Consumers Power Company

Stephen H. Howell
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January 5, 1979
Howe-1-79

Mr J G Keppler, Regional Director
Office of Inspection and Enforcement
US Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, IL 60137

MIDLAND NUCLEAR PLANT -
UNIT NO 1, DOCKET NO 50-329
UNIT NO 2, DOCKET NO 50-330
SETTLEMENT OF DIESEL GENERATOR FOUNDATIONS AND BUILDING

Reference: S H Howell letters to J G Keppler; Midland Nuclear Plant; Unit No 1, Docket No 50-329; Unit No 2, Docket No 50-330; Settlement of Diesel Generator Foundations and Building;

a) Serial Howe-183-78; dated September 29, 1978
b) Serial Howe-230-78; dated November 7, 1978
c) Serial Howe-267-78; dated December 21, 1978

This letter, as were the referenced letters, is an interim 50.55(e) report on the settlement of the diesel generator foundations and building.

Enclosure 1 provides the status of the actions being taken to resolve the problem.

Enclosure 2 provides some typographical corrections and clarification to Enclosure 1.

Another report, either interim or final, will be sent on or before February 23, 1979.

Stephen H Howell

Enclosure 1: MCAR 24, Settlement of the Diesel Generator Foundations and Building, Interim Report #3, dated December 27, 1978

Enclosure 2: Errata and Clarification for MCAR 24, Interim Report #3

CC: Director, Office of Inspection & Enforcement
Att: Mr John G Davis, Acting Director, USNRC (15)

Director, Office of Management
Information and Program Control, USNRC (1)

7901100286

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

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

SUBJECT: MCAR #24 (Issued 9/7/78)
Settlement of the diesel generator foundations and building

INTERIM REPORT #3

DATE: December 27, 1978

PROJECT: Consumers Power Company
Midland Plant Units 1 & 2
Bechtel Job 7220

Introduction

This report is submitted to advise of the interim status of the project's actions relating to the settlement of the diesel generator foundations and building as described in MCAR #24 and NCR 1482.

Description of Deficiency

The general foundation and building settlements (taken December 6, 1978) are shown in Figures 1 through 4 (attached).

Background Information

The Category I structures on the plant site are shown in Figure 5 (attached). Figure 5A indicates the plant structures which are Category II.

The plant fill was placed from 1975 to 1977. Seismic Category I structures placed on the plant fill include the diesel generator building, the underground diesel oil tanks, borated water storage tanks and basin, a portion of the service water pump structure, service water valve pits and the associated piping for each of the above systems. The arrangement of the diesel generator building is shown in Figure 6 (attached).

The settlement of Category I structures observed to date are as follows:

1) Reactor buildings - varies from 1/4 to 5/8 inch
2) Auxiliary building - approximately 3/8 inch
3) Service water pump structure - varies from 0 to 1/4 inch
4) Service water valve pits - approximately 1/4 inch
5) Borated water storage tanks - approximately 1/4 inch
6) Diesel generator building - 3-3/4 inches maximum
7) Diesel generator pedestal - 4-1/4 inches maximum

It is apparant that the structures on original soil show no settlement problem. These settlement values are consistent with the values in FSAR Figure 2.5-14A.

Soil Exploration

After the excessive settlement of the diesel generator building was observed, subsurface studies were conducted in the main plant area by Bechtel to provide information to be used for determining any required remedial measures. There are 29 borings, 14 dutch cone penetrations, and 1 test pit which were made in the diesel generator building. Boring, dutch cone penetration, and the test pit locations in the plant area are shown in Figure 7. Figure 8 shows the locations of those in the diesel generator building area.

Split spoon, Shelby tube, and Osterberg tube samples were taken from the borings and sent to the Goldberg-Zoino-Dunnicliff & Associates laboratory for testing. Bag samples were taken from the test pit. An undisturbed sample was taken from the pit in the diesel generator building. In-place density test was made in the test pit by Goldberg-Zoino-Dunnicliff & Associates.

Laboratory tests made to date have been concentrated on samples taken from the diesel generator building area with some tests made in other areas of the plant. Laboratory tests performed include:

a. Soil classification tests (e.g., Atterberg limits and gradation analyses)

b. Shear strength property tests consisting of torvane strength, unconfined compression strength, and unconsolidated undrained triaxial strength tests, along with unit weight and moisture content

c. Tests made to evaluate consolidation properties of the fill by conducting one-dimensional consolidation tests, specific gravity tests, and tests to evaluate the effects of saturation

d. Mineralogy tests made to evaluate the swelling potential of the fill material including cation exchange capacity and x-ray diffraction tests

e. Compaction tests to evaluate the percent compaction of fill materials

Results from these tests are being evaluated.

Corrective Action

The following alternative plans have been considered by project engineering:

1) No corrective action required

2) Modify the present strip foundations for the walls to a continuous mat foundation for the entire building.

3) Preload and consolidate the soil under the building.

4) Combine Items 2 and 3 above.

5) Underpin the building to transmit loads directly to the original soil layer.

6) Remove and replace the building and fill material.

Dr. R. Peck of Albuquerque, New Mexico, and Dr. A. Hendron, Jr. of the University of Illinois have been retained by Bechtel as soil consultants. Mr. John Dunnicliff of Goldberg-Zoino-Dunnicliff & Associates has been retained as our instrumentation consultant. Dr. Woods of the University of Michigan has been retained to interpret the results of the dutch cone penetration data. These evaluations are under way and will be addressed in subsequent reports.

Our soil consultants have indicated the fill is settling under its own weight. They advise us that there are only two suitable options at this time:

1) Remove and replace the building and fill material

2) Preload and consolidate the soil under the building

Of these corrective action plans, Dr. Peck and Dr. Hendron have recommended preloading and consolidating the soil under the building. This will allow the settlement of the building and underground utilities to take place before plant operation.

Modification of the foundation and underpinning the building were dismissed as possible solutions because the residual settlement of the utilities during the operation of the plant would not be minimized.

The preload option was selected because of the soil consultants' (Dr. Peck and Dr. Hendron) recommendations for corrective action. In order to maximize the preload and minimize the schedule impact, construction of the diesel generator building is being continued.

The exact amount of preload and the consolidation duration are difficult to determine. To assist in the determination of the necessary amount and duration of the preload, a system of instrumentation is being placed to record the soil movement and the pore water pressure during preload. The instrumentation consists of piezometers, settlement platforms, and Borros anchors at selected locations and elevations within and around the diesel generator building. Control instrumentation was installed in the area not affected by the preload. The additional settlement cannot be accurately predicted at this time.

Activities Completed Since Previous Report

The following activities were completed since the last interim report dated November 3, 1978:

1) Isolating Duct banks

The extent of the contact between the structure and the duct banks was explored. It was determined that the duct banks were restraining the diesel generator building from settling independently. Hence, it was decided to free the building from the duct bank restraint.

