

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

REGION III

PRESENTATION OF INVESTIGATION FINDINGS
OF THE
SETTLEMENT OF THE DIESEL GENERATOR BUILDING
AND PLANT AREA FILL

CONSUMERS POWER COMPANY
MIDLAND NUCLEAR POWER PLANT
UNITS 1 AND 2

FEBRUARY , 1979

7904030372

C/12

CONTENTS

1. Scope of Investigation
2. Identification and Reporting of the Diesel Generator Building Settlement
3. Review of PSAR/FSAR Commitments
4. Effects of Ground Water on Plant Area Fill
5. Compaction Requirements for Plant Area Fill
6. Moisture Control Requirements for Plant Area Fill
7. Subgrade Preparation for Plant Area Fill
8. Nonconformance Reports Identified
9. Settlement Calculations for Plant Area
10. Settlement of Administration Building Footings
11. Interface Between Diesel Generator Building and Electrical Duct Banks
12. Soils Placement and Inspection Activities
13. Inspection Procedures for Plant Fill
14. Final Conclusions

1. Scope of Investigation

The NRC Region III office performed an investigation to obtain information relating to design and construction activities affecting the Diesel Generator Building foundation and plant area fill and the activities involved in the identification and reporting of the settlement of the building.

The investigation consisted of 240 onsite hours by three NRC inspectors and included examination of pertinent records and procedures and interviews with personnel at the Midland Site, the Consumers Power Company offices in Jackson Michigan, and the Bechtel Power Corporation offices in Ann Arbor, Michigan.

2. Identification and Reporting of Diesel Generator Building Settlement

Inspection Facts

- Bechtel surveyors first noticed unusual settlement on July 22, 1978, while performing routine survey measurements.
- The result of the survey with unusual settlement was routinely transmitted to Bechtel Engineering. *July 26, 1978*
- Field Project Engineer instructed surveyors to recheck survey and perform survey more frequently. The building was monitored for about one month.
- *check* Apparent settlement continued and when it exceeded the values presented in the FSAR, a nonconformance report was prepared on August 18, 1978.
- On or about August 21, 1978, the NRC Resident Inspector was informed of the settlement.
- After an exploratory boring program began on August 25, 1978, and preliminary data indicated deficient material, CPCo reported the incident under 10 CFR 50.55(e). *on Sept 7, 1978*
- Formal ^{written} notification was made on September 29, 1978.

Conclusion

CPCo, after preliminary evaluation of the safety implications, notified the NRC in accordance with 10 CFR 50.55(e).

Finding

Compliance of 10 CFR 50.55(e), reportability requirements.

3. Review of PSAR/FSAR Commitments

Inspection Facts

- FSAR Tables 2.5-9 and 2.5-14 identified the type of foundation material to be controlled compacted cohesive (clay) fill.
- Bechtel Design Drawing C-45 (class 1 fill material areas) specify Zone 2 random fill as any material free of organics with no restrictions on gradation.
- FSAR Figure 2.5-48 (estimated ultimate settlements) indicates the Diesel Generator Building to be approximately 3 inches.
- FSAR Section 3.8.5.5 (structural acceptance criteria) indicates shallow spread footing foundation settlements to be 1/2 inch or less on compacted fill. The Diesel Generator Building had a shallow spread footing foundation.

statement not supported in PSAR from Down
Conclusions + *more report.*

- a. The FSAR did not accurately state the design basis or type of fill material supporting class 1 structures.
- b. The FSAR included conflicting values for the settlement of the Diesel Generating Building founded on spread footing.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion III (design control); failure to translate design basis as specified in the license application into instructions, procedures or drawings.

4. Effect of Ground Water on Plant Area Fill

Inspection Facts

- PSAR Amendment No. 1 and Dames and Moore report on foundation investigation indicates a planned drainage system to maintain the ground water level in the plant fill at elevation 603.
- PSAR Amendment No. 3 indicates this underdrainage system has been eliminated and the ground water is assumed to rise concurrently with the cooling pond to elevation 625.
- Bechtel consultant (Dr. Peck) has indicated that small changes in moisture content of the soil will probably result in increased compressibility.

