

## Bechtel Associates Professional Corporation

SUBJECT: MCAR 24 (issued 9/7/78)

Settlement of the Diesel Generator Foundations and Building  
(Insufficient Compaction in Plant Area Fill Related to  
Seismic Category I Structures and Facilities)

INTERIM REPORT 5

DATE: April 16, 1979

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

Introduction

1. The title has been expanded to include activities related to plant area fill under other Seismic Category I structures in addition to the diesel generator building.
2. Extensive effort has been expended to respond to the NRC letter dated March 21, 1979, concerning the subject 10 CFR 50.54 request regarding plant fill. Portions of activities regarding plant fill and settlement will be covered in response to those questions.
3. This report is submitted to advise of interim status, developments, and project actions related to plant backfill settlement in the following areas since Interim Report 4, dated February 16, 1979. Information provided in Interim Report 5 includes settlement data up to April 13, 1979, wherever possible.
  - a. Settlement of the diesel generator foundations and building as described in MCAR 24 and NCR 1482
  - b. Backfill under Seismic Category I structures other than the diesel generator building.

Description of Deficiency

1. Diesel Generator Foundation and Building

It was stated in Interim Report 1 of MCAR 24, dated September 22, 1978, that "the diesel generator building settlements were noticed to exceed anticipated values in July 1978." The "anticipated values" referred to were not the "estimated ultimate settlement" values given in FSAR Figure 2.5-48. (Estimated ultimate settlement is defined as the estimated value predicted for a 40-year plant life.) Instead, these "anticipated values" were merely values of settlement that were greater than the amount of settlement which would have been expected under usual conditions for the elapsed time. The July 1978 settlement readings were within the estimated maximum settlement values given in the FSAR.

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The diesel generator foundation and building settlement data are shown in Figures 1, 13, 14, and 14-1. The maximum/minimum time settlement curves for the diesel generator building and one diesel generator foundation, shown in Figures 15 and 16 of Interim Report 4, have been updated to include settlement for all locations shown in Figure 1. This updated information is shown in Figures 43 and 44.

## 2. Other Seismic Category I Structures

Settlement data for Seismic Category I structures other than the diesel generator building are shown in Figure 2. Additional soil borings are being performed to evaluate fill under Seismic Category I structures other than the diesel generator building. Updated information on fill material not meeting project specification requirements will be provided in the response to the NRC's 10 CFR 50.54 request.

### Corrective Action

#### 1. Diesel Generator Foundations and Building Settlements

Corrective actions for this area have been discussed in Interim Reports 3 and 4. The preloading was completed to 20 feet above the final plant grade on April 7, 1979. The instrumentation shown in Figure 17 of Interim Report 4 has been completely installed.

#### 2. Other Seismic Category I structures

The corrective actions will be discussed in response to the NRC's 10 CFR 50.54 request.

### Activities Related to Plant Fill and Settlement

#### 1. Diesel Generator Building and Foundations

##### a. Activities Completed Since Last Report

##### 1) Soil exploration

Soil exploration in the diesel generator building area was described in Interim Report 4 except for Dutch cone penetrometer soundings. Fourteen Dutch cone penetrometer soundings were performed in the area of the diesel generator building. The locations of these soundings are shown in Figure 8 of Interim Report 4. The soundings were performed according to the "Tentative Method for Deep, Quasi-Static Cone and Friction-Cone Penetration Tests of

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Soil," ASTM Standard Designation D 3441-75T. Test results indicate that the soil under the diesel generator building above an approximate elevation of 605 feet is highly variable in classification. These results are consistent with soil boring results. They indicate that the fill below the building is variable in strength properties and susceptible to nonuniform settlement.

## 2) Liquefaction study

An analysis of liquefaction potential for sand in all quadrants beneath the diesel generator building was performed. The analysis was based on the soil boring information, field quality control data, and the gradation tests performed by Goldberg, Zoino, Dunnicliff, & Associates, Inc. The results of the analysis show that the northwest quadrant of the fill beneath the building is susceptible to liquefaction. However, the liquefiable sand pockets in the northwest quadrant are only locally connected and are surrounded by cohesive soil and dense sand. Corrective actions for this problem will be addressed in response to the NRC's 10 CFR 50.54 request.

## 3) Strengthening of the turbine building wall

This item, as described in Interim Report 4, was completed prior to placing preload above the 10-foot level (elevation 644').

## 4) Preload operation

Preloading of the diesel generator building has been completed. The granular fill material for the preload has been placed to el 654' as shown in Figures 11 and 12. This completes Step VII in Figure 12. Step VI of the preload sequence, which was to hold the preload at 15 feet above final plant grade, was deleted.

## 5) Construction of diesel generator structure

The last section of the building (roof slab) was poured on March 22, 1979. The construction of the main structure has been completed. These additions of weight to the building will assist the consolidation process.

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## 6) Crack mapping

The existing cracks in the diesel generator building which were mapped before preloading are shown in Figure 45. The present level of the preload prevents further visual examination of the cracks.