The structure and utilities were closely monitored during the release of this restraint. No distress to date has been noted in the utilities due to the settlement.

There were gaps in the order of 1-1/2 inch between the mud mat and the footings in the northeast area of the building. These gaps were reduced to 3/4 inch or less when the duct banks were isolated from the building. Therefore, there will be no grout placed between the underside of the footing and the mud mat prior to preload.

To ensure the free movement, a minimum of 2 inches of Ethafoam will be placed around the duct bank and the excavated area filled with lean concrete prior to preloading.

2) Meeting at Midland Jobsite

A meeting was held on December 4, 1978, with the NRC, Consumers Power Company, and Bechtel representatives. The purpose of the meeting was to inform the NRC of the current status of the diesel generator building settlement.

3) Soil Instrumentation

The installation of the instrumentation described under "Corrective Action" has been completed.

Activities in Progress

The activities in progress include the following:

1) The foundation data survey program is outlined in FSAR Subsection 2.5.4.13.2. This program provides for survey data to be gathered at 60-day intervals until the end of construction. The survey data is gathered at 90-day intervals for the first year of operation. At the end of this period, the survey data will be reviewed and an appropriate survey interval program developed, based on building performance.

This foundation data survey program has been expanded to provide additional settlement points and some shortened survey intervals. The settlement points have been increased from 69 to 180. These additional points are for structures located on the plant fill. The data survey is presently being conducted on the structures at the following intervals:

a) Diesel generator building at 7 days
b) Remaining structures on plant fill at 14 days
c) Main structures at 60 days - no change from previous interval

2) Utility Monitoring

There are utilities passing near and under the diesel generator building as shown in Figures 9 and 10, some of which are Seismic Category I. These utilities are being evaluated based upon their

relationship to plant safety, plant operation, and geometric sensitivity to settlement. The integrity of these utilities will be verified by monitoring representative lines. The monitoring will include visual examination for damage and movement, pressure tests, and continuity tests as indicated in Figure 11.

The utilities which have been selected for profile monitoring are a condensate line and a service water line. See Figure 11 for the location of the lines.

3) Monitoring Cracks in the Diesel Generator Building Wall

The existing cracks in the diesel generator building are being mapped to assist in the evaluation of the structure after preloading. Some of the cracks have closed after the four duct banks were released. Strain gages will be placed at selected crack locations for monitoring during preload.

4) NRC Inspection Report

The following items addressed in NRC Inspection Reports 50-339/78-12 and 50-330/78-12 dated November 14, 1978, are being investigated by project engineering:

a. FSAR Tables 2.5-14, and 2.5-9 and 2.5-10 conflict with the fill material description in Drawings C-109, Rev 2 and C-117, Rev 6.

b. FSAR Table 2.5-21 and Subsection 2.5.4.5.3 conflict with Specification C-210 and Quality Control Instructions C-102 regarding required number of passes for compaction.

c. FSAR Subsection 3.8.5.5 - Expected settlement

d. Conflict between FSAR Figure 2.5-47 and project Drawing C-1001, Rev 5 regarding foundation elevation.

e. Conflict in Specification C210 regarding compactive effort and test method

f. Conflict between consultants' recommendation and Specification C-210 regarding lift thickness and compaction requirements

g. ±2% tolerance in moisture content permitted in Specification C-210 and whether the material that was placed related to the selected proctor

h. Cracks in the diesel generator building structure

i. NRC Question 362.2, Subsection 2.5.4.5.1

5) Direct Effect of Surcharge

The direct effect of the surcharge is being investigated as information becomes available. This will be addressed in detail in subsequent reports.

Future Activities

The activities planned for the future include the following:

1) Surcharge Operation

The consultants, Dr. R.B. Peck and Dr. A.J. Hendron, have recommended the preloading of the diesel generator building area to consolidate the underlying material. It is estimated that between 15 and 20 feet will be utilized. The preload berm will extend 20 feet minimum from the exterior of the building as shown in the referenced Figure 11 (attached). The preload berm between the diesel generator and turbine buildings will be detailed in future reports.

2) The following preparations are being made to prepare for the preload:

a) Freeze protection in the form of about 2 to 3 feet of sand is being placed on the present grade in the areas to be surcharged.

b) Because of the close proximity of the diesel generator and the turbine buildings, additional details are being developed to strengthen the turbine building wall for the surcharge load in this area.

c) The elevation of the water table is important in ensuring optimum use of the preload. The water table in the area of the diesel generator building is influenced by the water elevation of the cooling pond. The cooling pond will be filled concurrently with the placing of the surcharge. The soil consultants have concurred to start filling the cooling pond as soon as possible.

3) Analysis of Structures

Analyses will be performed as required to evaluate the effects on the structures.

Schedule Impact

The impact of the diesel generator building settlement problem on the schedule will be discussed in subsequent reports.

Submitted by: Richard N. Bair

Reviewed by: [signature]

Approved by: [signature]

Concurrence by: Karl Wiedner

BECHTEL ASSOCIATES PROFESSIONAL CORPORATION

RB/js
12/11/13

Enclosure 2
Howe-1-79

ERRATA AND CLARIFICATION FOR MCAR 24, INTERIM REPORT #3

- Page 2, Line 3:

  FSAR Figure 2.5-14A should read FSAR Table 2.5-14A

- Page 6, Paragraph 4) b.:

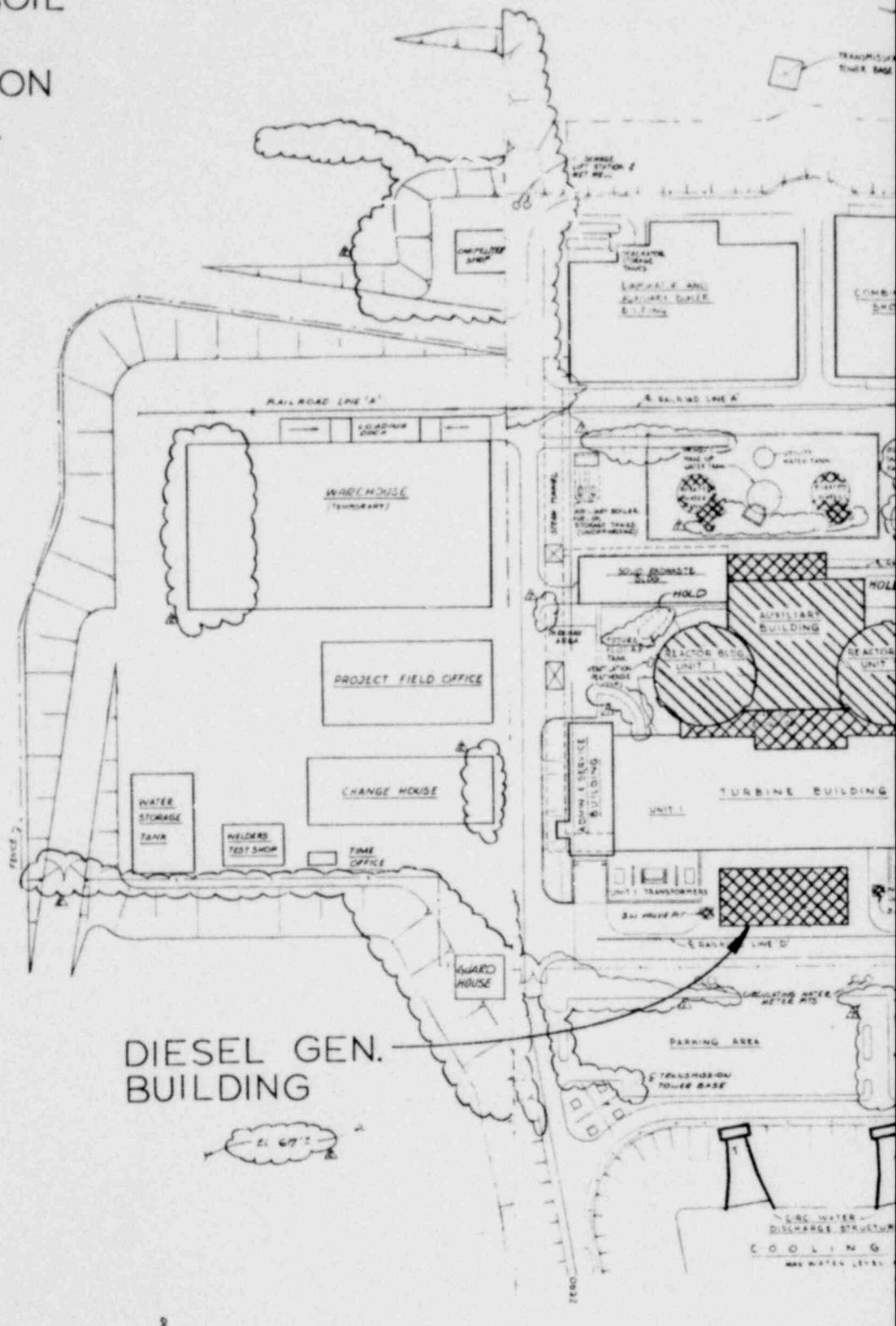
  C-102 should read C-1.02

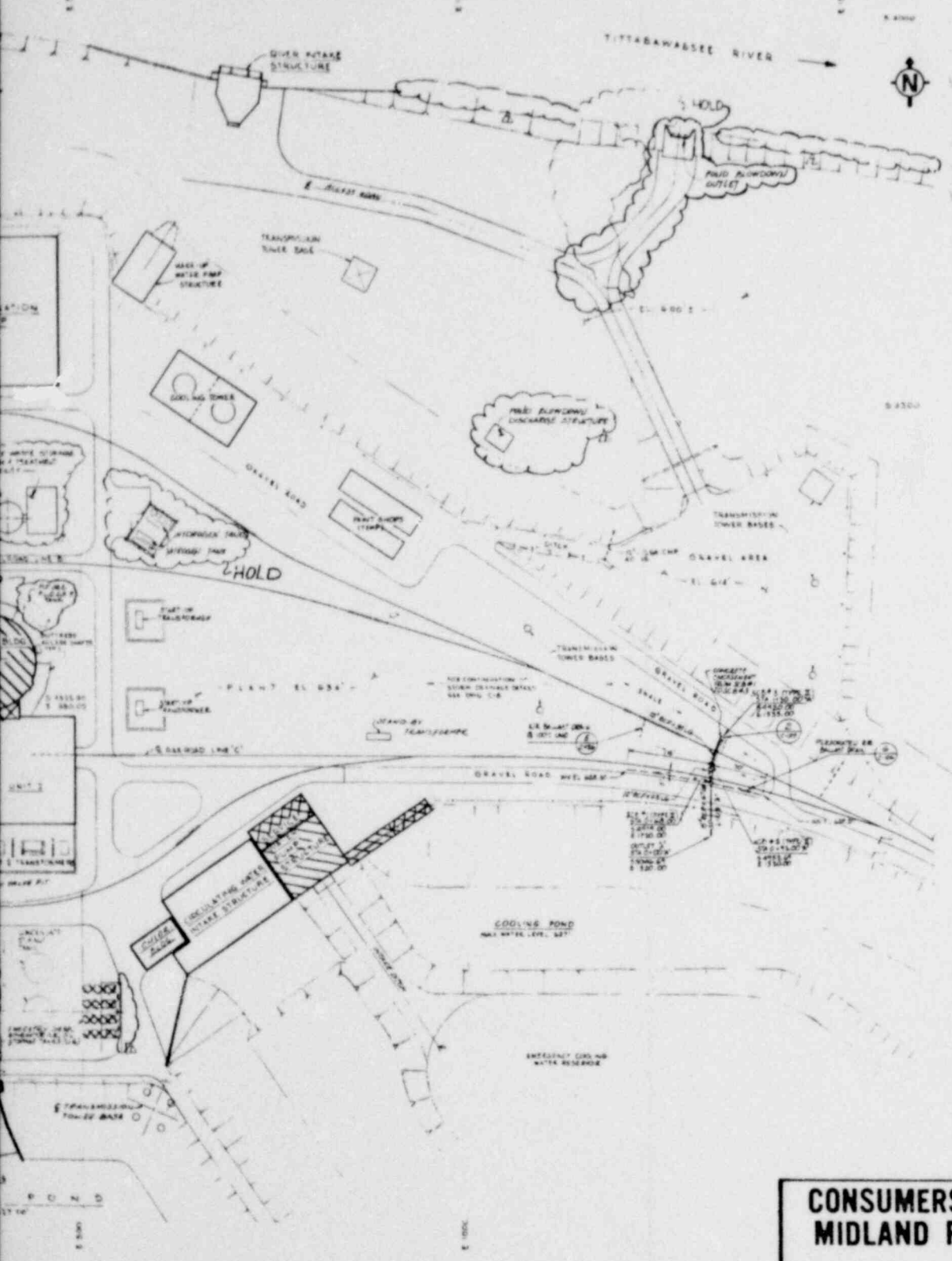
- Figure 8:

  Boring labeled D should not be on this Figure.