Conclusion

It has not been fully determined whether the full effects of saturating the fill was taken into account in the design basis.

Finding

Unresolved matter pending licensee evaluation on the effects of permitting the ground water to rise in the plant area fill.

5. Compaction Requirements for Plant Area Fill

Inspection Facts

- PSAR Amendment No. 3 required the following compaction:

Clay - 100% of maximum density using a compactive energy of 20,000 ft-lbs (equivalent to 95% of maximum density using ASTM 1557 Method D with 56,000 ft-lb energy).

Sand - 85% relative density.

- Bechtel Specification C-210 requirements:

Clay - 95% of maximum density using ASTM 1557 Method D (same as PSAR)

Sand - 80% relative density (less than PSAR)

- Bechtel implemented requirements:

Clay - 95% of maximum using Bechtel Modified Test Method using 20,000 ft-lbs (less than that required by the PSAR and Specification).

Sand - 80% relative density (less than PSAR required but met Specification requirement).

Conclusions

- a. Bechtel translated PSAR compaction requirement for clay in construction specification, however, failed to follow requirement.
- b. Bechtel did not translate PSAR compaction requirement for sand to construction specification.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion V (procedures); failure to implement construction specification requirements.

6. Moisture Control Requirements for Plant Area Fill

Inspection Facts

- Bechtel Specification C-210 required moisture conditioning in the borrow areas such that the moisture prior to compaction was within plus or minus 2% of optimum moisture content.
- CPCo and Bechtel QA identified that the moisture control was not being implemented prior to compaction on July 22, 1977.
- No association was made with a laboratory compaction standard (i.e., optimum moisture-maximum density curve) was made prior to compaction.
- From July 22, 1977, until June 1, 1978, Bechtel project engineering failed to provide adequate direction for control of moisture content.

Conclusion

For all practical purposes, moisture control was not implemented prior to the settlement failure of the Diesel Generator Building.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion XVI (corrective action); failure to take corrective action in a timely manner.

7. Subgrade Preparation of Plant Area Fill

Inspection Facts

- PSAR Amendment No. 3 and Dames and Moore foundation investigation report indicated that if the construction-schedule required foundation excavation to be left open during the winter that at least 3 1/2 feet of material be excavated before resumption of soils work or that same amount of cover material remain in place to prevent softening of subgrade soils due to frost action.
- Bechtel Specification C-210 only prohibited placement of soils frozen surfaces but did not include provision for frost protection of removal prior to resumption of work.
- Correspondence indicates that approximately only 2 inches of frozen/thawed soil was removed prior to resumption of soils work.

Conclusions

- a. PSAR requirement was not translated into the specification for soils work to preclude placement of soil over subgrade effected by frost action.
- b. Soil was not protected from frost action nor removed prior to resuming work.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion III (design control); failure to translate requirements into instructions or procedures.

8. Nonconformance Reports Identified

Inspection Facts

- CPGO and Bechtel QA identified repeated nonconforming conditions in the following areas of soils work:

Failing compaction tests due to using incorrect maximum lab density.

Moisture control tolerance.

Inadequate inspection.

Violation of lift thickness.

Gradation tests not taken.

Gradation requirements not met.

Inadequate test frequency.

Foremen directing soils not familiar with specification requirements.

- The most frequently used engineering disposition was to accept "use as is" with or without sound engineering basis.

Conclusion

The root of the deficiencies was not adequately corrected to preclude continued degradation of the quality of a safety related activity.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion XVI (corrective action); failure to take adequate corrective action to preclude repetition.

