UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

EXHIBIT
CPCo 2
11-18-80 mg

October 27, 1980

MEMORANDUM FOR: Ray Sutphin, Reactor Inspector

FROM: E. J. Gallagher, Reactor Inspector

SUBJECT: INPUT FOR SALP APPRAISAL ON MIDLAND 1 AND 2

The following is to inform you of the inspector's input for the SALP appraisal on the Midland 1 and 2 project. The inspector has been associated with the Midland project since October 1978 to the present in the civil/structural area. The following items have been designated for SALP appraisals:

1. Adequacy of management controls

   Consumers Power Co. has not provided adequate management control for the construction of the Midland project. Management has not been properly informed or involved in significant construction items.

2. Communication within functional group providing technical support

   Communication and technical support between CPCo and design organization has been poor. The design organization (Bechtel) has not provided clear technical direction.

3. Adequacy of committee and supervisory reviews and audits

   Audit findings have been made with CPCo management not directing attention to the "root cause" of the deficiency. Improvements are needed in this area.

4. Adequacy of records and record control systems

   In-process inspection records have not been maintained adequately. Findings have been made where in-process inspection records have been determined to be incorrect. Final review of these records have been taking place too far into the work activities to prevent poor records throughout a work activity.

5. Qualification and training of licensee personnel

Findings were made where the licensee did not adequately control the qualifications of the contractor's quality control personnel for the post-tensioning work activity. In general, CPCo performance in the area has not been adequate. The civil QA supervisor for CPCo has been in need of more staff to control the civil work activities for some time. Management has not supplied this personnel as of this appraisal.

6. Overall effectiveness and attitudes

CPCo in conjunction with their contractor has a poor attitude in compliance. In addition, CPCo has been reluctant to give the NRC requested documents without first clearing it with upper CPCo management. This has been considered as an inhibiting factor in our inspection program.

E. J. Gallagher

E J Gallagher

cc:
G. Fiorelli
D.W. Hayes
R.C. Knop

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EXHIBIT
CPCo 3
11-18-80

February 15, 1979

MEMORANDUM FOR: H. D. Thornburg, Director, Division of Reactor Construction Inspection, IE

FROM: James G. Keppler, Director

SUBJECT: MIDLAND SUMMARY REPORT

The attached report, which represents Region III's overall assessment of the Midland construction project to date from a regulatory standpoint, was discussed with you and representatives from your staff, NRR, and OELD during our meeting at HQ's on February 6, 1979. During that meeting, it was concluded that this report should be provided to OELD for transmittal to the Licensing Board and the various parties to the Hearing. As such, this information is being forwarded for your action.

Was not what was agreed in the mtg.

We believe the meeting was quite useful in receiving feedback from the various NRC people involved relative to our position on the status of this facility.

Please contact me if you have any questions regarding this matter.

James G. Keppler
James G. Keppler
Director

Attachment:
Midland Summary Report

2-7490

5a

8104160335

MIDLAND SUMMARY REPORT

Facility Data

Docket Numbers	- 50-329 and 50-330
Construction Permits	- CPPR-81 and CPPR-82
Permits Issued	- December 14, 1972
Type Reactor	- PWR; Unit 1, 492 MWe*; Unit 2, 818 MWe
NSSS Supplier	- Babcox & Wilcox
Design/Constructor	- Bechtel Power Corporation
Fuel Load Dates	- Unit 1, 11/81; Unit 2, 11/80
Status of Construction	- Unit 1, 52%, Unit 2, 56%; Engineering 80%

*Approximately one-half the steam production for Unit 1 is dedicated, by contract, to be supplied to Dow Chemical Corporation, through appropriate isolation heat exchangers. Capability exists to alternate to Unit 2 for the steam source upon demand.