BUILDINGS ON ORIGINAL SOIL

BUILDINGS ON PLANT FILL





REFERENCE DRAWINGS

C-1 SITE VICINITY PLAN (LATER)
C-2 SITE PLAN
C-4 STATION ARRANGEMENT DETAIL PLAN AREA 'A'
C-39 ACCESS RAILROAD PLAN & PROFILE, SHEET 1
C-43 CONDENSATE WATER SYSTEM
C-45 PLANT AREA FIRE PROTECTION SYSTEM
C-46 PLANT AREA CONSTRUCTION EXCAVATION
C-48 CLASS I FILL MATERIAL AREA
C-49 PLANT AREA DRAINAGE PROFILES
C-67 ACCESS ROAD PLAN & PROFILE, SHEET 1 (LATER)
C-80 PLANT AREA PIPING PLAN & DETAILS (LATER)
C-81 CIRCULATING WATER SYSTEM PLANS & SECTIONS
C-83 SANITARY SEWER LINE PLAN & PROFILES, SHEET 1
C-88 COOLING TOWER BASIN PLAN & SECTIONS (LATER)
C-98 ELECTRIC MANHOLES (LATER)
C-99 MAKE-UP WATER SYSTEM NEW CONST. REMAINING RIGHT PLAN
C-100 " " LOCATION PLAN & DETAILS
C-117 SERVICE WATER SYS. PLANT PLAN AREA, TRENCH & SPOOL LINES
C-120 LOCK AND ROAD "CONSTRUCTION HAUL ROUTE" 1
C-129 COOLING POND PLAN, SHEET 1
C-131 TRANSFORMER FOUNDATIONS, SHEET 1 (LATER)
C-132 DRAIN LINE LAYOUT & DETAILS, SHEET 1
C-139 DRAINAGE STRUCTURES, SHEET 1
C-147 FIELD ERECTED TANKS, SHEET 1 (LATER)
C-149 FENCING PLAN & DETAILS
C-150 UNDERGROUND PIPING - SECTIONS & DETAILS
C-158 TEMPORARY CONSTRUCTION LAYDOWN AREA
C-159 STATION AERIAL PHOTO
C-164 PROCESS STEAM PIPE TUNNEL, SEN. REMOVAL (LATER)
C-165 CONCRETE STR. DETAILS AND MATERIAL LISTS SHEET

NOTE
SEE GENERAL NOTES, SEE DRAWING C-4

ALL ELEVATIONS ARE REFERENCED TO U.S.G.S. DATUM
TO TIE ALL CO-ORDINATES AND AREAS SHOWN ON THESE
DRAWINGS TO THE SEN GRAFICAL COMPANY PLANE
CO-ORDINATE SYSTEM, ADD THE FOLLOWING CORRECTION
WESTERLY - EASTERLY - NO CHANGE
NORTHERLY - SOUTHERLY - ADD 540.59
FEET TO ALL SOUTHERLY CO-ORDINATES
(I.E. S 5000 FEET ON THESE CONSTRUCTION DRAWING
S 5540.59 FEET ON SEN GRAFICAL COMPANY PLANE
CO-ORDINATE SYSTEM)

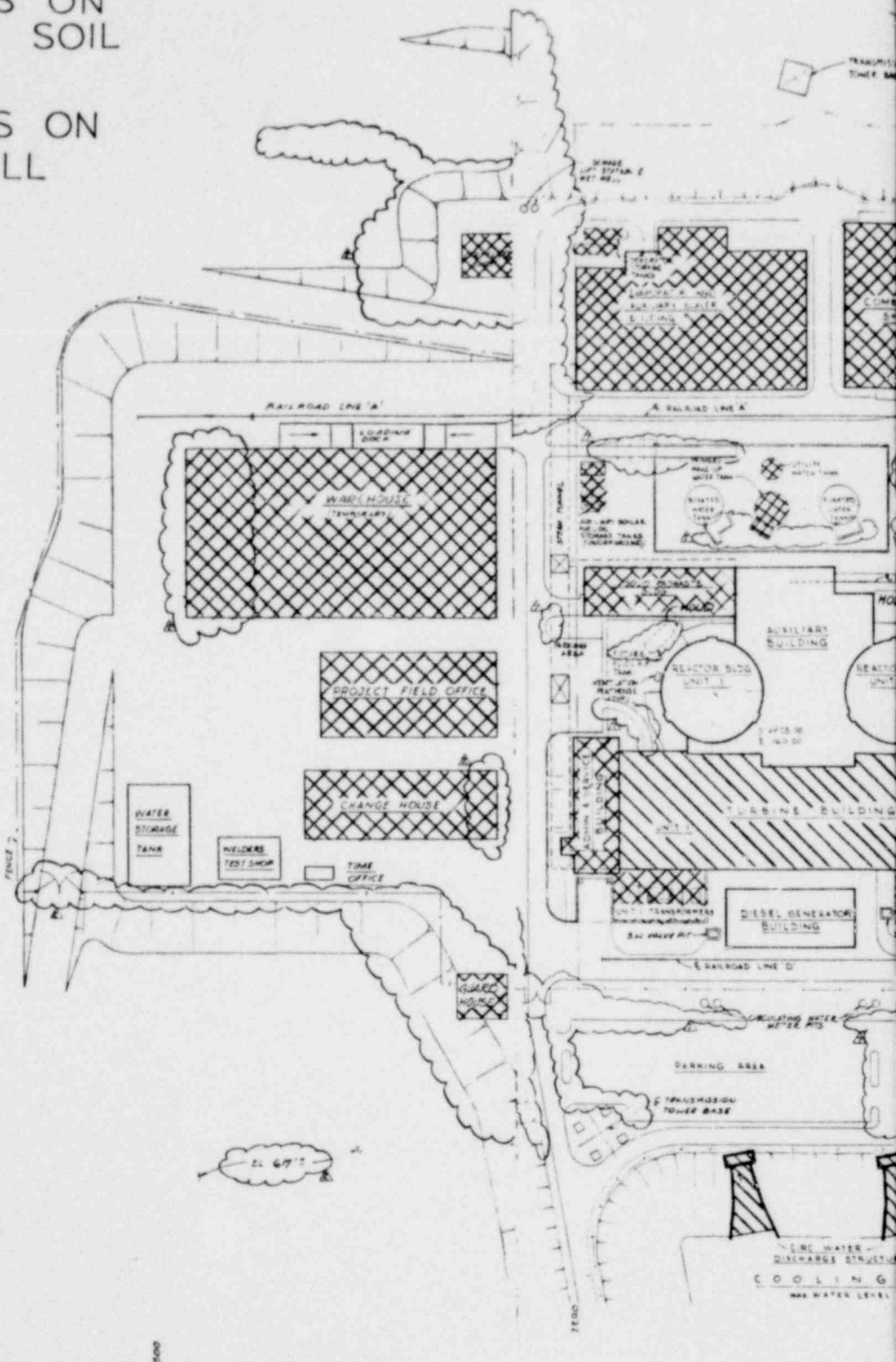
CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2

