NOV 1 2 1982

Docket Nos: 50-329 OM, OL
and 50-330 OM, OL

APPLICANT: Consumers Power Company

FACILITY: Midland Plant, Units 1 and 2

SUBJECT: SUMMARY OF JULY 27 - 30, 1982, AUDIT ON SOILS REMEDIAL ACTIVITIES

On July 27-30, 1982, the NRC staff and its consultants met in Ann Arbor, Michigan with Consumers Power Company (the Applicant), Bechtel and their consultants to audit analyses, designs and preparations for remedial measures to correct the foundations and utilities on inadequately compacted fill soils at the Midland site. Meeting attendees are listed by Enclosure 1.

On July 19, 1982, the staff issued a draft of the second supplement for the Midland SER which primarily addresses the soils settlement review. A listing of the outstanding review items in this draft SSER was prepared by the applicant and served as the meeting agenda. The list was updated at the conclusion of the meeting to indicate which of those items had been included in the staff's audit. Enclosure 2 is the resulting agenda. The same-numbered items from Enclosure 2 are discussed below in this summary. Selected handouts provided during the meeting are shown as attachments within Enclosure 3.

General Items

1 - 5. Not included in Audit

6. NRC input into the final SSER will cover range of applied bearing pressures' static and dynamic loading

A draft of FSAR Table 2.5-14, including bearing pressure data for the Auxiliary Building (AB), was provided (Attachment 1). The staff reviewed the table, noted that the information was acceptable and that once provided for the docket and verified, this item would be technically closed.

7 & 8. The applicant was requested to determine that 1.5 x FSAR seismic response spectra analyses are conservative for the auxiliary building (AB), service water pump structure (SWPS), and borated water storage tank (BWST) in comparison to site-specific response spectra (SSRS).

The applicant has not provided comparative plots of floor response spectra that were requested by the staff for all buildings (seismic margin review).

The NRC structural engineering staff reviewed calculations at 5 points of elevation for the AB to determine if 1.5 x FSAR response

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spectra enveloped the results obtained by using the SSRS. For these five points, the floor response spectra generated by the use of 1.5 times the FSAR spectra enveloped the respective floor response spectra developed from SSRS. Additional locations in this and other structures will be addressed as part of the seismic margin study.

The applicant also noted that the use of the floor response spectra derived from the seismic margin earthquake would be according to the seismic margin review criteria submitted to the staff by letter of September 25, 1981. The results of the seismic margin review will be submitted to the staff during the first quarter of 1983.

9. Test data on #9 and #10 Fox-Howlett rebar splices with up to 2% strain

Copies of test data up to 2% strain for #9 and #10 Fox-Howlett rebar splices were provided to the NRC during the audit. Copies were also sent to the NRC consultant, Science Applications Institute by letter dated July 16, 1982.

The NRC found the information acceptable after preliminary review. Pending subsequent NRC discussions with its consultant, this item may be closed.

10. Identification, inspection, and repair procedures for concrete crack repair

Criteria for concrete cracks were agreed upon and will be documented by the applicant in a letter in early August 1982 (Post script: see applicant's letter of August 2, 1982).

The crack repair program applies to the DGB, SWPS, Control Tower and Electrical Penetrations Areas of the Auxiliary Building and Feedwater Isolation Pits, which will be completed prior to the first refueling of the plant. It consists of the following three points:

(1) Repair by epoxy injection any cracks in the structures which are below the permanent ground water table and which exhibit weeping characteristic. This repair will be performed from the inside of the structures.

(2) Coat the splash zone of the exterior surface of the south wall of the Service Water Pump Structure which is in contact with cooling pond water with waterproofing compounds. The waterproofing compound will be one of the three compounds recommended by consultants in their report "Effects of Cracks on Serviceability of Structures in the Plant".

(3) Repair by epoxy injection existing cracks which are 20 mils and larger and apply a sealant to the surfaces of the concrete walls in the following accessible areas (i.e. areas where removal of soil or installed equipment or installed components is not necessary to perform the repair). The extent (length) of the crack that will be injected with epoxy will include at least that portion with crack width of 10 mils or larger.

Prior to the initiation of repairs, all cracks 20 mils and larger and weeping cracks in the applicable areas will be identified. A verification of this identification to a tolerance of +5 mils will be performed. This verification and subsequent will be in accordance with the quality program. The material for structural epoxy adhesive will be "concresive-1380" manufactured by Adhesive Engineering Company, or equivalent.

The areas to be repaired for each applicable building are as follows:

DGB

(a) All accessible interior reinforced concrete walls.
(b) All accessible exterior concrete walls.

CT&EPAs

(a) All accessible exterior concrete walls.

SWPS

(a) All accessible exterior walls.

11 & 12. Not included in audit.

Auxiliary Building

1. Resolution of allowable vertical differential settlement and strain that will stop underpinning construction and require installation of temeporary supports

The NRC staff reviewed the allowable settlement calculation resulting from analysis of the construction condition using a subgrade modules of 70 KCF and analysis of reduced support along the EPA due to tunneling (Attachment 4).

Attachment 2 provides definitions of "alert", "action" and "requalify" levels which were agreed upon for underpinning activities. Attachment 3 provides numerical values which were agreed upon. The levels apply to Phases II, III, and IV.

This item was accepted by the staff.

2. Compaction control specification for granular fill beneath feedwater isolation valve pits (FIVPs)

It was agreed that the fill beneath the FIVP will be tested using the procedures outlined in the Seabrook FSAR. A copy of a similar FSAR section was provided by the NRC. It was also agreed that the fines portion of the fill shall be non-plastic. This will be verified by the resident geotechnical engineer by appropriate testing (hydrometer of Atterberg limits). The backfill will be properly moisture conditioned by soaking immediately prior to compaction. The soaking means will be approved by the resident geotechnical engineer. Compaction acceptance criteria will be 95% modified proctor or 85% relative density (whichever testing standard results in the maximum dry density) based on tests performed prior to placement. The applicant also committed to performing a laboratory compaction or relative density test to establish maximum dry density on soil material taken from each field density test location. Bechtel compaction control specification will be revised.

Additional compaction equipment (e.g. self propelled double drum compactor) will be qualified by the test fill method.

3. Methodology for transferring final loads to permanent underpinning wall

Preliminary copies of Mergentime/Hanson Drawings S-74 and S-74a (see SSER #2, Appendix I) not yet reviewed by Bechtel, were provided for staff review. Analysis of the permanent wall and preliminary design details were also reviewed. The review included methodology, rebar stresses in critical areas, and connection to existing structure. The staff found these items to be acceptable.

The transfer of loads will be accomplished by the use of hydraulically actuated steel jacks that are incrementally increased to the specific loads determined by the structural analyses. When the predetermined loads have been developed by the jacks, the loads will be maintained and locked off provided that the following criteria are met:

(1) The pier will be loaded to 125% of its specified jacking load and continued at the load until the relative movement between the top of the pier and the underpinning structure is less than 0.01 in. in a continuous 1 hour period. When this condition is satisfied,

(2) The pier load will be reduced to 110% of its specified jacking load and continued at that load until the relative movement between the top of the pier and the underpinning structure is less than 0.01 in. for a continuous 24-hour period. When this condition is satisfied, the pier will be locked off.

(3) Jacking loads for the permanent underpinning will be maintained at the specified value for at least 30 days.

(4) A semilogarithmic plot of settlement versus time will be developed to allow determination of when secondary consolidation has been reached.

(5) The settlement increment in the last 30 days of sustained load will not exceed 0.05 in.

(6) The settlement in the last 10 days of sustained load will not exceed 0.01 in.

(7) Wedges to be used for the permanent wall will be driven tight and permanently welded in place. In case a predicted jacking load is not obtained (when a 0.03-in. upward movement of the existing structure occurs) jacking loads should be reduced to 80% of the load at which the movement occurred and this load will be used in the analyses to determine subsequent jacking loads.

4. Updated scope of construction for Phases III and IV

The plan which describes the construction scope (Drawing 7220-SK-C-0101) (see SSER #2, Appendix I) was reviewed. A discussion was also held regarding construction sequence. The staff found these matters to be acceptable.

5. Resolution of pier and plate load test details on maximum test load, locations, and time for performing test

The load test will be performed on Pier W-11. The proposed load sequence is to jack the load from 0 to 50% of the bearing pressure allowed for the seismic loading combination, then decrease the load to 25%, and then increase the load to 130%. The staff agreed that no additional plate load test is required. The staff found these details to be acceptable.

6. Long-term settlement monitoring plan during plant operation

This is a technical specifications item. The information will be provided to the NRC as part of the FSAR technical specification submittal in October 1982.

7. FSAR documentation on as-built conditions

This is a confirmatory item which will provide the level of construction information typical of an FSAR. The information will be provided to the NRC once the appropriate construction stage has been achieved.

8. Design modification at freezewall crossing with duct banks

The applicant had previously committed to provide a report addressing the installed surcharge loading program, monitoring results and backfill techniques. The proposed method for backfilling monitoring pits will be provided prior to accomplishing the work. This carryover item from earlier meetings continues as a confirmatory issue.

9. Resolution of required depths of construction dewatering wells

The applicant agreeds with a staff position that, when excavating in cohesionless (natural or fill) soils, the groundwater will be maintained 2 feet below the advance of excavation.

In addition, a probing program will be used in selected piers. As a minimum, these piers include E12, W12, E10, W10, E7, W7, E4, W4, CT1, CT6, and CT12. Test holes between 1 in. and 4 in. in diameter will be advanced to a depth of 5 ft beneath the proposed bearing level (from a level 5 ft above the bearing level) in these 11 selected piers to determine whether groundwater under pressure exists in sufficient volume to require special pier dewatering. It water pressures are low, excavation to the bearing level will continue. If water pressures are shown to be high in the test holes, special dewatering (e.g., wellpoint or other suitable means) will be used to lower the water table at that pier to at least 2 ft below the bearing level. The hole beneath the final bearing level will be grouted. Although the available information indicates that the bearing stratum is a fairly homogeneous hard clay, it is possible that special pier dewatering will be needed. These holes will be used

by the applicant as a conservative measure to confirm subsurface conditions before the bearing level is reached. Interpretation will be done by the resident geotechnical engineer. This item is acceptable to the staff on this basis.

10. Monitoring matrix showing allowable settlements and strains

An updated copy of the monitoring matrix (Bechtel Drawing 7220 C-1493(Q), Rev. 1) (Attachment 7) was provided. Alert, action and requalify levels will be added as agreed above (AB Item 1).

The staff agreed that no alert or action level needs to be established for monitoring strain. However, the strain data are considered supplementary to understand the behavior of the building and strain levels greater than 0.0010 in/in. are a factor to be considered in the raising of the alert and action settlement levels. This item is acceptable to the staff on this basis.

11. Electrical penetration area (EPA) and control tower (CT) relative horizontal movement criteria

The NRC staff reviewed drawings showing the gap detail between the EPA/CT and the turbine building (TB). The minimum gap between structural members of the CT and TB is 3 in.; the minimum gap between structural members of the EPA and TB is 6 in.

The staff agreed that no acceptance criteria will be required for horizontal movement during underpinning. Data from the horizontal instrumentation measurements will be recorded and used as supplementary information to the differential settlement records in the overall evaluation of structure movement during underpinning work.

