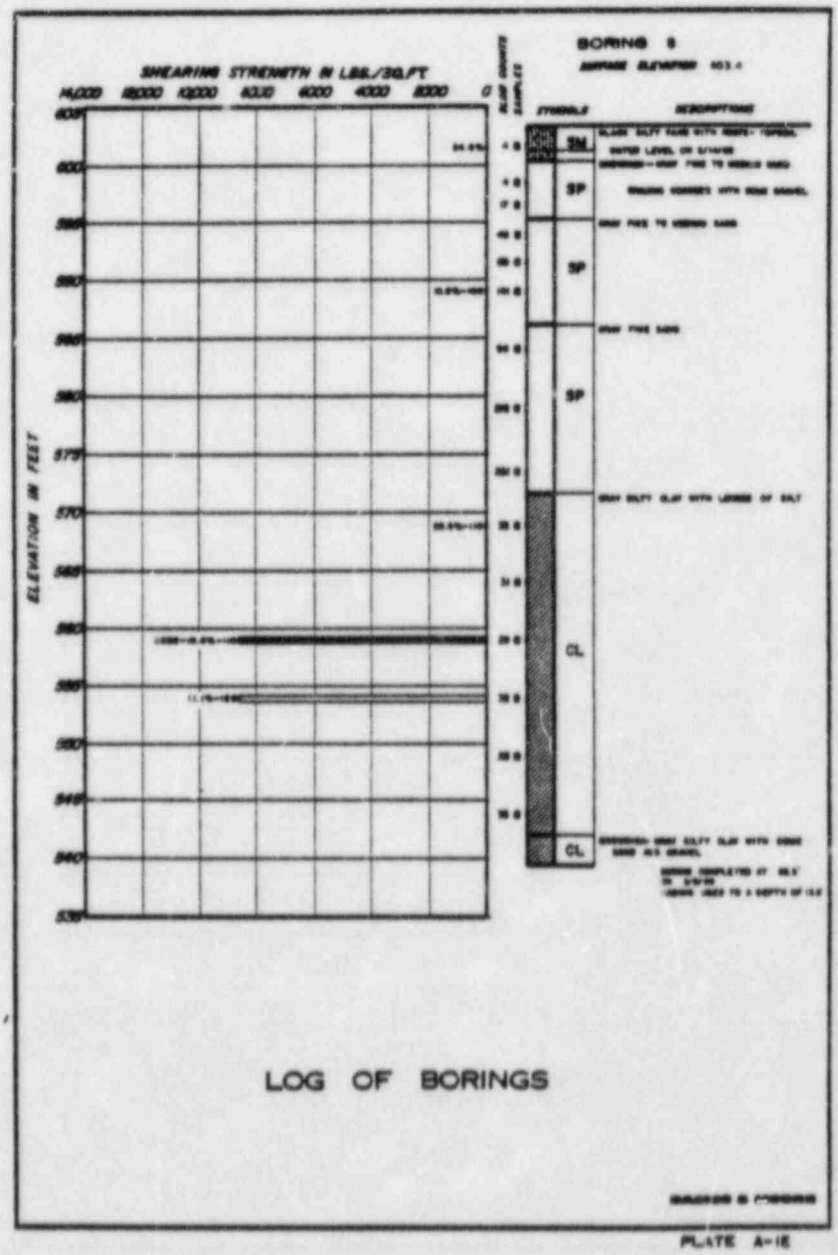
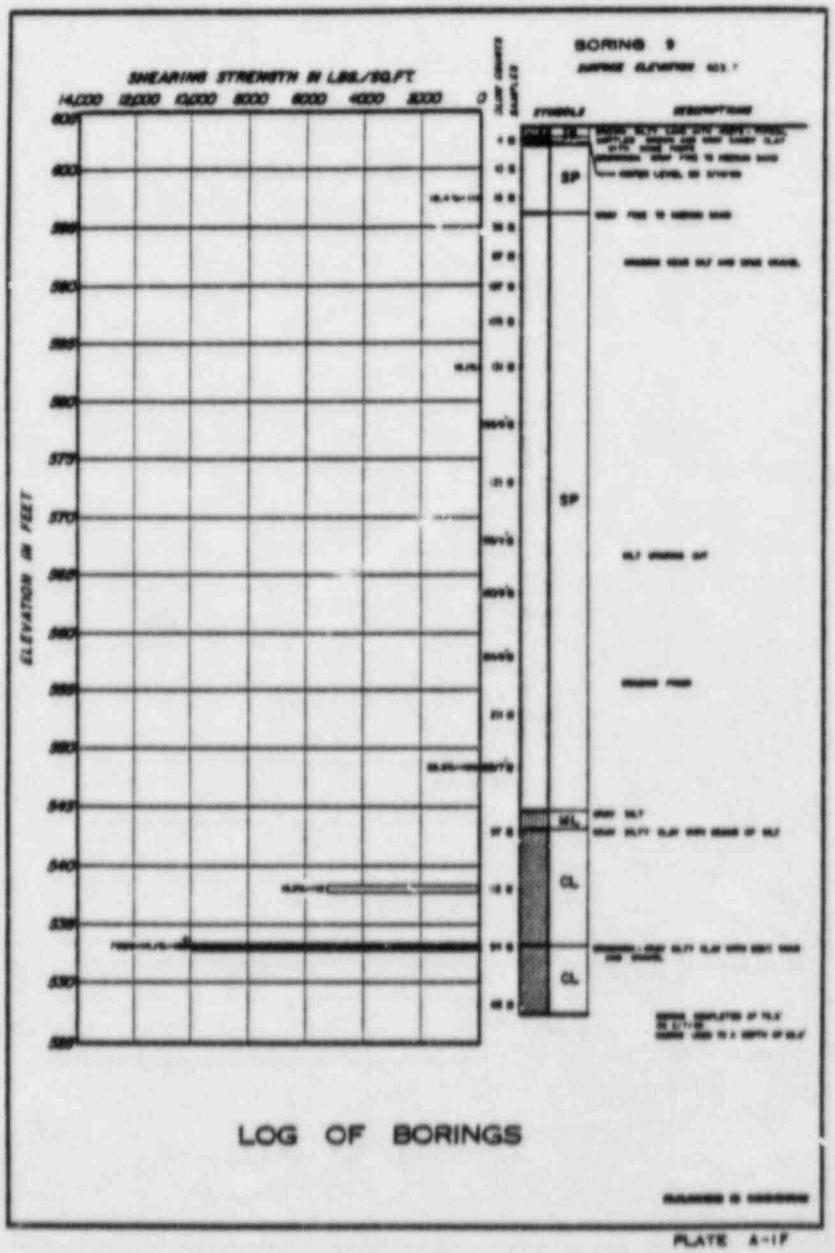

BORING 7
SHEARING STRENGTH IN LBS./SQ.FT.
14,000 12,000 10,000 8000 6000 4000 2000 0
ELEVATION IN FEET
SYMBOLS
DESCRIPTIONS
SM
SP
SP
SP
CL
CL
LOG OF BORINGS

PLATE A-10



LOG OF BORINGS

PLATE A-1E



LOG OF BORINGS

PLATE A-1F

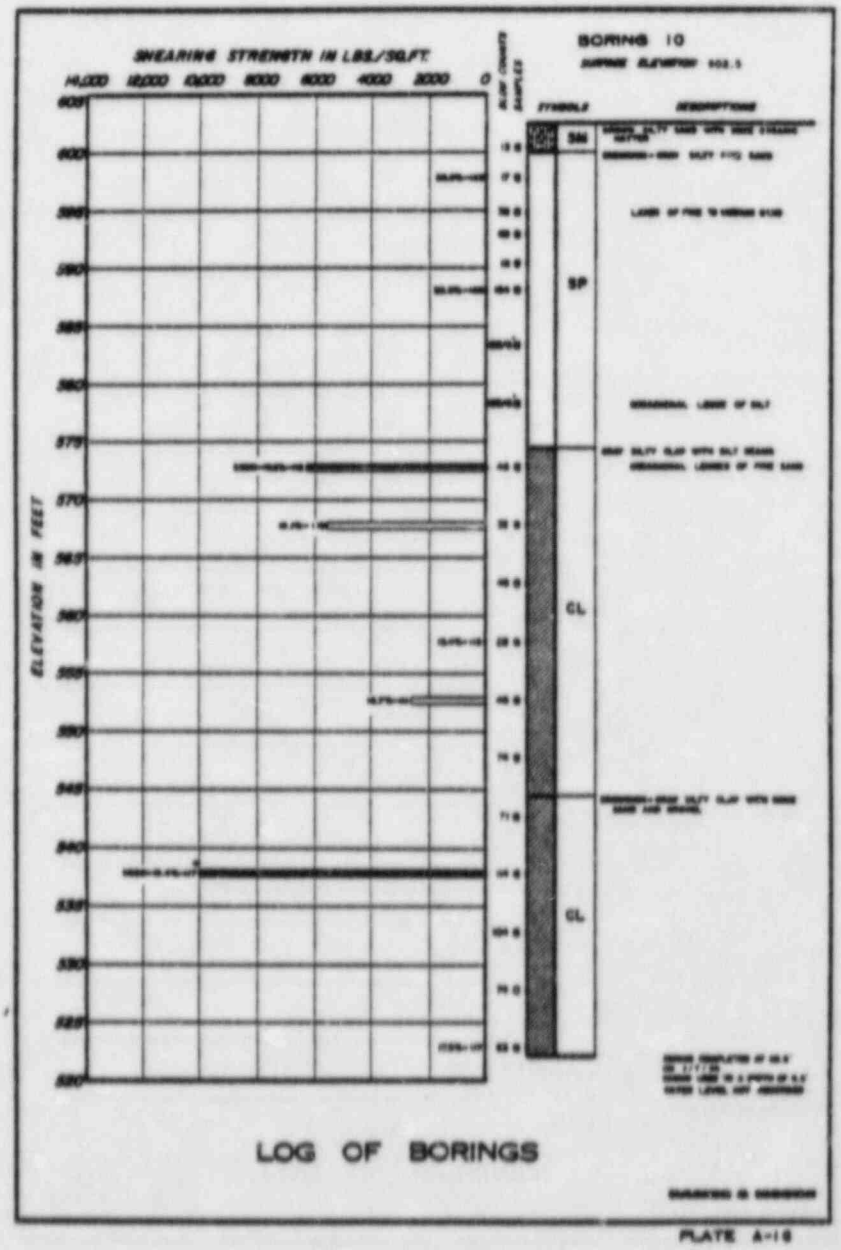

SHEARING STRENGTH IN LBS./SQ.FT.
14,000
12,000
10,000
8000
6000
4000
2000
0
ELEVATION IN FEET
BORING 10
SYMBOLS
DESCRIPTIONS
SM
SP
CL
CL
LOG OF BORINGS

PLATE A-16

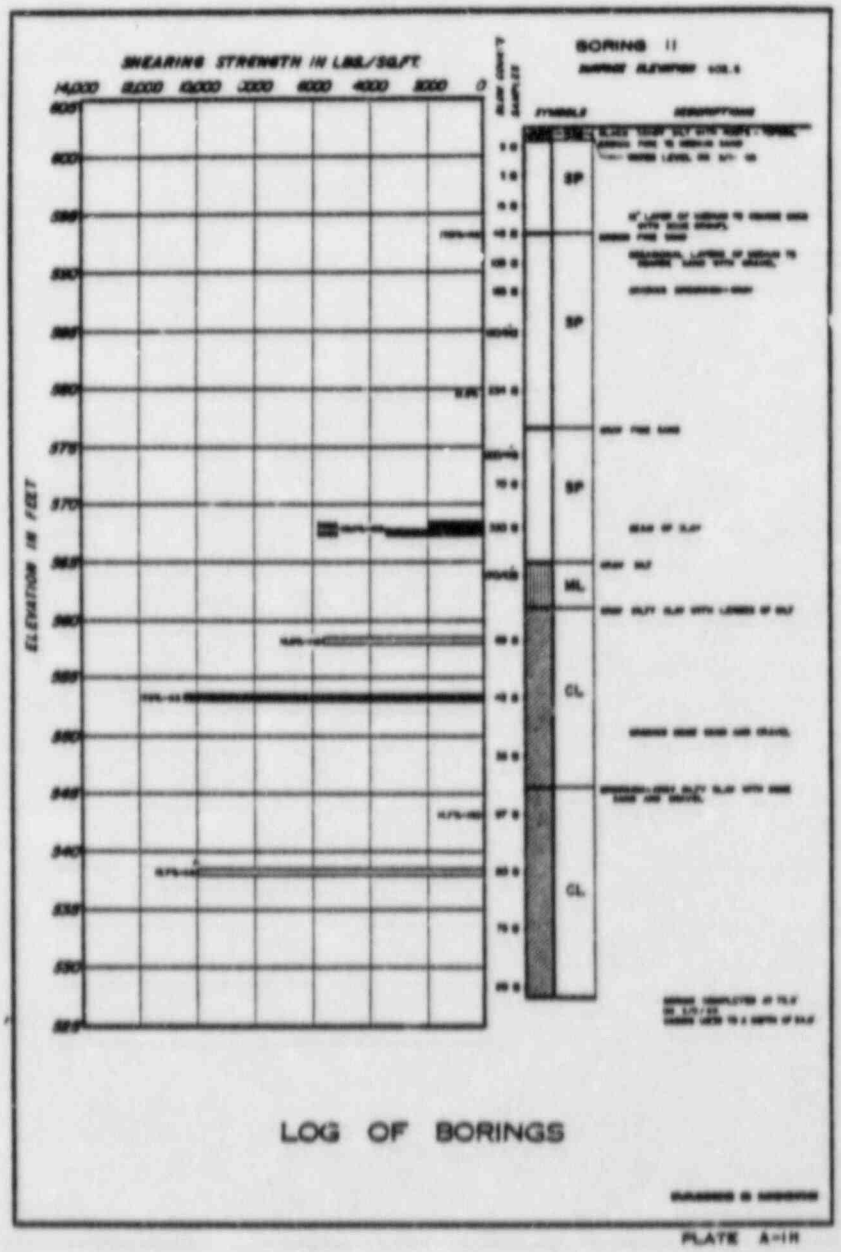
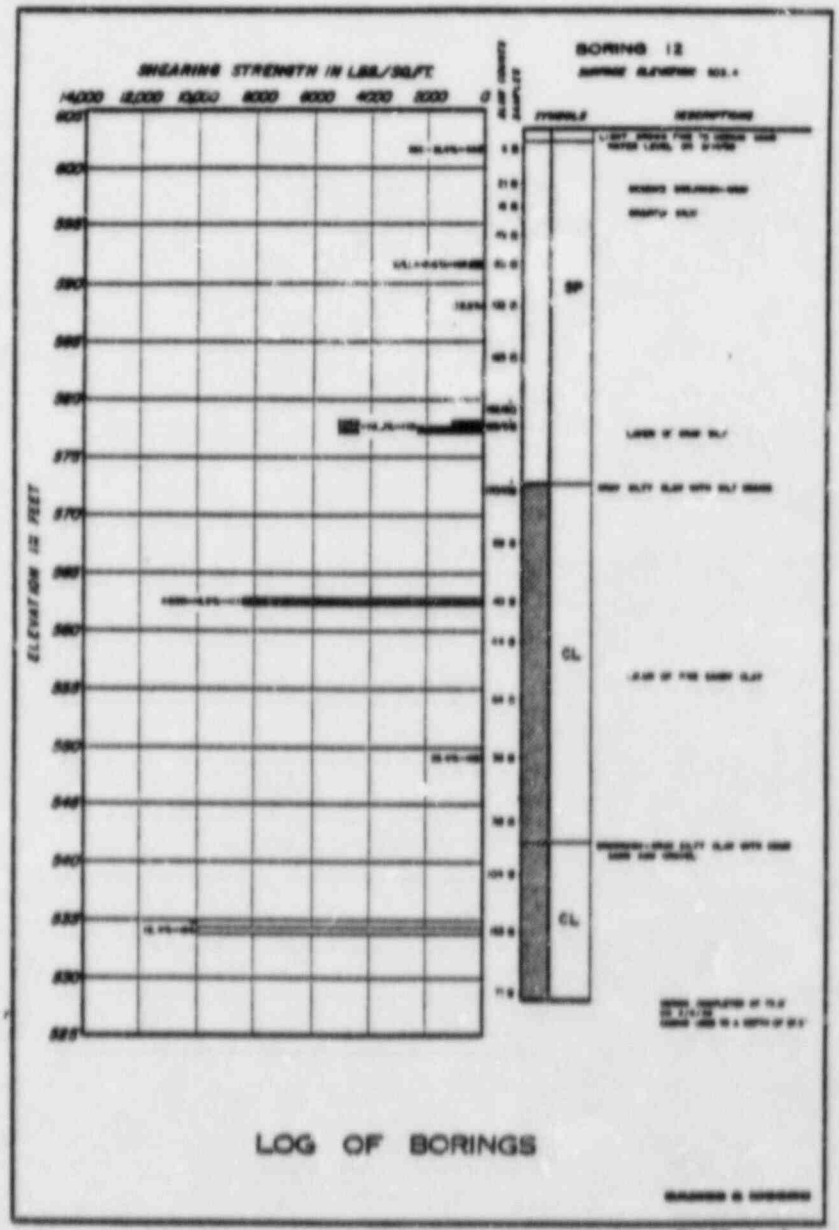
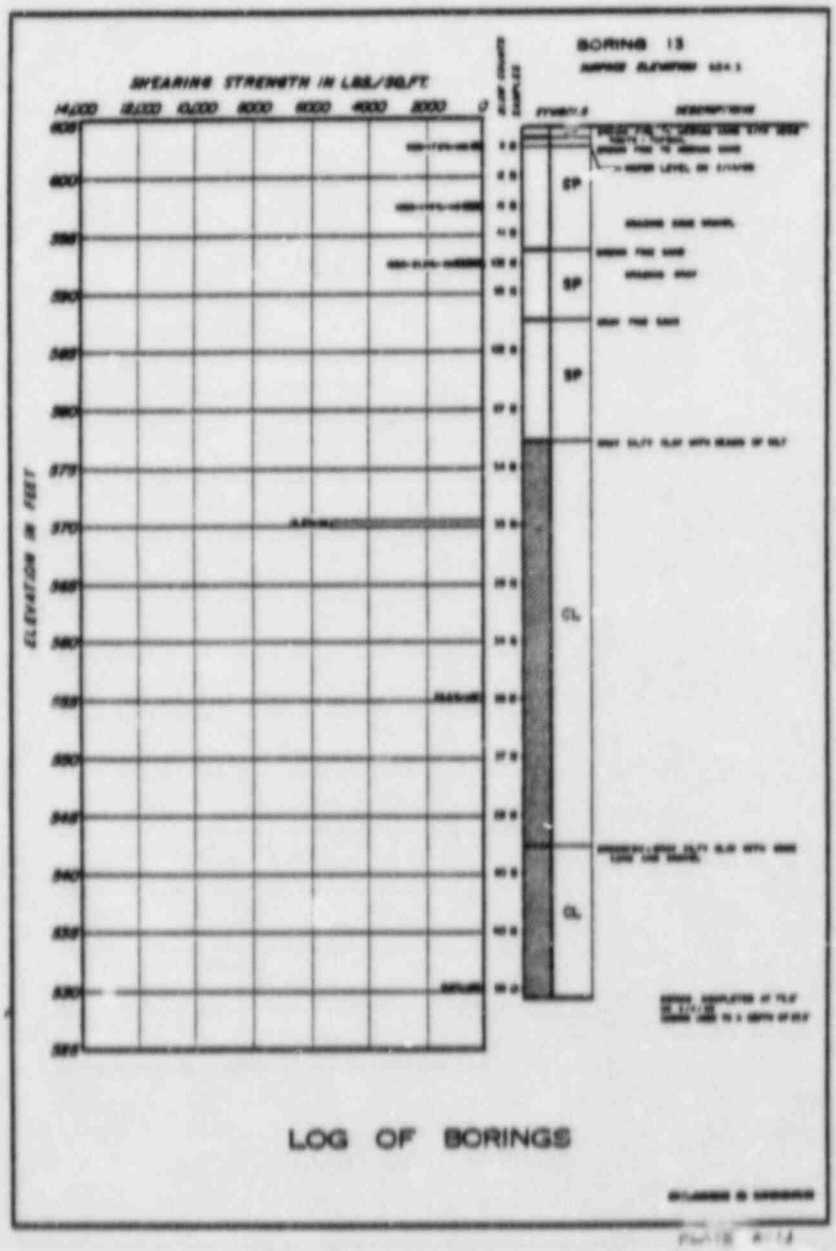

SHEARING STRENGTH IN LBS./SQ.FT.
14,000
12,000
10,000
8000
6000
4000
2000
0
ELEVATION IN FEET
BORING 11
SYMBOLS
DESCRIPTIONS
SP
SP
SP
ML
CL
CL
LOG OF BORINGS