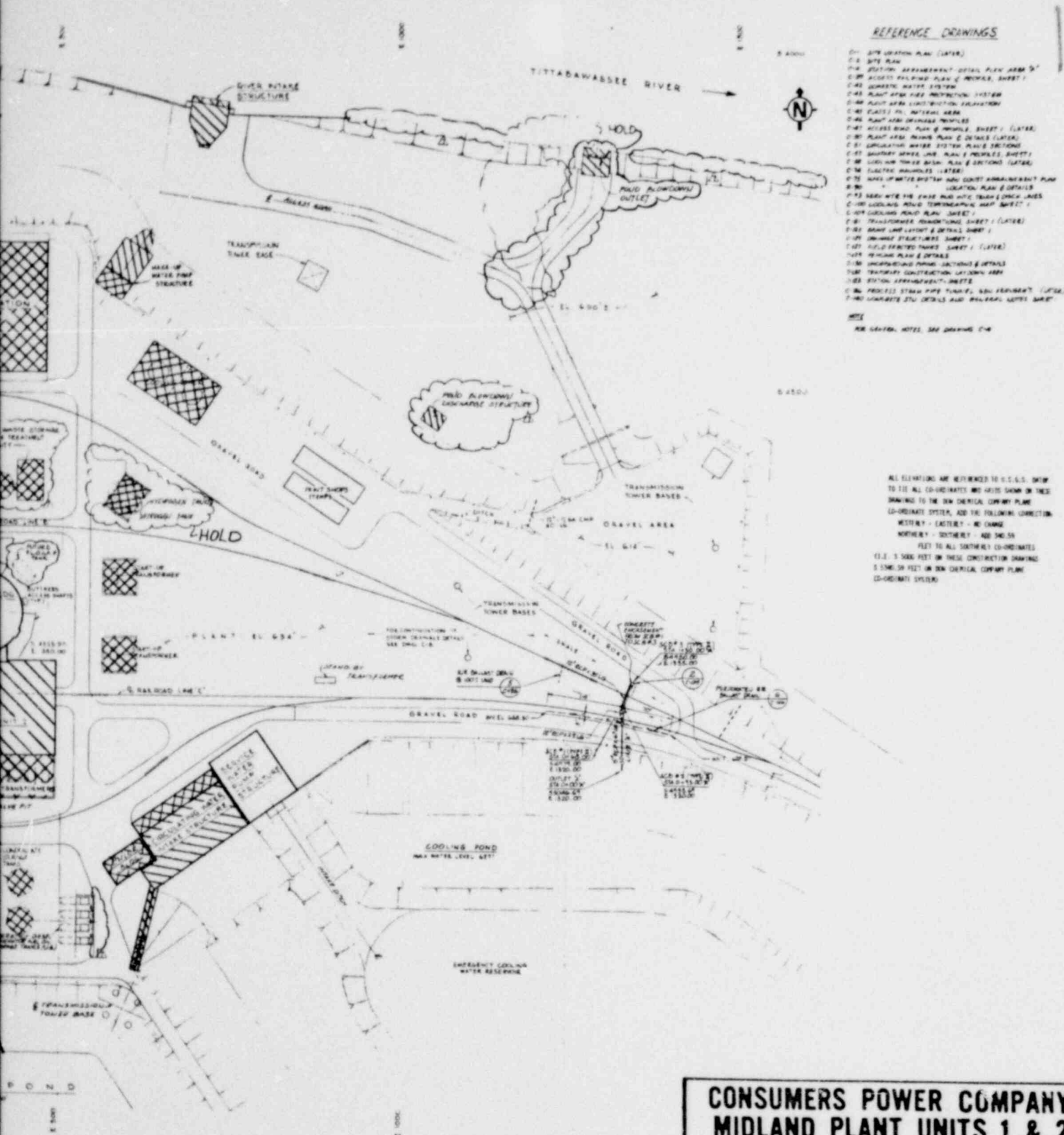
CLASS I STRUCTURES

Figure 5 REV. 3R

BUILDINGS ON ORIGINAL SOIL

BUILDINGS ON PLANT FILL





REFERENCE DRAWINGS

C-1 SITE LOCATION PLAN (LATER)
C-2 SITE PLAN
C-3 STATION ARRANGEMENT - DETAIL PLAN AREA 'A'
C-4 ACCESS RAILROAD PLAN & PROFILE, SHEET 1
C-5 DOMESTIC WATER SYSTEM
C-6 PLANT AREA FIRE PROTECTION SYSTEM
C-7 PLANT AREA CONSTRUCTION EXCAVATION
C-8 CLASS II FILL MATERIAL AREA
C-9 PLANT AREA DRAINAGE PROFILES
C-10 ACCESS ROAD PLAN & PROFILE, SHEET 1 (LATER)
C-11 PLANT AREA ROADS PLAN & DETAILS (LATER)
C-12 CIRCULATING WATER SYSTEM PLAN & SECTIONS
C-13 SANITARY SEWER LINE PLAN & PROFILES, SHEET 1
C-14 COOLING TOWER BASIN PLAN & SECTIONS (LATER)
C-15 ELECTRIC MANHOLES (LATER)
C-16 MAKE-UP WATER SYSTEM NEW COAST ARRANGEMENT PLAN
C-17 " " LOCATION PLAN & DETAILS
C-18 SERVICE WATER PIPE, STATE ROAD WATER TOWER & CHURCH LINES
C-19 COOLING POND TERMINATION MAP SHEET 1
C-20 COOLING POND PLAN SHEET 1
C-21 TRANSFORMER FOUNDATIONS SHEET 1 (LATER)
C-22 BRINE LINE LAYOUT & DETAILS SHEET 1
C-23 DRAINAGE STRUCTURES SHEET 1
C-24 H.P.D. ERECTED TANKS SHEET 1 (LATER)
C-25 FENCING PLAN & DETAILS
C-26 UNDERGROUND PIPING SECTIONS & DETAILS
C-27 TRANSFORMER CONSTRUCTION LAYDOWN AREA
C-28 STATION ARRANGEMENT SHEET 2
C-29 PROCESS STEAM PIPE TUNNEL, SEAL ARRANGEMENT (LATER)
C-30 CONCRETE STU DETAILS AND MATERIAL LISTS SHEET