Chronological Listing of Major Events

July 1970	Start of Construction under exemption
9/29-30 & 10/1/70	Site inspection, four items of noncompliance identified, extensive review during CP hearings
1971 - 1972	Plant in mothballs pending CP
12/14/72	CP issued
9/73	Inspection at Bechtel Ann Arbor offices, five items of noncompliance identified
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3/12/75	RIII held management meeting with CP

8/21/75	CP reported that 42 sets of #6 tie bars were missing in Auxiliary Building
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12/10/76	CP revised Midland QA program accepted by NRR
2/28/77	Unit 2 bulge of containment liner discovered
4/19/77	Tendon sheath omissions of Unit 1 reported
4/29/77	IAL issued relative to tendon sheath placement errors
5/5/77	Management meeting at CP Corporate Office relative to IAL regarding tendon sheath problem

5/24-27/77	Special inspection by RIII, RI and HQ personnel to determine adequacy of QA program implementation at Midland site
6/75 - 7/77	Series of meetings and letters between CP and NRR on applicability of Regulatory Guides to Midland. Commitments by CP to the guides was responsive
7/24/78	Construction resident inspection assigned
8/21/78	Measurements by Bechtel indicate excessive settlement of Diesel Generator Building. Officially reported to RIII on September 7, 1978
12/78 - 1/79	Special investigation/inspection conducted at Midland sites Bechtel Ann Arbor Engineering offices and at CP corporate offices relative to Midland plant fill and Diesel Generator building settlement problem

Selected Major Events

Past Problems

1. Cadweld Splicing Problem and Show Cause Order

A routine inspection, conducted on November 6-8, 1973, as a result of intervenor information, identified eleven examples of four noncompliance items relative to rebar Cadwelding operations. These items were summarized as: (1) untrained Cadweld inspectors; (2) rejectable Cadwelds accepted by QC inspectors; (3) records inadequate to establish cadwelds met requirements; and (4) inadequate procedures.

As a result, the licensee stopped work on cadweld operations on November 9, 1973 which in turn stopped rebar installation and concrete placement work. The licensee agreed not to resume work until the NRC reviewed and accepted their corrective action. However, Show Cause Order was issued on December 3, 1973, suspending Cadwelding operations. On December 6-7, 1973 RIII and HQ personnel conducted a special inspection and determined that construction activity could be resumed in a manner consistent with quality criteria. The show cause order was modified on December 17, 1973, allowing resumption of Cadwelding operations based on the inspection results.

The licensee answered the Show Cause Order on December 29, 1973, committing to revise and improve the QA manuals and procedures and make QA/QC personnel changes.

Prehearing conferences were held on March 28 and May 30, 1974, and the hearing began on July 16, 1974. On September 25, 1974, the Hearing Board found that the licensee was implementing its QA program in compliance with regulations and that construction should not be stopped.

2. Rebar Omission/Placements Errors Leading to IAL

Initial identification and report of rebar nonconformances occurred during an NRC inspection conducted on December 11-13, 1974. The licensee informed the inspector that an audit, had identified rebar spacing problems at elevations 642' - 7" to 652' - 9" of Unit 2 containment. This item was subsequently reported per 10 CFR 50.55(e) and was identified as a item of noncompliance in report Nos. 50-329/74-11 and 50-330/74-11.

Additional rebar deviations and omissions were identified in March and August 1975 and in April, May and June 1976. Inspection report Nos. 50-329/76-04 and 50-330/76-04 identified five noncompliance items regarding reinforcement steel deficiencies.

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Licensee response dated June 18, 1976, listed 21 separate items (commitments) for corrective action. A June 24, 1976 letter provided a plan of action schedule for implementing the 21 items. The licensee committed not to resume concrete placement work until the items addressed in licensee's June 24 letter were resolved or implemented. This commitment was documented in a RIII letter to the licensee dated June 25, 1976. Although not stamped as an IAL, in-house memos referred to it as such.

Rebar installation and concrete placement activities were resumed in early July 1976, following completion of the items and verification by RIII.