PLATE A-11

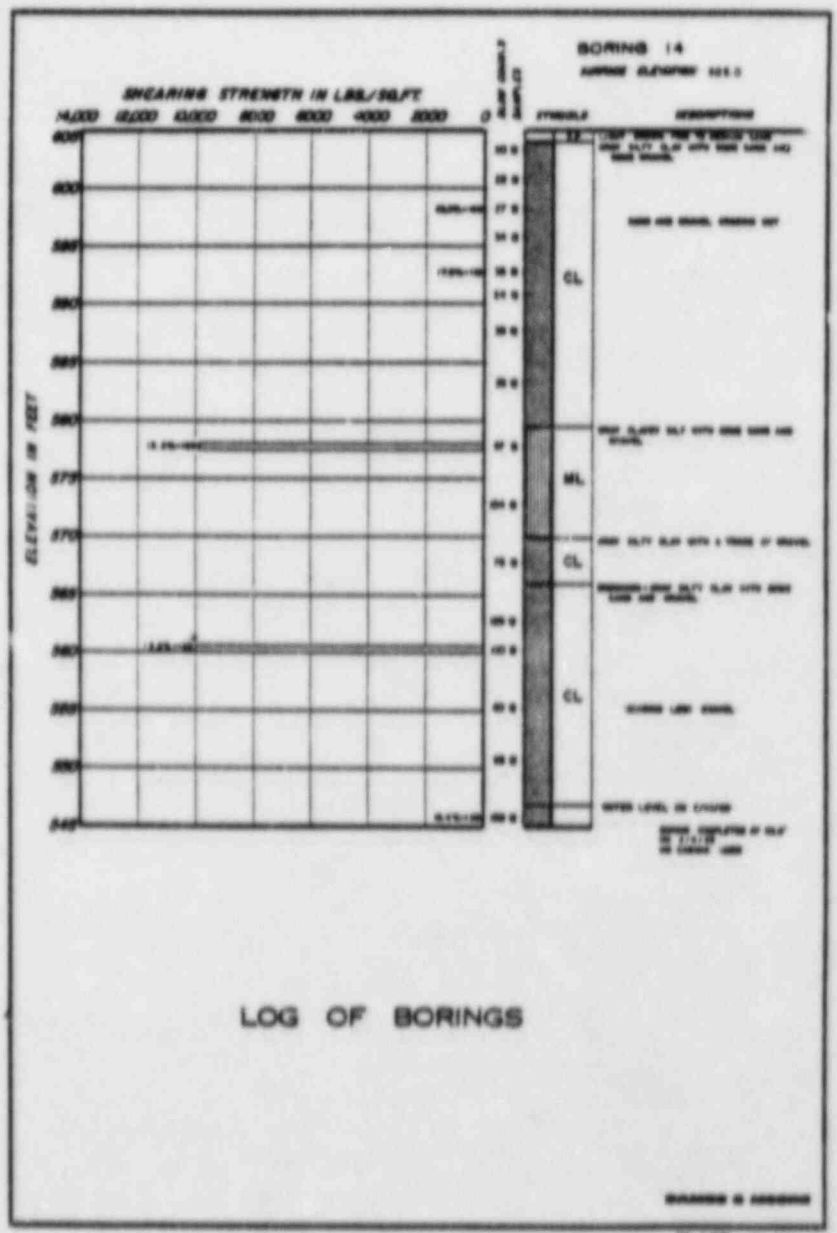


LOG OF BORINGS

PLATE A-11

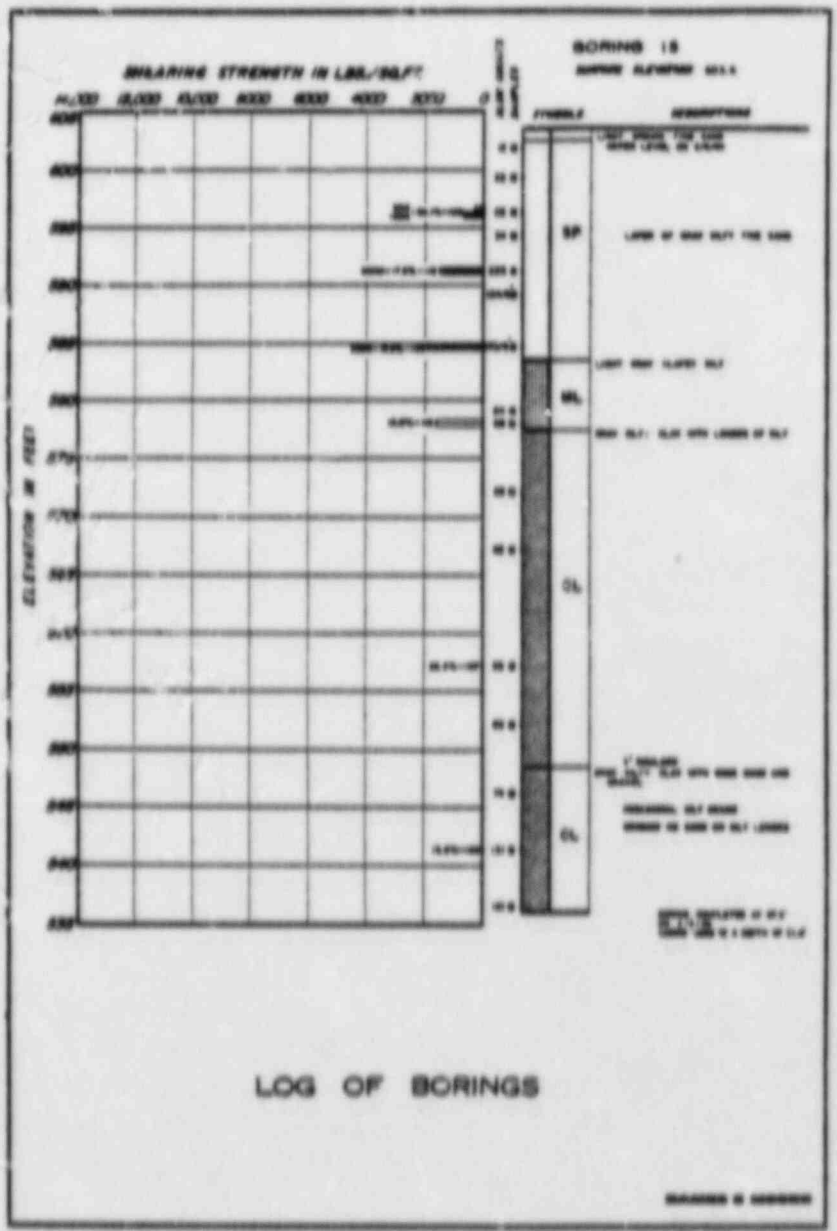


LOG OF BORINGS



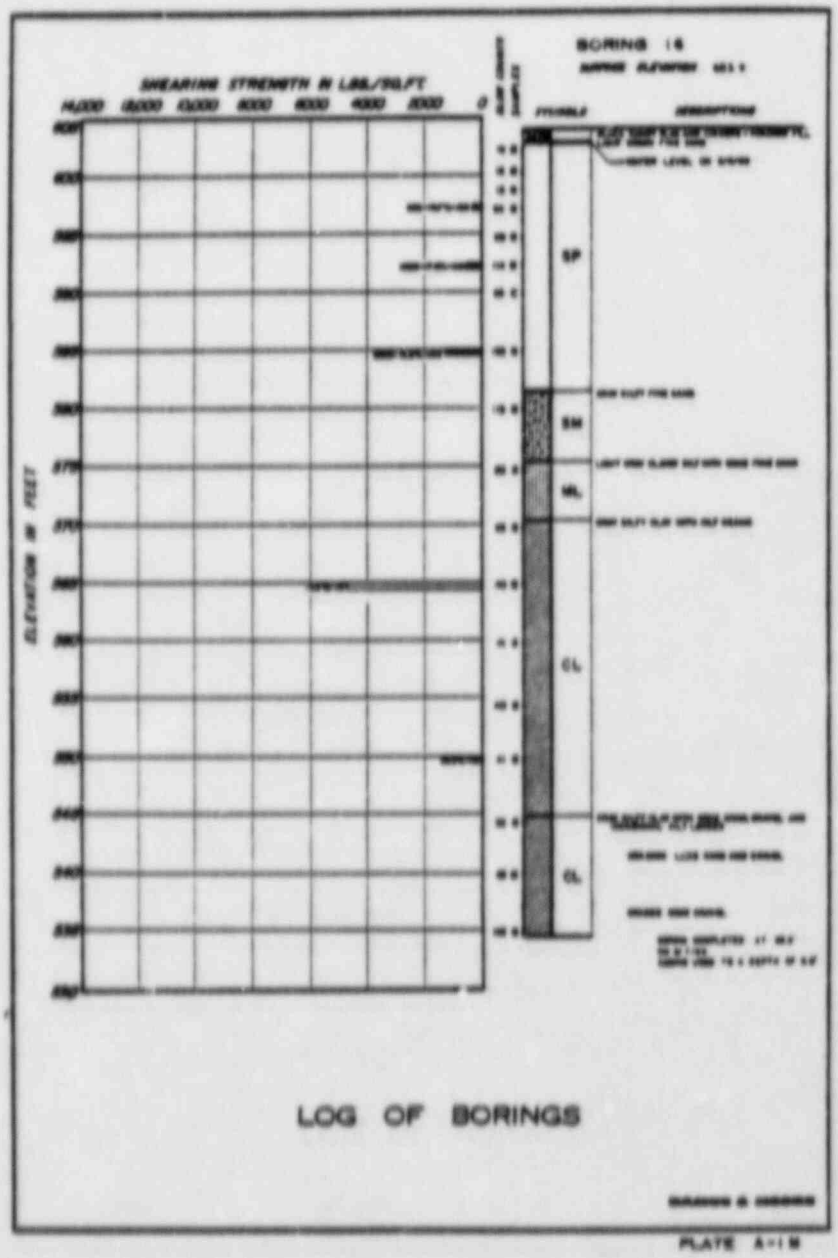
LOG OF BORINGS

PLATE A-1.K



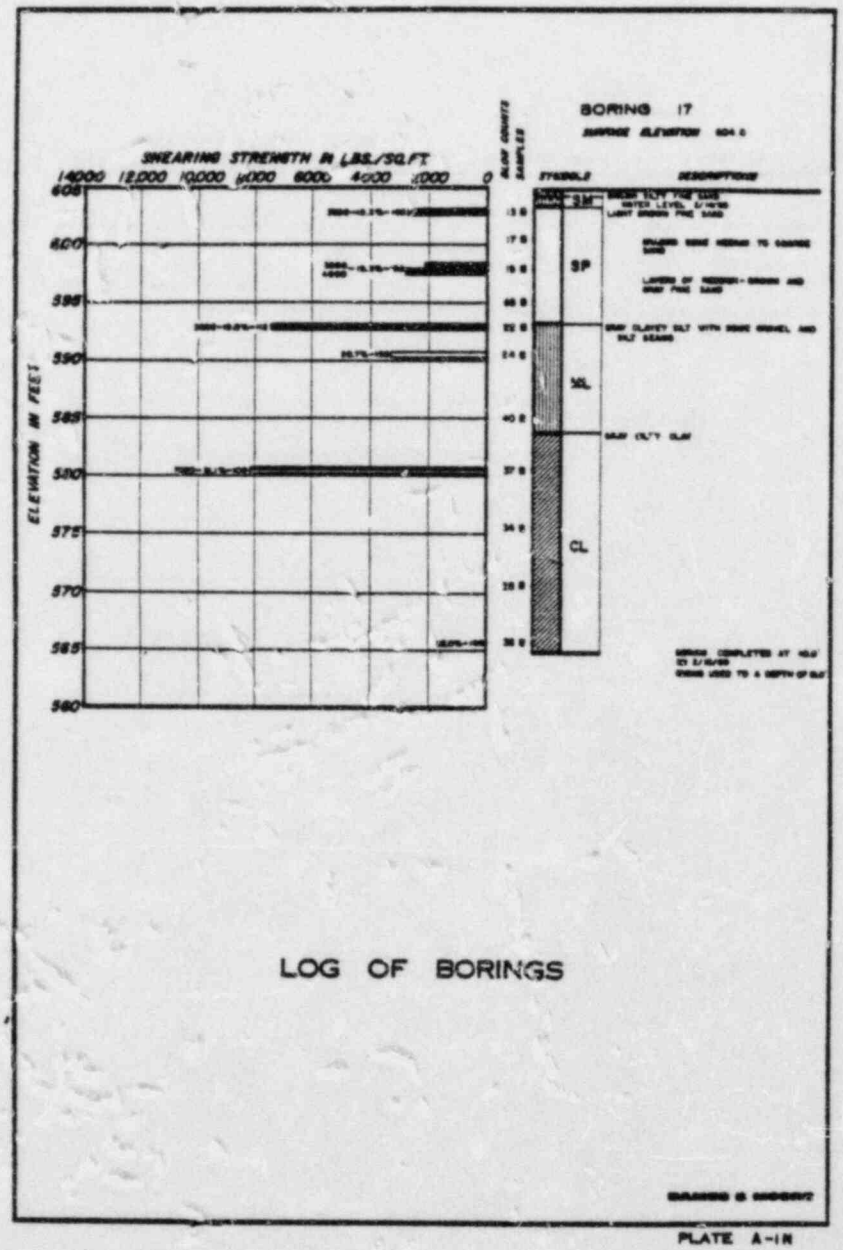
LOG OF BORINGS

PLATE A-1 L



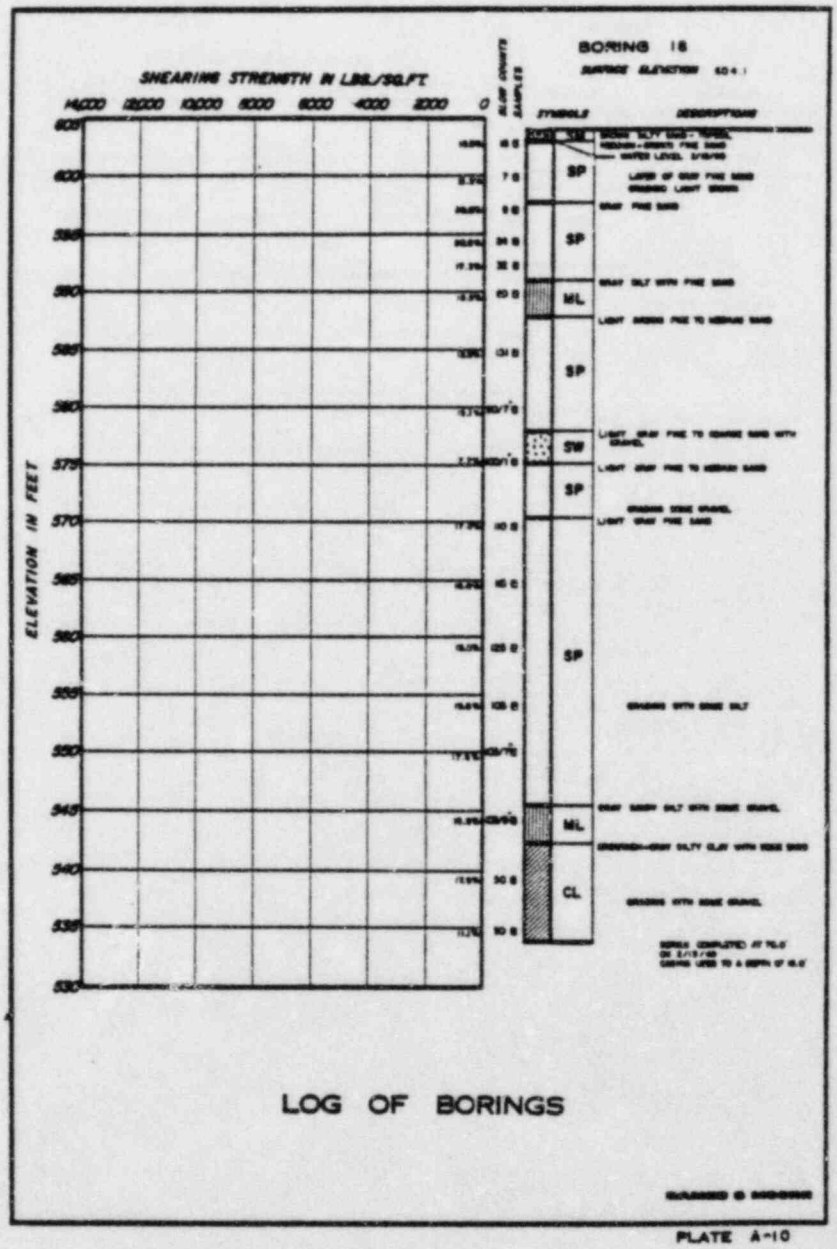
LOG OF BORINGS

PLATE A-16



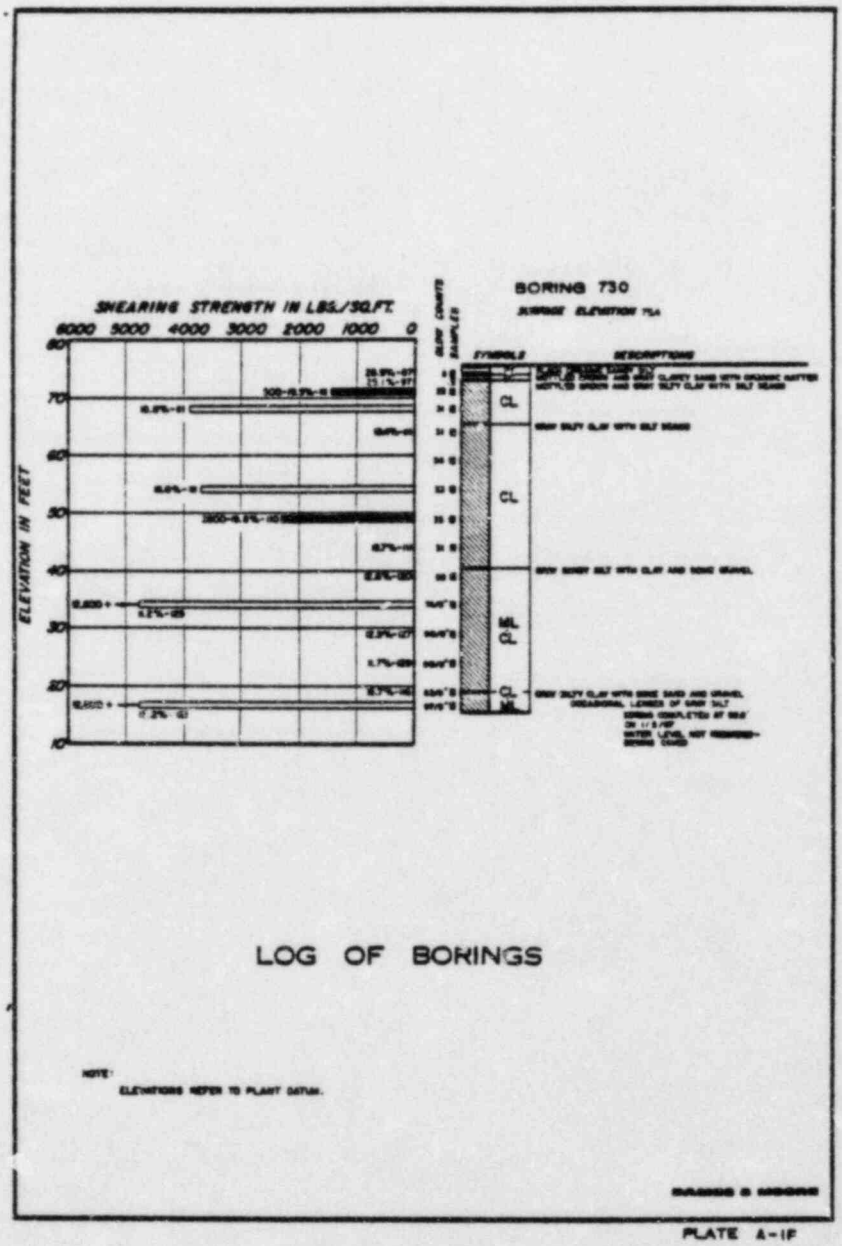
LOG OF BORINGS

PLATE A-1N



LOG OF BORINGS

PLATE A-10



LOG OF BORINGS

NOTE:
ELEVATIONS REFER TO PLANT DATUM.

PLATE A-1F

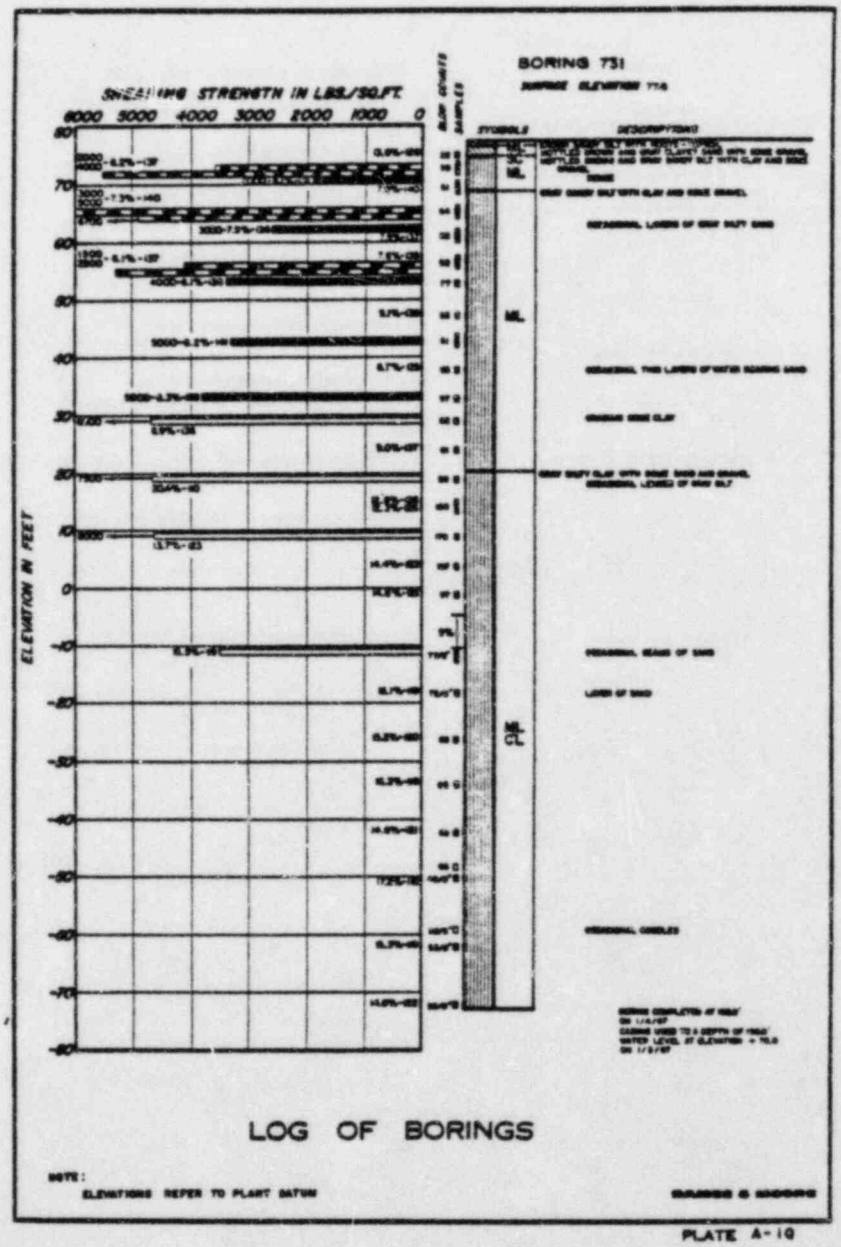
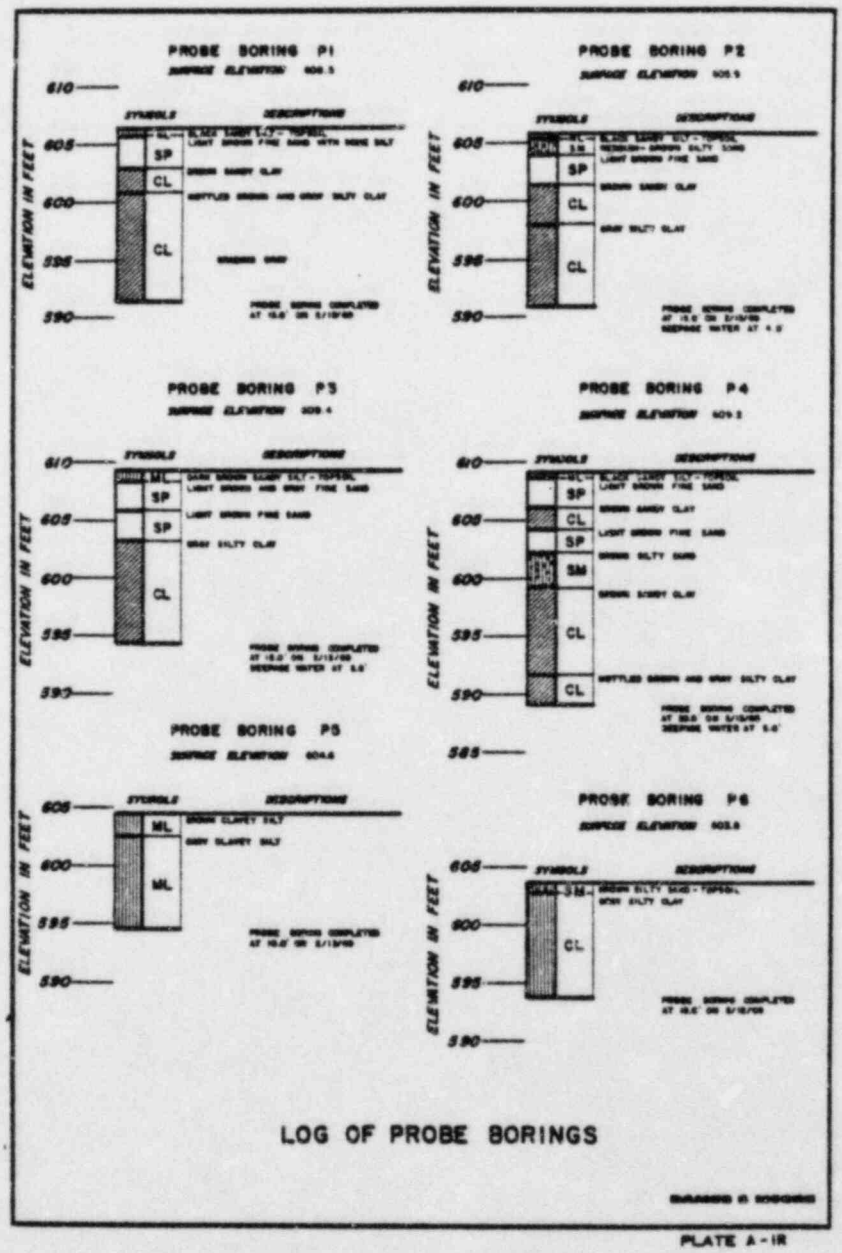

BORING 731
SHEARING STRENGTH IN LBS./SQ.FT.
6000 5000 4000 3000 2000 1000 0
ELEVATION IN FEET
SYMBOLS
DESCRIPTIONS
ML
CH
LOG OF BORINGS
NOTE:
ELEVATIONS REFER TO PLANT DATUM

PLATE A-10



LOG OF PROBE BORINGS

PLATE A-1R

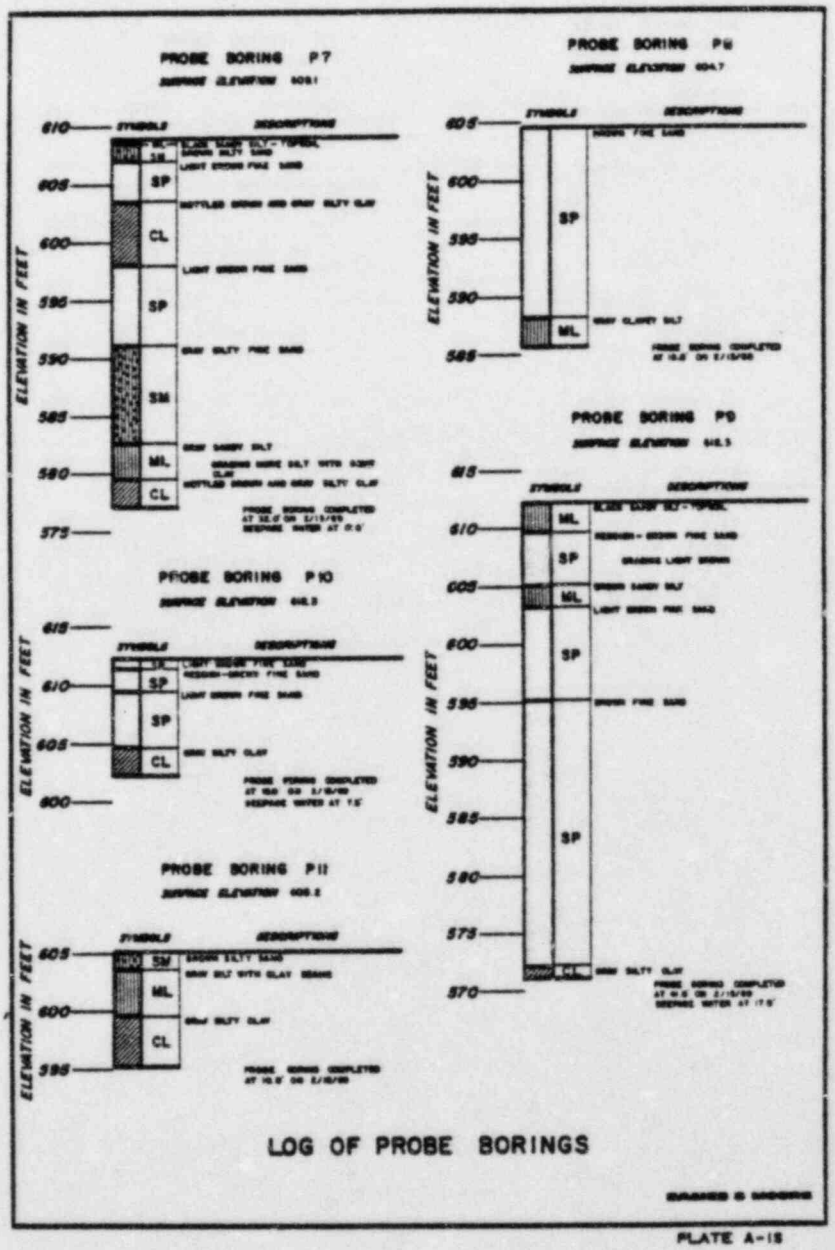

PROBE BORING P7
PROBE BORING P8
PROBE BORING P9
PROBE BORING P10
PROBE BORING P11
ELEVATION IN FEET
SYMBOLS
DESCRIPTIONS
SP
CL
ML
SM
LOG OF PROBE BORINGS