12. Changes in pier configuration

The applicant has determined that piers CT4X and CT9X located along Column line K_c at 5.9 and 7.2 will not be required. Piers will be required at H_k and 5, and at H_k and 8. The NRC staff reviewed Bechtel Drawing 7720-SK C-0101 (Rev. 0) and Mergentime/Hanson drawing S-74 (Rev. 2) showing the details of these piers (see SSER #2, Appendix I). This is acceptable to the staff.

13. Details on stiffened bulkhead during drift excavation

The NRC staff reviewed and agreed with the calculations of the drift/stiffened bulkhead design. The staff also

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agreed to constructing the drift support system in 2-foot increments, with lagging and tight backpacking completed up to the bottom of the EPA foundation slab and with an excavation bench on the FIVP side.

14. As-built plan for deep-seated benchmarks

The NRC staff reviewed Bechetel Drawings 7220-C-1490 and C-1491 (Attachment 7) showing as-built locations of the AB deep-seated benchmarks and found them to be technically acceptable.

15. Review of Specification 7220-C-200, Emergency Actions

The flow charts for the emergency actions of Specification 7220-C-200 were reviewed in detail. The staff found the flow charts to be acceptable.

Service Water Pump Structure

1. Complete staff review of sliding and lateral soil pressure calculation under dynamic loading

The NRC staff completed review of the sliding and lateral soil pressure calculation. Seismic loads equal to 1.5 times the FSAR SSE loads were used and were found to exceed SSRS loads. Factors of safety against sliding were 1.45 (N-S direction) and 1.50 (E-W direction), which exceed the staff's minimum requirement of 1.1. This technical item is closed.

2. Resolution of pier and plate load test details on maximum test load, locations, and time for performing test

The load test will be performed on Pier 1 (east side). The proposed load sequence is to jack the load from 0 to 50% of the bearing pressure allowed for the seismic loading combination, then decrease the load to 25%, and then increase the load to 130%. The staff agreed that no plate load test will be required. This technical item is closed.

3. Resolution of required depths of construction dewatering wells

For monitoring of construction dewatering at the SWPS, 12 piezometers will be provided. Six will be sealed in the zone from el 570' to el 590'. Soil sampling will be continuous from el 570' to el 585' in borings at the location of the six perimeter piezometers. The other six will be installed at the subcontractor's discretion.

The water surface will be maintained 2 feet below the bottom of pier excavations if sand is present within 8 ft of the pier foundations as indicated by the continuous sampling in the six perimeter piezometers. If sand layers are identified in the exploratory borings for the piezometer installations, the wells will be lowered to maintain the 2 foot requirement. The results of the explorations and the final installation depths of the dewatering wells are to be provided to the NRC staff when available. This technical item is closed.

4. Methodology for transferring loads from jacks to permanent wall and locking off

Drawing 7220-C-2035-Q Rev. 2, with the relevant parts of Specification 7220-C-194 showing final load transfer procedures, were reviewed by the NRC staff and found to be acceptable. This technical item is closed.

5. Long-term settlement monitoring plan during plant operation

This is a technical specification issue. The information will be provided to the NRC as part of the FSAR technical specification submittal in October 1982.

6. FSAR documentation on as-built conditions

This is a confirmatory item with technical issues resolved. The information will be provided to the NRC once the appropriate construction stage has been achieved.

6a. Strain monitoring to measure acceptable allowable strain

The NRC staff's evaluation of the applicant's June 14, 1982, submittal indicated the proposed 5/16 inch displacement (extension) criterion over a single 20-foot gage length was not acceptable and the staff recommended that several gages of shorter lengths be installed to permit identification of the more highly stressed sections. In the meeting of June 25, 1982, the applicant committed to using four 5-foot long gages in place of or in addition to the single 20-foot gage. The action and alert limits for the 5-foot long gages will be based on the yield strain of the reinforcing steel.

7. Staff input into the final SSER will describe computed earth pressures under both static and dynamic loading and design methods

Review of computed earth pressures was completed. This technical item is closed.

8. The NRC staff is to review and evaluate the applicant's analysis as identified in response to Request 2.8 of Enclosure 8, NRC letter dated 5/25/82 (interaction of circulating water and SWPS wall).

The NRC staff reviewed the drawing showing the structural gap between the circulating water intake structure (CWIS) and the SWPS, and compared this gap with the predicted deflections for each structure under earthquake loads. The 1 in. minimum gap is sufficient to accomdate the relative calculated gap of 0.518 in. Simarily, the 1 in. gap between the SWPS and the cooling pond retaining wall accomodates the calculated relative gap of 0.25 in. during a SSE. This item is closed.

9. Check dowels for shear and tension capability

The staff reviewed the design calculations, discussed the design methodology, and determined the shear and tension capability of connections for the underpinning to the existing structure. The items were found to be acceptable. This item is closed.

Borated Water Storage Tank

1. Long-term settlement monitoring plan during plant operation

This is a technical specification issue. The information will be provided to the NRC as part of the FSAR technical specification submittal in October 1982.

2. FSAR documentation on as-built conditions

This is a confirmatory item with technical issues resolved. This information will be provided to the NRC once the appropriate construction stage is achieved.

3. Staff calculational review for governing loading combinations in structural design

The NRC staff reviewed the calculation for design of the new ring beam foundation for applicable load combinations. The governing load combination is:

$U = 1.4D + 1.4T + 1.4F + 1.7L + 1.7H + 1.9E$
where component loads are identified by FSAR Section 3.8.6.3.1.

The staff also reviewed the methodology used for design of a typical section considering forces and moments and found it to be acceptable. Additional information of a confirmatory nature will be provided as part of the seismic margin study to demonstrate the adequacy of use of 1.5 times the FSAR response spectra relative to use of SSRS.

Underground Piping

1. Staff evaluation of previously submitted reports on underground piping not completed

The NRC staff and its consultant from ETEC reviewed the calculations for stresses due to seismic and settlement effects. The staff agreed with the assumptions, methodology, and results of the analyses.

The staff completed its geotechnical review of previously submitted reports. The applicant agreed to add five additional settlement and strain monitoring stations as requested, plus settlement markers at each end of transition zones of replaced/rebedded pipes as shown on Drawing 7220-SK-C-745 (see SSER #2, Figure 2.11). The five addi- tional settlement and strain marker locations are station 1 + 32 and 3 + 15 for line 26"-OHBC-15; station 1 + 55 for line 26"-OHBC-20; station 0 + 80 for line 26"-OHBC-55 and station 3 + 00 for line 26"-OHBC-54. The The applicant also agreed to change the monitoring frequency to once per month for the first 6 months of plant operation. The frequency of readings will be lengthened to the 90 day interval following the intial six month period if the settlement readings have stabilized (not larger than 0.10 inch change from the previous reading). This will be written into the technical specifications. This item is closed.

2. The applicant's proposed reinstallation of 26-inch and 36-inch diameter pipes including review of analysis, properties of backfill, extent of excavation, details of transition, and controls during consturction

The staff consultant visited the site and observed the arrangement of the service water piping in the SWPS.

The design approach for reinstallation of the service water pipe was reviewed and approved. The applicant provided a preliminary stress summary table for the piping to be reinstalled. The final table will be provided by August 20, 1982. Drawing 7220-SK-C-745 was marked to show the settlement and strain monitoring locations that were agreed upon.

Properties of the proposed backfill were provided for review. It is planned to use a mixture of sand, cement, and fly ash. The commercial name of this product is "K-Krete" (Attachment 6).

The next FSAR revision will document the design for the reinstalled piping, properties of the backfill material, and the stress summary table. This item is closed.

3 & 5. Plant control restricting placement of heavy loads over buried piping and conduits

Technical specification proposal by applicant for long-term settlement and strain monitoring plan during plant operation

These are technical specification items. The information will be provided to the NRC as part of the FSAR technical specification submittal.

4. FSAR documentation on as-built conditions

This is a confirmatory item with all technical issues resolved. The information will be provided to the NRC once the appropriate construction stage is acheived.

Diesel Generator Building Analysis

1. Resolution of assumptions (structural rigidity) and completion of analysis that uses correct settlement values; documentation of these results with comparison to recorded and predicted settlements

The NRC staff reviewed calculations for the diesel generator building which included settlement effects prior to, during, and after surcharge, including predicted values for the life of the plant.

The maximum calculated stress for the period March 28, 1978, to August 18, 1978, is approximately 11 ksi.

The NRC staff expressed the need to further review the results of calculations on the effects of settlement on the DGB including the method used by the applicant to characterize the shape of the structure resulting from actually recorded settlements and predicted settlement values.

Bearing pressures were reviewed and found to be acceptable.

2. Long-term settlement monitoring plan during plant operation

~~This is a technical specification item. The information~~ will be provided to the NRC as part of the FSAR technical specification submittal.

Permanent Dewatering

1. Resolve availability of 60-day period in view of recharge rate in wells in AB railroad bay area

   The applicant reviewed with the NRC staff the events related to the rupture of a construction water pipe which affected the recharge response in the railroad bay area.

   Information in response to written questions by NRC Hydraulic Engineering Section were provided for future review in Bethesda and included information on the period to initiate shutdown. This period will be documented in the technical specifications. A report will be submitted after system installation to document the water contours developed by the permanent dewatering system. This report will provide verification of any water source in the railroad bay area.

2. Requirements of permanent dewatering system during plant operation

   This is a technical specification item. The information will be provided to the NRC as part of the FSAR technical specification submittal.

3. Results of typical well fines monitoring

   The applicant provided typical results from the July fines monitoring of the AB construction dewatering wells.

Well	5 micron (ppm)	50 micron (ppm)
ME-7	0.5	0.2
ME-8	1.1	0.4
ME-9	0.5	0.3
ME-46	0.6	1.0

   This item is closed.

Other Items

A presentation was given on the project organization and consultants for the soils work (Attachment 5).