9. Settlement Calculations for Plant Area Fill

Inspection Facts

- Bechtel settlement calculations for the Diesel Generator Building were based on a uniform mat foundation with a uniformly distributed load of intensity of 3000 psf.
- FSAR Section 3.8.4.1.2 (Diesel Generator Building) indicates the foundation to be a spread footing type with a load intensity of 4000 psf with independent diesel generator pedestal.
- Borated water storage tanks are supported by a circular spread footing. The settlement calculations were based on a uniform circular mat foundation.
- FSAR Table 2.5-16 indicates the soil compressibility parameter to be 0.003 for the soil between elevation 603 and 634. Settlement calculations assumed an index of compressibility of 0.001.

Conclusion

The estimated settlement values for the Diesel Generator Building and borated water tanks shown in FSAR Figure 2.5-48 were based on conditions that are at variance to existing conditions such as foundation type, load intensity and soil compressibility.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion III (design control); failure to translate design basis as specified in the license application into instructions, procedures or drawings.

10. Settlement of Administration Building Footings

Inspection Facts

- Administration Building was originally supported by Zone 2 random fill material.
- Administration building foundation material was tested to the same compaction requirements as class 1 fill.
- Administration Building foundation material was placed similar to class 1 fill; by hand held and motorized equipment.
- Bechtel report identified basic cause of administration failure due to the result of repeated erroneous selection of laboratory compaction standard (i.e., incorrect selection of moisture-density standard for soil material being compacted).
- Only two borings were authorized to investigate the extent of the deficient soil outside the Administration Building area. Administration failure was then considered to be local condition.
- CPCo management (Corporate Project Engineer and Manager) were not properly informed of the administration settlement.

Conclusions

- a. CPCo did not adequately investigate the extent of the soil deficiency in the rest of the class 1 fill.
- b. No program changes were implemented to preclude the continued erroneous selection of the laboratory compaction standard.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion XVI (corrective action); failure to take adequate corrective action to identify the extent of the deficiency nor preclude repetition.

11. Interface Between Diesel Generator Building and Electrical Duct Banks

Inspection Facts

- Bechtel Electrical Design Drawing E-502 includes a detail to provide separation between the duct banks and diesel generator footing (i.e., styrofoam bond breaker to permit settlement of the Diesel Generator independent of the duct banks).
- Bechtel Construction Drawing C-45 permits the use of random fill Zone 2.
- Correspondence from Bechtel engineering to field (December 27, 1974) permits the use of lean concrete as replacement for Zone 1 and 2 material.
- Bechtel field used concrete around electrical duct banks under the diesel generator footings.

Conclusion

Due to permitting the use of concrete indiscriminately as random fill the uniform settlement of the Diesel Generator Building was restricted in the areas of the duct banks.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion V (procedures); failure to provide adequate instructions to preclude the use of a material that would cause differential settlement.

12. Soils Placement and Inspection Activities

Inspection Facts

- Bechtel Design Criteria C-501 requires soils operations to be performed under technical supervision of a qualified soils engineer to verify all materials are placed and compacted in accordance with criteria.
- Labor foreman were directing soil operations relative to test locations, test frequency, compaction and moisture.
- Bechtel field and QC inspectors were rarely in the areas where soil operations took place.
- Accuracy of test locations were a chronic problem.
- Moisture was added to the soil after compaction if moisture test failed.

Conclusion

Personnel directing the soils operation were not trained in the area of soils work nor were they considered to be qualified soils engineers.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion II (Quality Assurance); failure to provide training to personnel performing safety related activities.

13. Inspection Procedures for Plant Fill

Inspection Facts

- Bechtel Procedure C-1.02 (compacted backfill) was written as a replacement for Procedures C-210-4 and C-211-1.
- Procedure C-1.02 relaxed certain inspection point to surveillance only. For example:

<u>Activity</u>	<u>Inspection Procedure</u>		
	<u>C-210-4</u>	<u>C-211-1</u>	<u>C-1.02</u>
Material Free of Organics	-	I	S(V)
Material Moisture Conditioned	S	I	S(V)
Material Not Frozen	-	I	S(V)
Compacted to Density	W	S	S(V)
Lift Thickness Required	W	I	S(V)

Conclusions

- a. Inspection procedures for soils work were relaxed from original procedural requirements to leaving insufficient mandatory hold points to ascertain backfill materials were installed to requirements.
- b. It was ascertained that surveillance was infrequent and inadequate to verify conformance.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion X (inspection); failure to provide adequate inspection plans.