PLATE A-18

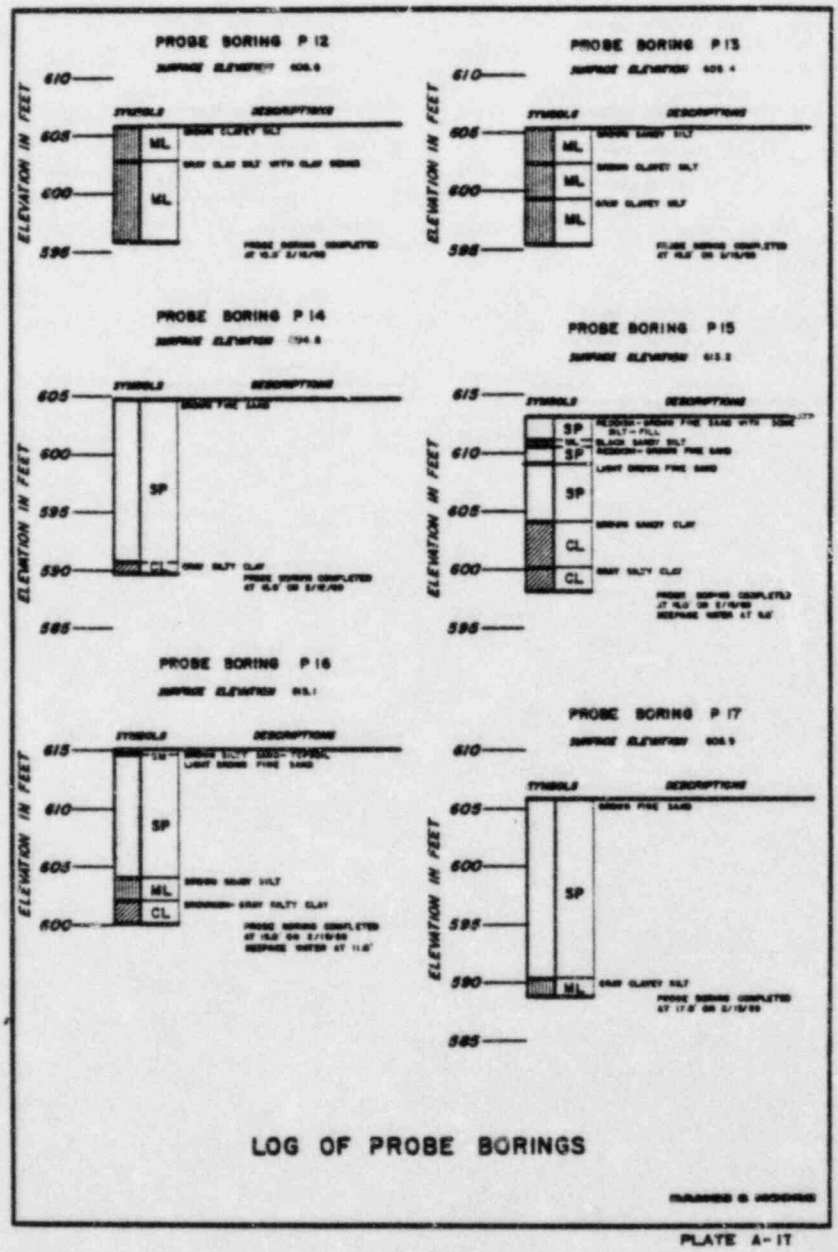

PROBE BORING P 12
PROBE BORING P 13
PROBE BORING P 14
PROBE BORING P 15
PROBE BORING P 16
PROBE BORING P 17
ELEVATION IN FEET
SYMBOLS
DESCRIPTIONS
ML
SP
CL
LOG OF PROBE BORINGS

PLATE A-17

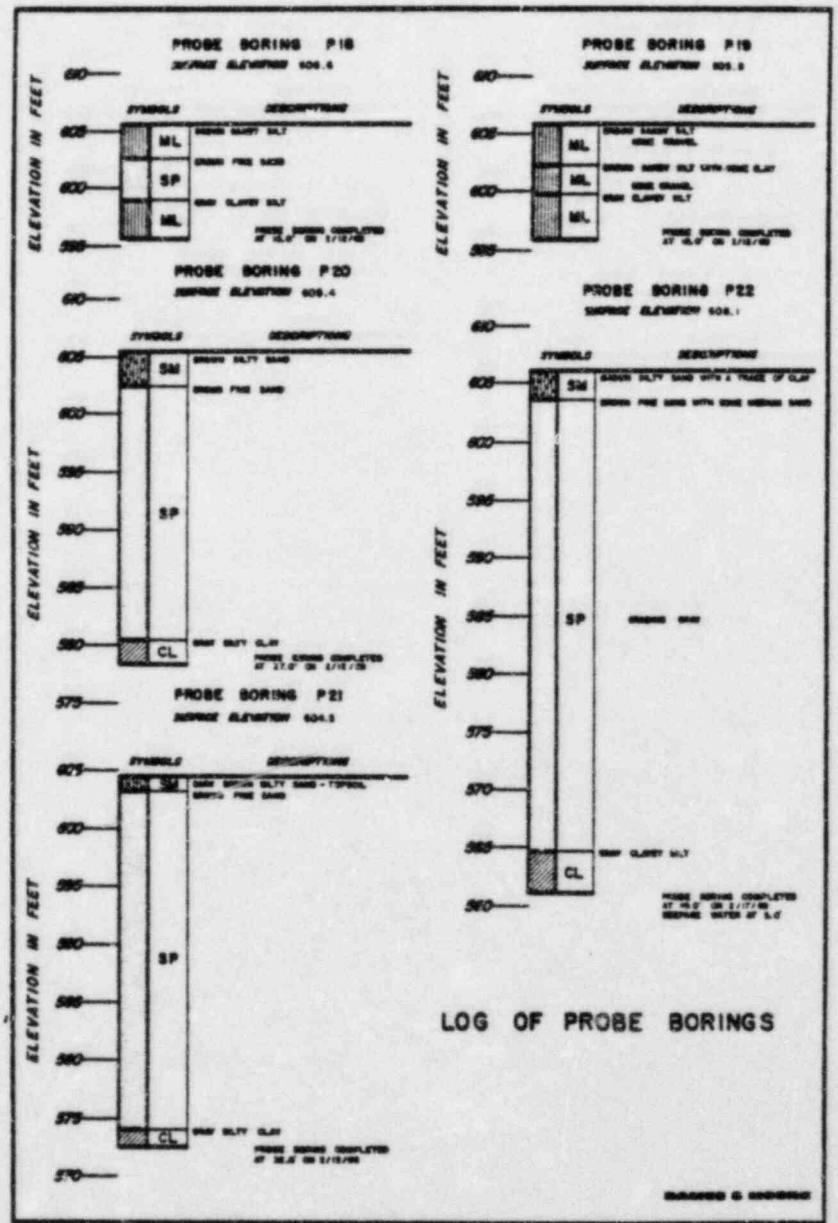
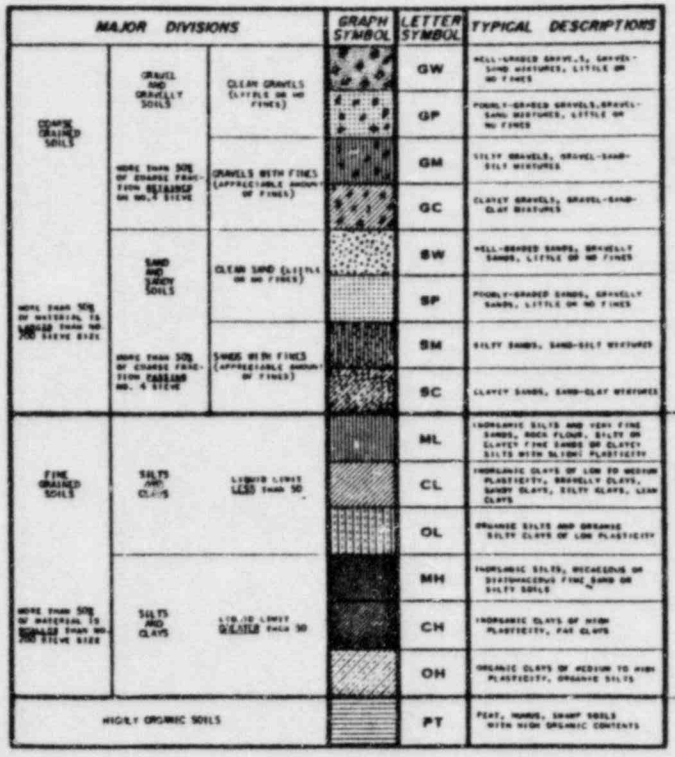

PROBE BORING P18
PROBE BORING P19
PROBE BORING P20
PROBE BORING P21
PROBE BORING P22
ELEVATION IN FEET
SYMBOLS
DESCRIPTIONS
ML
SP
SM
CL
LOG OF PROBE BORINGS

PLATE A-10



NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

SOIL CLASSIFICATION CHART

DIRECT SHEAR AND FRICTION TESTS

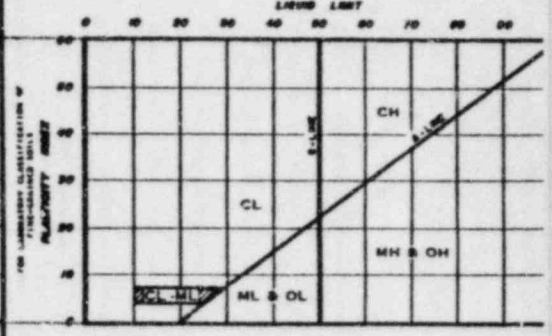
UNCONFINED COMPRESSION TESTS

TRIAXIAL COMPRESSION TESTS

ROCK COMPRESSION TESTS

KEY TO TEST DATA

KEY TO SAMPLES



PLASTICITY CHART

UNIFIED SOIL CLASSIFICATION SYSTEM

DAMES & MOORE

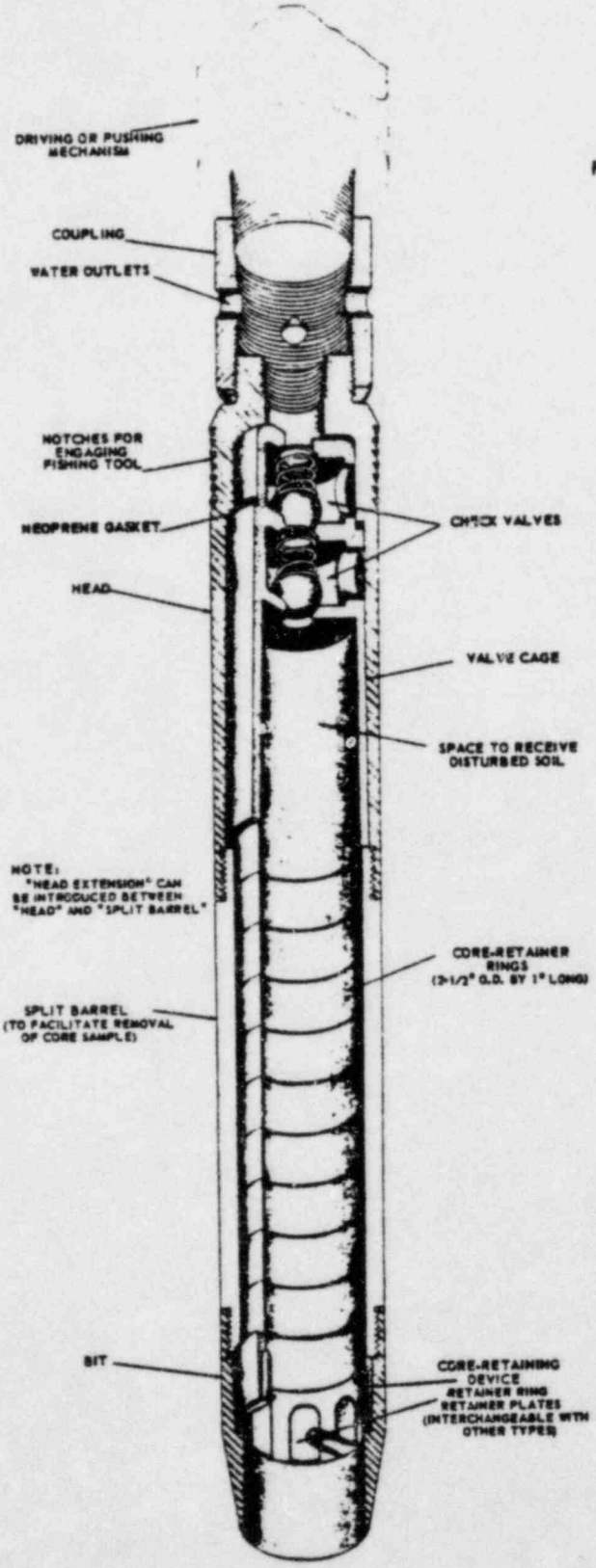
PLATE A-2

REVISIONS BY_____DATE_____TI ____
BY_____DATE_____TO GO_____

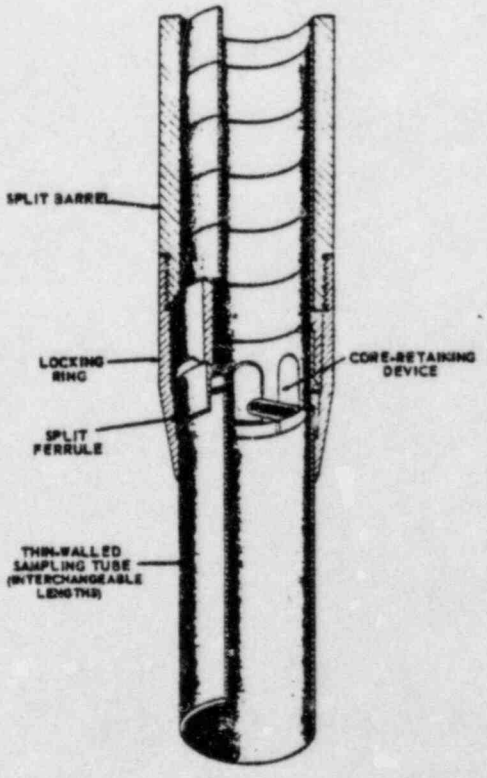
BY_____DATE_____
CHECKED BY_____
COPY TO GO_____FILE_____

SOIL SAMPLER TYPE U

FOR SOILS DIFFICULT TO RETAIN IN SAMPLER
U. S. PATENT NO. 2,318,062



ALTERNATE ATTACHMENTS



DAMES & MOORE
APPLIED EARTH SCIENCES

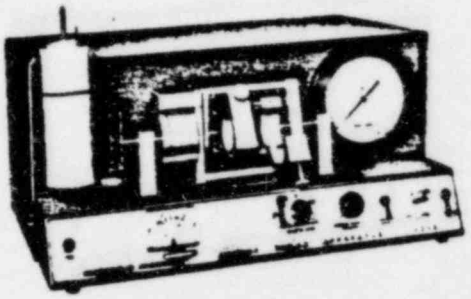
PLATE A-3

REVISIONS BY _____ DATE _____

BY _____ DATE _____
CHECKED BY _____ FILE _____

METHOD OF PERFORMING DIRECT SHEAR AND FRICTION TESTS

DIRECT SHEAR TESTS ARE PERFORMED TO DETERMINE THE SHEARING STRENGTHS OF SOILS. FRICTION TESTS ARE PERFORMED TO DETERMINE THE FRICTIONAL RESISTANCES BETWEEN SOILS AND VARIOUS OTHER MATERIALS SUCH AS WOOD, STEEL, OR CONCRETE. THE TESTS ARE PERFORMED IN THE LABORATORY TO SIMULATE ANTICIPATED FIELD CONDITIONS.



DIRECT SHEAR TESTING & RECORDING APPARATUS

EACH SAMPLE IS TESTED WITHIN THREE BRASS RINGS, TWO AND ONE-HALF INCHES IN DIAMETER AND ONE INCH IN LENGTH. UNDISTURBED SAMPLES OF IN-PLACE SOILS ARE TESTED IN RINGS TAKEN FROM THE SAMPLING DEVICE IN WHICH THE SAMPLES WERE OBTAINED. LOOSE SAMPLES OF SOILS TO BE USED IN CONSTRUCTING EARTH FILLS ARE COMPACTED IN RINGS TO PREDETERMINED CONDITIONS AND TESTED.

DIRECT SHEAR TESTS

A THREE-INCH LENGTH OF THE SAMPLE IS TESTED IN DIRECT DOUBLE SHEAR. A CONSTANT PRESSURE, APPROPRIATE TO THE CONDITIONS OF THE PROBLEM FOR WHICH THE TEST IS BEING PERFORMED, IS APPLIED NORMAL TO THE ENDS OF THE SAMPLE THROUGH POROUS STONES. A SHEARING FAILURE OF THE SAMPLE IS CAUSED BY MOVING THE CENTER RING IN A DIRECTION PERPENDICULAR TO THE AXIS OF THE SAMPLE. TRANSVERSE MOVEMENT OF THE OUTER RINGS IS PREVENTED.

THE SHEARING FAILURE MAY BE ACCOMPLISHED BY APPLYING TO THE CENTER RING EITHER A CONSTANT RATE OF LOAD, A CONSTANT RATE OF DEFLECTION, OR INCREMENTS OF LOAD OR DEFLECTION. IN EACH CASE, THE SHEARING LOAD AND THE DEFLECTIONS IN BOTH THE AXIAL AND TRANSVERSE DIRECTIONS ARE RECORDED AND PLOTTED. THE SHEARING STRENGTH OF THE SOIL IS DETERMINED FROM THE RESULTING LOAD-DEFLECTION CURVES.

FRICTION TESTS

IN ORDER TO DETERMINE THE FRICTIONAL RESISTANCE BETWEEN SOIL AND THE SURFACES OF VARIOUS MATERIALS, THE CENTER RING OF SOIL IN THE DIRECT SHEAR TEST IS REPLACED BY A DISK OF THE MATERIAL TO BE TESTED. THE TEST IS THEN PERFORMED IN THE SAME MANNER AS THE DIRECT SHEAR TEST BY FORCING THE DISK OF MATERIAL FROM THE SOIL SURFACES.

DAMES & MOORE
APPLIED EARTH SCIENCES

PLATE

REVISIONS BY DATE

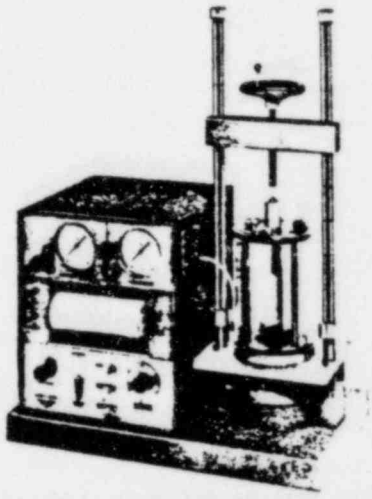
FILE

BY DATE

CHECKED BY

METHODS OF PERFORMING UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS

THE SHEARING STRENGTHS OF SOILS ARE DETERMINED FROM THE RESULTS OF UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS. IN TRIAXIAL COMPRESSION TESTS THE TEST METHOD AND THE MAGNITUDE OF THE CONFINING PRESSURE ARE CHOSEN TO SIMULATE ANTICIPATED FIELD CONDITIONS.



TRIAXIAL COMPRESSION TEST UNIT

UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS ARE PERFORMED ON UNDISTURBED OR REMOLDED SAMPLES OF SOIL APPROXIMATELY SIX INCHES IN LENGTH AND TWO AND ONE-HALF INCHES IN DIAMETER. THE TESTS ARE RUN EITHER STRAIN-CONTROLLED OR STRESS-CONTROLLED. IN A STRAIN-CONTROLLED TEST THE SAMPLE IS SUBJECTED TO A CONSTANT RATE OF DEFLECTION AND THE RESULTING STRESSES ARE RECORDED. IN A STRESS-CONTROLLED TEST THE SAMPLE IS SUBJECTED TO EQUAL INCREMENTS OF LOAD WITH EACH INCREMENT BEING MAINTAINED UNTIL AN EQUILIBRIUM CONDITION WITH RESPECT TO STRAIN IS ACHIEVED.

YIELD, PEAK, OR ULTIMATE STRESSES ARE DETERMINED FROM THE STRESS-STRAIN PLOT FOR EACH SAMPLE AND THE PRINCIPAL STRESSES ARE EVALUATED. THE PRINCIPAL STRESSES ARE PLOTTED ON A MOHR'S CIRCLE DIAGRAM TO DETERMINE THE SHEARING STRENGTH OF THE SOIL TYPE BEING TESTED.

UNCONFINED COMPRESSION TESTS CAN BE PERFORMED ONLY ON SAMPLES WITH SUFFICIENT COHESION SO THAT THE SOIL WILL STAND AS AN UNSUPPORTED CYLINDER. THESE TESTS MAY BE RUN AT NATURAL MOISTURE CONTENT OR ON ARTIFICIALLY SATURATED SOILS.

IN A TRIAXIAL COMPRESSION TEST THE SAMPLE IS ENCASED IN A RUBBER MEMBRANE, PLACED IN A TEST CHAMBER, AND SUBJECTED TO A CONFINING PRESSURE THROUGHOUT THE DURATION OF THE TEST. NORMALLY, THIS CONFINING PRESSURE IS MAINTAINED AT A CONSTANT LEVEL, ALTHOUGH FOR SPECIAL TESTS IT MAY BE VARIED IN RELATION TO THE MEASURED STRESSES. TRIAXIAL COMPRESSION TESTS MAY BE RUN ON SOILS AT FIELD MOISTURE CONTENT OR ON ARTIFICIALLY SATURATED SAMPLES. THE TESTS ARE PERFORMED IN ONE OF THE FOLLOWING WAYS:

UNCONSOLIDATED-UNDRAINED: THE CONFINING PRESSURE IS IMPOSED ON THE SAMPLE AT THE START OF THE TEST. NO DRAINAGE IS PERMITTED AND THE STRESSES WHICH ARE MEASURED REPRESENT THE SUM OF THE INTERGRANULAR STRESSES AND PORE WATER PRESSURES.

CONSOLIDATED-UNDRAINED: THE SAMPLE IS ALLOWED TO CONSOLIDATE FULLY UNDER THE APPLIED CONFINING PRESSURE PRIOR TO THE START OF THE TEST. THE VOLUME CHANGE IS DETERMINED BY MEASURING THE WATER AND/OR AIR EXPELLED DURING CONSOLIDATION. NO DRAINAGE IS PERMITTED DURING THE TEST AND THE STRESSES WHICH ARE MEASURED ARE THE SAME AS FOR THE UNCONSOLIDATED-UNDRAINED TEST.

DRAINED: THE INTERGRANULAR STRESSES IN A SAMPLE MAY BE MEASURED BY PERFORMING A DRAINED, OR SLOW, TEST. IN THIS TEST THE SAMPLE IS FULLY SATURATED AND CONSOLIDATED PRIOR TO THE START OF THE TEST. DURING THE TEST, DRAINAGE IS PERMITTED AND THE TEST IS PERFORMED AT A SLOW ENOUGH RATE TO PREVENT THE BUILDUP OF PORE WATER PRESSURES. THE RESULTING STRESSES WHICH ARE MEASURED REPRESENT ONLY THE INTERGRANULAR STRESSES. THESE TESTS ARE USUALLY PERFORMED ON SAMPLES OF GENERALLY NON-COHESIVE SOILS, ALTHOUGH THE TEST PROCEDURE IS APPLICABLE TO COHESIVE SOILS IF A SUFFICIENTLY SLOW TEST RATE IS USED.

AN ALTERNATE MEANS OF OBTAINING THE DATA RESULTING FROM THE DRAINED TEST IS TO PERFORM AN UNDRAINED TEST IN WHICH SPECIAL EQUIPMENT IS USED TO MEASURE THE PORE WATER PRESSURES. THE DIFFERENCES BETWEEN THE TOTAL STRESSES AND THE PORE WATER PRESSURES MEASURED ARE THE INTERGRANULAR STRESSES.