* Karl & Rinaldi comments incorporated DSH

Darl S. Hood, Project Manager
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7/27/82

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ENCLOSURE 1 (Con't)

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Enclosure 2

7/30/82

O - Open Item
CON - Confirmatory Item
TS - Operating License Technical Specification
R - Technical Resolution Staff Input Pending
C - Closed Item

MIDLAND PLANTS UNIT 1 AND 2
REVIEW OF DRAFT SER, SUPPLEMENT NO 2

		SSER STATUS	AUDIT ITEM
GENERAL ITEMS			
1.	Staff's input for the final SSER will include summary of subsurface investigations.	R	No
2.	Staff's input into final SSER will describe laboratory and field testing.	R	No
3.	Staff's input into the final SSER will include staff evaluation of pertinent soil profiles sectional views.	R	No
4.	Summerize the settlement history of Catagory I structures other than the AB & SWPS.	R	No
5.	Long term settlement monitoring plans during plant operation for other structures.	TS	No
6.	NRC's input into the final SSER will cover range of applied bearing pressures static and dynamic loading.	R	Yes
7.	Applicant was requested to determine that 1.5 x FSAR seismic response spectra analyses are conservative for the auxiliary building, SWPS, and BWST in comparison to site specific response spectra.	CON	Yes
8.	Applicant has not provided comparative plots of floor response requested by the staff for all buildings (seismic margin review).	O	Yes

		SSER STATUS	AUDIT ITEM
9.	Test data on #9 and #10 Fox Howlett with up to 2% strain.	CON	Yes
10.	Identification, inspection and repair procedures for concrete crack repair.	CON	Yes
11.	Use of concrete expansion anchors to attach piping and equipment to masonry walls is disallowed by Staff criteria (non-soils).	O	No
12.	Staff's input into the final SSER will summarize geotechnical engineering review efforts and SHAKE computer code studies.	R	No

		SSER STATUS	AUDIT ITEM
AUXILIARY BUILDING			
1.	Resolution of allowable vertical differential settlement and strain that will stop underpinning construction and require installation of temporary supports.	O	Yes
2.	Compaction control specification for granular fill beneath FIVP's.	O	Yes
3.	Methodology for transferring final loads to permanent underpinning wall.	O	Yes
4.	Updated scope of construction for Phases 3 and 4.	O	Yes
5.	Resolution of pier a[redacted] test details on maximum test load, locations and time for performing test.	O	Yes
6.	Long term settlement and strain monitoring plan during plant operation.	TS	Yes
7.	FSAR documentation on as-built conditions.	CON	No
8.	Design modification at freezewall crossing with duct banks.	CON	No
9.	Resolution of required depths of construction dewatering wells.	CON	Yes
10.	Monitoring matrix showing allowable settlements and strains	CON	Yes
11.	EPA and CT relative horizontal movement criteria	CON	Yes
12.	Changes in pier configuration	CON	Yes
13	Details on stiffened bulkhead during drift excavation	CON	Yes
14.	As built plan for deep seated benchmarks	CON	Yes
15.	Review of emergency actions C-200	CON	Yes

		SSER STATUS	AUDIT ITEM
SERVICE WATER PUMP STRUCTURE			
1.	Complete Staff review of sliding and lateral soil pressure calculations under dynamic loading.	CON	Yes
2.	Resolution of pier and plate load test details on maximum test load, locations, and time for performing test.	CON	Yes
3.	Resolution of required depths of construction dewatering wells.	O	Yes
4.	Methodology for transferring loads from jacks to permanent wall and locking-off.	O	Yes
5.	Long term settlement and strain monitoring plan during plant operation and program for monitoring horizontal movement.	TS	Yes
6.	FSAR documentation on as-built conditions.	CON	No
6a.	Strain monitoring to measure acceptable allowable strain.	CON	Yes
7.	Staff's input into final SSER will describe computed earth pressures under both static and dynamic loading and design methods.	R	Yes
8.	Staff to review and evaluate Applicant's analysis as identified in response to Request 2.8 of Enclosure 8, NRC letter dated 5/25/82. (interaction of circ water & SWPS walk)	CON	Yes
9.	Check dowels for shear and tension capability.	CON	Yes

		SSER STATUS	AUDIT ITEM
BORATED WATER STORAGE TANK			
1.	Long term settlement monitoring plan during plant operation.	TS	No
2.	FSAR documentation on as-built conditions.	CON	No
3.	Staff calculational review for governing loading combinations in structural design.	CON	Yes

		SSER STATUS	AUDIT ITEM
UNDERGROUND PIPING			
1.	Staff's evaluation of previously submitted reports on underground piping not completed.	R	Yes
2.	Applicant's proposed reinstallation of -inch 36-inch diameter pipes including review of analysis, properties of backfill, extent of excavation details of transition, controls during construction.	O	Yes
3.	Plant control restricting placement of heavy loads over buried piping and conduits.	TS	No
4.	FSAR documentation on as-built conditions.	CON	No
5.	Tech Spec proposal by Applicant for long term settlement and strain monitoring plan during plant operation.	TS	No

	SSER STATUS	AUDIT ITEM
DIESEL GENERATOR BUILDING ANALYSIS		
1. Resolution of assumptions (structural rigidity)and completion of analysis that uses correct settlement values. Documentation of these results with comparison to recorded and predicted settlements.	O	Yes
2. Long term settlement monitoring plan during plant operation.	TS	No

	SSER STATUS	AUDIT ITEM
PERMANENT DEWATERING		
1. Resolve availability of 60 day period in view of recharge rate in wells in railroad bay area of Auxiliary Building.	O	Yes
2. Requirements on permanent dewatering system during plant operation.	TS	No
3. Results of typical well fines monitoring	CON	Yes

Enclosure 3

Selected Handouts for

July 27-30, 1982, Audit

OFFICE ▶							
SURNAME ▶							
DATE ▶							

attachment 1
sheet 1 of 4

Recd 7/30/82

FOR INFORMATION ONLY

RS-003-03

7220

TABLE 2.5-14

SUMMARY OF CONTACT STRESSES AND ULTIMATE
BEARING CAPACITY FOR FOUNDATIONS
SUPPORTING SEISMIC CATEGORY I AND OTHER SELECTED STRUCTURES

18
44

consider change to comparison w/gross

Unit	Supporting Soils	Foundation Elevation	Contact Stress Beneath Footing (lb/ft^2)				Net Ultimate Bearing Capacity (lb/ft^2)	Factor of Safety	
			Gross Dead and Live Load	Net Dead and Live Load	Gross Dead, Live, and Seismic Load	Net Dead, Live, and Seismic Load		NET Dead and Live Load	NET Dead, Live, and Seismic Load
Category I Structures									
Reactor containment buildings	Very stiff to hard natural cohesive soils	582.5	10,000	3,300	19,500	12,800	45,000	13.6	3.5
Auxiliary building area[1] A	Very stiff to hard natural cohesive soils	562	7,000	—	8,200	1,000	45,000	NA	45.0
Auxiliary building areas B and C[1]	Very stiff to hard natural cohesive soils	579	6,600	400	10,200	4,000	45,000	11.2	11.3
Auxiliary building Area D[1]	Very stiff to hard natural cohesive soils	556	15,000	13,400	20,600	19,000	45,000	3.4	2.4
Auxiliary building Areas E and F[1]	Very stiff to hard natural cohesive soils	571	11,000	4,300	19,800	13,100	45,000	10.5	3.4
Auxiliary building Area G[1]	Zone 2[3]	630.5	1,400	1,000	3,400	3,000	15,000	15.0	5.0
Auxiliary building Area H[1]	Zone 2[3]	610	1,400	NA	5,100	2,200	30,000	NA	13.6
Auxiliary building Areas I and J[1]	Very stiff to hard natural cohesive soils	569	6,800	0	9,200	2,400	45,000	NA	18.8

44

Attachment 1
Sheet 2 of 4

RS-003-03

TABLE 2.5-14 (continued)

Unit	Supporting Soils	Foundation Elevation	Contact Stress Beneath Footing (lb/ft^2)				Net Ultimate Bearing Capacity (lb/ft^2)	Factor of Safety	
			Gross Dead and Live Load	Net Dead and Live Load	Gross Dead, Live, and Seismic Load	Net Dead, Live, and Seismic Load		Net Dead and Live Load	Net Dead, Live, and Seismic Load
Auxiliary building Areas K and L[1]	Very stiff to hard natural cohesive soils	579	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Feedwater isolation valve pit	Structural sand backfill	601	4,200	(4)	10,100	5,800	25,000	(4)	4.3
Diesel generator building	Zone 2[3]	628	4,400	3,600	5,700	4,900	14,000	3.9	2.9
Diesel generator pedestal foundation	Zone 2[3]	628	1,670	900	2,050	1,300	8,000	8.9	6.2
Borated water storage tank	Zone 2[3]	629	2,000	1,400	4,600	4,000	12,000	8.6	3.0
Service Water Pump Structure									

44

Attachment 1
Sheet 3 of 4

FOR INFORMATION ONLY

RS-003-03

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TABLE 2.5-14 (continued)

Unit	Supporting Soils	Foundation Elevation	Contact Stress Beneath Footing (lb/ft^2)				Net Ultimate Bearing Capacity (lb/ft^2)	Factor of Safety		44
			Gross Dead and Live Load	Net Dead and Live Load	Gross Dead, Live, and Seismic Load	Net Dead, Live, and Seismic Load		Dead and Live Load	Dead, Live, and Seismic Load	
Circulating water isolation system	Very stiff to hard natural cohesive soils and dense natural sands	596.5	4,030	3,800	4,090	3,900	25,000	6.6	6.4	

Note: Factor of safety is defined as the ratio of net ultimate bearing capacity to net contact stress beneath footing.

(1) Refer to Figure 2.5-47 for auxiliary building areas.

(2) ~~Revised values are to be provided by amendment following reanalysis.~~ 18

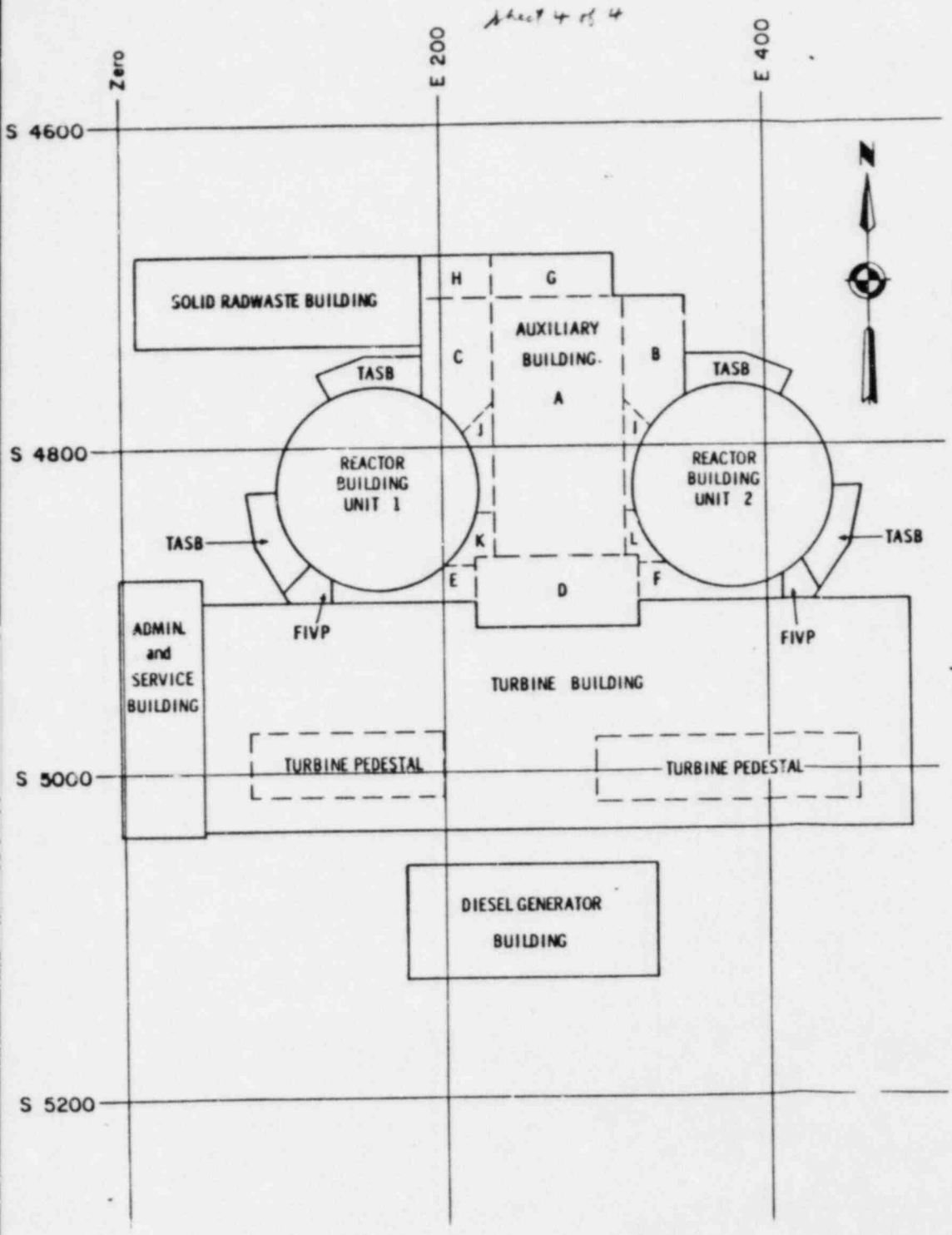
(3) Refer to Table 2.5-10 for description of Zone 2 soil.