14. Final Conclusions

- There was inadequate control and supervision of plant fill material placement.
- Corrective action regarding nonconformance related to plant fill was either not taken or was inadequate.
- Certain design bases and construction specifications were not followed.
- Weaknesses exist in the interface between various components within the construction contractor's organization.
- The FSAR contains inconsistent, incorrect and unsupported statements.



NUCLEAR REGULATORY COMMISSION
REGION III
190 ROOSEVELT ROAD
GLEN ELLEN, ILLINOIS 60131

CPCO
SER. CL. NO. 1
FOR ID. AS OF 1/2/81

March 12, 1979

MEMORANDUM FOR: H. D. Thornburg, Director, Division of Reactor
Construction Inspection
Office of Inspection and Enforcement

FROM: James G. Keppler, Director

SUBJECT: MIDLAND DIESEL GENERATOR BUILDING AND PLANT AREA
FILL

Meetings on this subject were held on February 23, 1979 and March 5, 1979, between Consumers Power Company, Bechtel Corporation and NRC. These meetings were a continuation of the investigation conducted by our inspectors during December 11-13, 18-20, 1978 and January 4-5, 9-11, 22-25, 1979.

During the February 23, 1979 meeting we presented to Consumers Power Company our preliminary investigation findings, a copy of which was previously forwarded to you.

During the March 5, 1979 meeting Consumers Power Company provided their response to those findings, copies of which are enclosed.

Our summary findings with regard to this matter are as follows:

1. The quality assurance program for obtaining proper soil compaction of the Midland site was deficient in a number of areas.
2. Soil of the type used in the foundation of the diesel generator building is also located, to varying degrees, under other Class I structures. Whereas excessive settlement has been observed with the diesel generator building, the settlement of other Class I structures has not exceeded predicted values.
3. Several incorrect statements are contained in the F.I.R. with respect to the soil foundation.

In addition to these findings, we have compiled a list of technical questions which bear on the resolution of this problem. These are enclosed for your use in working with NRC.

~~8104160341~~

810318, 893

4/13

As previously discussed with you, one of our concerns is related to why construction activities at the Midland site, which could be affected by a Class I structure settlement should be continued while the total cause of the diesel generator settlement has not yet been determined. During the meeting on March 5, 1979, this question was posed to the licensee. Their response was that continuing scheduled construction work would not compromise the committed evaluations or remedial actions nor make irrevocable any conditions which do not fully satisfy FSAR or licensing requirements. Based on this, they are willing to accept the risk of continued construction.

In that we have questioned the licensee's intent to continue construction, we consider that the matter also warrants examination by HQ. This examination we feel also involves NRR for the following reasons:

1. If one assumes the foundation settlement placement was in accordance with design, then the matter of design adequacy becomes questionable.
2. If one assumes foundation placement did not meet design specification, one must question acceptability of the soils condition under the affected structures. It should be pointed out again, that the type of soils placed under the diesel generator building were also the type placed under other Class I structures and associated pipes and utility lines.
3. In light of items a and b above, the matter of seismic design also becomes one of concern.
4. Because of the licensee's total evaluation of the specific cause for the diesel generator and plant area fill settlement is not yet complete, the question of FSAR design review and its acceptability may warrant further attention by NRR.

As an alternate approach to the issue, consideration should be given to an NRC Directive or Show Cause Order which could expedite the licensee's confirmation to the NRC that continued construction will not compromise the design function of the involved structures for the life-time of the plant. It may also expedite the licensee's investigation into the basic cause of the diesel generator settlement and its relationship (or absence) to other Class I structures.

H. D. Thornburg

- 3 -

March 12, 1975

We will continue to followup on this matter and keep you informed of new information.