REVISIONS BY _____ DATE _____

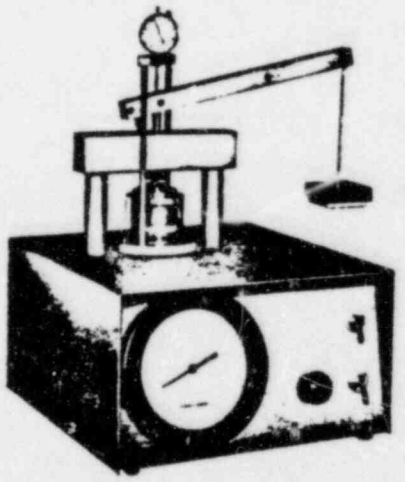
BY _____ DATE _____

CHECKED BY _____ FILE _____

METHOD OF PERFORMING CONSOLIDATION TESTS

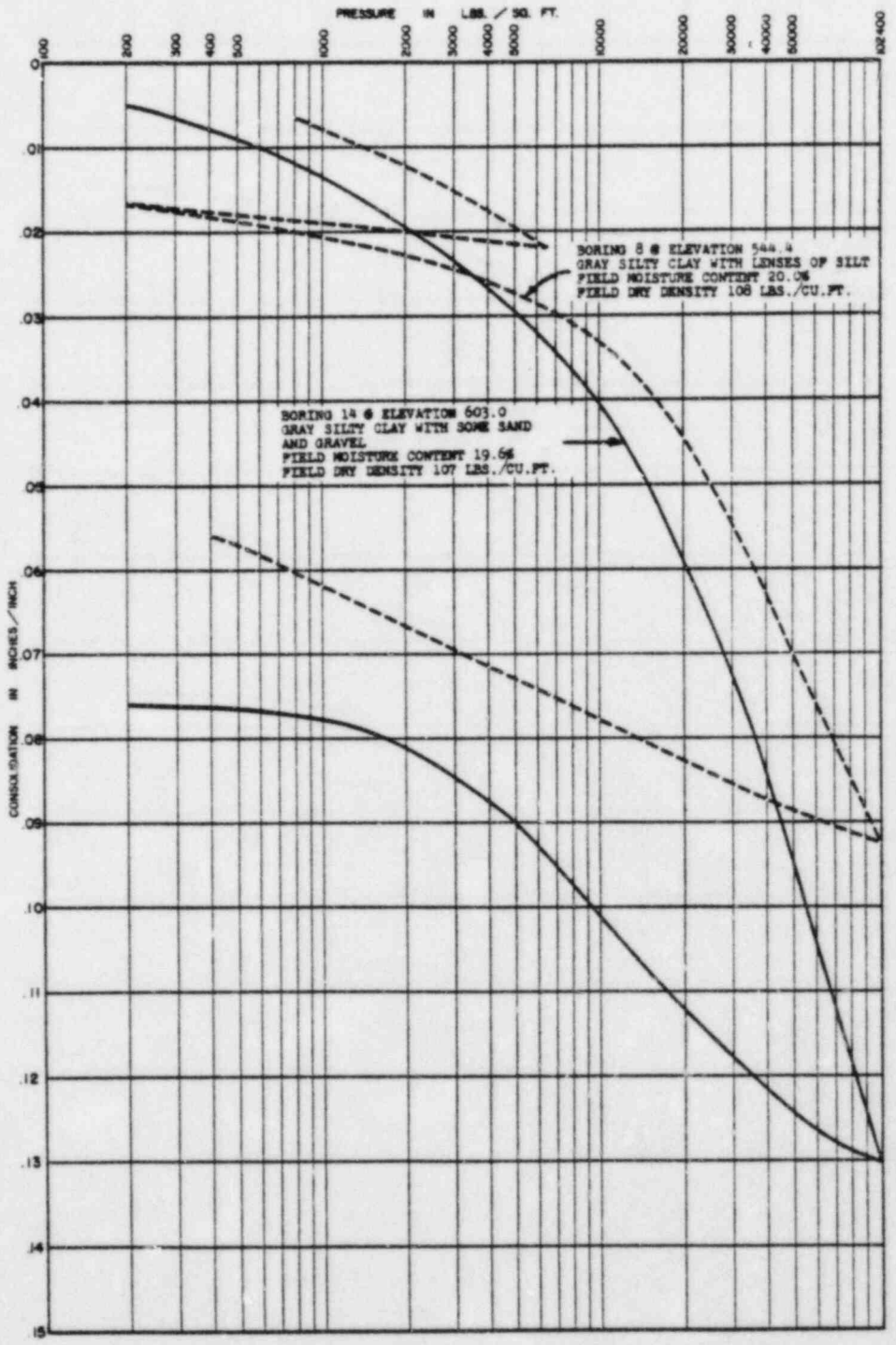
CONSOLIDATION TESTS ARE PERFORMED TO EVALUATE THE VOLUME CHANGES OF SOILS SUBJECTED TO INCREASED LOADS. TIME-CONSOLIDATION AND PRESSURE-CONSOLIDATION CURVES MAY BE PLOTTED FROM THE DATA OBTAINED IN THE TESTS. ENGINEERING ANALYSES BASED ON THESE CURVES PERMIT ESTIMATES TO BE MADE OF THE PROBABLE MAGNITUDE AND RATE OF SETTLEMENT OF THE TESTED SOILS UNDER APPLIED LOADS.

EACH SAMPLE IS TESTED WITHIN BRASS RINGS TWO AND ONE-HALF INCHES IN DIAMETER AND ONE INCH IN LENGTH. UNDISTURBED SAMPLES OF IN-PLACE SOILS ARE TESTED IN RINGS TAKEN FROM THE SAMPLING DEVICE IN WHICH THE SAMPLES WERE OBTAINED. LOOSE SAMPLES OF SOILS TO BE USED IN CONSTRUCTING EARTH FILLS ARE COMPACTED IN RINGS TO PREDETERMINED CONDITIONS AND TESTED.



DEAD LOAD-PNEUMATIC CONSOLIDOMETER

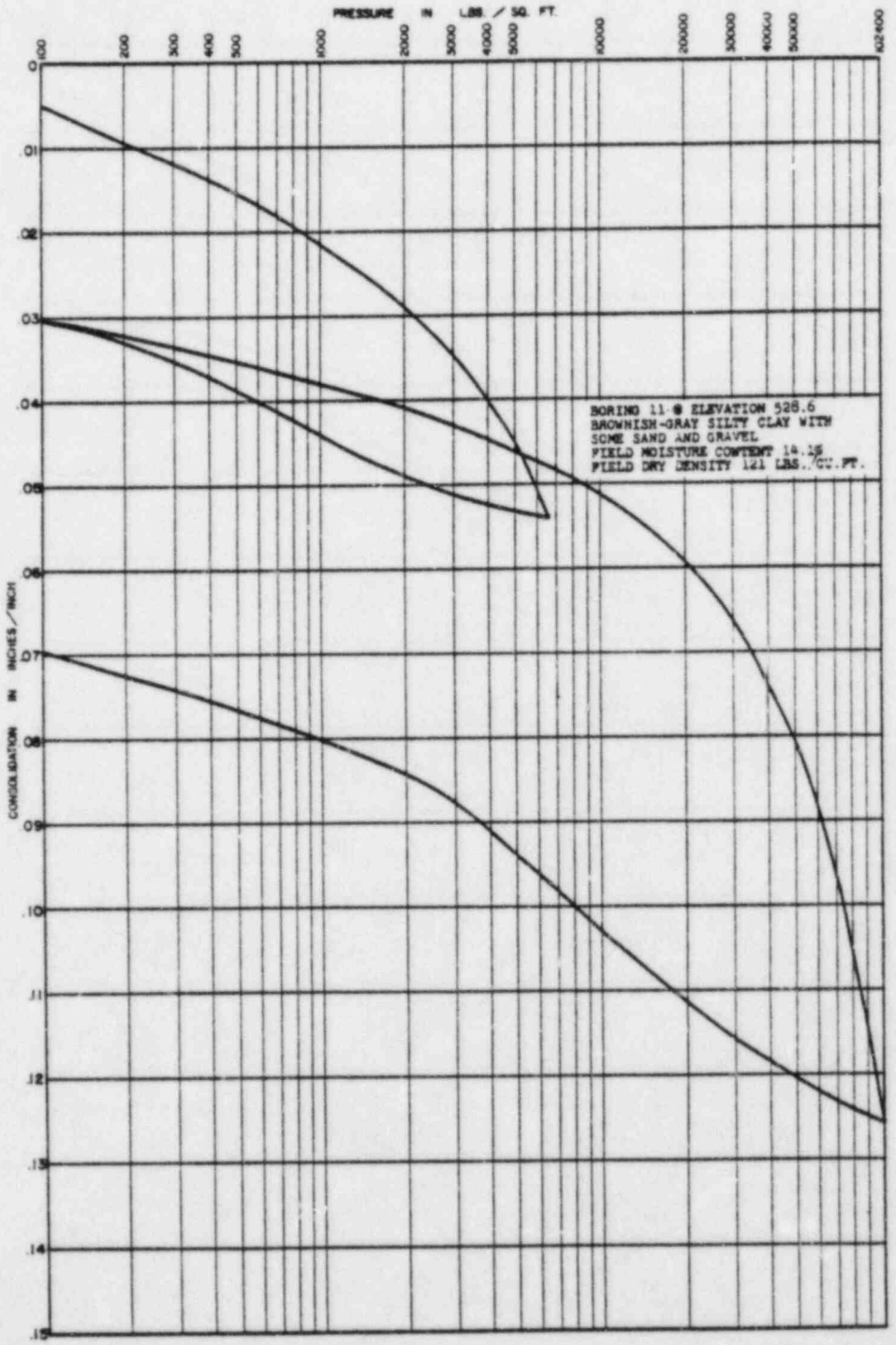
IN TESTING, THE SAMPLE IS RIGIDLY CONFINED LATERALLY BY THE BRASS RING. AXIAL LOADS ARE TRANSMITTED TO THE ENDS OF THE SAMPLE BY POROUS DISKS. THE DISKS ALLOW DRAINAGE OF THE LOADED SAMPLE. THE AXIAL COMPRESSION OR EXPANSION OF THE SAMPLE IS MEASURED BY A MICROMETER DIAL INDICATOR AT APPROPRIATE TIME INTERVALS AFTER EACH LOAD INCREMENT IS APPLIED. EACH LOAD IS ORDINARILY TWICE THE PRECEDING LOAD. THE INCREMENTS ARE SELECTED TO OBTAIN CONSOLIDATION DATA REPRESENTING THE FIELD LOADING CONDITIONS FOR WHICH THE TEST IS BEING PERFORMED. EACH LOAD INCREMENT IS ALLOWED TO ACT OVER AN INTERVAL OF TIME DEPENDENT ON THE TYPE AND EXTENT OF THE SOIL IN THE FIELD.



CONSOLIDATION TEST DATA

DAMES & MOORE

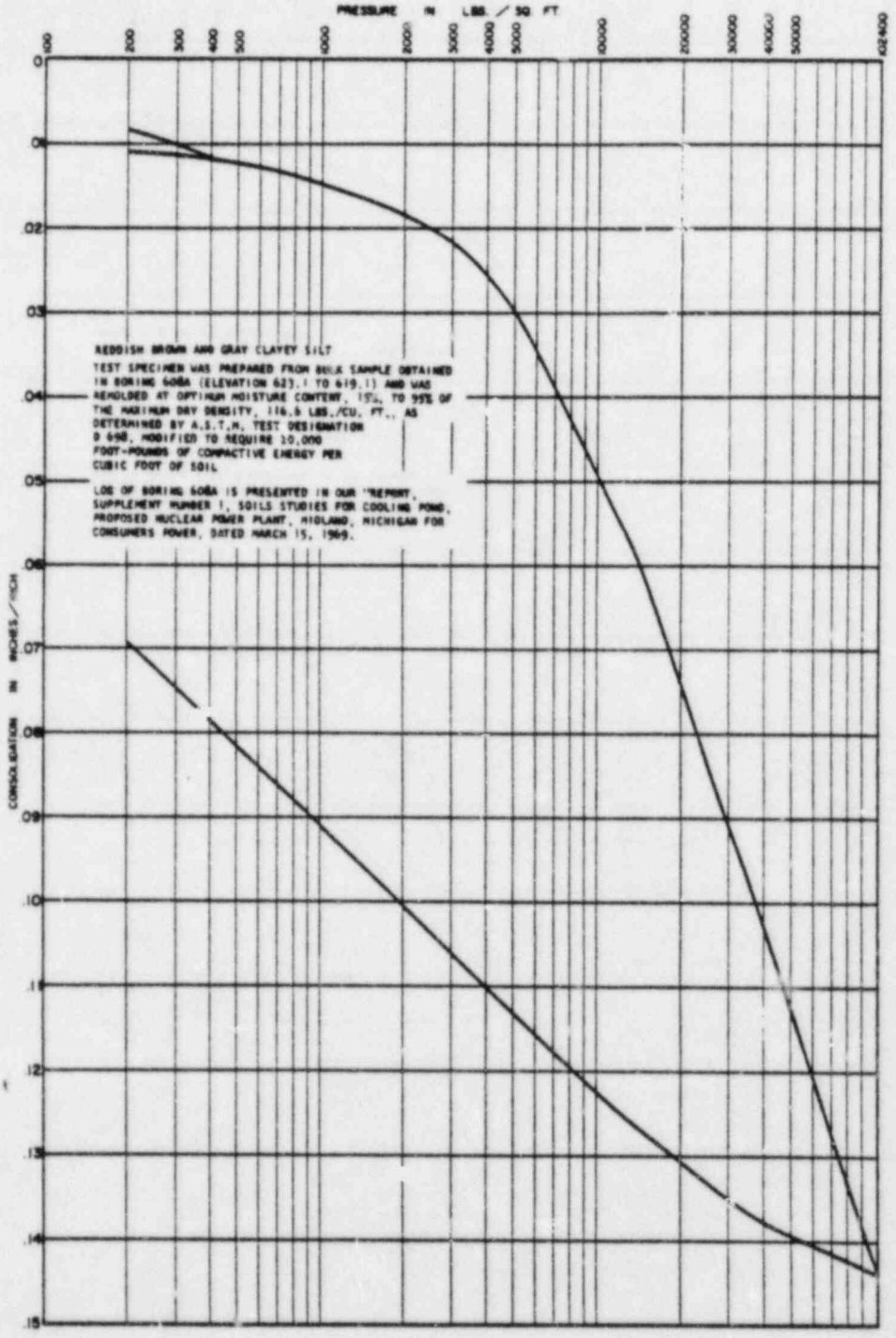
PLATE A-7F



CONSOLIDATION TEST DATA

DAMES & MOORE

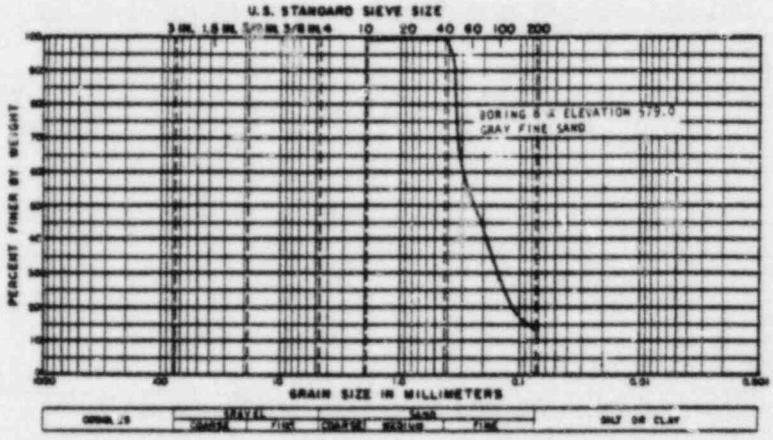
PLATE A-7G

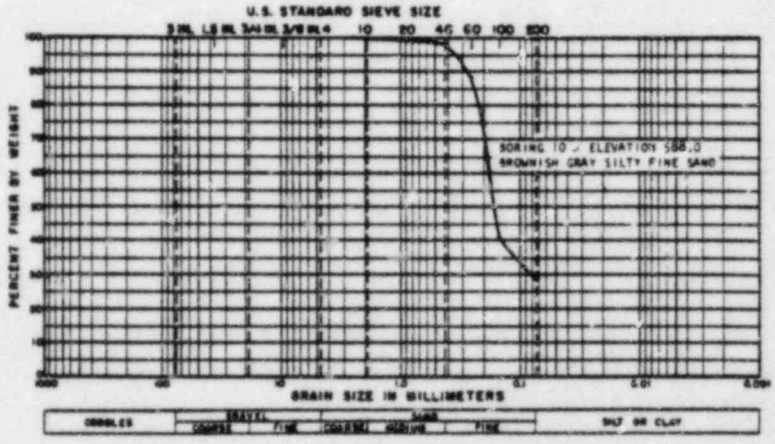


CONSOLIDATION TEST DATA

DAMES & MOORE

PLATE A-7H





GRAIN SIZE ANALYSES

DAMES & MOORE

PLATE A-11

Griffin Wellpoint Corporation

JACKSONVILLE, FLORIDA
904-388-7612
HOUSTON, TEXAS
713-923-2724
HAMMOND, INDIANA
219-931-1662
WEST PALM BEACH, FLORIDA
305-683-0702
NORFOLK, VIRGINIA
703-625-6524
NEW YORK, N. Y.
2[illegible]292-1800
CHICAGO, ILLINOIS
312-374-2255
QUEBEC, CANADA
663-3231

February 22, 1969

Dames & Moore Company
309 West Jackson Blvd.
Chicago, Illinois 60606

Re: Nuclear Power Plant
Midland, Michigan

Attention: Mr. Bill Moore

Gentlemen:

From a study of available preliminary plans, boring data, soil samples, grain-size curves and a soil profile of the proposed excavation area, we propose the excavation be open-cut on the Northeast side on approximately two (2) horizontal to one (1) vertical slopes, (to allow for berms at elevation 600.0 and 585.0 for unwatering and stabilizing this area of pervious material with a 2-stage interconnected wellpoint system. (See attached sketch).

Although the soil samples visually appear to be a fine sharp and clear sand, the grain size analysis, and previous wellpoint dewatering in this area, indicates that the wellpoints must be installed with vertical sand filter-wicks for required drainage and drawdown.

Since the clay strata varies in depth over this Northeast Side, there may be some dips in the clay that will require a small amount of sand-bagging. However, since the pervious soils get deeper away from the excavation and toward the Northeast, this sandbagging should be a minimum item.

Our estimate of the cost of this dewatering (with no mark-up) is approximately $ 68,000.00 for six months pumping, plus (or minus) $ 270.00 per calendar day thereafter.

If there are any questions on the above.....or changes in the plant location .....please call us.

Very truly yours,
GRIFFIN WELLPOINT CORPORATION
(Indiana)

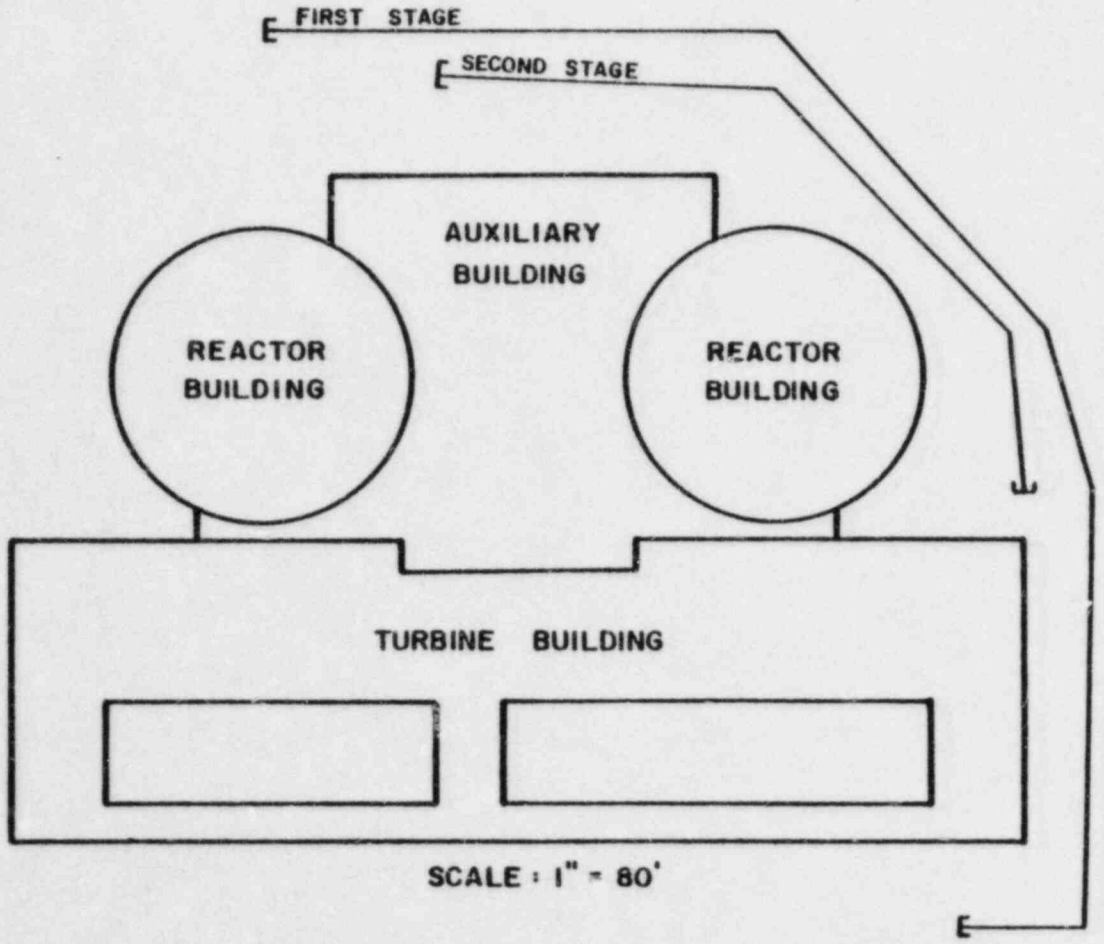
R. H. Hockberger
Vice President

RHH/ms
Enclosure: Sketch of 2-stage wellpoint location

PLATE A-12

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



SKETCH OF PROPOSED LOCATIONS OF UPPER AND LOWER DEWATERING SYSTEMS

DRAWING REFERENCE:

ORIGINAL SKETCH PREPARED BY
GRIFFIN WELLPOINT CORPORATION

DAMES & MOORE

PLATE A-13

3

Gentlemen:

I am Thiru Thiruvengadam. I am with Consumers Power Company as a Staff Engineer in the Project Engineering Services Department.

3.0 Remedial Work

I will be describing the remedial measures in progress or planned for the first five items on the agenda under Article 3.(Slide 3.1.1). Namely, DGB, SWS, tank farm, diesel oil storage tanks and underground facilities. These remedial measures are discussed in great detail in our responses to 50.54(f) questions and 50.55(e) submittals. Therefore, I will be presenting only a brief outline of the remedial work.

3.1 Diesel Generator Building (Slide 3.1.2)

The diesel generator building is a box-shaped structure. Its main purpose is to provide a housing for the four emergency diesel generators. The structural walls are very rigid. The building is supported on strip footings. The building and the generator pedestal are founded on approximately 30 feet of fill. In summer of last year, settlements more than anticipated values were observed. A detailed soil investigation was conducted. The backfill was found to consist of soft to very stiff clay with pockets and layers of very loose to dense sand backfill. The conclusion of the investigation was that the fill was not adequately compacted. Based upon the recommendation of our soil consultants, Professors Peck and Hendron, the remedial measure chosen was to preload the existing backfill by layers of sand surcharge.

(Slide 3.1.3) - This slide shows in plan the extent of sand surcharge. The surcharge was gradually applied in steps. To date, the backfill under the diesel building is subjected to 20 feet thick of sand surcharge. This slide (Slide 3.1.4) shows a cross section of the

building and the surcharge. The surcharge will produce stresses in the fill greater than the amount the fill would experience when the structure is operational. This surcharge will remain until excess pore pressures are essentially dissipated and the rate of residual settlement becomes small and can be predicted conservatively by extrapolation.

The preload consolidates soft areas of clay fill; however, will not significantly improve the quality of loose sands. The potential of liquefaction of these sands and aerial dewatering of the plant site as a remedial measure for this problem will be presented later in detail.

(Slide 3.1.5) - This slide shows plan and cross-sectional elevation of a typical diesel generator pedestal. This is a reinforced concrete structure having a minimum compressive strength of 4000 psi. The fill beneath the pedestals have also consolidated resulting in differential settlement. Differential settlement of the pedestals will have no effect on alignment of the engine and the generator because they are both mounted on the same foundation. Furthermore, because of the enormous stiffness of the pedestal, no significant warping is expected and the top of the pedestal will generally lie within one plane. The diesel generator will be set in a level position irrespective of the amount of differential settlement between the corners of the pedestal. It will be achieved either by a suitable layer of grout on the pedestal or by chipping a few inches of top concrete and refinishing it to the required level.

The machine itself has considerable tolerance limits for tilt and roll. Delaval Turbines, the manufacturer of the diesel generator, stated that

of the pedestal or a forward tilt of 1.4° and roll of 5° combined

a 5° combined backward tilt and roll will not affect the performance of the engine and the generators. Furthermore, during operation of the plant, if further differential settlement causes to exceed this tolerance. the manufacturer states that the generators can be shimmed back to level position. Therefore, in summarizing for the DOE, the remedial work of preload is in progress and dewatering of site is being planned for implementation soon. No further remedial work on the pedestal than that mentioned before is anticipated.

3.2 Service Water Pump Structure

(Slide 3.1.1) - The service water pump structure is located in the southeast end of the site adjacent to the cooling pond. This (Slide 3.2.1) slide shows a plan view of the structure. The cooling pond is on the southern side. Major portion of the structure is founded on natural soil material except for the northern portion which is founded on fill. (Slide 3.2.2) - This slide shows a cross-section view of the structure. As mentioned earlier, the northern section, which is cantilevered off the main building, is founded on backfill material. As a follow-up to the investigation of all Class I structures on fill, several borings were taken in this area. The borings indicated that the backfill consists of soft to very stiff clay and loose to very dense sand. The conclusion was that some areas of the fill material under the northern part of the structure were not sufficiently compacted.

However, no significant settlement of the structure has been noted. The reason for this is that the existing dead loads from this portion are being supported by the rest of the structure through cantilever action.

The remedial measure chosen was to support the north wall on piles [illegible]. The choice of piles is an economical and expedient solution with minimal impact on the schedule.

(Slide 3.2.3) - This slide shows in plan the layout of piles. A total of 16 piles is planned at this time. The piles will have a capacity of 100 tons and are designed as bearing piles to carry only vertical load. The piles will be pipe piles filled with concrete. They will be predrilled through the fill and driven into the glacial till. The length of piles is expected to be 50 feet.

(Slide 3.2.4) - This slide shows the method of transferring vertical load from the wall to the piles by a system of reinforced concrete corbels.

(Slide 3.2.5) - The concrete corbels will be anchored to the wall by a system of anchor bolts. The pipe piles in turn would be jacked against the corbels to effect the transfer of load.

A test pile will be load tested to determine its capacity.

3.3 Tank Farm

(Slide 3.3.1) - This slide shows tank farm in plan. There are two BWSTs, a utility tank and a primary storage tank. Of these, only BWSTs are safety related. The BWST has a capacity of 500,000 gallons, 52 feet in diameter and 32 feet in height.

(Slide 3.3.2) - The tank is supported on a short concrete ring girder ending in a strip footing. The tank by itself is quite flexible.