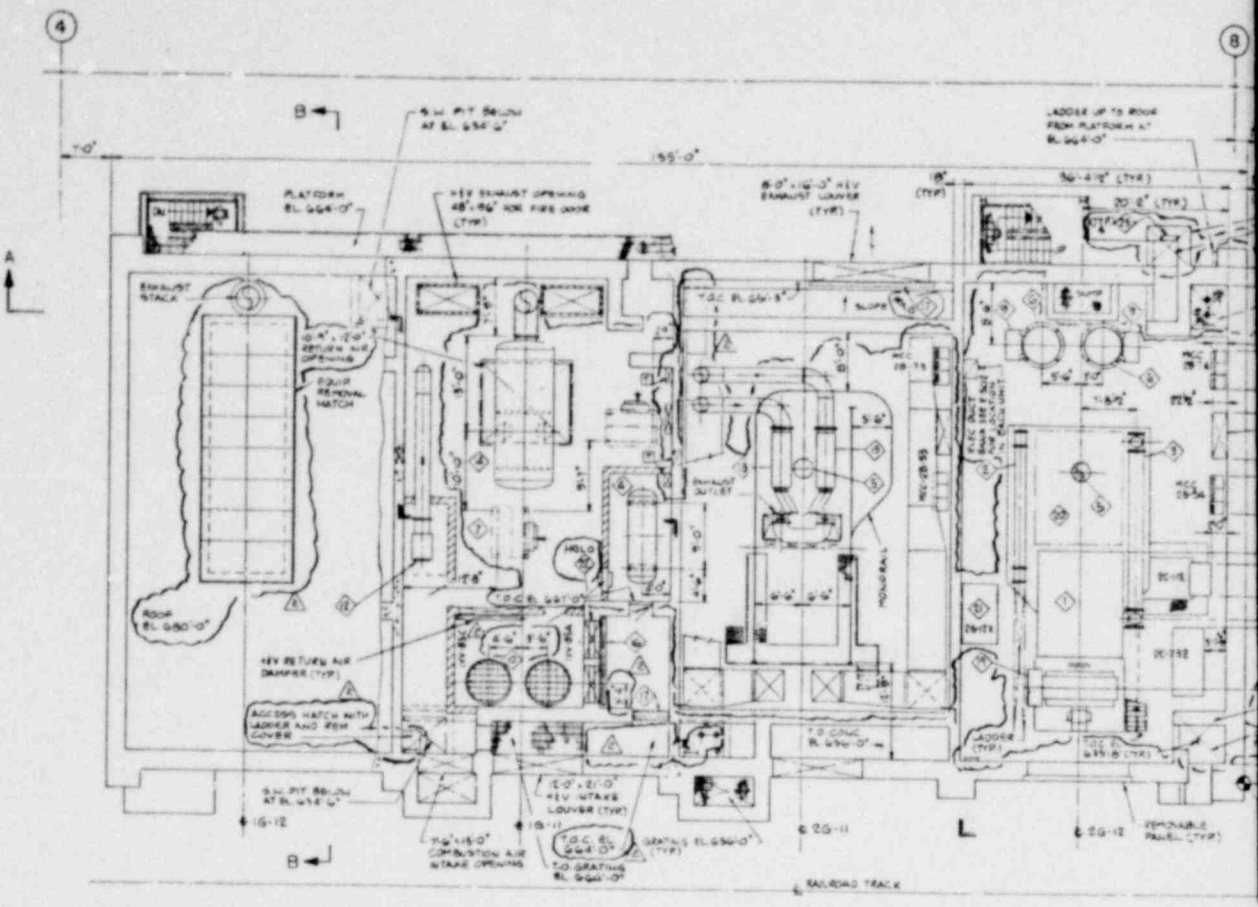
NOTE
FOR GENERAL NOTES, SEE DRAWING C-1

ALL ELEVATIONS ARE REFERENCED TO U.S.G.S. DATUM
TO TIE ALL CO-ORDINATES AND AXES SHOWN ON THESE
DRAWINGS TO THE DOW CHEMICAL COMPANY PLANT
CO-ORDINATE SYSTEM, ADD THE FOLLOWING CORRECTION
WESTERLY - EASTERLY - NO CHANGE
NORTHERLY - SOUTHERLY - ADD 340.59
FEET TO ALL SOUTHERLY CO-ORDINATES
(I.E. 5 000 FEET ON THESE CONSTRUCTION DRAWINGS
IS 5340.59 FEET ON DOW CHEMICAL COMPANY PLANT
CO-ORDINATE SYSTEM)