James W. Ray
for James G. Kepler
Director

Enclosures:
As stated

MIDLAND QUESTIONS

1. The licensee has stated that the fill has settled under its own weight. What assurance is provided that the fill has not settled locally under:
 - a. Structures with rigid mat foundations as portions of the auxiliary building or service water pump structures.
 - b. Class I piping in the fill resulting in lack of continuous support causing additional stress not accounted for in design.
2. How has the lack of compaction and the increase in soil compressibility affected the seismic response spectra used in design and therefore, the soil-structure interaction during seismic loading?
3. After current preloading material is removed will additional borings be taken to ascertain that the material has been compacted to the original requirements set forth in the PSAR and construction license application?
4. Since the foundation material is variable as described in 50.55(e) interim report number 4, how can long term differential settlement be predicted to assure reliable startup of the D/G in the event of emergency?
5. What tolerance does the D/G manufacturer require on the alignment of the D/G for reliable operation and startup?
6. Preliminary information indicates that the piping in fill under and in the vicinity of the D/G building have gross deformations induced either prior to or during the preload program. What is the extent of the deformation. Is this deformation beyond predicted? If so, what plans are being taken to correct the condition?
7. The borated water storage tanks and diesel fuel oil tanks have not yet been constructed and are to be located in questionable plant fill of varying quality. Why should those Class I structures be constructed prior to assuring the foundation material is capable of supporting such structures for the plant life?

MIDLAND QUESTIONS

8. PSAR Figure 2.5-48 shows estimated ultimate settlements which indicate a differential settlement across individual mat foundation and within individual structures. Was this differential accounted for in the original design of the mat foundation and in the design of structural member within the structure. If not, what effect does this differential settlement have on additional stresses induced in the mat or in structure members such as slab-beam-column connections?

9. Based on the information provided in CCo interim report number 4, it appears that the tests performed on the exploratory borings indicate soil properties that do not meet the original compaction criteria set forth in the PSAR and specification for soils work. What assurance is there that the soil under other Class I structures not accessible to exploratory boring meet the control compaction requirements?



OFFICE OF THE COMMISSIONER

UNITED STATES NUCLEAR REGULATORY COMMISSION WASHINGTON, D.C. 20555



CPCO DEP. EX. NO. 2 FOR ID. AS OF 1/6/81

December 29, 1980

DOCKET NUMBER 50-3290M PROD. & UTIL. FAC. 3300M

MEMO TO: Samuel J. Chilk Secretary

FROM: Thomas R. Gibbon Legal Assistant to Commissioner Bradford

SUBJECT: POSSIBLE EX PARTE CONTACT IN MIDLAND PROCEEDING, DOCKET # 50-3290M AND # 50-3300M

On July 30, 1980, I had extensive discussions with James G. Keppler, Director of Region III, and other Region III personnel on general NPC enforcement issues. During the course of these general discussions, we touched briefly upon the Midland case. I have recently reviewed my notes of these conversations and have now realized that the Midland conversation could be considered an ex parte contact. Accordingly, I request that pursuant to 10 CFR 2.780, you serve a copy of this memo and the attached summary of discussion upon all the parties in the Midland proceeding and also place these documents in the PDR. With regard to the summary of the discussion, Mr. Keppler notes that while there are some technical inaccuracies, the substance of the discussion is portrayed correctly.

Attachment: As stated

cc: James G. Keppler

~~8406070414~~

Keppler also stated that the Commissioners needed to express in one form or another the philosophy that once something is found wrong at the construction site, construction will stop in that area until the issue was resolved. He gave the example of Midland where I&E found that the diesel generator building had settled excessively. They also found that there was no Q/A program of any substance related to the basic foundation of the site. He said there really wasn't a Q/A program in this area. In response to this, the NRC issued an order which said that this should be remedied or work would be stopped in 30 days. The company requested a hearing and, therefore, stayed the order. Midland is continuing work today which will make resolution of the settlement problem much more difficult. Keppler said that the staff had not yet made up their minds on whether the fix proposed by Midland is acceptable. Therefore, the project continues to be built and the problem gets worse. He wanted the work stopped until the problem is solved.