Additional action taken is as follows:

a. By the NRC

(1) Assignment of an inspector full-time on site for five weeks to observe civil work in progress

(2) IE management meetings with the licensee at their corporate offices

(3) Inspection and evaluation by Headquarter personnel

b. By the Licensee

(1) June 18, 1976 letter committing to 21 items of corrective action

(2) Establishment of an overview inspection program to provide 100% reinspection of embedments by the licensee following acceptance by the contractor QC personnel

c. By the Contractor

(1) Personnel changes and retraining of personnel

(2) Prepared technical evaluation for acceptability of each identified construction deficiency

(3) Improvement in their QA/QC program coverage of civil work (this was imposed by the licensee)

3. Tendon Sheath Placement Errors and Resulting Immediate Action Letter (IAL)

On April 19, 1977, the licensee reported, as a Part 50, Section 50.55(e) item, the inadvertent omission of two hoop tendon sheaths from a Unit 1 containment concrete placement at elevation 703' - 7". The tendon sheaths were, for the most part, located at an elevation in the next higher concrete placement lift, except that they were diverted to the lower placement lift to pass under a steam line penetration and it was where they were omitted. Failure to rely on the proper source documents by construction and inspection personnel, contributed to the omission.

An IAL was issued to the licensee on April 29, 1977, which spelled out six licensee commitments for correction which included: (1) repairs and cause corrective action; (2) expansion of the licensee's QC over view program; (3) revisions to procedures and training of construction and inspection personnel.

A special QA program inspection was conducted in early May 1977. The inspection team was made up of personnel from RI, RIII, and HQ. Although five items of noncompliance were identified, it was the concensous of the inspectors that the licensee's program was an acceptable program and that the Midland construction activities were comparable to most other construction projects.

The licensee issued its final report on August 12, 1977. Final review on site was conducted and documented in report No. 50-329/77-08.

Current Problems

1. Plant Fill - Diesel Generator Building Settlement

The licensee informed the RIII office on September 8, 1978, of per requirements of 10 CFR 50.55(e) that settlement of the diesel generator foundations and structures were greater than expected.

Fill material in this area was placed between 1975 and 1977, with construction starting on diesel generator building in mid-1977. Filling of the cooling pond began in early 1978 with the spring run-off water. Over the year the water level has increased approximately 21 feet and in turn increasing the site gound water level. It is not known at this time what effect (if any) the higher site ground water level has had on the plan fill and excessive settlement of the Diesel Generator Building. It is interesting to note however, that initially the PSAR indicated an underdrain system would be installed to maintain the ground water at its normal (pre pond) level but that it later was deleted.

The NRC activities, to date, include:

a. Transfer of lead responsibility to NRR from IE by memo dated November 17, 1978

b. Site meeting on December 3-4, 1978, between NRR, IE, Consumers Power and Bechtel to discuss the plant fill problem and proposed corrective action relative to the Diesel Generator Building settlement

c. RIII conducted an investigation/inspection relative to the plant fill and Diesel Generator Building settlement

The Constructor/Designer activities include:

a. Issued NCR-1482 (August 21, 1978)

b. Issued Management Corrective Action Report (MCAR) No. 24 (September 7, 1978)

c. Prepared a proposed corrective action option regarding placement of sand overburden surcharge to acc lerate and achieve proper compaction of diesel generator building sub soils

Preliminary review of the results of the RIII investigation/inspection into the plant fill/Diesel Generator Building settlement problem indicate many events occurred between late 1973 and early 1978 which should have alerted Bechtel and the licensee to the pending problem. These events included nonconformance reports, audit findings, field memos to engineering and problems with the administration building fill which caused modification and replacement of the already poured footing and replacement of the fill material with lean concrete.

2. <u>Inspection and Quality Documentation to Establish Acceptability of Equipment</u>

This problem consists of two parts and has just recently been identified by RIII inspectors relative to Midland. The scope and depth of the problem has not been determined.