## 7) Utility monitoring

Pipes passing near and under the diesel generator building have been profiled in accordance with the monitoring program discussed in Interim Report 4. Pipe profiles are shown in Figure 60. Checks on Seismic Category I electrical ducts in the yard area show no obstructions.

## b. Activities in Progress

### 1) Settlement monitoring

#### a) Instrumentation data

Plots of borros anchors, surface plates (settlement platforms), and preload intensity are shown in Figures 46 through 56. Piezometer and cooling pond water level plots are shown in Figures 57 through 59.

Throughout the preload stages, 39 piezometers within the preload area were monitored on a daily basis, while the 28 settlement marker, 32 settlement platforms, and 45 borros anchors were monitored weekly. Instrumentation placed outside the preload area was also monitored for comparison. The results show that the preload program is causing the anticipated building settlement. Indications from piezometer readings are being studied.

#### b) Evaluation of underground pipe for preload pressure

The effect of preload on the circulating water pipes is being monitored as addressed in Interim Report 4. Figure 11 has been updated to show the roundness monitoring requirements for these pipes.

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## c) Crack monitoring

Some of the existing cracks in the diesel generator building walls are being electronically monitored. Since Interim Report 4 there has been essentially no change in the size of the cracks, monitored per Figure 18 of Interim Report 4.

## 2) Structural evaluation/analysis

An analytical model is being developed to analyze the effects of settlement of the diesel generator building and foundations. A seismic analysis, considering a range of possible soil parameters, is in progress.

## 3) Acceptance criteria

### a) Structural analysis

Criteria to evaluate the diesel generator structure and the foundations for the effect of settlement are being developed. These will be addressed in response to the NRC's 10 CFR 50.54 request.

### b) Removal of preload

Evaluation of the settlement readings will provide a basis for deciding when to remove the preload and predicting the maximum residual settlements of the diesel generator building.

## 2. Other Seismic Category I Structures and Facilities

### a. Activities Completed Since Last Report

#### 1) Soil exploration

Additional borings have been taken. The locations of these borings are shown in Figure 42.

#### 2) Crack mapping

The main structural elements of the service water pump structure and auxiliary building penetration rooms have been examined for cracks. The cracks identified in the service water structure have been mapped as shown in Figure 62.

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## 3) Settlement monitoring

- a) Emergency diesel fuel oil tanks have been filled with water and their settlements are being recorded.
- b) Pipes in the general plant fill area which have been profiled are shown in Figure 61.
- c) A borros anchor has been installed in the auxiliary building control tower at the same location as boring AX-6 shown in Figure 42.

## b. Future Activities Planned

Activities include continuation of the monitoring program, evaluation of fill under Seismic Category I structures, evaluation of the structures and facilities, and identification of any needed corrective action.

## Effect on Project Schedule

The current schedule analysis indicates an estimated potential delay in construction completion and system turnover of 2 months for the present corrective action program for the diesel generator foundations and buildings. The impact of this potential delay in system turnover on the preoperational testing schedule is yet to be determined. However, no impact on the fuel load date due to this delay is anticipated.

The potential for schedule impact for any needed corrective action related to other Seismic Category I structures is yet to be determined.

Submitted by: Amelia Gandy

Reviewed by: Boil B. She

Approved by: K. Wiedner

Concurrence by: Karl Wiedner

AG/js  
4/4/1

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## DRAWING SUMMARY

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Figures Included in MCAR 24

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1	Foundation Settlement Monitoring	3, 4, 5
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3	Settlement Data	3 (Replaced by Figure 13)
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5	Seismic Category I Structures	3
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15	Diesel Generator Building Settlement Data Time Rate	4 (Replaced by Figure 43)
16	Diesel Generator Pedestal 4 Settlement Data Time Rate	4 (Replaced by Figure 44)
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23	Cross Section D-D' Diesel Generator Building	4
24	Cross Section E-E' Diesel Generator Building	4
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April 30, 1979  
Howe-132-79

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

References: 1. 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
- (d) Serial Howe-1-79; dated January 5, 1979
- (e) Serial Howe-58-79; dated February 23, 1979

- 2. G S Keeley letter to J G Keppler: Midland Project -  
Docket No 50-329 and 50-330; Re: 10 CFR 50.54 -  
Request on Plant Fill; Serial 692, dated April 24, 1979

This letter, as were references 1. (a) through (e), is an interim 50.55(e)  
report on the settlement of the diesel generator foundations and building.

The enclosure provides the status of the actions being taken to resolve the  
problem. This enclosure references a 50.54(f) Report which contains more  
information regarding both the diesel generator building foundation and area  
fill upon which other Class I structures are built. The 50.54(f) Report was  
transmitted to you via reference 2. Please consider it as part of our response  
on this subject.

Another interim report will be sent on or before July 13, 1979.

*Stephen O. Dowell*

Enclosure: MCAR 24, Settlement of the Diesel Generator Foundations and  
Building, (Insufficient Compaction in Plant Area Fill Related  
to Seismic Category I Structures and Facilities), Interim  
Report #5, dated April 16, 1979

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