Adjoining the ring girder for each tank there is a small box-shaped [illegible] pit. This houses valves and other controls. At present, construction of ring girder and valve pits are complete and installation of piping is in progress. As a follow-up to to the investigation of all Class I structures founded as fill, several borings and test pit examinations were done in the tank farm area. The results of the investigation indicate that the tanks are supported on medium to very stiff clay backfill with occasional medium to very dense sand layers. The condition of the fill is suitable for the support of the tanks. To confirm this, the tanks will be constructed and filled with water in order to make a full-scale test of the foundation soil.

The (Slide 3.3.3) slide shows the layout of borated water lines entering the tank through the valve pit. The piping connections are being made to allow start-up, flushing, filling and testing of the tank. Selected points on the piping between BWST and the auxility building will be monitored for settlement during construction phase. Any differential settlement ~~that was~~ measured will be analyzed in accordance with established procedures.

In summary, the backfill material on which the BWSTs are founded is satisfactory and will be confirmed by a load test. Borated water lines will be monitored and evaluated for any differential settlements. Therefore, no remedial action is anticiapted for these structures.

3.4 Diesel Oil Storage Tanks

(Slide 3.1.1) - The oil storage tanks are located southeast of the diesel generator building. There are 4 tanks, each 17 feet in diameter and 44 feet in length.

(Slide 3.4.1) - There is six feet of earthen cover over the top of the tank. The tank is supported at three points anchored to concrete pedestals. The tanks are founded on backfill and results of boring program indicated that the tanks are supported on medium to stiff sandy clay backfill. This soil condition is adequate to support the tanks. Moreover, the weight of the tanks is approximately equal to the fill that it replaced. In order to verify that the fill is satisfactory, these tanks have been filled with water and settlements are being monitored. It has been three months since the tanks have been filled with water and no appreciable settlements have been noted yet. Therefore, the backfill is adequate and no remedial measures are anticiapted.

3.5 Underground Facilities

The underground facilities that will be discussed are Seismic Category I piping and electrical duct banks. This (Slide 3.1.1) slide shows safety-related piping, namely Service Water Lines, from the auxiliary building to the service water structure and diesel generator building to the service water structure. Borated water lines from the auxiliary building to BWST and diesel oil lines from the diesel oil storage tanks to the diesel generator building. Electrical duct banks are also shown in this slide.

To evalute the present condition of piping, a representative group of piping was selected and profiled by a Mold Aquaducer Profile Settlement Gauge. This (Slide 3.5.1)slide shows for illustrative purposes a plot of one of the lines profiled. All the pipes profiled were reanalyzed taking into account the measured differential settlement in accordance with the provisions of current codes. The analyses

showed that the effect of differential settlement on the stresses were minimal and much below the level of allowable stresses. A detailed discussion of piping stress analysis would be covered later if required.

In summary, the piles are very ductile and calculations show that effects of differential settlement undergone so far have minimal effect on stresses. Therefore, no remedial work is anticipated with regards to buried piping.

Electrical Duct Banks

The duct banks are reinforced concrete elements enclosing PVC and rigid steel conduits thus providing voids for the cables. Earlier, Mr Tom Cooke described the continuity checks that are performed by passing a rabbit through all the voids. This program establishes the fact that, to date, the duct banks are intact. Furthermore, the duct banks are reinforced with nominal amount of steel therefore possess considerable amount of ductility in bending.

(Slide 3.5.2) - A preliminary calculation indicated that a typical duct bank of 100 feet in length can undergo a maximum of ½" of central deflection in purebending at ultimate load.

In summary, the integrity of the duct bank is established by passing a rabbit through during construction and the duct bank by itself is ductile and can absorb considerable amount of differential settlement without significant stresses. Therefore, no remedial measures are anticipated for duct banks.

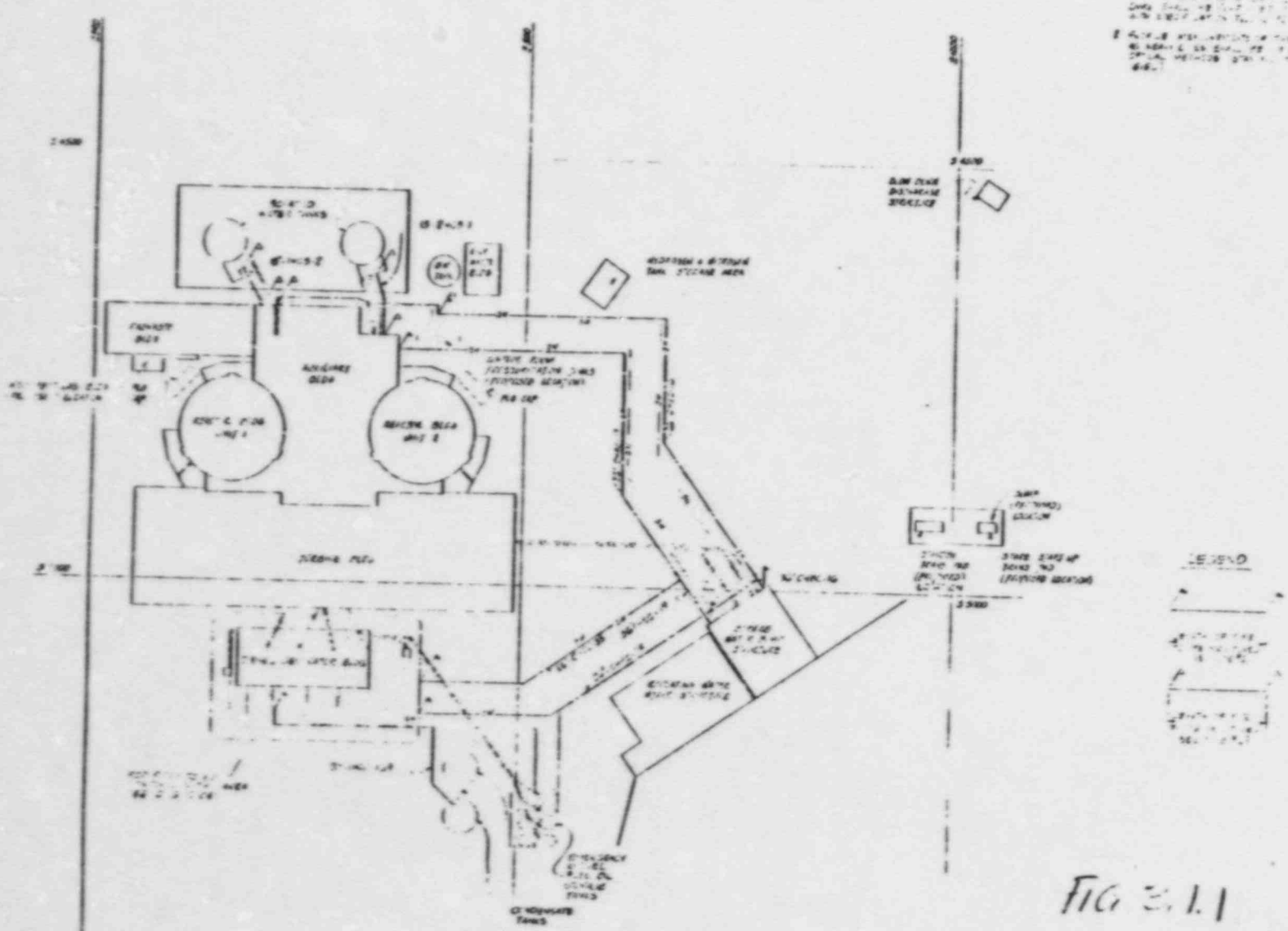
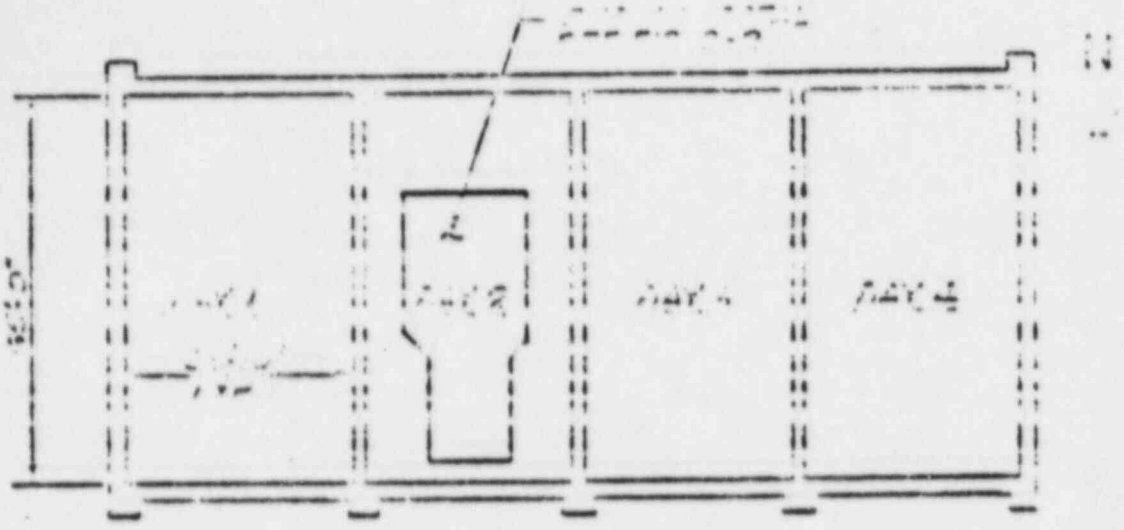
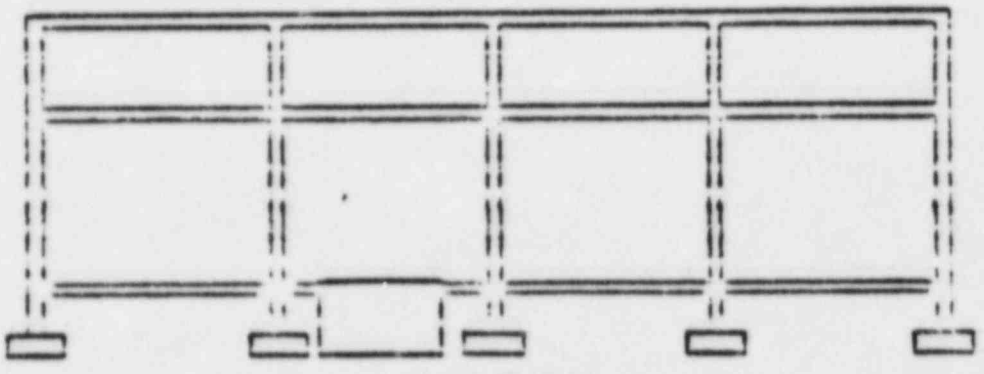


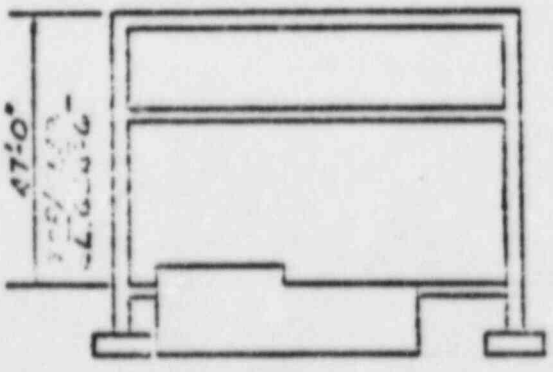
FIG 2.1.1



PLAN



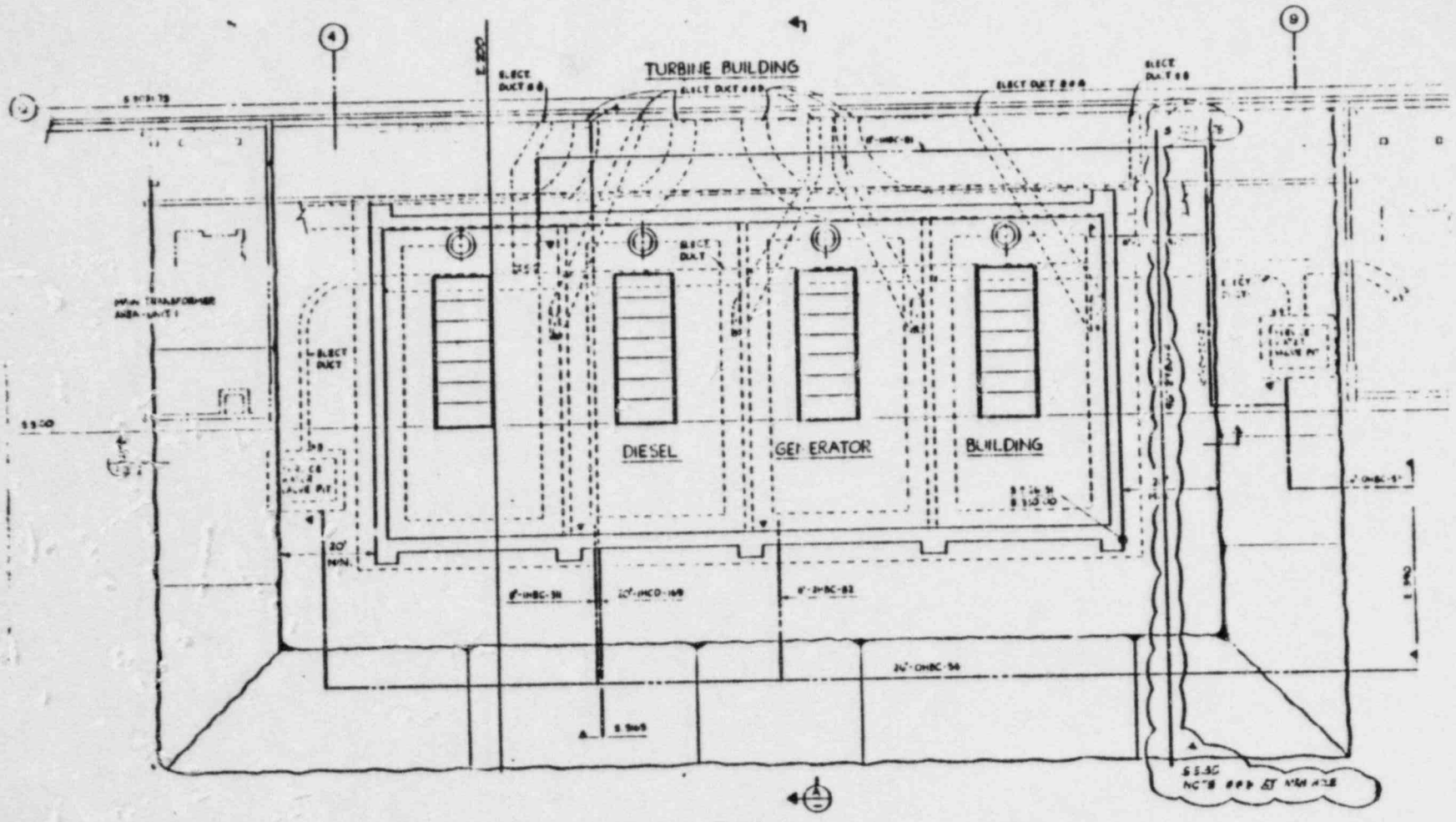
SECTION
LOOKING SOUTH



SECTION
LOOKING WEST

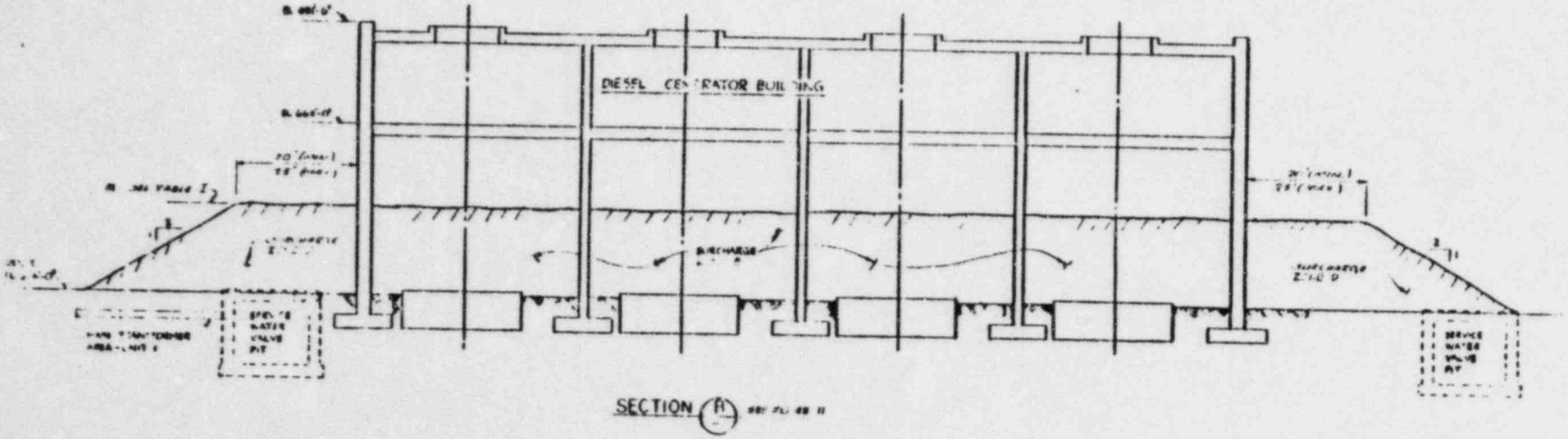
FIG. 3.1.2

MIDLAND PLANT UNITS 1 & 2 CONSUMERS POWER COMPANY	
DIESEL GENERATOR BLDG PLAN & SECTIONS	
FIGURE 1.2-9	DATE: 4/24/79


TURBINE BUILDING
DIESEL
GENERATOR
BUILDING
ELECT DUCT
MAIN TRANSFORMER AREA
20' MIN.

PLAN

Fig. 3.1.3



SECTION (A)