(4) For these cases, the applied loads are less than or about equal to the depth of embedment times the unit weight of the soil. Therefore, net loads are negative or insignificant and the factor of safety against bearing capacity failure is not applicable. 44

2. LOAD IS TRANSFERRED TO AREAS D, E & F AS A RESULT OF THE UNDERPINNING OPERATION. (FROM K&L)

5. GROSS SOIL PRESSURE UNDER THE AREAS A THRU L ASSUME THE WATER TABLE IS AT EL. 585'-0.

Attachment 1
Sheet 4 of 4



	El_m	P_s	P_{n1}	P_{n2}
AREA FILL LOAD	603	4.03	4.03	2.53
SOLID RADWASTE BLDG	629.5	4.9	4.9	4.9
AUXILIARY BLDG A	562	9.7	6.66	2.60
B & C	579	2.9	1.09	-1.95
D	609	5.3	5.3	4.18
E & F	609	6.0	6.0	4.88
G	630.5	0.9	0.9	0.9
H	610	0.9	0.9	-0.16
I & J	569	1.4	-1.15	-4.77
K & L	579	0.8	-1.06	-4.05
REACTOR BLDGS 1 & 2	582.5	10.0	8.39	5.61
TURBINE BLDG.	609	3.0	3.0	1.88
TURBINE PEDESTALS (2)	602	5.0	4.87	3.31
DIESEL GENERATOR BUILDING	628	SEE	NOTE	6
FEEDWATER ISOLATION VALVE PIT (FIVP)	616.0	1.5	1.5	0.81
TENDON ACCESS SHAFT BUTTRESS (TASB)	587.5	1.0	-0.27	-2.73
ADMINISTRATION AND SERVICE BUILDING	629.5	4.5	4.5	4.5

NOTES:

1. El_m is the elevation of the bottom of the foundation,
2. P_s is the gross structural load.
3. P_{n1} is the net load intensity before the cooling water reservior filling $P_{n1} = P_s$ - Excavation load (corrected for bouyancy).
4. P_{n2} is the net load intensity after the cooling water reservior filling $P_{n2} = P_{n1}$ - Hydrostatic pressure.
5. All units for load intensity in kips per foot square (ksf), elevations in feet from U. S. G. S. datum.
6. $P_s = P_{n1} = P_n = 3.0$ ksf was used for the diesel generator building load and 2.0 ksf was used for the surcharge load for determining the influence on the power block structures only.

0 25 50 100 150 200
SCALE IN FEET

FOR INFORMATION ONLY

7220

RS-003-03

ATTACHMENT TO
CALC. NO. DQ 67(Q) Rev 0

SH 4

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Soil Pressures Used
In Settlement Analysis
of Power Block
(CK-G-59, Rev 2)

FSAR Figure 2.5-47

Alert Level

All values up to the alert level are considered to be within normal working ranges.

Settlement readings should be reviewed by the resident structural engineer daily. In general, for readings below the alert level, attention should be focused on the value of the readings versus the construction progress and any indication of trends that would indicate the alert level will be exceeded.

Once the alert level is exceeded, the site resident engineer must inform engineering in Ann Arbor of the situation. The data including information from the other appropriate data mechanisms should be evaluated in total. Where trends exist that indicate the action level is likely to be reached, plans should be evaluated to remedy the situation. (Note: It is recognized that the evaluation may well conclude that no changes are warranted.)

Action Levels*

Differential settlement values which reach the action level must be reviewed by the resident structural engineer and as soon as possible by engineering in Ann Arbor.

and actions described in Specification C-200
Plans, should be initiated to modify the condition that caused the settlement reading to ~~exceed~~ reach the action level. Consumers Power Company must be informed of the revised plan so that the NRC can be advised of the situation. The revised plan shall be initiated immediately upon verbal notification by the resident structural engineer. ~~(Note: It is recognized that the evaluation may well conclude that no changes are warranted.)~~ If continuous ~~movement beyond~~ action level occurs, immediate ~~action shall be taken per Specification C-200.~~

Reporting Level

~~(Reporting Level 1)~~

If the differential settlements reach 0.50 inch, the applicant will start discussions with NRC for consideration of and concurrence with future actions before implementing those actions.

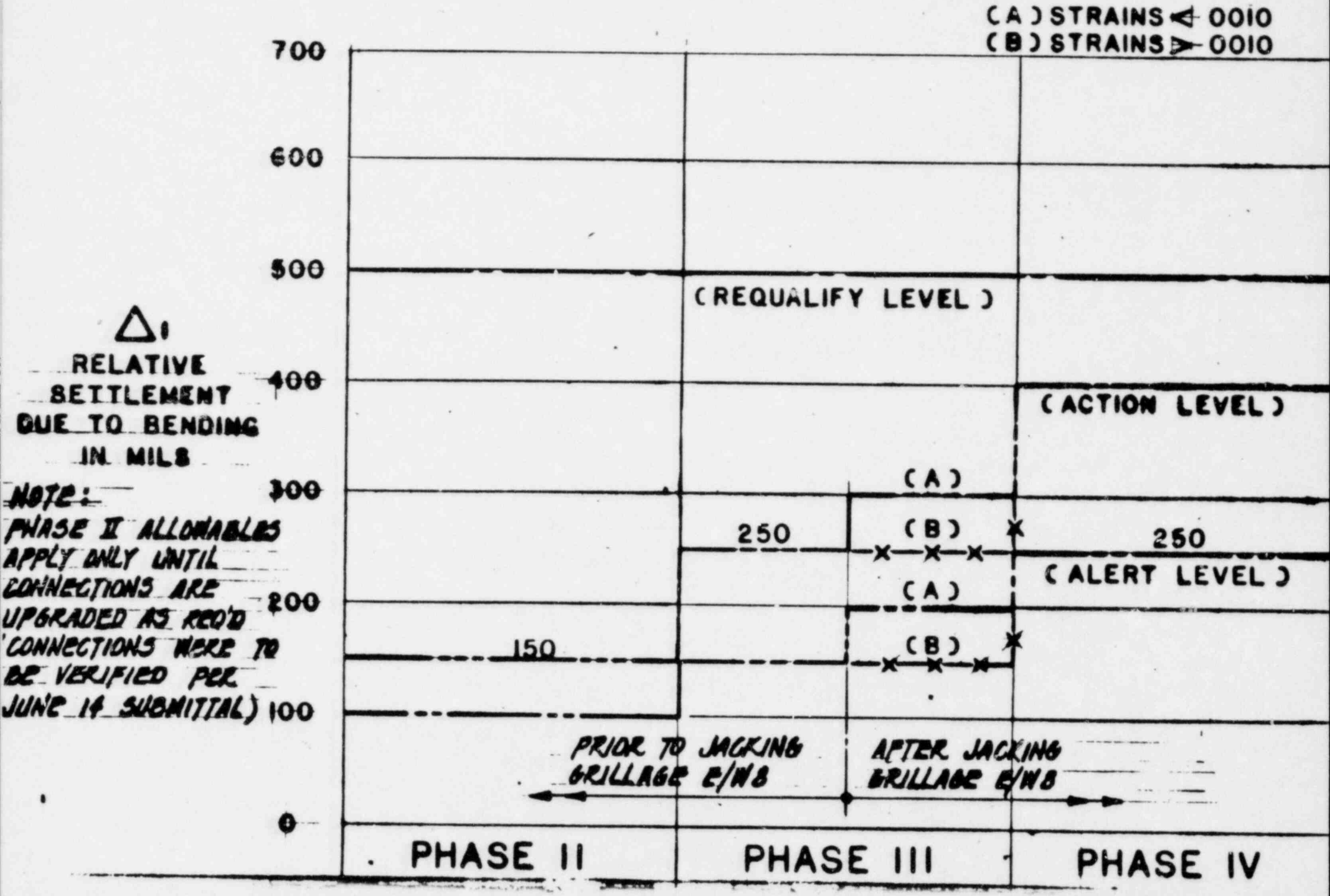
* - Cracking levels correspond to these definitions for Alert and Action.