The first part concerns the adequacy of engineering evaluation of quality documentation (test reports, etc.) to determine if the documentation establishes that the equipment meets specification and environmental requirements. The licensee, by the Licensee's overview program

on November 13, 1978, issued a construction deficiency report (10 CFR 50.55(e)) relative to this matter. Whether the report was triggered by RIII inspector inquiries or by IE Circular or Bulletin is not known. An interim report dated November 28, 1978 was received and stated Consumers Power was pursuing this matter not only for Bechtel procured equipment but also for NSS supplied equipment.

The second part of the problem concerns the adequacy of equipment acceptance inspection by Bechtel shop inspectors. Examples of this problem include: (1) Decay Heat Removal Pumps released by the shop inspector and shipped to the site with one pump assembled backwards, (2) electrical penetrations inspected and released by the shop inspector for shipment to the site. Site inspections to date indicate about 25% of the vendor wire terminations were improperly crimped.

Inspection History

The construction inspection program for Midland Units 1 and 2 is approximately 50% complete. This is consistent with status of construction of the two units. (Unit 1 - 52%; Unit 2 - 56%) In terms of required inspection procedures approximately 25 have been completed, 33 are in progress and 36 have not been initiated.

The routine inspection program has not identified an unusual number of enforcement items. Of the selected major events described above, only one is directly attributable to RIII enforcement activity (Cadweld splicing). The other were identified by the licensee and reported through the deficiency report system (50.55(e)). The Midland data for 1976 - 78 is tabulated below.

Year	Number of Noncompliances	Number of Inspections	Inspector Hours On Site
1976	14	9	646
1977	5	12	648
1978	11	18	706

A resident inspector was assigned to the Midland site in July 1978. The on site inspection hours shown above does not include his inspection time.

The licensee's QA program has repeatedly been subject to in-depth review by IE inspectors. Included are:

1. July 23-26 and August 8-10, 1973, inspection report Nos. 50-329/73-06 and 50-330/73-06: A detailed review was conducted relative to the implementation of the Consumers Power Company's QA manual and Bechtel Corporation's QA program for design activities at the Bechtel Ann Arbor office. The identified concerns were reported as discrepancies relative to the Part 50, Appendix B, criteria requirements.

2. September 10-11, 1973, report Nos. 50-329/73-08 and 50-330/73-08: A detailed review of the Bechtel Power Corporation QA program for Midland was performed. Noncompliances involving three separate Appendix B criteria with five different examples, were identified.

3. February 6-7, 1974, reports No. 50-329/74-03 and 50-330/74-03: A followup inspection at the licensee's corporate office, relative to the items identified during the September 1973 inspection (above) along with other followup.

4. June 16-17, 1975, report Nos. 50-329/75-05 and 50-330/75-05: Special inspection conducted at the licensee's corporate office to review the new corporate QA program manual.

5. August 9 through September 9, 1976, report Nos. 50-329/76-08 and 50-330/76-08: Special five-week inspection regarding QA program implementation on site primarily for rebar installation and other civil engineering work.

6. May 24-27, 1977, report Nos. 50-329/77-05 and 50-330/77-08: Special inspection conducted at the site by RIII, IE and RI personnel to examine the QA program implementation on site by Consumers Power Company and by Bechtel Corporation. Although five examples of noncompliance to Appendix B, Criterion V, were identified, the consensus of the inspectors involved was that the program and its implementation for Midland was considered to be adequate.

Although the licensee's Quality Assurance program has under gone a number of revisions to strengthen its provisions, no current concern exist regarding its adequacy. Their Topical QA Plan has been reviewed and accepted by NRR through revision 7. Implementation of the program has been and continues to be subject to further review with the mid-construction program review presently scheduled for March or April 1979.

Consumers Power Company expanded their QA/QC auditing and surveillance coverage to provide extensive overview inspection coverage. This began in 1975 with a commitment early in their experience with rebar installation problems and was further committed by the licensee in his letter of June 18, 1976, responding to report Nos. 50-329/76-04 and 50-330/76-04. This overview inspection activity by the licensee has been very effective as a supplement to the constructor's own program. Currently, this program is functioning across all significant activities at the site.