FIG 3.1.4

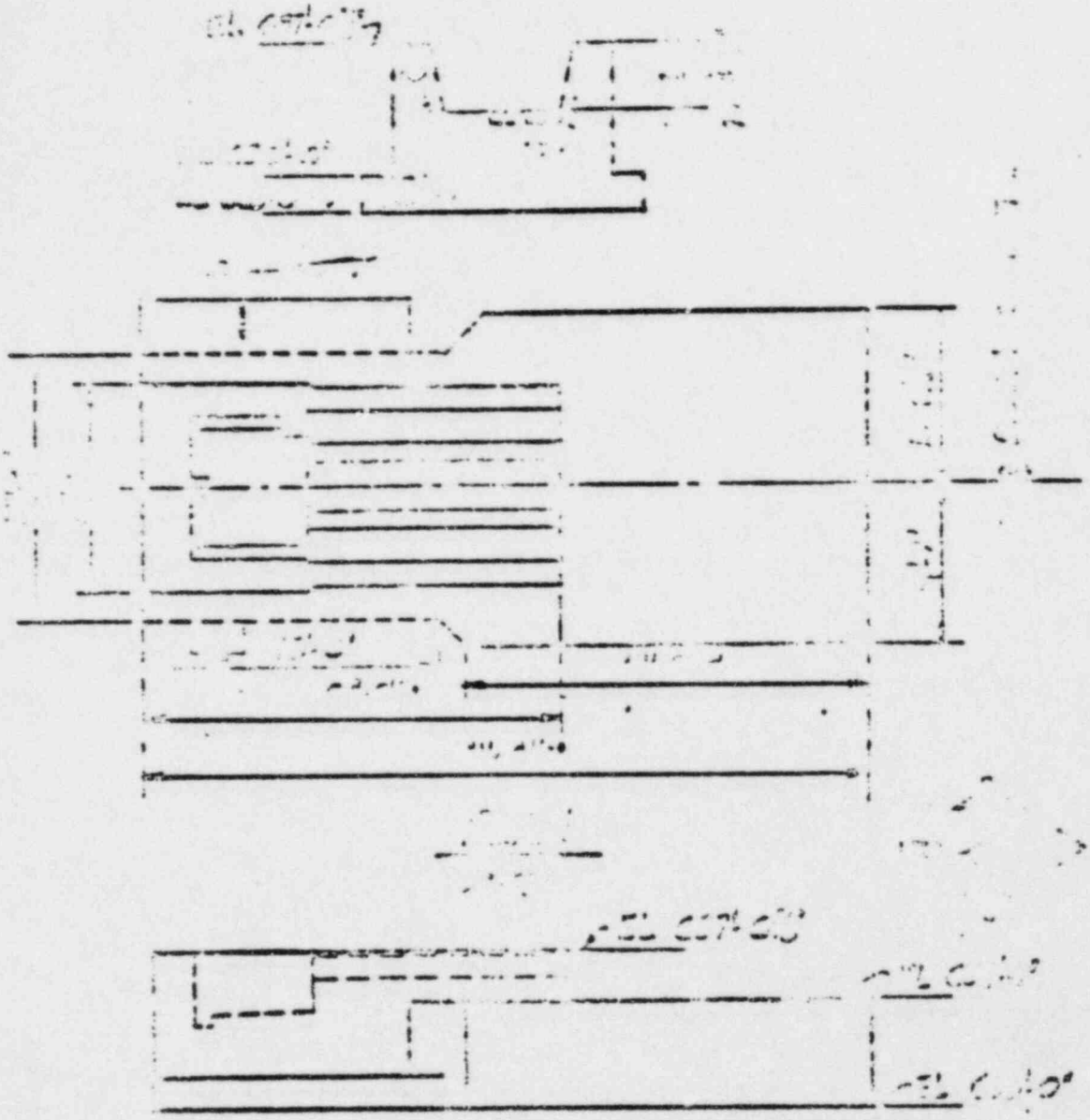


FIG 3.1.5

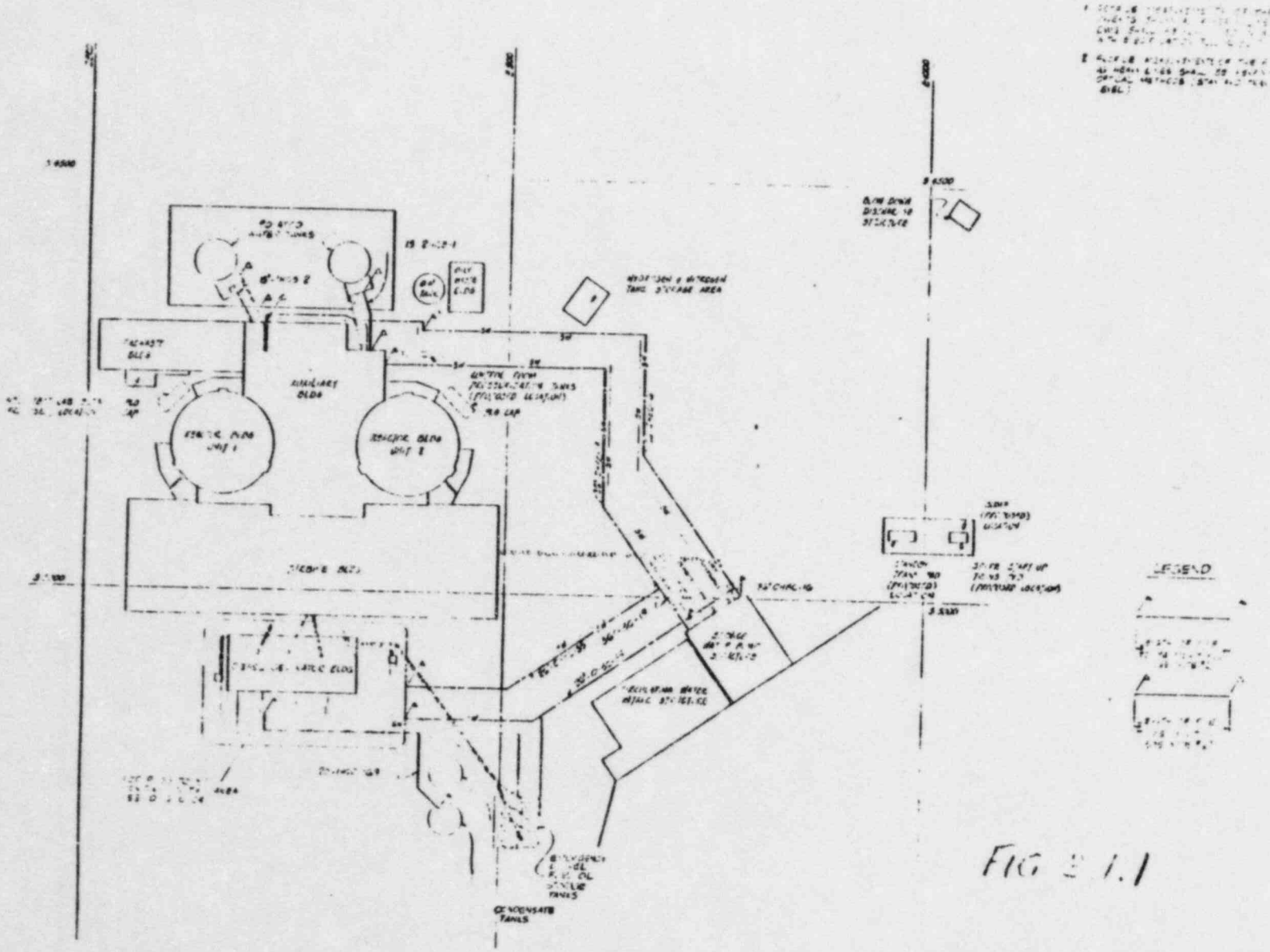
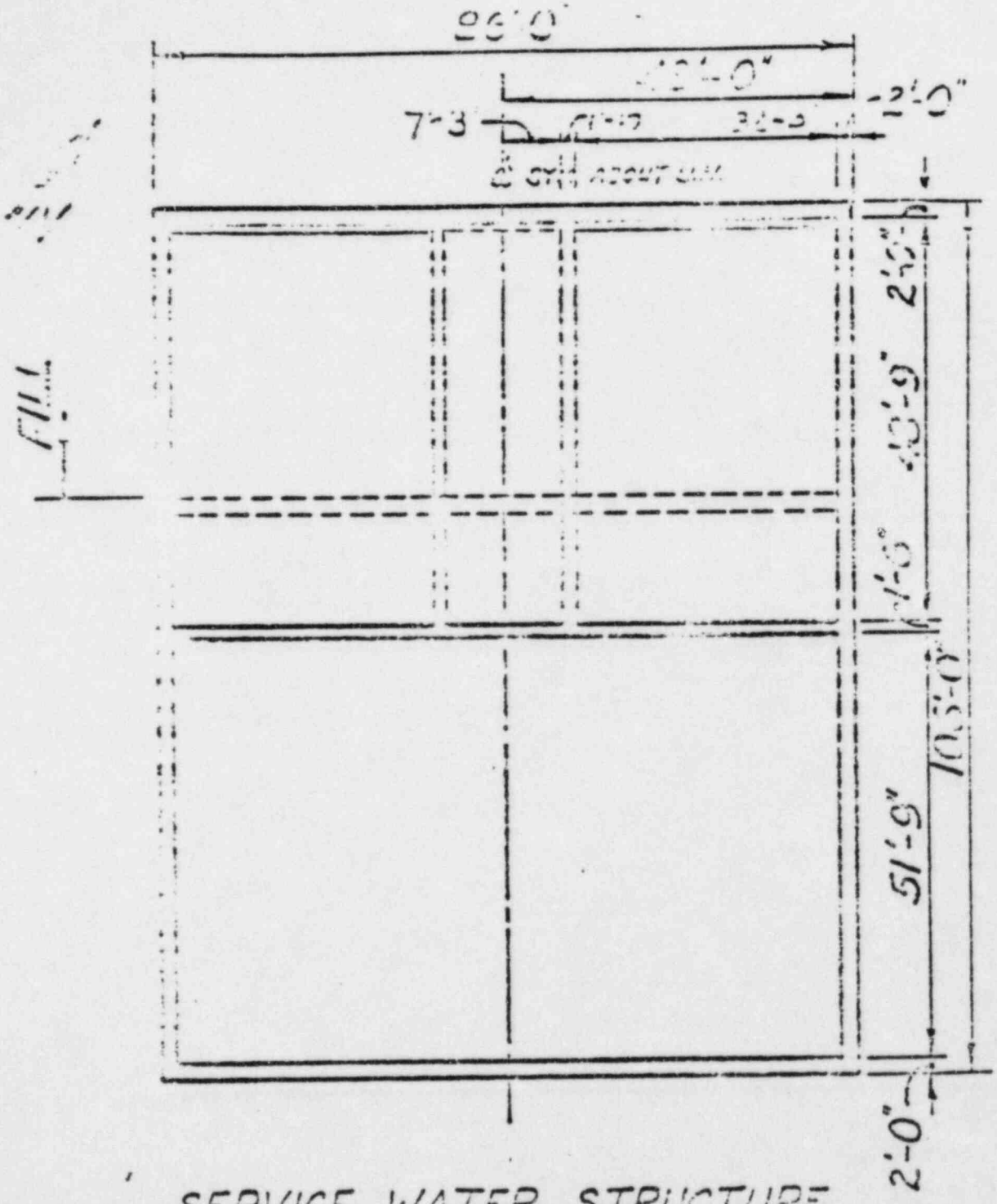
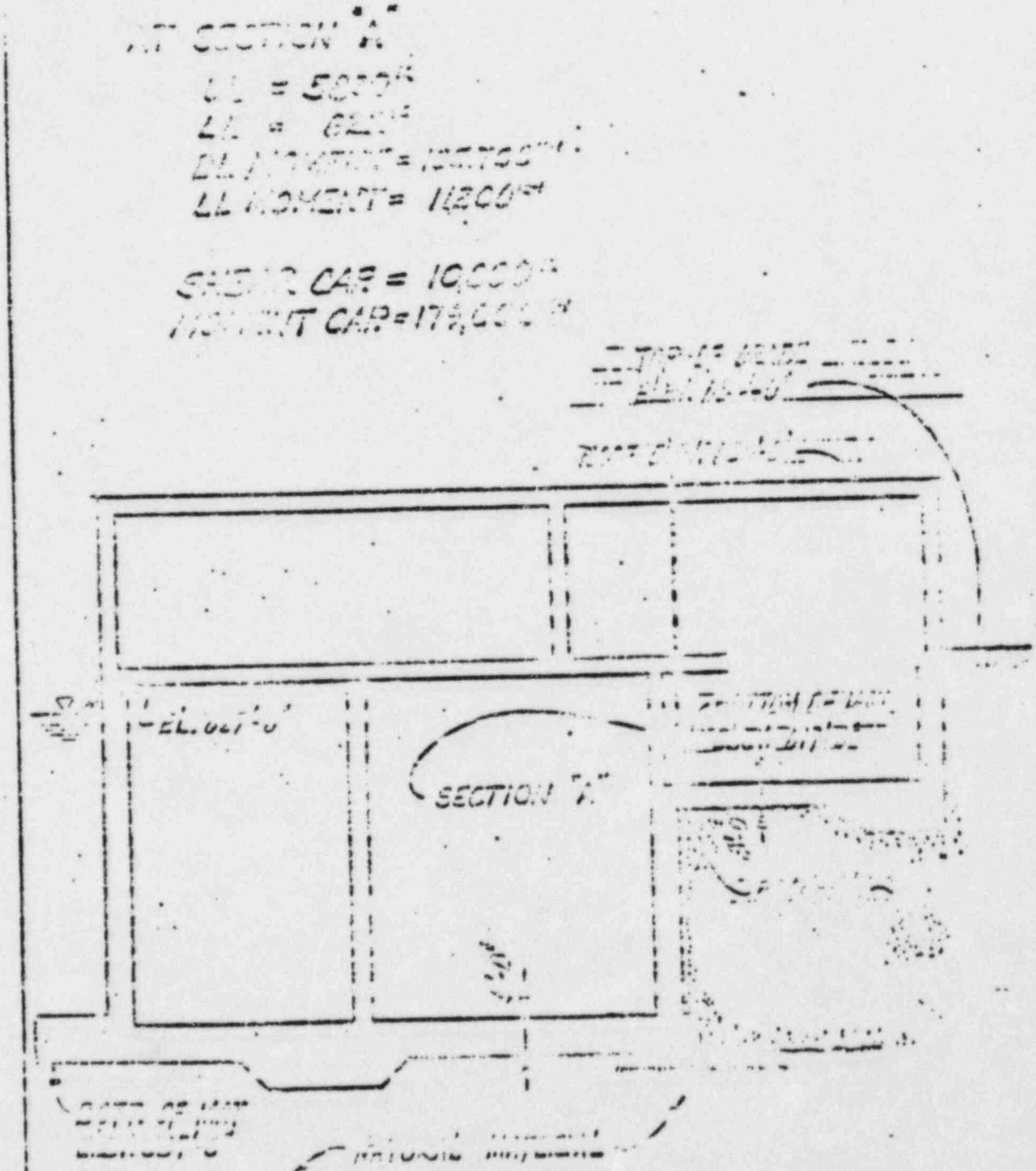


FIG 2.1.1



SERVICE WATER STRUCTURE
PLAN AT EL. 634'-6"

FIG 3.2.1



TYPICAL SECTION

SERVICE WATER

STRUCTURE

FIG. 3.2.2

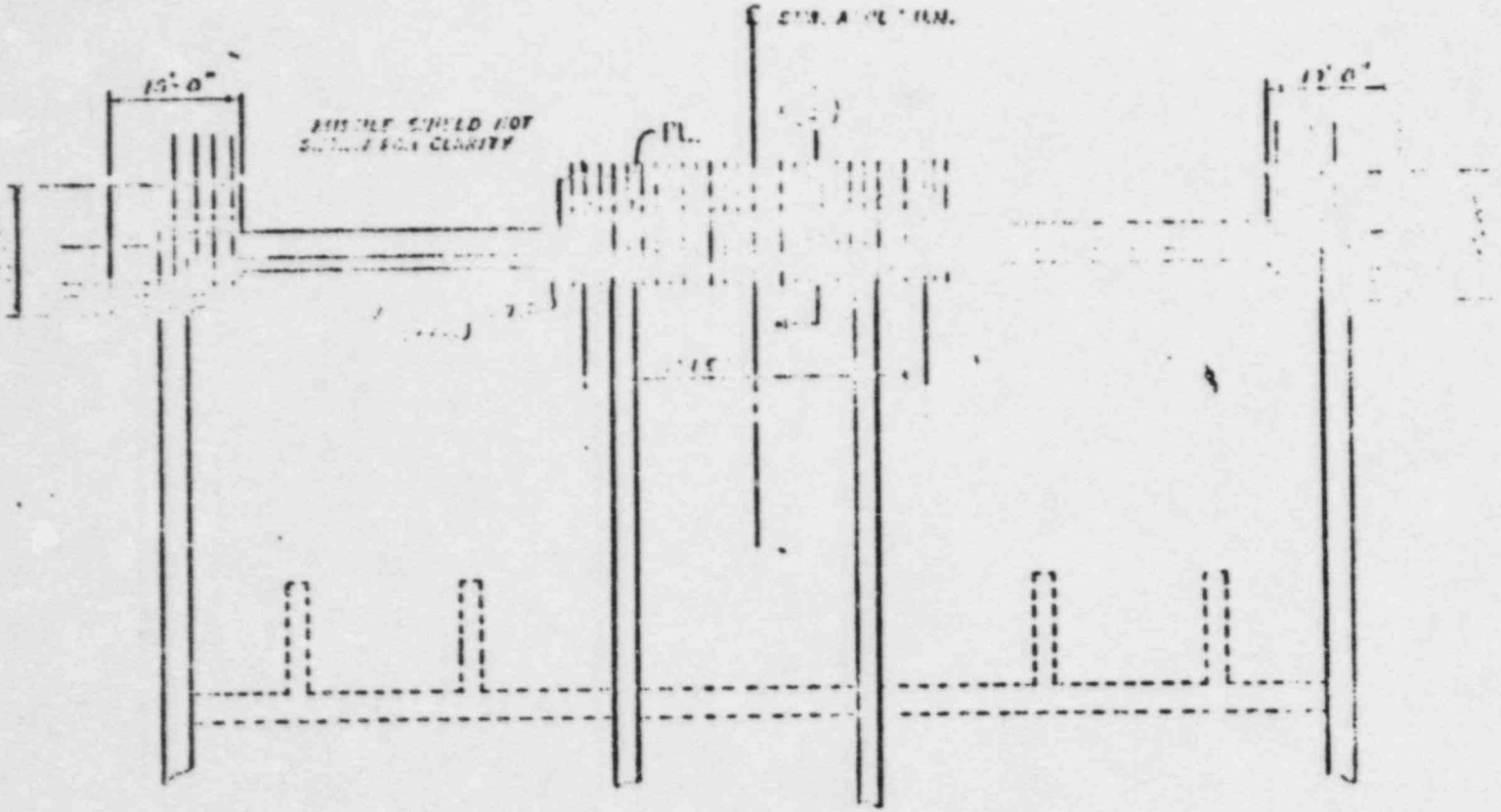


FIG. 3.2.2

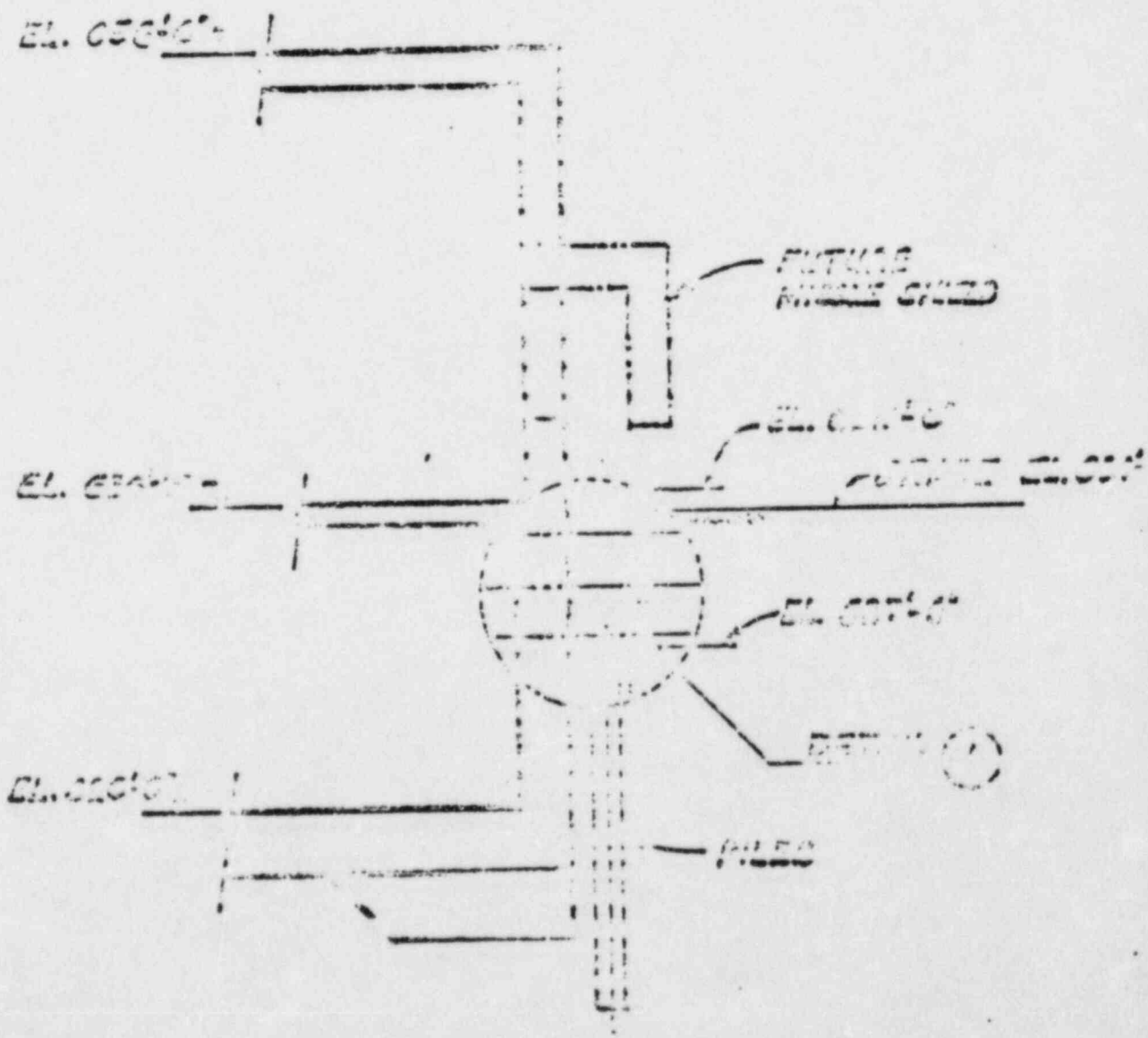


FIG 3.2.4

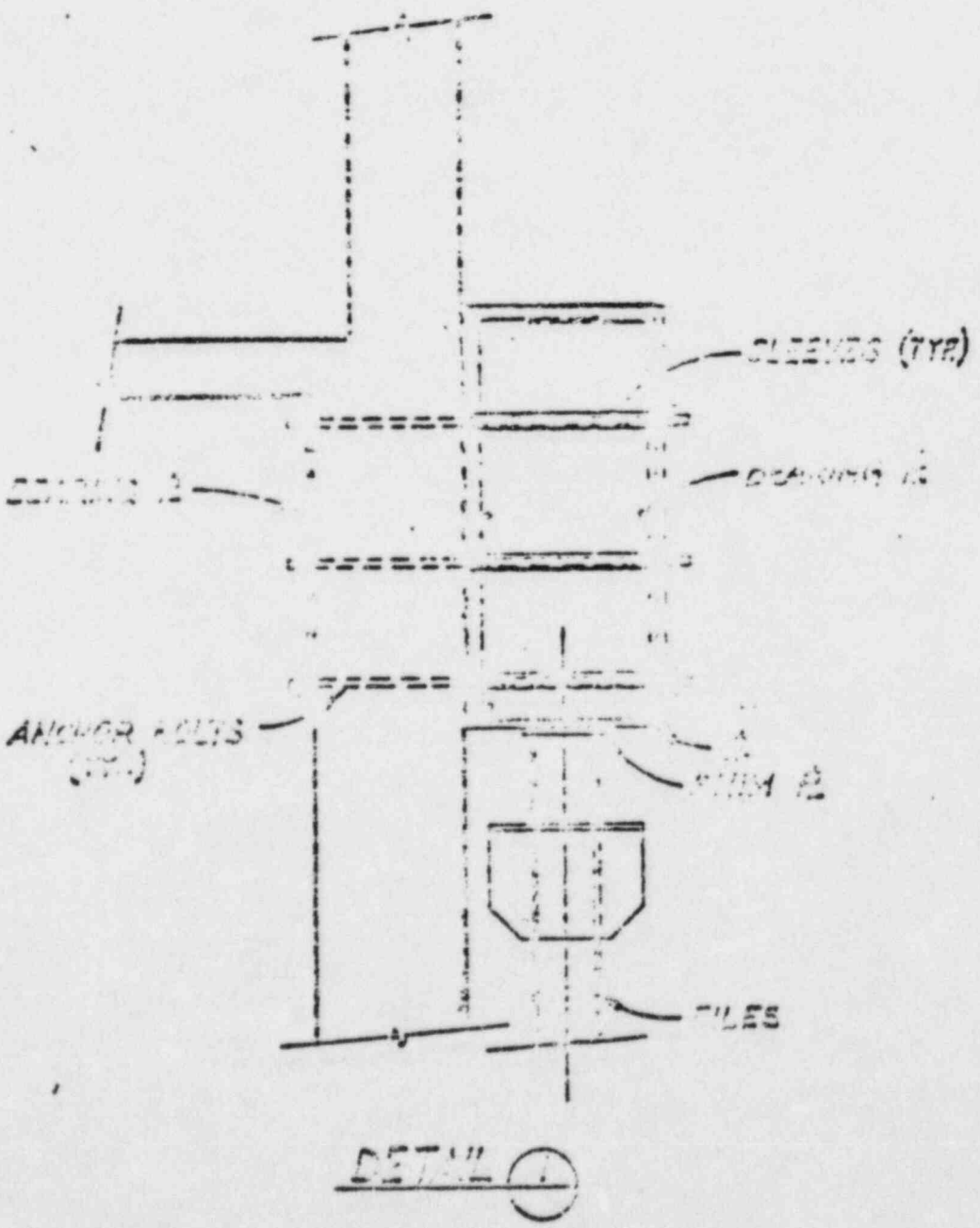
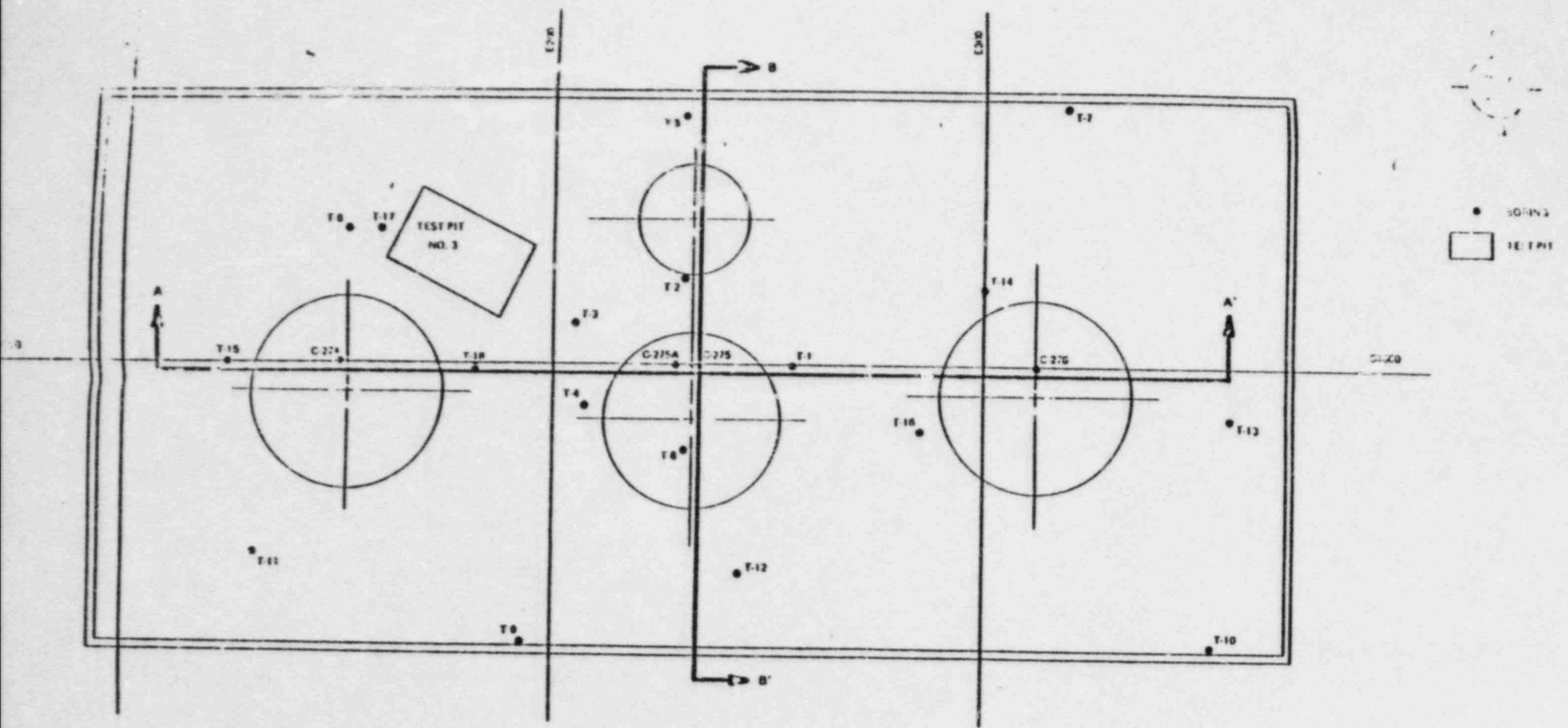


FIG 3.2.5


B
B'
A
A'
T-1
T-2
T-3
T-4
T-5
T-6
T-7
T-8
T-9
T-10
T-11
T-12
T-13
T-14
T-15
T-16
T-17
T-18
TEST PIT
NO. 3
C-275A
C-275
C-276
C-274

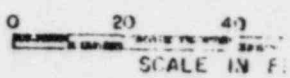
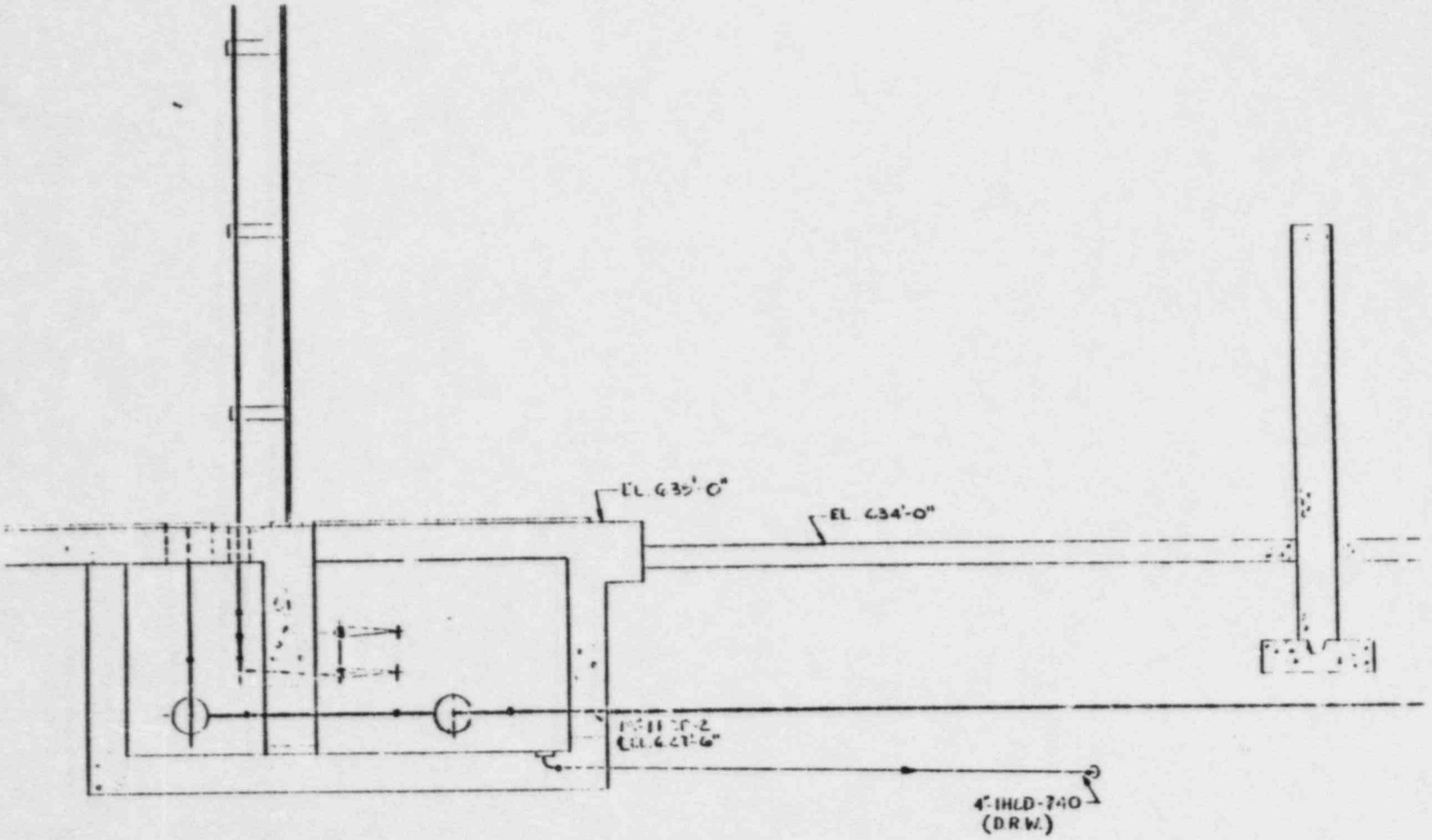