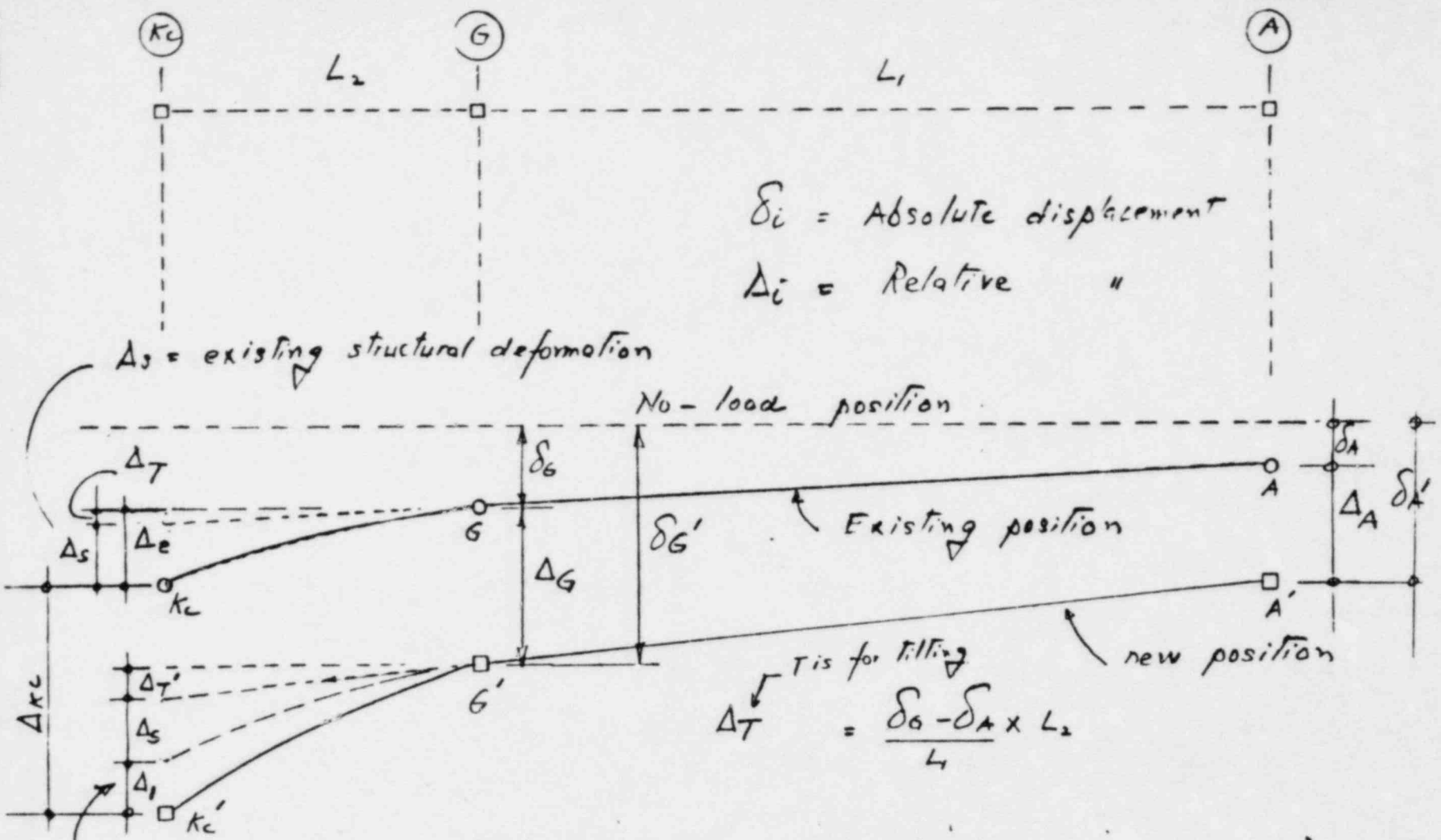
/dj

072801

REMEDIAL SOILS

SETTLEMENT MONITORING MATRIX





$$\Delta_{allowable} = \left\{ \Delta_{KC} + \cancel{\Delta_s} + \Delta_T \right\} - \left\{ \Delta_G + \Delta_T' + \cancel{\Delta_s} \right\}$$

$$= \Delta_{KC} + \Delta_T - \Delta_G - \Delta_T'$$

7/29/82

Attachment 4

CALCULATED DISPLACEMENTS AT DEEP SEATED BENCHMARKS

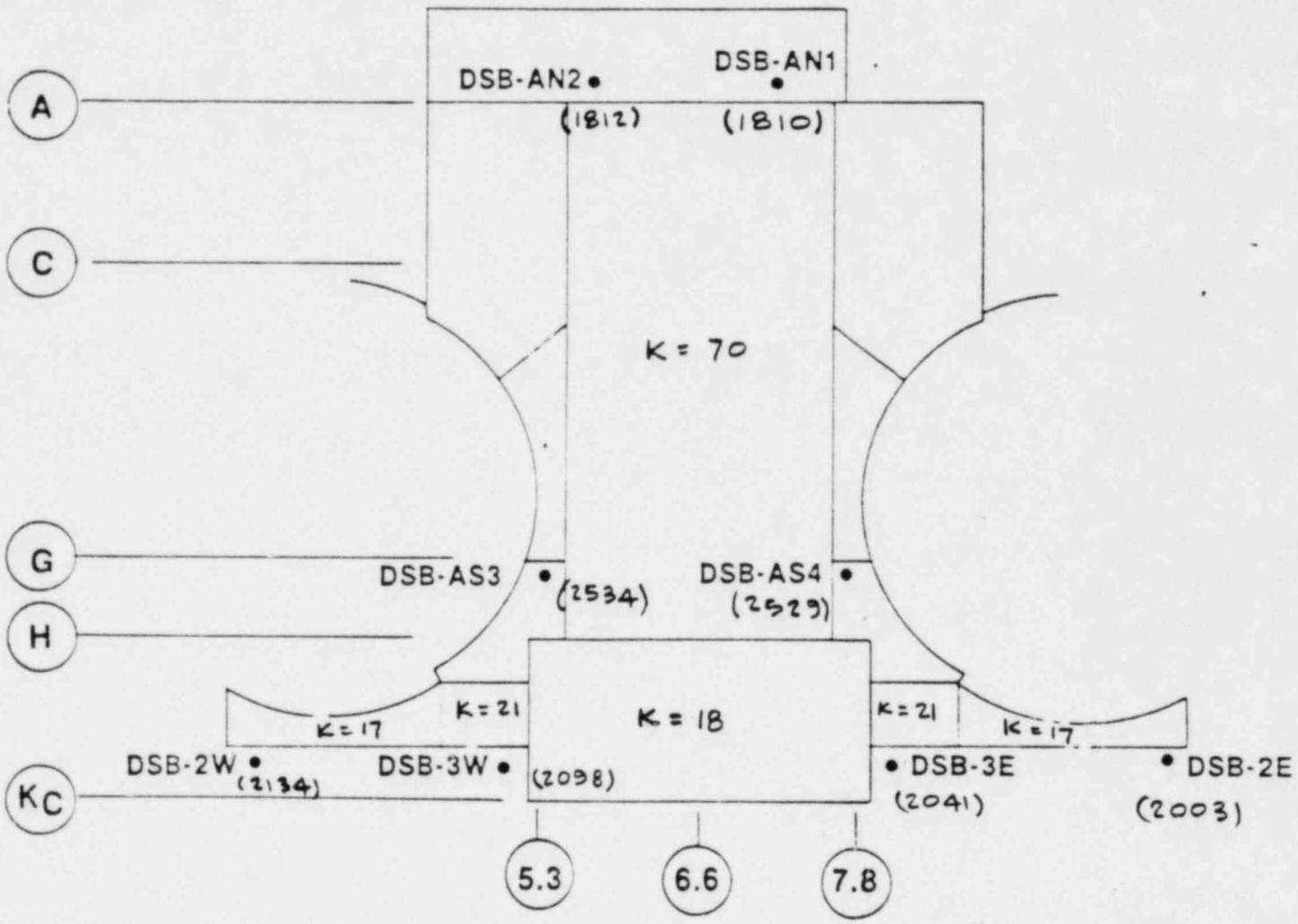


Figure 1

*Exact locations are shown on drawings C-1490 and C-1491

G-2516-C2

BECHTEL

Attachment 4

501 (9-70)

DISPLACEMENTS WITH K = 70 KCF

NODE	BENCH MARK	EXIST NG 1	STAGE 1 2	3	STAGE 2 4	5	STAGE 3 6	7	
1810	DSB-AN1	-1.03"	-0.974	-1.037	-1.007	-1.120	-0.560	-0.854	
1812	DSB-AN2	-1.10	-1.056	-1.117	-1.091	-1.204	-0.649	-0.942	
2003	" - 2E	-2.25	-2.484	-2.158	-2.158	-1.834	-3.915	-2.853	
2041	" - 3E	-2.36	-2.556	-2.315	-2.419	-1.993	-4.160	-3.021	
2038	" - 3W	-2.48	-2.688	-2.44	-2.563	-2.129	-4.333	-3.180	
2134	" - 2W	-2.54	-2.844	-2.492	-2.56	-2.197	-4.369	-3.265	
2529	" - AS4	-1.70	-1.776	-1.669	-1.72	-1.553	-2.48	-1.991	
2534	" - AS3	-1.[illegible]	.884	-1.772	-1.834	-1.663	-2.619	-2.118	

(1) - EXISTING DISPLACEMENTS
2 - STAGE 1 SOIL REMOVAL
3 - " 1 " " + JACKING LOAD
4 - " 2 " "
5 - " 2 " " + JACKING LOAD
6 - " 3 " "
7 - " 3 " " + JACKING LOAD