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2

CLASS II STRUCTURES

Figure 5A REV. 3R

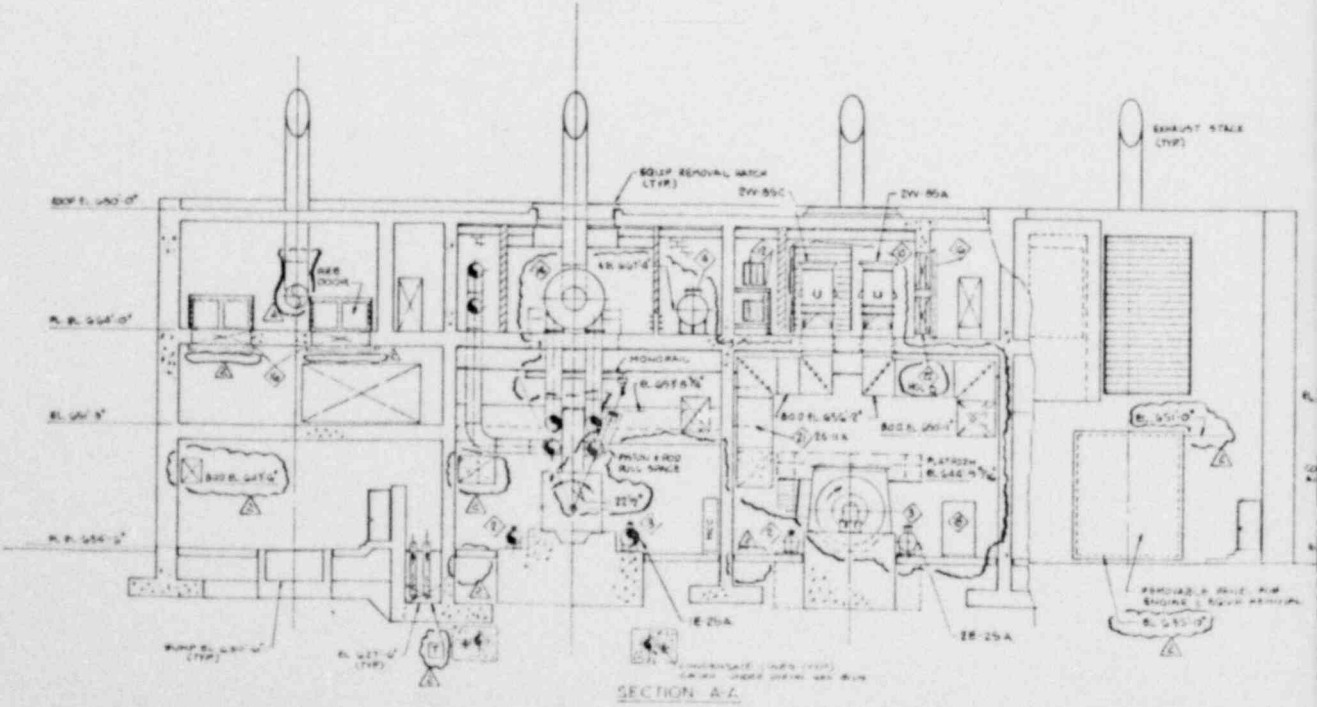


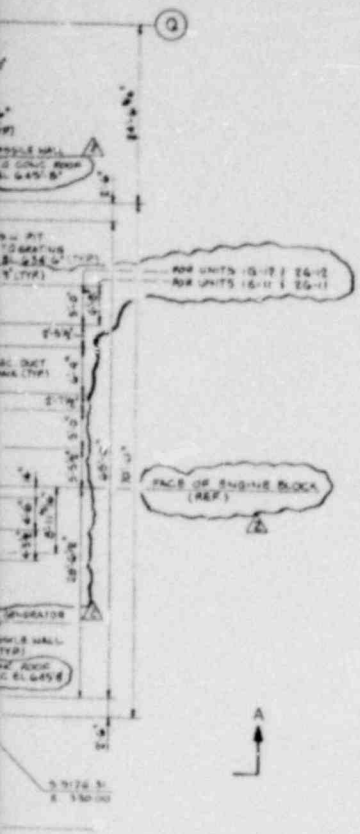
PLAN AT ELEV. 680'-0"

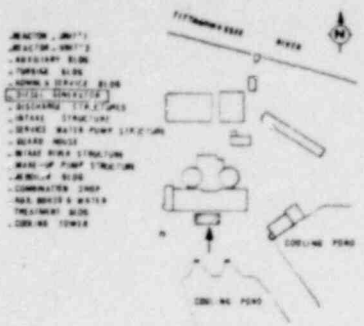
PLAN AT ELEV. 664'-0"
(TYP UNLESS NOTED OTHERWISE)

PLAN BELOW ELEV 660'-0"

PLAN ABOVE ELEV 654'-6"
(TYP UNLESS NOTED OTHERWISE)





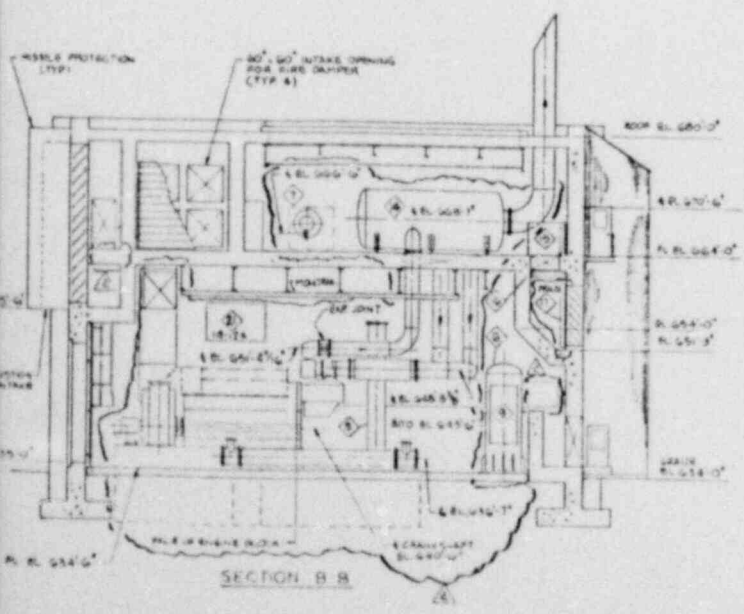


KEY PLAN

1. DIESEL ENGINE (4 UNITS @ EL. 25'-11", 16'-12", 25'-12") AND GENERATOR
2. LUBE OIL COOLER (4 UNITS : E-9A (B), 2E-9A (B))
3. JACKET WATER COOLER (E-25A (B), 2E-25A (B))
4. DIESEL FUEL OIL DAY TANK (T-77A (B), 2T-77A (B))
5. JACKET WATER STAND PIPE (T-94A (C), 2T-94A (C))
6. STARTING AIR RECEIVER TANK (T-95A (C), 2T-95A (C))
7. STARTING AIR COMPRESSOR (K-10A (C), (K-10 B (D)) (2K-10A (C), (2K-10 B (D))
8. STARTING AIR COOLER (E-8A (C), (E-8B (D)) (2E-8A (C), (2E-8B (D))
9. STARTING AIR DRYER (M-102A (C), (M-102 B (D)) (2M-102A (C), (2M-102 B (D))
10. H&V SUPPLY FAN (VV-85A (A OR B), 2VV-85A (A OR B))
11. CONTROL PANEL (1C-111, 2C-111, 1C-112, 2C-112)
12. COMBUSTION AIR INTAKE FILTER (F-9A (C), (F-9B (C)) (2F-9A (C), (2F-9B (C))
13. COMBUSTION AIR INTAKE SILENCER (M-100A (C), (M-100 B (D)), (2M-100A (C), (2M-100 B (D))
14. EXHAUST SILENCER (M-101A (B), (2M-101C (D))
15. FIRE DOOR
16. CONTROL DAMPER
17. TORNADO DAMPER
18. GENERATOR PANEL (1C-231, 1C-232, 2C-231, 2C-232)
19. AC BOX ASSY
20. AUXILIARY SKID
21. NEUTRAL GROUNDING RESISTOR (1S-115, 1S-124) (2S-115, 2S-124)
22. FIRE DAMPER
23. CO_2 PANEL