Enforcement History

Approximately 6 months after restart of construction activities (11 months after CP issuance) an inspection identified four noncompliance items regarding cadwelding activities. This resulted in a show cause order being issued on December 3, 1973. This enforcement action was aired publicly during hearings held by the Atomic Safety Licensing Board in May 1974. The hearing board issued its decision in September 1974 that concluded that construction could proceed with adequate assurance of quality.

Identification of reinforcing bar problems began in December of 1974 with the licensee reporting improper spacing of rebar in the Unit 2 containment wall. Further reinforcing bar spacing and/or omission of rebar was identified in August 1975 and again in May 1976 with the citations of 5 noncompliances in an inspection report. An IE:HQ notice of violation was issued regarding the citations in addition to the licensee issuing a stop work order. The licensee issued a response letter dated June 18, 1976 committing to 21 items of corrective action. A Bechtel prepared technical assessment for each instance of rebar deficiency was submitted to and review by IE:HQ who concluded that the structures involved will satisfy the SAR criteria and that the function of these structures will be maintained during all design conditions. The RIII office of NRC performed a special five week inspection to assess the corrective action implementation without further citation.

The licensee reported that two hoop tendon sheaths were omitted in concrete placements of Unit 2 containment wall in April 1977. An Immediate Action Letter was issued to the licensee on April 29, 1977 listing six items of licensee commitments to be completed. A special inspection was performed on May 24-27, 1977 with four NRC inspectors (1-HQ, 1-RI, and 2-RIII). Although five items of noncompliance were identified, it was the consensus of the inspectors that the QA/QC program in effect was adequate. The constructors nonconformance report provided an alternate method of installation for the tendon sheaths that was accepted.

The RIII office of inspection and enforcement instituted an augmented on site inspection coverage program during 1974, this program has continued in effect ever since and is still in effect. It is noted that the noncompliance history with this program is essentially the same as the history of other RIII facilities with a comparable status of construction. Further on site inspection augmentations was accomplished with the assignment of a full time resident inspector in August, 1978.

The noncompliance history for the Midland Project is provided in the following table.

ENFORCEMENT ACTIONS

Noncompliances

Criteria (10 CFR 50 Appendix B)
( ) Number of Occurrances

V, X, XI, XVI

Construction haulted pending CP

II V(5) XIII, XV, XVII

V(2) XVI

V(4) X, XII, XV, XVI, XVII, XVIII

V(5) 10 CFR 50.55(e) item

V(4) VI(2), VII, IX(3), XVI

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ENFORCEMENT ACTIONS

Noncompliances

Year	# Total	Criteria (10 CFR 50 Appendix B) ( ) Number of Occurrances
1970	4	V, X, XI, XVI
1971-1972	0	Construction haulted pending CP
1973	9	II V(5) XIII, XV, XVII
1974	3	V(2) XVI
1975	0	
1976	10	V(4) X, XII, XV, XVI, XVII, XVIII
1977	5	V(5) 10 CFR 50.55(e) item
1978	11	V(4) VI(2), VII, IX(3), XVI

Criteria

II	QA Program
V	Instructions Procedures Drawing Control Work
VI	Document Control
VII	Control of Purchased Material
IX	Control of Special Processes
X	Inspection
XII	Control Measuring - Test Equipment
XIII	Handling - Storage
XV	Nonconforming Parts
XVI	Corrective Actions
XVII	QA Records
XVIII	Audits