ASSUMPTIONS

(1) ONLY 13 ELEMENTS REDUCED IN STIFFNESS

Attachment 4

CALCULATED DISPLACEMENTS AT DEEP SEATED BENCHMARKS

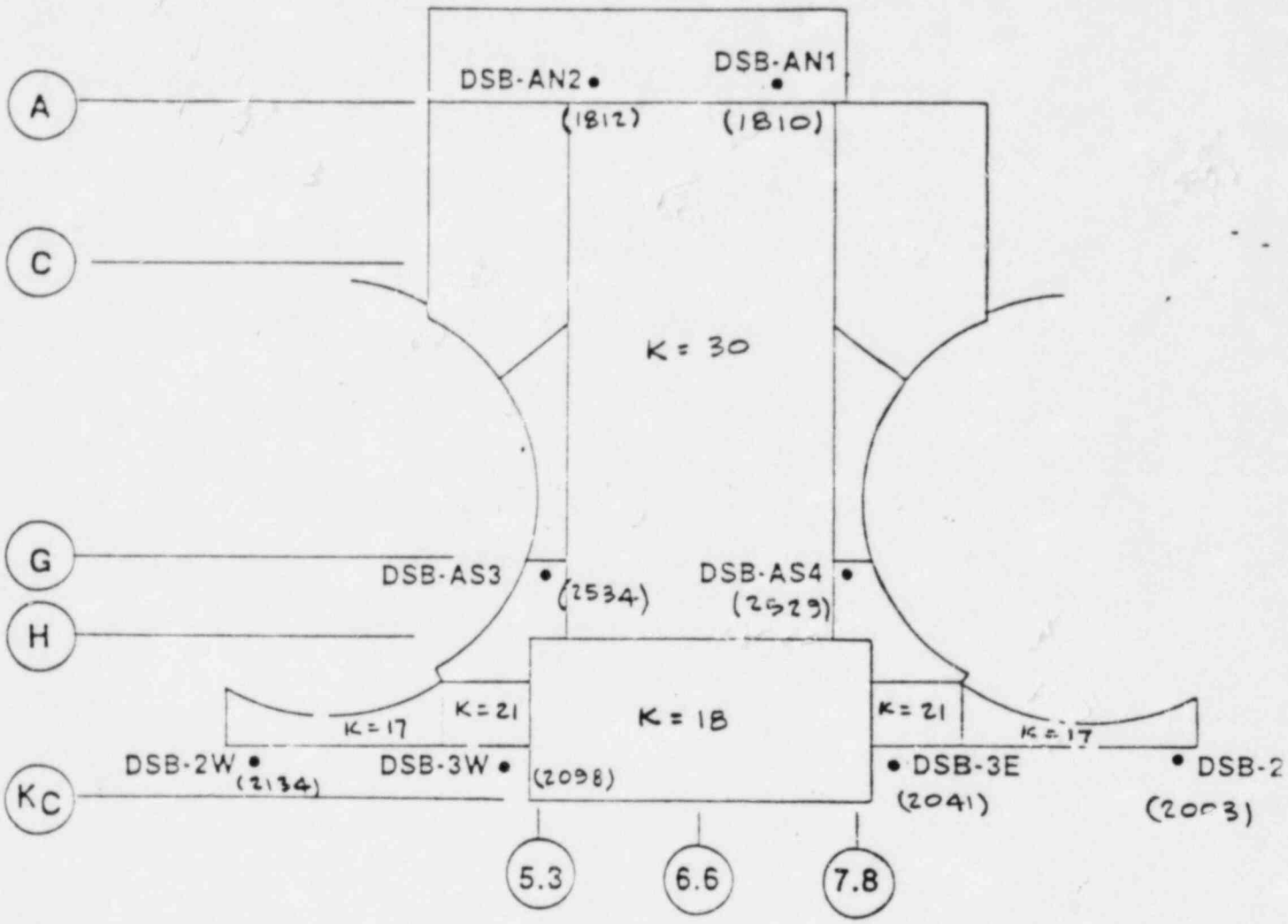


Figure 1

*Exact locations are shown on drawings C-1490 and C-1491

G 25 8-02

Attachment 4

BECHTEL

DISPLACEMENTS WITH K = 30 KCF

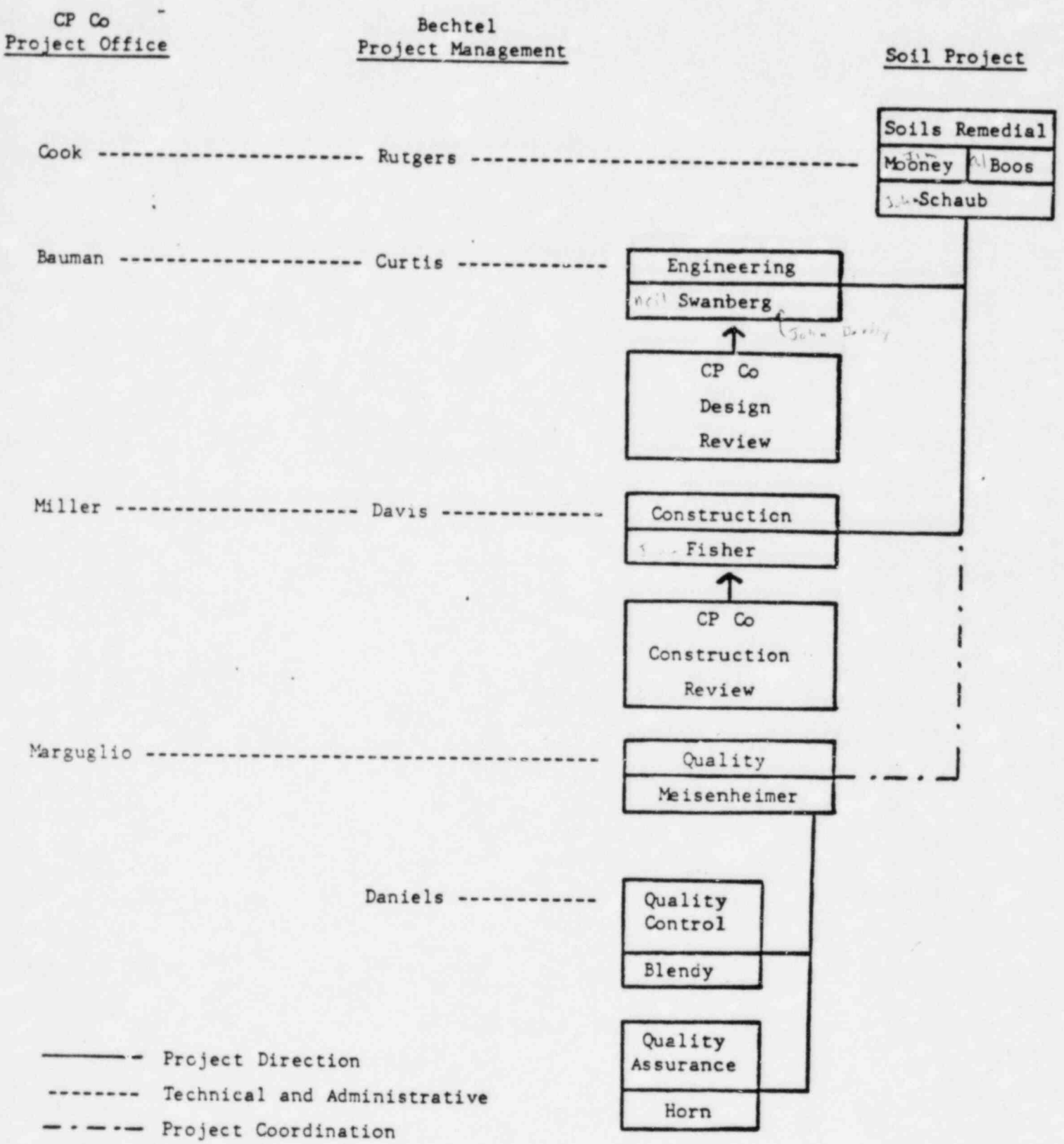
	EXISTING	1ST STAGE		2ND STAGE		3RD STAGE		4TH STAGE	
		3A	3A+3B	4A	4A+4B	5A	5A+5B	7A	7A+7B
1810	-2.79"	-2.79"	-2.81"	-2.80"	-2.88"	-2.82	-2.93	-2.77	-2.83
1812	-2.83	-2.851"	-2.87"	-2.86"	-2.95"	-2.88	-2.99	-2.86	-2.92
2003	-3.26	-3.41"	-3.19"	-3.3"	-2.66"	-3.22	-2.38	-3.46	-3.12
2041	-3.32	-3.44"	-3.29"	-3.36"	-2.72"	-3.31	-2.44	-3.65	-3.28
2098	-3.34	-3.516"	-3.37"	-3.46"	-2.80"	-3.41	-2.52	-3.8	-3.42
2134	-3.46	-3.62"	-3.42"	-3.53"	-2.88"	-3.47	-2.62	-3.86	-3.50
2529	-3.08"	-3.10"	-3.04"	-3.06"	-2.76"	-3.06	-2.63	-3.28	-3.08
2534	-3.11"	-3.16"	-3.01"	-3.13"	-2.83"	-3.14	-2.69	-3.34	-3.20

3A	- STAGE 1	SOIL REMOVAL		
3A + 3B	- "	"	"	+ JACKING LOAD
4A	- " 2	"	"	
4A + 4B	- " 2	"	"	+ JACKING "
5A	- " 3	"	"	
5A + 5B	- " 3	"	"	+ JACKING "
7A	- " 4	"	"	
7A + 7B	- " "	"	"	+ JACKING "

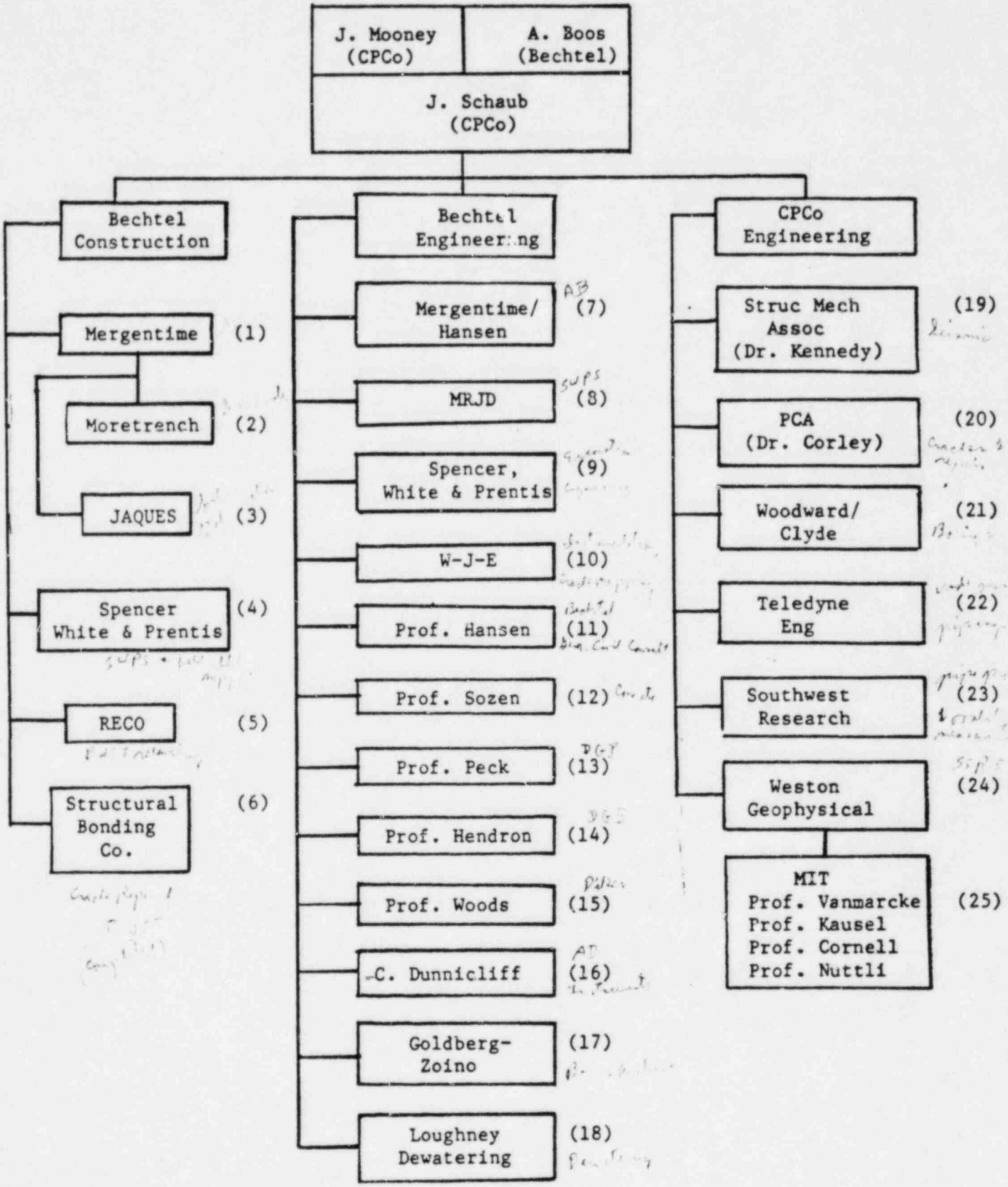
attachment 5

7/29/82

MIDLAND PROJECT



LIST OF SPECIALTY CONSULTANTS AND SUBCONTRACTORS FOR MIDLAND REMEDIAL SOILS WORK



LIST OF SPECIALTY CONSULTANTS
AND SUBCONTRACTORS FOR
MIDLAND REMEDIAL SOILS WORK

1.	Subcontractor	Performing underpinning of auxiliary building and FIVP foundation material replacement
2.	Subcontractor	Responsible for groundwater control in support of auxiliary building underpinning
3.	Subcontractor	Responsible for soils stabilization (if necessary)
4.	Subcontractor	Performing service water pump structure underpinning; also providing system for temporary support of utilities during fill replacement north of SWPS and CWIS
5.	Subcontractor	Has developed a proposal for and will relevel borated water storage tank 1T-60
6.	Subcontractor	Performed crack repair on BWST foundations
7.	Consultant	Providing input for design of auxiliary building underpinning and review major underpinning details of auxiliary building
8.	Consultant	Providing input for design of service water pump structure underpinning and review major underpinning details of auxiliary building and SWPS; also providing overview of construction at the Midland jobsite
9.	Consultant	Providing input for integrating SWPS underpinning and removal of soil in designated part of service water piping
10.	Consultant	Providing instrumentation of auxiliary building and SWPS to detect movement and measure strain of selected points; also developed procedures and performed crack mapping in auxiliary building and SWPS
11.	Consultant	Bechtel chief civil engineer's staff; reviews structural model, analytical technique and results of analysis for auxiliary building, SWPS, and BWST
12.	Consultant	Provides input to Bechtel regarding behavior of concrete, including variation of staffness due to cracking in concrete