HOLD

HOLD

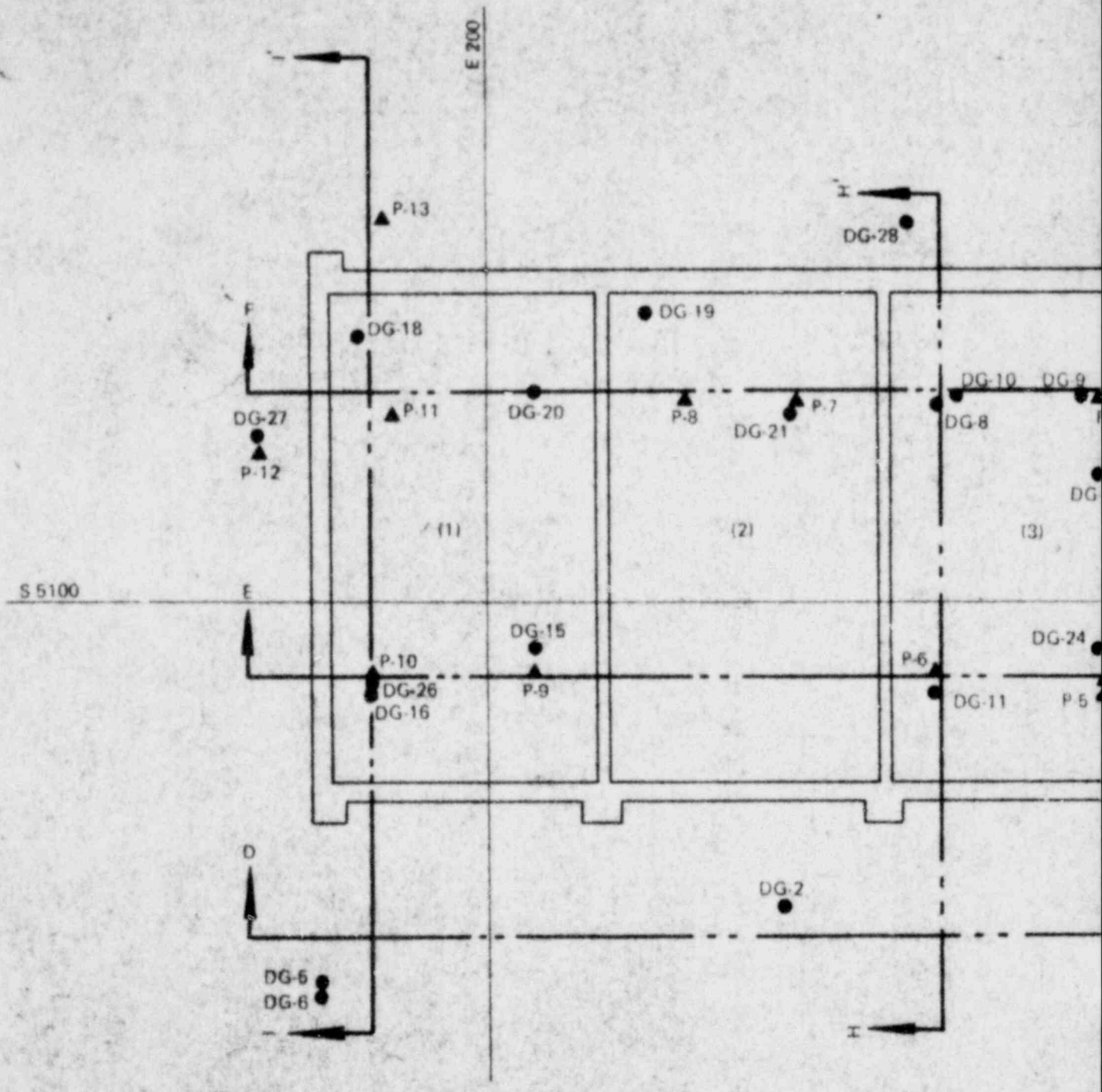


NOTE:
1. EQUIPMENT NOT DIMENSIONALLY LOCATED DUE TO INSUFFICIENT ENGINE INFORMATION
2. (T) INDICATES TEMPORARY PIPE AND/OR ELECTRICAL BLOCKOUT.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2

Diesel Generator Building

Figure 6 REV. 3R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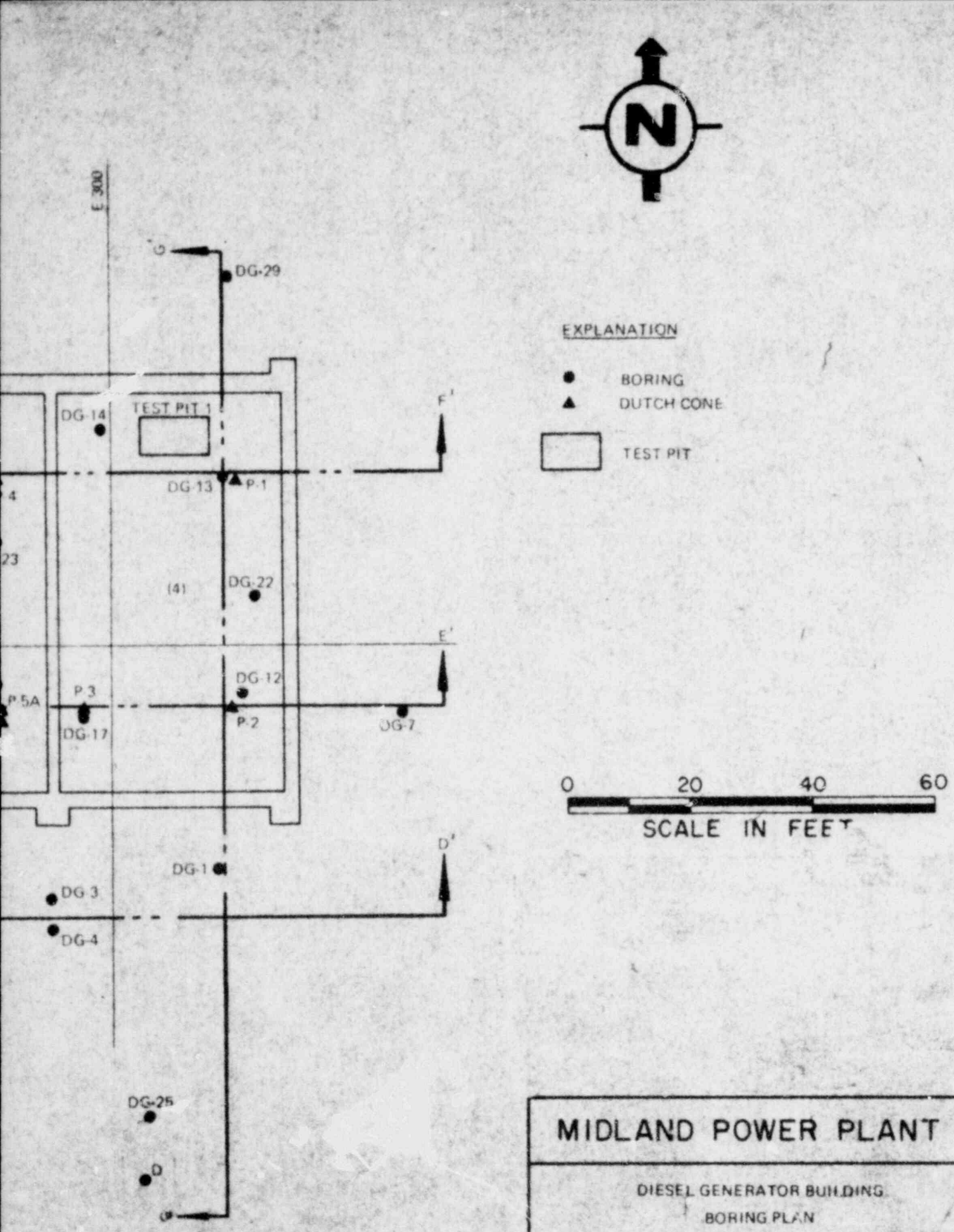

MIDLAND POWER PLANT

DIESEL GENERATOR BUILDING
BORING PLAN

DRAWING NO.	REV.
FIGURE 8	3R

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