Summary and Conclusions

Since the start of construction Midland has experienced some significant problems resulting in enforcement action. In evaluating these problems they have occurred in clumps: (1) in September 1970 relative to improper placement, sampling and testing of concrete and failure of QA/QC to act on identified deficiencies; (2) in September 1973 relative to drawing control and lack of or inadequate procedures for control of design and procurement activities at the Bechtel Engineering offices; (3) in November 1973 relative to inadequate training, procedures and inspection of cadweld activities; (4) in April, May and June 1976 resulting from a series of RIII in-depth QA inspections and meetings to identify underlying causes of weakness in the Midland QA program implementation relative to embedments. (The noncompliance items identified involved inadequate quality inspection, corrective action, procedures and documentation, all primarily concerned with installation of reinforcement steel); (5) in April 1977 relative to tendon sheath omissions; and (6) in August 1978 concerning plant soil foundations and excessive settlement of the Diesel Generator Building.

Following each of these problem periods (excluding the last which is still under investigation), the licensee has been responsive and has taken extensive action to evaluate and correct the problem and to upgrade his QA program and QA/QC staff. The most effective of these licensee actions has been an overview program which has been steadly expanded to cover almost all safety related activities.

The evaluation both by the licensee and IE of the structures and equipment affected by these problems (again except the last) has established that they fully meet design requirements.

Since 1974 these problems have either been identified by the licensee's quality program or provided direction to our inspectors.

Looking at the underlying causes of these problems two common threads emerge: (1) Consumers Power historically has tended to over rely on Bechtel, and (2) insensitivity on the part of both Bechtel and Consumers Power to recognize the significance of isolated events or failure to adequately evaluate possible generic application of these events either of which would have led to early identification and avoidance of the problem including the last on plant fill and diesel generator building settlement.

Notwithstanding the above, it is our conclusion that the problems experienced are not indicative of a broadbreakdown in the overall quality assurance program. Admittedly, deficiencies have occurred which should have been identified earlier by quality control personnel, but the licensee's program has been effective in the ultimate identification and subsequent correction of these deficiencies. While we cannot dismiss the possibility that problems may have gone undetected by the licensee's overall quality assurance program, our inspection program has not identified significant problems overlooked by the licensee --- and this inspection effort has utilized many different inspectors.

The RIII project inspectors believe that continuation of: (1) resident site coverage, (2) the licensee overview program including its recent expansion into engineering design/review activities, and (3) a continuing inspection program by regional inspectors will provide adequate assurance that construction will be performed in accordance with requirements and that any significant errors and deficiencies will be identified and corrected.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

EXHIBIT
CPCo 4
11-18-80 MG

October 18, 1979

MEMORANDUM FOR: R. C. Knop
D. W. Hayes
D. H. Danielson
K. Naidu
G. Maxwell
W. Hansen
P. Barrett
R. Cook
T. Vandel
F. Jablonski
E. Lee
G. Gallagher
K. Ward
I. Yin

FROM: G. Fiorelli, Chief, Reactor Construction and Engineering Support Branch

SUBJECT: MIDLAND CONSTRUCTION STATUS REPORT AS OF OCTOBER 1, 1979

The attached report was finalized based on your feedback requested in my memo of October 5, 1979. If you still feel adjustments are necessary please contact me. If you consider the report characterizes your current assessment of the Midland project, please concur and pass it along promptly.

G. Fiorelli

G. Fiorelli, Chief
Reactor Construction and
Engineering Support Branch

Enclosure: As stated

cc: J. G. Keppler

8405230075

MIDLAND SUMMARY REPORT UPDATE

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5/5/77	Management meeting at CP Corporate Office relative to IAL regarding tendon sheath problem