13.	Consultant	Provided recommendations on remedial action for the diesel generator building and the general approach to permanent plant dewatering and underpinning
14.	Consultant	Provided recommendations on remedial action for the diesel generator building and the general approach to permanent dewatering and underpinning; provided testimonies on static and seismic stability, ECWR dikes, and the BWST soils aspects
15.	Consultant	Made dutch cone and shear wave velocity measurements; performed dike stability calculations and settlement calculations
16.	Consultant	Provided consulting services on instrumentation for diesel generator building
17.	Subcontractor	Performed laboratory and field soil tests and installed and monitored instrumentation
18.	Consultant and Subcontractor	Provided consulting and subcontract service on site temporary dewatering; subcontractor to SW&P on SWPS temporary dewatering
19.	Consultant	Provided overview of design basis, seismic criteria, and dynamic models for seismic analyses; separately performed seismic margin review for site specific response spectra earthquake
20.	Consultant	Performed evaluation of cracks in concrete structures, specifically, auxiliary building, FIVP, SWPS, and DGB under existing conditions, their effects on structural integrity and serviceability; will also be responsible for evaluation of concrete cracks during underpinning
21.	Subcontractor	Performed soil investigation through boring programs and developed laboratory test results
22.	Consultant	Overall consultant on underground piping; developed acceptance criteria for same
23.	Consultant	Performed pipe profile measurements
24.	Consultant	Developed site specific response spectra; performed seismic hazard analysis and soil amplification studies through fill material
25.	Consultants	Provide consulting services to Weston Geophysical for soil amplification, studies, seismic hazard analysis and seismology

SUMMARY OF SOIL CONSTANTS FOR K-KRETE (1)

Attachment 6
sheet 1

	OBE 0.06g	SSE 0.12g (2)	References	
Compression wave velocity	10,000 fps	10,000 fps	1,2	14 15
Shear wave velocity	5,000 fps	5,000 fps	1,2	18
Surface wave velocity	4,675 fps	4,675 fps	1,3	21
Maximum particle velocity (all wave types)	2.40 in/sec	8.64 in/sec	4	24 25
Maximum particle acceleration (all wave types)	23.16 in/sec^2	69.48 in/sec^2 (3)	3,5	28 29
Soil unit weight	130 pcf	130 pcf		32
Poisson's ratio	0.25	0.25		35
Angle of internal friction	25°	25°		38 39
Coefficient of lateral pressure	0.33	0.33		42 43
Coefficient of friction	0.466	0.466		46
Shear wave velocity (3)				49
E max	3,322 fps	3,322 fps		51
E min	1,500 fps	1,500 fps		53
Ultimate compressive strength	250 psi	250 psi		56 57
Maximum soil strain in/in	(6.17) 10^{-5} in/in	(1.85) 10^{-4}	1	60 61
				63

(1) K-KRETE is a brand name for a type of low-strength fly ash concrete to be used in place of compacted backfill. 65 66

(2) The shear modulus and Young's modulus are assumed to remain constant with shear strain. 68 69

(3) SSE acceleration has been increased by 50% to provide a margin for the site-specific response spectra. 71 72

REFERENCES: 75

1) TPD Design Guide C-2.44, Seismic Analyses of Structures and Equipment for Nuclear Power Plants, Rev 0 79

2) Subsurface Investigation and Foundation Soil Report, Vol 2 of 2, Dec 1975, Appendix 2C 83

3) Iqbal, N.A., and Goodling, E.C. Jr., Seismic Design of Buried Piping, 2nd ASCE Specialty Conference on Structural Design of Nuclear Power Plant Facilities, New Orleans, Louisiana, Dec 1975 86 87

4) Newmark, N.M., Blume, J.A., and Kapur, K.K., Seismic Design Spectra for Nuclear Power Plants, ASCE, Journal of the Power Division, Nov 1973 90 90

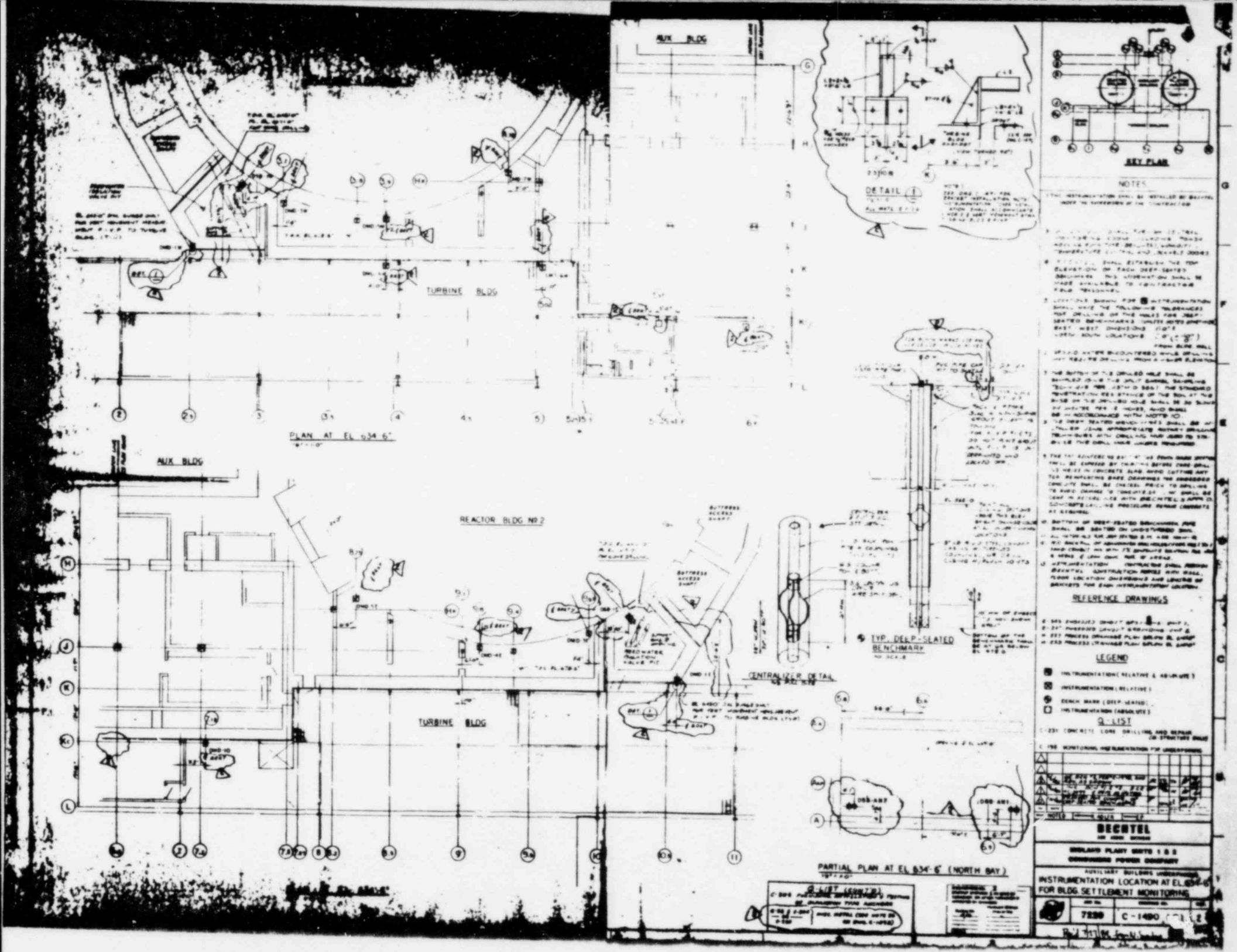
5) Midland Civil Design Criteria, Standard C-501, Rev 11 93