0
20
SCALE IN F

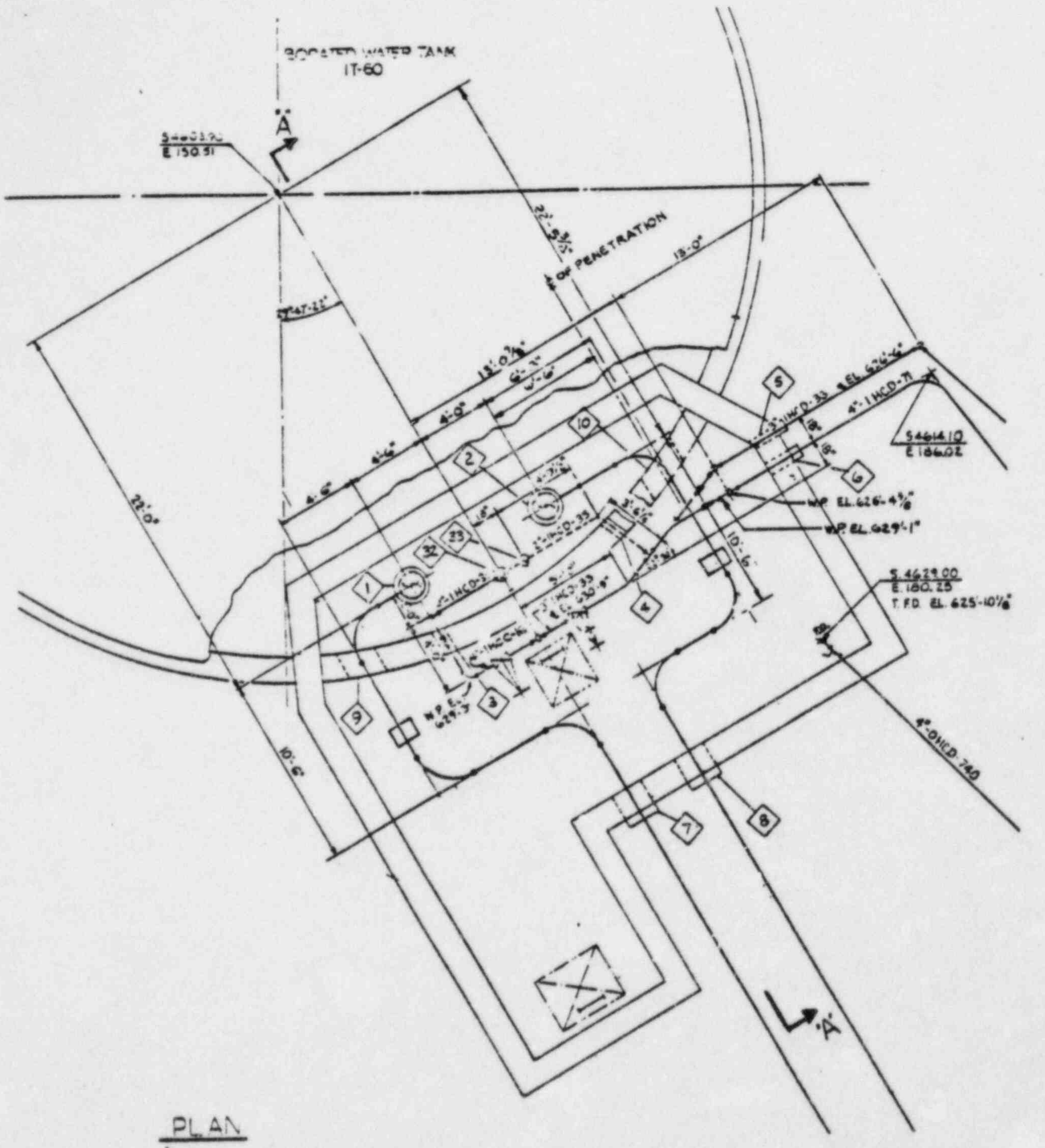
FIG. 3.1



SECTION A-A

FIG 2.3.2

BORATED WATER STORAGE



BORATED WATER TANK
1T-60
S 4603.90
E 150.51
A
OF PENETRATION
13'-0"
22'-0"
10'-6"
S 4614.10
E 186.02
W.P. EL. 629'-1"
S 4629.00
E 180.25
T. FD. EL. 625'-10 1/8"
4"-OHCD-740
A

PLAN

FIG. 3.3.3

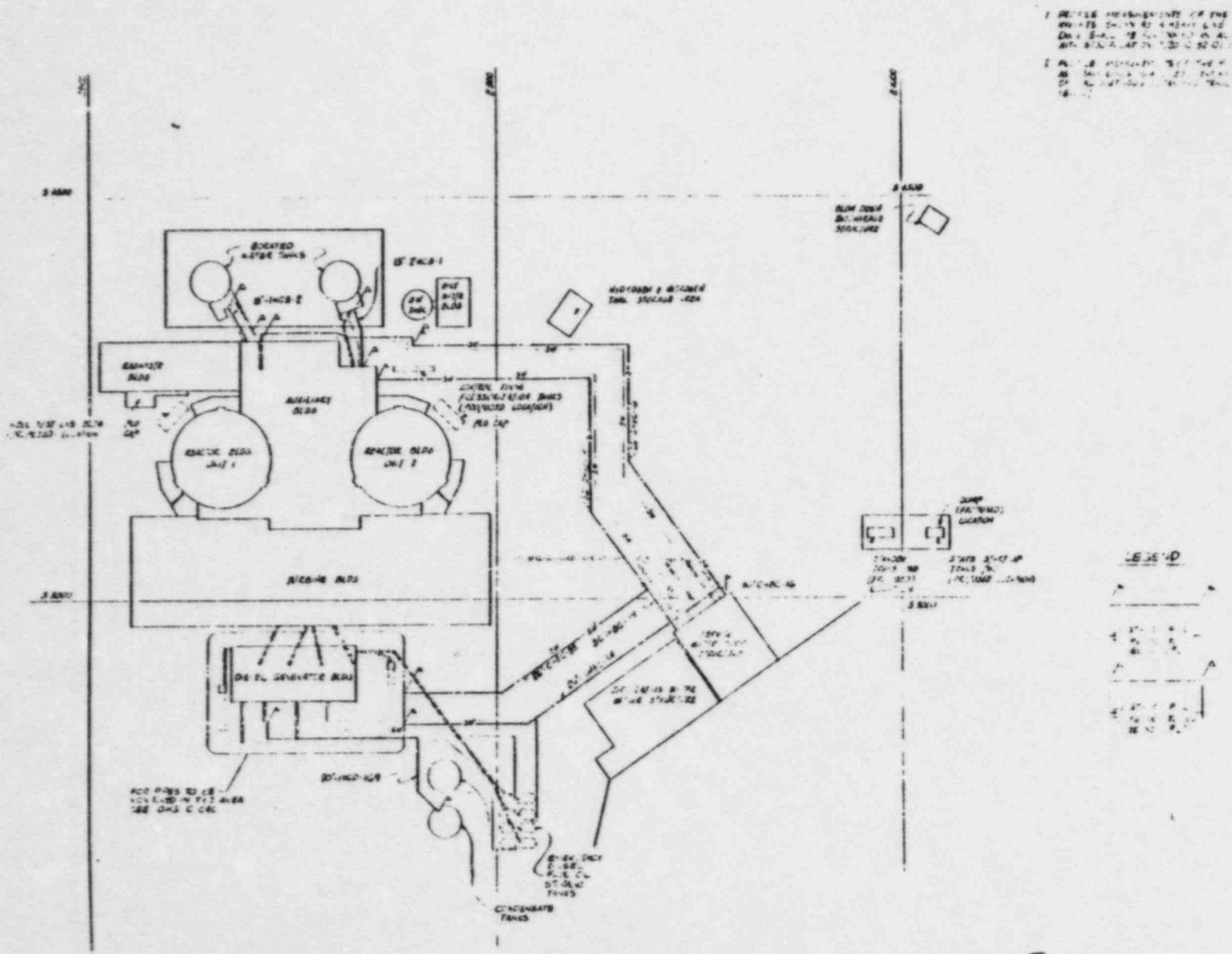
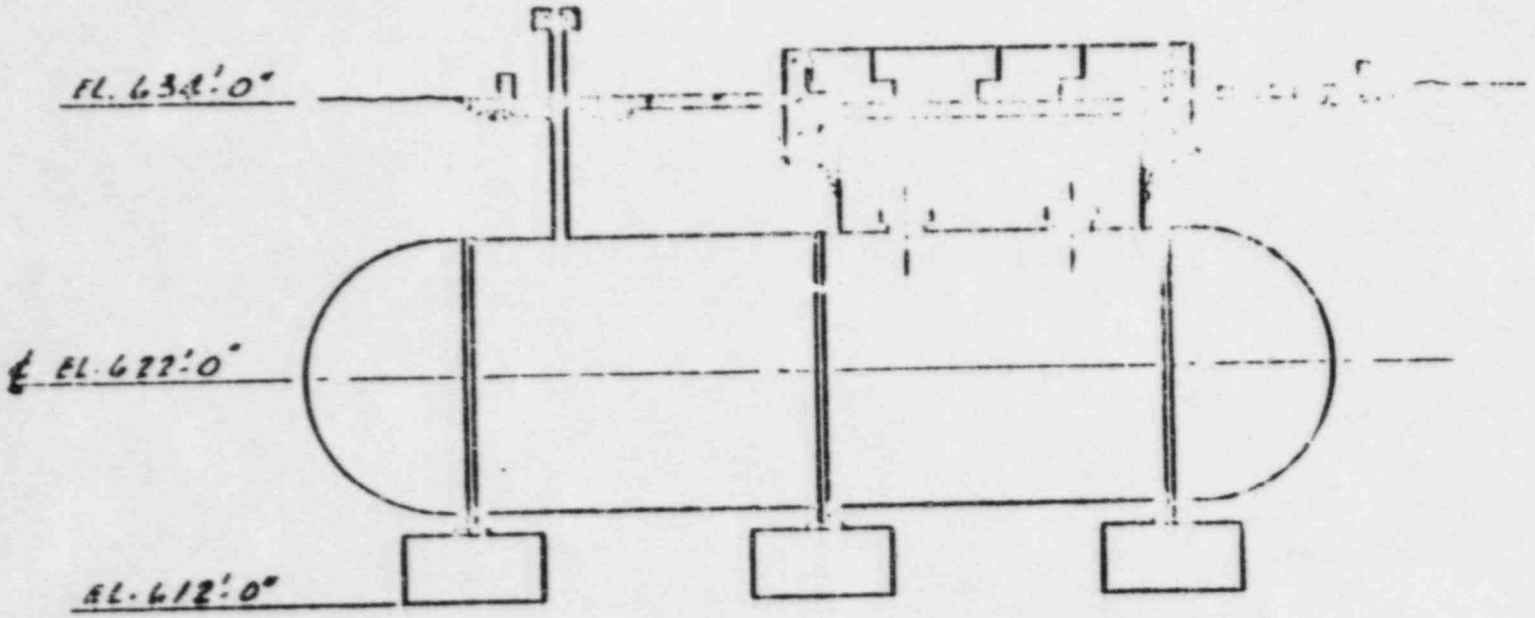


FIG. 2.1.1



ELEVATION

EMERGENCY DIESEL FUEL OIL STORAGE TANKS (2)

FIG. 2.4.1

G-1617-04

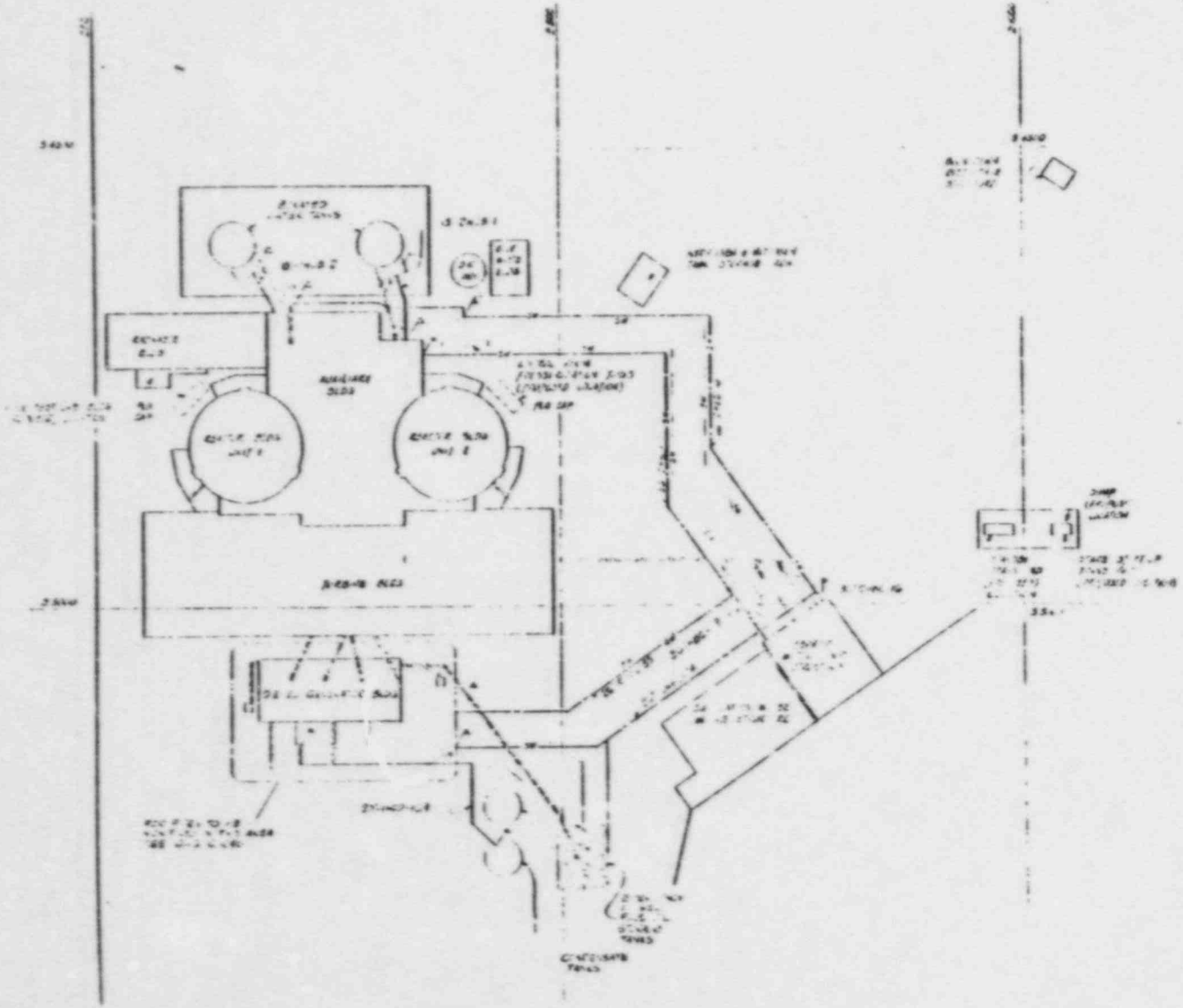
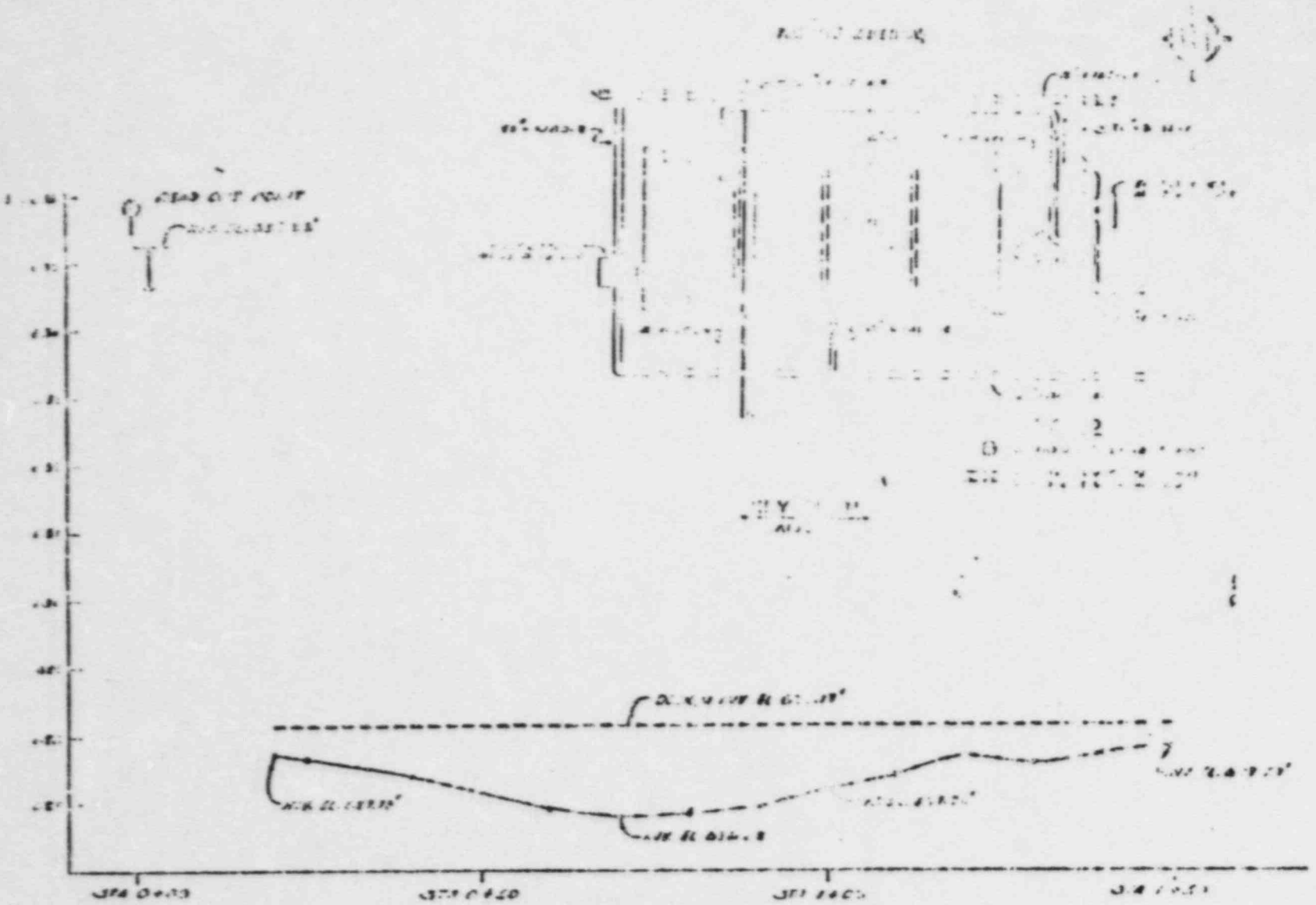


FIG 3.1.1



PROFILE

Title - Structural Backfill C-1.11

4

30

11:45 a.m.
4/19/74

CAHunt and/or [redacted]:

Would you be available this afternoon to get involved in a real hot technical approval requirement for Q-List material which is on the Critical Path right now of construction at the site? If so, I would like you to review the facts with Don Sibbald (80016 or -25) at the site and then get together with John Hink so that we can get a proper approval of the material that engineering would approve the Field to use.

MPHanson

jmb

Rixford — J. Hink

[illegible]: structural backfill

[illegible] Work - not include [illegible] [illegible]
Structural backfill to be done by Bechtel [illegible]
C-301 [illegible] [illegible] [illegible]
[illegible] material + compaction.
[illegible] cannot find specified material.
C-301 written with spec C-[illegible]

1. [illegible]
2. [illegible] not included
Soil testing not incl.
3. ASTM [illegible] [illegible]
4. [illegible] [illegible]
Materials D 422-63 72 Gradation
D 2049-69 [illegible]
D 2216-71 Moisture [illegible]
5. Backfill
Wall requirement,
Requires much inspection

Cohesionless free draining
[illegible] -
[illegible] backfill

5.2 Placement clean

subgrade ok

No large lumps clods

No frozen surface + no frozen until 12"

5.3 Power tampers - size required & adequate compaction.

5.4 [illegible] % Relative Density

5.5 Testing

frequency 1 in 500 CY large areas

1 in 10 [illegible] CY

CAH:

Found attached on my desk after lunch Friday

Talked to Don Sibbald who told me that Bechtel is currently using lean concrete as backfill under the extended portions of the Aux Bldg at a cost of about $20/yd³ + labor and equipment. About 150 to 200,000 yd³ are involved.

Sibbald told me that Bechtel had a procedure (C-301 Rev 0 Dated 10-10-73) specifying the gradation of backfill material thinking it was available on site. The material on site will not meet that spec and since no Tech Spec had ever been made up to purchase, Bechtel went to concrete. Sibbald has prices for offsite material to meet spec at delivered cost of about $3.25/yd³. Material on-site can be supplied at a cost of about $0.75/yd³ that comes close to meeting original spec and it was Sibbald's understanding that the material would be useable if the spec were changed slightly. This is Q-List material. Sibbald and MPH were asking for verbal approval of the gradation at C-; So a procurement spec could be made up to purchase off-site material. Sibbald would like Bechtel to buy

enough to keep the job moving while the on-site material is checked to see if it could be used Called John Hink but he was arranging a conference call with Sibbald, Hink, Bechtel Soils and myself to resolve.

Results of Conference call: Sibbald not included

C-301 had been prepared assuming on-site availability Gradation specifies very low fines content (passing 200) to avoid Liquifaction probabilities. On-site material runs about 20% passing 200

C-21 is being prepared based on C-301 to enable purchase of off-site material. Spec will not be ready until Monday after J. Allen returns. Allen was original ~~Author~~ soils engineer on project.

Hink will call again monday to clean up
I told Hink I felt ~~the~~ cost differences appear to make it preferable to use sand even if it had to be imported

Hink also would like to arrange a meeting with you at A2 to review the PMF report prior to a meeting with the AEC coming up shortly
April 25 or 26

• Gradation for Structural Backfill as received by telephone

Size	% retained fine	% retained coarse
1"		0
#4		25%
#10	0%	50%
#40	40%	45%
#200	95%	

EXHIBIT D

Bechtel Associates Professional Corporation
Ann Arbor, Michigan

I SPEC

TECHNICAL SPECIFICATION

FOR

SUBCONTRACT FOR

AREA DEWATERING SYSTEM

FOR THE

CONSUMERS POWER COMPANY

MIDLAND PLANT

MIDLAND MICHIGAN

~~8405230053~~

No	DATE	REVISIONS	BY	CH'K	APPR
2	11-12-79	Revised as noted on facing sheet; INC SCN 9001			
1	7/11/79	Issued for subcontract - revised as noted on facing sheet			
0	6/18/79	ISSUE FOR BIDS			

ORIGIN: BAPC

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1&2
MIDLAND MICHIGAN

JOB No. 7220
SPEC DES GUIDE No. C-88-Q
REV 2

SHEET 1 OF

AA-G-100373

SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.
1	2												
11	2												
111	2												
1	2												
2	2												
3	2												
4	2												
5	2												
6	2												
7	2												
8	2												
9	2												
APPENDIX A													
A-1	0												
1	2												
2	0												
3	0												
4	0												

NO.	DATE	REVISIONS	BY	CHK'D	APP'D	NO.	DATE	REVISIONS	BY	CHK'D	APP'D
2	11/14/79	Revised shts. i,ii,iii 1-9,App A sht 1									
1	9/11/79	Issued for subcontract; rev. sh. i,ii,iii,2-9									
0	10/12/77	ISSUE FOR BIDS									

BECHTEL

FACING SHEET

AREA DEWATERING SYSTEM
CONSUMERS POWER COMPANY
MIDLAND POWER PLANT UNITS 1&2
MIDLAND, MICHIGAN

JOB No. 7220

C-88-Q

Rev 7

AA-G-1142/3

TECHNICAL SPECIFICATION

FOR

SUBCONTRACT FOR

AREA DEWATERING SYSTEM

CONTENTS

1. SCOPE

A. GENERAL

1) The work to be performed under this Subcontract shall consist of designing a dewatering system capable of lowering the groundwater to a minimum elevation of 580 feet with the pond at el 627'±. The lowering of the groundwater will allow others to excavate portions of the auxiliary building and feedwater isolation valve pit in a dry condition. This specification includes Q-listed work to be performed exclusively by Contractor as noted in Article 7.

B. ITEMS INCLUDED

1) Design, furnish, install, maintain, operate, and remove dewatering system as indicated in the design drawings.

2) Provide and maintain standby equipment and power of sufficient capacity to perform the intended work.

3) Install, maintain, and observe observation wells and/or piezometers and test pits for logging the water table elevations at the locations as required and approved by Contractor.

4) Dispose of the groundwater to the cooling pond by installing a piping system from the dewatering system indicated in the drawings to the site storm drain system. 3

5) Provide protection of the dewatering system in areas designated as construction access as shown in the drawings.

6) Grout placement for all dewatering holes and wells upon completion of the subgrade dewatering.

7) Install 1/4-inch petcocks, bushing, and nipples at each dewatering well for obtaining samples of the return water.