5/24/77	Special inspection by RIII, RI and HQ personnel to determine adequacy of QA program implementa:ion at Midland site.
6/75 - 7/77	Series of meetings and letters between CP and NRR on applicability of Regulatory Guides to Midland. Commitments by CP to the guides was responsive.
7/24/78	Construction resident inspection assigned.
8/21/78	Measurements by Bech*el indicate excessive settlement of Diesel Generator Building. Officially reported to RIII on September 7, 1978.
12/78 - 1/79	Special investigation/inspection conducted at Midland sites, Bechtel Ann Arbor Engineering offices and at CP corporate offices relative to Midland plant fill and Diesel Generator building settlement problem.
2/7/79	Corporate meeting between RIII and CPC to discuss project status and future inspection activities. CPC informed construction performance on track with exception of diesel/fill problem.
2/23/79	Meeting held in RIII with Consumers Power to discuss diesel generator building and plant area fill problems.
3/5/79	Meeting held with CPC to discuss diesel generator building and plant area fill problems.
3/21/79	10 CFR 50.54 request for information regarding plant fill sent to CPC by NRR.
5/5/79	Congressman Albosta and aides visited Midland site to discuss TMI effect on Midland.
5/8-11/79	Mid-QA inspection conducted.

Significant Major Events

Past Problems

1. Cadweld Splicing Problem and Show Cause Order

A routine inspection, conducted on November 6-8, 1973, as a result of intervenor information, identified eleven examples of four noncompliance items relative to rebar Cadwelding operations. These items were summarized as: (1) untrained Cadweld inspectors; (2) rejectable Cadwelds accepted by QC inspectors; (3) records inadequate to establish cadwelds met requirements; and (4) inadequate procedures.

As a result, the licensee stopped work on cadweld operations on November 9, 1973 which in turn stopped rebar installation and concrete placement work. The licensee agreed not to resume work until the NRC reviewed and accepted their corrective action. However, Show Cause Order was issued on December 3, 1973, suspending Cadwelding operations. On December 6-7, 1973, RIII and HQ personnel conducted a special inspection and determined that construction activity could be resumed in a manner consistent with quality criteria. The Show Cause Order was modified on December 17, 1973, allowing resumption of Cadwelding operations based on the inspection results.

The licensee answered the Show Cause Order on December 29, 1973, committing to revise and improve the QA manuals and procedures and make QA/QC personnel changes.

Prehearing conferences were held on March 28 and May 30, 1974, and the hearing began on July 16, 1974. On September 25, 1974, the Hearing Board found that the licensee was implementing its QA program in compliance with regulations and that construction should not be stopped.

2. Rebar Omission/Placements Errors Leading to IAL

Initial identification and report of rebar nonconformances occurred during an NRC inspection conducted on December 11-13, 1974. The licensee informed the inspector that an audit, had identified rebar spacing problems at elevations 642' - 7" to 652' - 9" of Unit 2 containment. This item was subsequently reported per 10 CFR 50.55(e) and was identified as a item of noncompliance in reports Nos. 50-329/74-11 and 50-330/74-11.

Additional rebar deviations and omissions were identified in March and August 1975 and in April, May and June 1976. Inspection report Nos. 50-329/76-04 and 50-330/76-04 identified five noncompliance items regarding reinforcement steel deficiencies.

Licensee response dated June 18, 1976, listed 21 separate items (commitments) for corrective action. A June 24, 1976 letter provided a plan of action schedule for implementing the 21 items. The licensee suspended concrete placement work until the items addressed in licensee's June 24 letter were resolved or implemented. This commitment was documented in a RIII letter to the licensee dated June 25, 1976. Although not stamped as an IAL, in-house memos referred to it as such.

Rebar installation and concrete placement activities were satisfactorily resumed in early July 1976, following completion of the items and verification by RIII.

Additional action taken is as follows:

a. By the NRC

(1) Assignment of an inspector full-time onsite for five weeks to observe civil work in progress.

(2) IE management meetings with the licensee at their corporate offices

(3) Inspection and evaluation by Headquarters personnel

b. By the Licensee

(1) June 18, 1976 letter committing to 21 items of corrective action.

(2) Establishment of an overview inspection program to provide 100% reinspection of embedments by the licensee following acceptance by the contractor QC personnel.

c. By the Contractor

(1) Personnel changes and retraining of personnel.

(2) Prepared technical evaluation for acceptability of each identified construction deficiency.