Enclosure 3

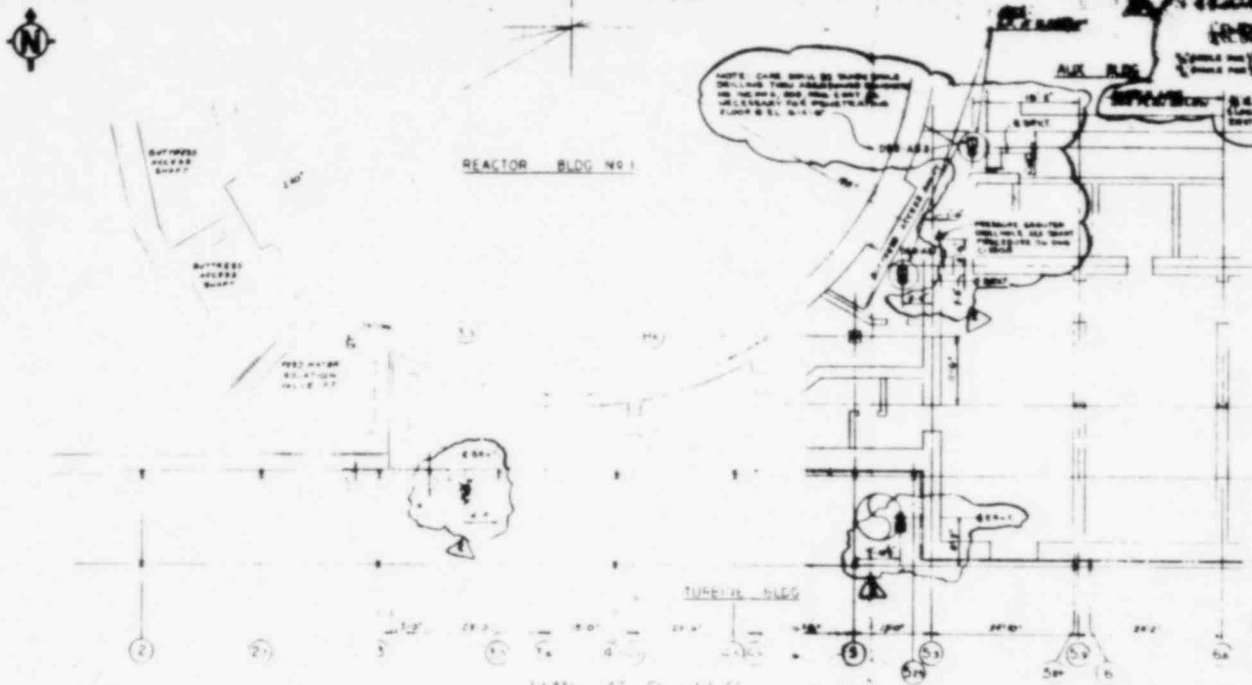
Attachment 7

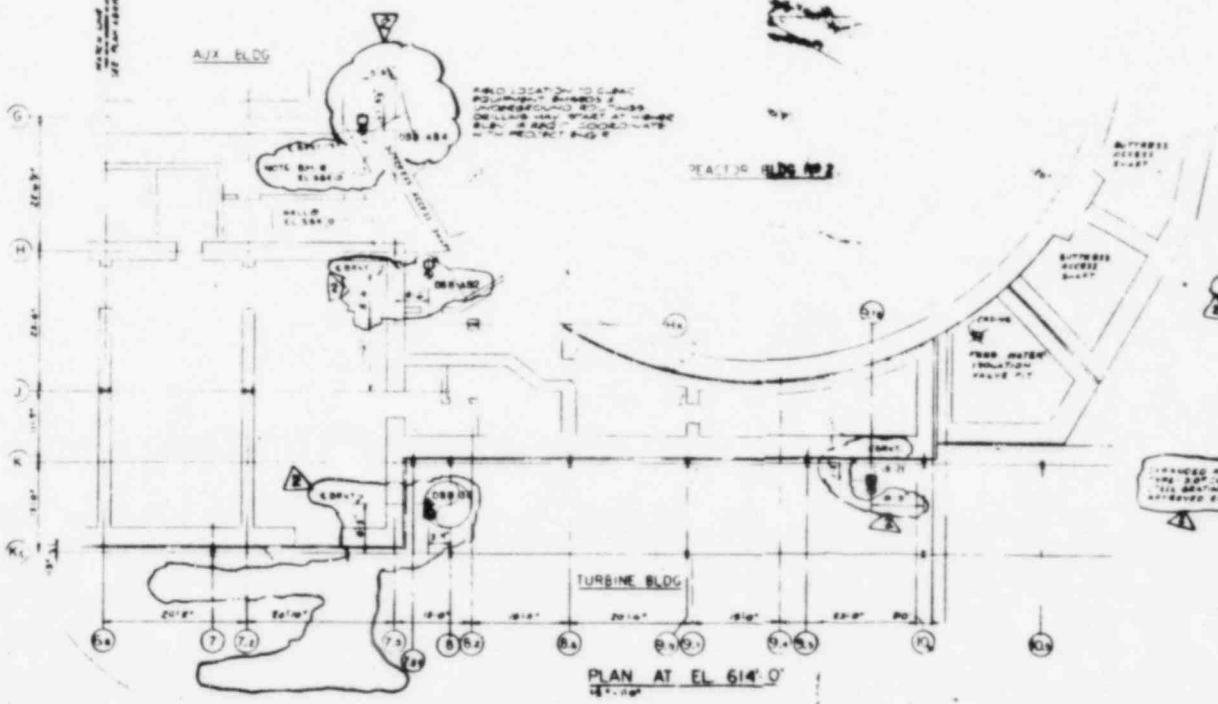
INDEX

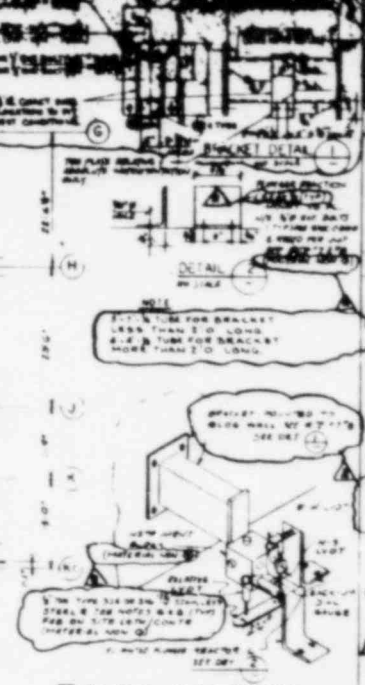
Bechtel Drawing	7220-C-1490(Q), Rev. 2
Bechtel Drawing	7220-C-1491(Q), Rev. 2
Bechtel Drawing	7220-C-1493(Q), Rev. 1
Bechtel Drawing	7220-C-1495(Q), Rev. 0

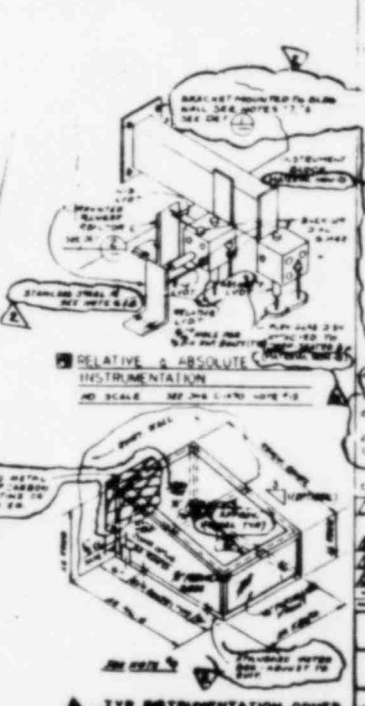

AUX BLDG
TURBINE BLDG
PLAN AT EL 634'6"
REACTOR BLDG NO 2
DETAIL
KEY PLAN
NOTES
REFERENCE DRAWINGS
LEGEND
TYP. DEEP-SEATED BENCHMARK
CENTRALIZER DETAIL
PARTIAL PLAN AT EL 634'6" (NORTH BAY)
BECHTEL
MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY
INSTRUMENTATION LOCATION AT EL 634'-6"
FOR BLDG SETTLEMENT MONITORING
7220
C-1490

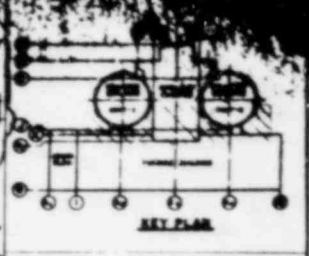
C-1491











NOTES

Q-LIST

DECNTEL

INSTRUMENTATION LOCATION AT EL 614'-0" FOR BLDG SETTLEMENT MONITORING

7999 C-1491

C-1493(0)

BUILDING MOVEMENT MONITORING MATRIX

NO.	LOCATION	[illegible]	WHEN OPERATIONAL	[illegible]	INSTRUMENT	[illegible]
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BUILDING MOVEMENT MONITORING MATRIX

NO.	LOCATION	[illegible]	WHEN OPERATIONAL	[illegible]	INSTRUMENT	[illegible]
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NOTES

[illegible]

TABLE 1

△4 MONITORING		
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BUILDING STRAIN MONITORING MATRIX (BEAMS, WALLS AND SLABS)

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[illegible]	[illegible]					
[illegible]	[illegible]					
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[illegible]	[illegible]					
[illegible]	[illegible]					
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[illegible]	[illegible]					
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[illegible]	[illegible]			1 STRAIN GAGE	[illegible]	[illegible]

Q-LIST

CORRECTIVE ACTION DURING UNDERPINNING

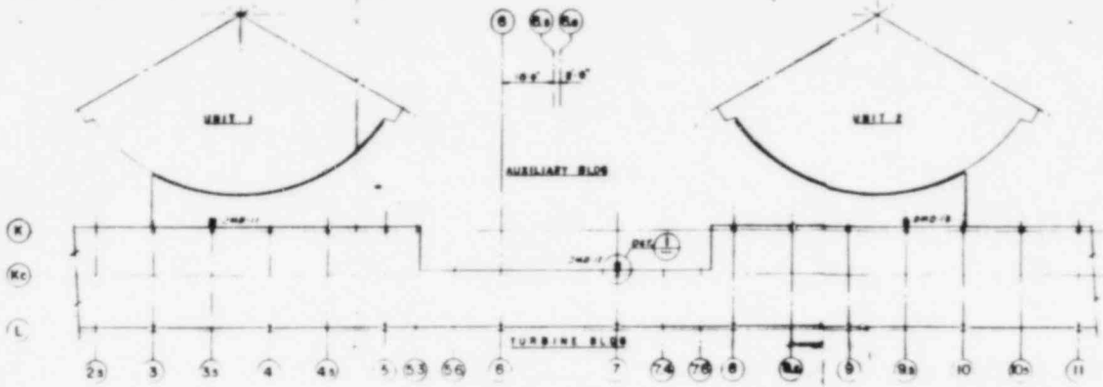
BECHTEL

MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

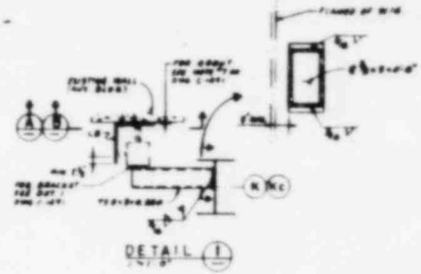
AUXILIARY BLDG. & F.I.V.P.
INSTRUMENTATION SYSTEM
MONITORING MATRIX SH. 1

JOB No.	DRAWING No.	REV.
7220	C-1493 (Q)	1

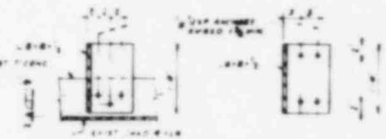
C-1495



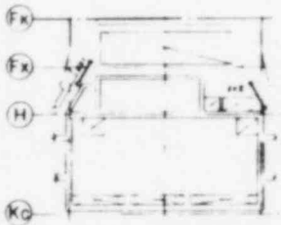
PLAN AT ELEV. 695'-0"



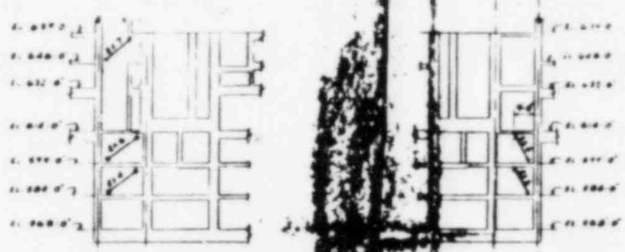
DETAIL 1



SECTION A SECTION B

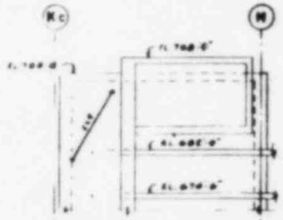


PLAN AT ELEV. 659'-0"

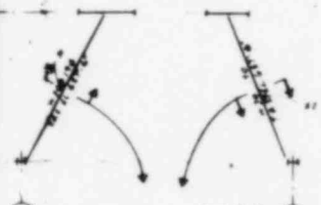


WALL AT COL. LINE 5.3 & 6.6 WALL AT COL. LINE 7 & 7.8

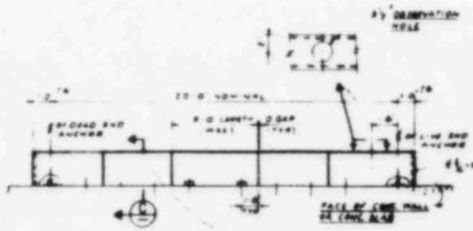
WALL AT COL. LINE 5.3



WALL AT COL. LINE 7.8



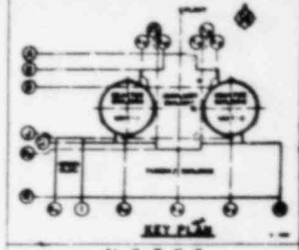
PLAN AT ELEV. 659'-0"



TYPICAL EXTENSOMETER SUPPORT BRACKETS & COVER

DETAIL OF REAR END ANCHOR DETAIL OF LINE END ANCHOR

SECTION C



KEY PLAN

NOTES

REFERENCE DRAWINGS

Q LIST

MEETING SUMMARY DISTRIBUTION

NOV 12 1982

Docket No(s): 50-329/330 OM, OL
NRC/PDR
Local PDR
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PRC System
LB #4 r/f
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