8) Provide all reducers, couplings, piping etc necessary to adapt Contractor's flow meters to discharge line, fire hydrant, and recirculation line. 4

C. RELATED ITEMS NOT INCLUDED

1) Access roads to the area

2) Inspecting the water being pumped to determine the amount of fines being removed. In this specification, fines are defined as any nonorganic materials coarser than 0.005 millimeter. 5

3) Concrete grout for sealing holes and wells

4) Excavation required (trenching) to provide the areas for installing the dewatering systems

5) Location of all utilities, embedded plant facilities, and other subsurface structures at the location of the dewatering system

6) Drilling holes through the turbine building and auxiliary building concrete floors at elevations 614' and 634' at the locations required by Subcontractor

7) Repairing the holes drilled in the auxiliary building and turbine building concrete floors

8) Electrical power to operate the pumps

9) All lines, grade, survey, excavation, fill, backfill, and protection of dewatering equipment at the road or ramp crossing as necessary

10) Repair and/or replacement of any utilities, embedded plant facilities, and/or other substructure damage encountered at the locations indicated by Contractor for locating eductor wells

2. QUALITY STANDARDS

A. GENERAL

1) Subcontractor shall be responsible for the quality of items and services to meet the requirements of this specification, applicable codes and standards, and other contract documents.

3. SUBMITTALS

A. STANDARD FORMS

1) Engineering document and quality verification document requirements are summarized in Form G-321-D and are augmented by detailed requirements in this specification.

B. PROCEDURES

Subcontractor shall submit the following procedures (in detail) to the satisfaction of Contractor.

1) Dewatering plant area procedure

2) Test pits procedure

3) Observation wells

4) Jetting procedure

5) Grouting procedure

4. SERVICE REQUIREMENTS

A. OPERATIONAL REQUIREMENTS

1) An adequate dewatering system shall be installed to lower and control the groundwater to provide a dry condition during construction, excavation, and placement of fill materials. The dewatering system shall be capable of lowering and continuously maintaining the groundwater level to el 600' initially so construction work can start and then lowering and maintaining the groundwater level as directed by Contractor to a minimum elevation of 580' until a written directive from Contractor to cease dewatering operations has been received.

2) Deleted

3) Contractor shall provide operating electrical power. The drawing will indicate these locations.

B. SUBCONTRACTOR'S RESPONSIBILITY

1) Subcontractor shall be solely responsible for the design, installation, operation, and removal of a dewatering system. This system shall prevent the loss of fines in the soil, seepage, boils, quick conditions, or softening of the foundation strata. The stability of sides and bottom of excavation shall be maintained, thereby resulting in every phase of the excavation and construction being performed in dry conditions.

C. DATA AVAILABLE

1) The subsurface data and preliminary pump test results are available upon request and are for Subcontractor's information only. Subcontractor assumes the responsibility for any deductions, interpretations, or conclusions made on the basis of these data.

2) The test boring report and the Dames and Moore Report for this plant are located at Contractor's office and are available for review.

3) The estimated elevation of the groundwater table is 627 feet.

D. APPROVAL OF DEWATERING SYSTEM

1) Approval by Contractor of the dewatering system proposed by Subcontractor will be only with respect to the basic methods Subcontractor intends to use. Approval of the dewatering system will be based on the demonstrated performance of the system to satisfy the requirements for dewatering as specified.

E. CONTROL

1) The observation wells, piezometers, and measurements of fines shall be used as a primary basis of determining compliance with the requirements of this specification. 2

2) Test pits shall be used only as directed by Contractor in writing.

5. FIELD OPERATIONS

A. GENERAL

1) Subcontractor shall furnish, install, operate, and maintain the dewatering system and, upon completion, remove all dewatering equipment except as approved in writing in advance by Contractor. Subcontractor shall perform all associated work required to remove and control the subsurface water so that the excavation, construction, and backfilling operations can be performed completely in dry conditions as approved by Contractor. All associated work required to remove and control localized pockets of trapped groundwater within the excavation will be done by others. 2

B. TRENCHING

1) Contractor shall perform excavation where required to allow for installation of the dewatering system.

C. TESTING DEWATERING SYSTEM

1) Prior to any excavation below the groundwater level, the dewatering system shall be tested and placed in operation to lower the water levels as required and shall function continuously as required to provide a dry construction area. The pumping shall continue until the excavation and backfill operations are completed to the upper limits of the original groundwater level. Subcontractor shall obtain written approval from Contractor before discontinuing the dewatering operation.

D. DISPOSAL OF WATER

1) Subcontractor shall be responsible for all surface and subsurface water resulting from its operations and shall dispose of all water removed from the dewatering system in a manner that will not endanger public health, property, or any portion of the work under construction by other Subcontractors and associates working in the area. The water shall be conveyed through piping from the dewatering system to the existing site storm drain system only after it has been monitored for fines. 2

E. STANDBY EQUIPMENT

1) Subcontractor shall provide standby equipment installed and available for immediate operation as may be required to maintain the dewatering adequately on a continuous basis in the event that all or any part of the dewatering system may become inadequate or fail.

2) Subcontractor shall provide and maintain, in an operable condition, standby diesel-powered pumps and/or generators of sufficient capacity to start and operate all pumps and other required dewatering equipment for the duration of the dewatering.

F. OBSERVATION WELLS

1) Subcontractor shall supply, install, take measurements, and maintain the required number of observation wells and/or piezometers and such additional observation wells as may be ordered by Contractor. Water levels in the observation wells and/or piezometers and volume of water shall be recorded and submitted to Contractor daily, Monday through Friday, during dewatering.

2) The observation wells shall be of a type that will permit portions of the riser to be removed as the excavation work progresses. The proposed type shall be submitted to Contractor for approval prior to installation.

3) Subcontractor shall, by adding or removing water from all observation well risers, demonstrate that the observation wells are functioning properly prior to commencement of dewatering.

4) Any observation wells and/or piezometers that become inactive, damaged, or destroyed by Subcontractor shall be replaced within 24 hours by Subcontractor at no additional expense to Contractor.

5) Jetting shall not be used for the installation of the observation wells/dewatering wells under any structure. Controlled jetting may be used for the installation of the observation wells/dewatering wells outside the structures, provided the jet water is brought up through the inside of the jetted casing and does not blow up the outside of the jetted casing. The above is applicable after the casing has been installed 10 feet below the ground surface. Jetting shall be done in accordance with the Subcontractor's approved procedure. 1

G. DEWATERING

1) Subcontractor shall be solely responsible for the arrangement, location, and depths of the dewatering system necessary to accomplish the work described under this section of the specification. Limits of the work are shown in the drawing. The dewatering shall be accomplished in a manner that will reduce the hydrostatic head in water-bearing strata below any excavation to the extent that the water level and piezometric water levels in the construction area are substantially (a minimum of 3 feet) below the prevailing excavation surface; will prevent the loss of fines, seepage, boils, quick conditions, or softening of the foundation strata; will maintain stability of the sides and bottom of the excavation; and will result in all construction operations being performed in a dry condition. For the area outside of the structures where pervious soil strata overlay considerably less pervious soil strata above the subgrade level, the groundwater in the pervious strata shall be lowered to within less than 2 feet of the top of the less pervious strata. As the area is excavated to the top of the less pervious strata, any groundwater remaining perched in the pervious strata above the less pervious strata shall be removed by others. If the water bearing strata are found to be absent, the well location shall be abandoned and the hole shall be sealed in accordance with Paragraph 5.G.7 of this specification. 2

2) The dewatering operation shall be controlled in such a manner that the amount of fines of the soil in the discharge water shall be limited to 5 ppm. This is to be determined by measuring the amount of fines in the return line and discharge line corresponding to the quantity of groundwater measured at the discharge line. 2

a) All dewatering and observation wells located within the turbine building shall be installed using stainless steel well screen and risers. Unless directed otherwise in writing by the onsite geotechnical engineer. 2

b) Dewatering wells located outside the turbine building area may be installed with a 6-inch diameter well screen, provided there is a sufficient quantity of sand and approval is obtained from the Contractor's onsite field geotechnical engineer. ⚠2

3) Jetting procedures shall be approved in advance in writing by Contractor and as indicated in Subparagraph 5.F.5 of this specification. ⚠2

4) If the dewatering requirements are not satisfied because of inadequacy or failure of the dewatering system, loosening of the foundation strata and/or instability of the slopes may occur. The supply of all labor, materials, and the performance of all work necessary to carry out additional work for reinstatement of foundation soil resulting from such inadequacy or failure shall be undertaken by Subcontractor to the full satisfaction of Contractor, and at no additional expense to Contractor.

5) Prior to any excavation below the groundwater level, the dewatering system shall be placed into operation to lower the water levels as required and then shall be operated continuously 24 hours a day, 7 days a week until construction and placement of the subgrade structure and backfill has been satisfactorily completed and no longer requires dewatering, as notified by Contractor in written form.

6) Subcontractor shall obtain written approval from Contractor before discontinuing the operation of the dewatering system.

7) Subcontractor shall seal, with 2,000 psi minimum concrete grout, any dewatering equipment buried or left in place under the structure and all observation wells, test pits, and holes after the dewatering operation is discontinued in accordance with the latest Michigan Wells Act.

6. INSPECTION

A. CONTRACTOR

1) Contractor shall inspect the effluent of the well points to determine the amount of material (fines) being removed by the dewatering operation. This monitoring is Q-listed and shall be in accordance with 10 CFR 50, Appendix B.

2) The dewatering system shall be accepted by Contractor based on the difference in quantity of fines measured in the return line and discharge line and correlated with the quantity of groundwater being discharged ⚠2

through a water meter calibrated in gallons. The average quantity of fines shall not exceed the ratio of 5 ppm. The average quantity of fines shall be determined by testing a sample of water from the return line and the discharge line every Monday and Thursday that the pumping is in operation using a 1-liter Buchner funnel. The filter paper shall not be coarser than 0.005 millimeters. The corresponding number of gallons of groundwater pumped through an In-Line flowmeter located on the discharge line shall also be recorded by Contractor and the average ppm calculated. Contractor shall also monitor the number of gallons of recirculating water in Subcontractors eductor system. Contractor shall supply the 1-liter Buchner funnel and filter paper (no coarser than 0.005 millimeters) for the testing, and three flowmeters; one on the recirculation water line (10-inch Sparling In-Line with totalizer, Saddle Mount Series FM112) one on the discharge line (6-inch Sparling In-Line with totalizer Saddle Mount Series FM112) and one on the hydrant (3-inch Sparling In-Line with totalizer Series 162). If an individual test indicates the fines are greater than 5 ppm but the average ratio of fines to ground water pumped is less than 5 ppm, Subcontractor shall be alerted. If the quantity of fines exceeds the average ratio of 5 ppm for the total quantity of groundwater pumped, Subcontractor shall be notified that it has 24 hours to correct the condition. If, after 24 hours, Subcontractor has not been able to correct the problem, Contractor shall begin a systematic testing of each individual dewatering well. Any dewatering wells found to produce greater than 5 ppm of fines shall be repaired by Subcontractor or removed from the system. Subcontractor shall notify Contractor whenever it intends to purge any collected fines from the eductor tank. Subcontractor will estimate the quantity of water purged, and Contractor will collect all material from Subcontractor's eductor tank. The discharged bottom material shall be sieved through a Number 325 U.S. standard screen. The collected material shall be retained and stored for inspection by the onsite field geotechnical engineer. 2

3) Each individual well shall be inspected by Contractor during installation in accordance with the following criteria. After the initial 15 minutes of pumping, the effluent shall be tested for fines using a 1-liter Buchner funnel. 2
   a) If the fines observed are 10 ppm or less, the well shall be accepted. 2
   b) If the fines observed exceed 100 ppm, the well shall be rejected and pumping stopped. 2
   c) If the fines observed are less than 100 ppm, but more than 10 ppm, the pumping shall stop. The well may be retested in accordance with the above 2

criteria after a minimum of a 1-hour delay. If the well has not met the acceptance criteria for fines within three retests, the well shall be rejected and pumping stopped.

4) Records shall be maintained for each well and for the entire system, including the amount of fines (ppm) each time readings are taken. | 2

B. SUBCONTRACTOR

1) Subcontractor shall perform all inspection and recording of the piezometers/observation wells in accordance with its approved procedure. All other inspection shall be in accordance with Subcontractor's approved procedures.

7. CLEANING AND RESTORATION

A. Subcontractor shall leave the work area in the same condition as prior to the start of operation and to the satisfaction of Contractor.

8. QUALITY ASSURANCE REQUIREMENTS

A. The monitoring of the fines of the soil in the discharge water is Q-listed and shall be performed and controlled by Contractor's quality assurance program.

B. Contractor has the authority to stop or regulate any part of the dewatering operation to prevent damage to any part of Contractor's work.

9. MEASUREMENT FOR PAYMENT

A. BASIS OF MEASUREMENT

1) The measurement of payment shall be in accordance with the terms of the subcontract. | 2

APPENDIX A

DOCUMENTATION REQUIREMENTS

1.0 The Subcontractor shall furnish documentation in accordance with the specification as summarized and directed by form G-321-D. To complete form G-321-D, the Subcontractor shall check in column 8 which documents are being transmitted, and shall sign line 21. The Subcontractor shall fill in lines 13 through 20 as applicable. Entries such as N/A (not applicable) and "See attached sheets" are permissible. The completed G-321-D form 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

Specification 7220-C-88(Q)
Appendix A

2

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 Conformance Check	9. Inspection Release	10. Engineering Review	11. Field QCE Check In	12. Remarks
4.2E	3.B.5	Reproducible	1	1	X		N/A						
		Microfilm											
4.2F	3.B.1 3.B.2	Reproducible	1	1	X		N/A						
		Microfilm											
4.2E	3.B.3 3.B.4	Reproducible	1	1	X		N/A						
		Microfilm											
8.0E	4.D.1 5.F.2	Reproducible	1	1	X		N/A						
		Microfilm											
25.0V	4.E.1 5.F.1	Reproducible	N/A				2	B	⚠				
		Microfilm											
27.0E	4.D.1 5.C.1	Reproducible	1	1	X		N/A						
		Microfilm											
27.0V	4.D.1 5.C.1	Reproducible	N/A				2	B	⚠				
		Microfilm											
		Reproducible											
		Microfilm											
		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 — This 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

BECHTEL 6-321-0 AA REV 2 5/74	MIDLAND PLANT UNITS 1 AND 2 CONSUMERS POWER COMPANY	JOB NO. 7220 P.O./SPEC. NUMBER 7220-C-88(Q)
	ENGINEERING AND QUALITY VERIFICATION DOCUMENT REQUIREMENTS	SHEET 1 OF 4 REV. 2

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.	Code b. With hardware shipment	Code c.
Bechtel Associates Professional Co. P.O. Box 1000 Ann Arbor, Michigan 48106 Attn: Project Engineer, Job 7220	Bechtel Power Corp. 3500 E. Miller Rd. Midland, Michigan 48640	N/A

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 this column, and include the authorization documents) in the Verification Document Package.
13, 14, 15	Enter information as required.
1.	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, cable 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 SUPPLIER SHIPPING PREPARATION PROCEDURE (E)

DOCUMENT CATEGORY DEFINITIONS

(E) – Engineering Documents. This term comprises procedures, drawings, specifications, QA plans, prototype qualification test reports, and other similar documents that require Bechtel approval prior to fabrication, or prior to use of the document in the design, fabrication, installation, or other work process. 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 procedure specification and supporting welding procedure qualification test records required for welding, hard facing, overlay, brazing and soldering. A verification report of welds performed includes the identification of the qualified welder(s), and the procedure(s) used, and certification that the welder(s) were qualified.

13.0 WELD ROD CONTORL PROCEDURES (E), AND VERIFICATION REPORTS (V) – The procedures for controlling issuance, handling, storage and traceability. Verification report(s) for weld rod are defined as certified material test reports which include the requirements defined by the code and material specification imposed by the procurement documents.

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 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.

Send to Chuck Hunt
via JAX.

FEB 2 6 ...

PROBLEM: "UNCOMPACTED BACKFILL" Plant Area-does not Include Dikes

	IS	IS NOT	DISTINCTION	CHANGES
WHAT?	D/G Bldg.	Power Block	Recent Plant Area Fill	Use of both C-210, C-211 Prior - used only C-210
	X-Former Pads	Evaporator Bldg	Not part of Dike/ North Plant Area Fill	Sand & clay vx clay alone
	Condensate Tanks	Cooling Tower	Fill placed during different time periods	Two contractors - Bechtel & Canonie
	Radwaste Bldg*	Steam Tunnel	Last ares to be backfilled	Bechtel used C-211
	Tank Farm*	Service** Water	Settlements seem to occur in spread type footings	Large equipment to large & small equipment
	*Not as significant or wide spread as other areas	Circulating Water	Excavation/Re-excavations (significant areas	Use of ramps/temporary fill
	Guard House	**Problem exists with sands around structure but not under		
WHEN?	Occurred After 1975	Prior to 1975	Slowdown of 75 with personnel changes	Specification interpretations by didfferent individuals
			Late in jobless emphasis on civil work	deletion of 4" lift requirement
			Cooling Pond Filled	Urgent need to see work completed
				Sand/structural fill used together with clays
				Qualification of personnel may have changed
				Differing weather conditions
				Rebar problems occurred

PROBLEM: "UNCOMPACTED BACKFILL" Limited to Plant Area - does not Include Dikes

	IS	IS NOT	DISTINCTION	CHANGES
	Plant Area Fill AFter 1975	Plant Area Fill prior to 1975	Sand incorporated in fill	Sand/clay interfaces - softing of clays due to watering
E X T E N T ?	elev 612' & above	Below elev 612'	Smaller areas of fill	Larger lift thickness for equipment and harder to control lift thickness
	Most significant problem area south & southeast of Turb Bldg		Most extensive examination re-excavations	Introduction of smaller equipment
		Glacial Till Undisturbed	Require handling & Placement by Equipment	
W H E R E ?	Backfill (clay) (sands)	Natural sands	Clays - N/W Plant dike sand/clay rest of area	More mixing & material interfacing
		Backfill Concrete	Area exposed the longest during construction	More winters
		North/West Plant Fill		

Test	Possible Causes			Cause
	Yes	No	?	
Use of different Specification	X			Problem is only associated with areas which used Spec C-211
Recent Work		X		
Not Part of Dike/Plant (N/W) Area			X	
Placement of Fill during different periods	X			Different personnel different equipment
Last Areas to be Backfilled	X			Schedule pressures
Occurs on spread FIGS	X			Design may be deficient
Excavations Re-Excavation	X			Most significant problem in area where most excavation/re-excavation occurred
Introduction of C-211	X			Differing requirements/people/ interpretations
Different Materials	X			Differing methods for compaction - addition of water to sands
Use of small equipment	X			Not able to compact as effectively (no test pads for small equipment qualifications)
75 Slow Down	X			Changes in personnel and discontinuing of work
Filled Cooling Pond		X		Designed to be in saturated condition
Less emphasis on civil work	X			Less supervision and inspection
Specification intrepretation	X			Relates to personnel
Larger lifts per spec.	X			Coupled with small equipment

Test	Yes	No	?	Cause
Schedule pressures	X			Complete work hastily
Personnel qualifications	X			No soils engineer on site
Smaller fill areas	X			Relates to equipment and lifts
More Freeze-thaw cycles	X			These areas filled during several winters
Weather (dry or wet) also when material was placed			X	
Removal of temporary ramps and fill	X			Uncompacted materials placed and left in large amounts
Rebar Problem occurred	X			Deals - priorities for inspection/ extent of inspection

ACTION PLAN

1. Define problem areas better by boring logs and TOPO's (PMO - work on this).
2. Define problems by elevations (use boring logs) (PMO - QA later).
3. Define difference between C-211 and C-210 (QA).
4. Define what work was done by Bechtel and Canonie (PMO).
5. Define where trenches were made (excavations) (photos, TOPO's, etc) (PMO - QA).
6. List all equipment used by a) Bechtel
   b) Canonie
   (photos, rental sheets).
7. Look at changes in personnel/qualifications (QA, PMO).
8. Look at assignments of supervision to earthwork by period.
9. Look at telecons/FCR's to spec, DR's (QA).
10. Look at specs and also photos.
11. Look at rate fill in areas where there was problems (PMO).
12. Check problem areas with completion of the year's work (freeze - thaw) do with 4.
13. Look at number of QC people assigned to soils, their time involved with soils (IR's, FE Reports).
14. Ramps - Check photos, TOPO's, compare with borings (also gravelly areas in borings)

    (can do in conjunction with 12, 4) (QA, PMO).
15. Review weather date for periods of problems (PMO).

DEMARCATION STATEMENT:
"INSUFFICIENTLY COMPLETED BACKFILL"

	Is	Is Not	Distinctions	Changes
WHAT	DG Bldg Admin Bldg Transf FND Cond Tank Area Diesel Tanks	Pond Dikes Plant Area Dikes Incl Evap Bldg Cooling Tower Radwaste Bldg Tank Farm Area Pipe Tunnel	Spec / Acceptance Criteria Diff Material	Reliance on Testing Introduced Struct Backfill C-211
WHERE	Plant Fill Area	Glacial Till (Undisturbed) Insitu Natural Sand Backfill under Powerblock N&W Plant Dikes Pond Dikes (1) Undisturbed Plant Fill (? Cond Tank Area)	Smaller Areas Temporary Fill Ramps Q-Listed Process (Inspection)	Small Equipment Nonuniform Compaction Different Contractors Test Frequency

Preliminary 2/15/79

POSSIBLE CAUSES

Test		Cause
SPECIFICATION/ACCEPTANCE CRITERIA	No	Used All over Site
TESTING	✓	Questionable, under Review, Check RW
DIFFERENT MATERIAL (3)	?	Under Review, Relates to Proctors
STRUCTURAL BACKFILL	No	Used All over Site
REEXCAVATED AND REFILLED AREA (Procedures and Controls)	✓ ?	Investigate Photos, Procedures, Controls
SMALLER AREAS	No ?	Subcategory of Reexcavated Area
NONUNIFORM COMPACTION		Used All over Site
SMALL EQUIPMENT (Large Lifts)	✓	Review Photos
TEMPORARY FILL NOT REMOVED ?	✓	Review Photos
RAMPS NOT REMOVED ?	No (6)	
DIFFERENT CONTRACTORS	?	Check RW
TEST FREQUENCY		

Preliminary 2/15/79

POSSIBLE CAUSES (Cont.)

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

Preliminary 2/15/79

ITEMS TO INVESTIGATE FOR MOST PROBABLE CAUSE(S)

REEXCAVATION AND BACKFILL
- Material Selection
- Inadequate Procedures & Controls
- Review Photos, Procedures, Controls & Subcontractor Daily Reports

TEMPORARY FILL AND RAMPS NOT REMOVED
- Inadequate Procedures & Controls
- Review Photos, Procedures, Controls & Subcontractor Daily Reports

Q-LISTED PROCESS-INSPECTION PROCESS (4)
- Review Surveillance & Inspection Procedures in Relation to Other Findings
- Audit Procedures Bechtel and Canonie

TESTING
- Results are Questionable - Relied on (4)
- Testing is under Review
- Procedure Changed 9/78

PERSONNEL
- Minimal Involvement of Technical Support after 74-75 Slowdown
- Bulk of Earthwork Complete
- Review Qualifications of Testing, Inspection, & Supervisory Personnel

Preliminary 2/15/79

TR1 x C FEB 2 2 ...9

To CAHunt, P14-209B

From TCCooke/RWG

Date February 20, 1979

Subject MIDLAND PROJECT GWO 7020 - SETTLEMENT OF MIDLAND DIESEL GENERATOR BUILDING
File: B3.0.3 Serial: CSC-3852

Consumers Power Company

INTERNAL CORRESPONDENCE

CC GSKeeley

Reference: CPCo Memo - DRW-12-78 and DRW-13-78

In reference to the comments presented in DRW-13-78, we provide the following response for each numbered comment.

1. Although the Bechtel summary reports the percentage as percent compaction, it is in fact percent relative density. A relative density of 125% does seem to be unreasonable, however, our efforts have been focused on clays. A number of proctor curves have been examined for compatibility with the zero air voids curve and some of these tests fall outside the curve which would indicate the selection of an incorrect standard for that particular type fill.

2. Many tests were conducted other than those attached. A ramp was constructed in this area and these tests were not included but tests were available.

3. Tests are requested to be taken every 500 cubic yards. There is no specification requirement to locate tests under buildings, utilities, or other references. Therefore, test locations are randomly selected.

4. With the addition of the ramp tests, the number of tests appear to exceed the amount required. Since location is not addressed by the specification, we cannot address the question of test locations.

5. In determining the causes for this problem these items are being examined.

6. The borings and resultant tests are being examined both by Bechtel and the consultants.

7. An extensive monitoring program has been implemented to identify the magnitude of differential settlements.

8. The settlement rate for the Diesel Generator Building is significantly greater than that observed in other structures.

9. There are no settlement vs. time curves to compare the to date settlements with, but continued monitoring has shown that during the preload cycle the settling has started to slow down and to

level off as more weight is added to the area around the buildings. It is safe to say, however, that the to date settlements exceed Bechtel's expectations.

We hope this satisfactorily addresses your comments. We assume that any other comments or questions have been brought out at subsequent meetings with Bechtel's consultants and ourselves, which you have attended.

Should you have any further questions, please contact us.

plw

MEETING NOTICE

MAY 2 5 1979

BECHTEL JOB NO. 7220-101
PROJECT Midland

K-T. ANALYSIS

SUBJECT OF THE MEETING

Cause Investigation and Analysis of Plant Area Backfill Settlement Problems

DAY Wednesday, May 30, 1979

TIME 9:30 a.m. TO Noon

LOCATION Conference Room 7B3

ATTENDEES

Bechtel	Consumers
S. Afifi	D. Horn
A. Boos	C. Hunt
R. Castleberry (optional)	B. Wheeler
B. Dhar	
J. Hink	
P. Martinez	
G. Richardson	
J. Wanzeck	
K. Wiedner	

The addressee, checked above, if unable to attend, is requested to:

☒ NOTIFY CHAIRPERSON ☐ SEND REPRESENTATION

PURPOSE OF THE MEETING

- Discuss action items listed in March 12, 1979 meeting notes (each attendee is requested to prepare responses to the action items as appropriate)
- Prepare outline and strategy for cause presentation to NRC scheduled for mid-June, 1979.

☐ AGENDA ATTACHED ☐ MEETING NOTES WILL BE DISTRIBUTED

CHAIRPERSON	PHONE	DATE
Karl Wiedner	x 7169	5/22/79

AAO-618