(3) Improvement in their QA/QC program coverage of civil work (this was imposed by the licensee).

3. Tendon Sheath Placement Errors and Resulting Immediate Action Letter (IAL)

On April 19, 1977, the licensee reported, as a Part 50, Section 50.55(e) item, the inadvertent omission of two hoop tendon sheaths from a Unit 1 containment concrete placement at elevation 703' - 7" due to having already poured concrete in an area where the tendons were to be directed under a steam line. The tendons were subsequently rerouted in the next higher concrete lift.

An IAL was issued to the licensee on April 29, 1977, which spelled out six licensee commitments for correction which included: (1) repairs and cause corrective action; (2) expansion of the licensee's QC overview program; (3) revisions to procedures and training of construction and inspection personnel.

A special QA program inspection was conducted in early May 1977. The inspection team was made up of personnel from RI, RIII and HQ. Although five items of noncompliance were identified, it was the concensus of the inspectors that the licensee's program was an acceptable program.

The licensee issued it's final report on August 12, 1977. Final review onsite was conducted and documented in report No. 50-329/77-08.

Current Problems

1. The licensee informed the RIII office on September 8, 1978, per requirements of 10 CFR 50.55(e) that settlement of the diesel generator foundations and structures were greater than expected.

   Fill material in this area was placed between 1975 and 1977, with construction starting on the diesel generator building in mid-1977. Review of the results of the RIII investigation/inspection into the plant fill/Diesel Generator Building settlement problem indicate many events occurred between late 1973 and early 1978 which should have alerted Bechtel and the licensee to the pending problem. These events included nonconformance reports, audit findings, field memos to engineering and problems with the administration building fill which caused modification and replacement of the already poured footing and replacement of the fill material with lean concrete.

   Causes of the excessive settlement ~~include~~: (1) inadequate placement method - unqualified compaction equipment and excessive lift thickness; (2) inadequate testing of the soil material; (3) inadequate QC inspection procedures; (4) unqualified quality control inspectors and field engineers; (5) over reliance on inadequate test results.

The proposed remedial work and corrective action are as follows:

(1) Diesel Generator Building - apply surcharge load in and around building to preconsolidate the foundation material. Continue to monitor soil response to predict long-term settlement.

(2) Service Water Pump Structure - Install piles to hard glacial till to support that portion of the structure founded on plant fill material.

(3) Tank Farm - Fill has been determined to be suitable for the support of Borated Water Storage Tanks. Tanks are to be constructed and hydro tested while monitoring soil response to confirm support of structures.

(4) Diesel Oil Tanks - No remedial measure; backfill is considered adequate.

(5) Underground Facilities - No remedial work is anticipated with regards to buried piping.

(6) Auxiliary Building and F. W. Isolation Valve Pits - Installed a number of caissons to glacial till material and replace soil material with concrete material under valve pits.

(7) Dewatering System - Installed site dewatering system to provide assurance against soil liquidification during a seismic event.

The above remedial measures were proposed to the NRC staff on July 18, 1979. No endorsement of the proposed actions have been issued to the licensee to date. The licensee is proceeding with the above plans.

The NRC activities, to date, include:

a. Lead technical responsibility and program review was transferred to NRR from IE by memo dated November 17, 1978.

b. Site meeting on December 3-4, 1978, between NRR, IE, Consumers Power and Bechtel to discuss the plant fill problem and proposed corrective action related to the Diesel Generator Building settlement.

c. RIII conducted an investigation/inspection relative to the plant fill and Diesel Generator Building settlement. Findings are contained in Report 50-329/78-20; 330/78-20 dated March 1979.

d. NRC/Consumers Power Company/Bechtel meetings held in RIII office to discuss finding of investigation/inspection of site settlement (February 23, 1979 and March 5, 1979).

e. NRC issue of 10 CFR 50.54(f) regarding plant fill dated March 21, 1979.

f. Several inspections of Midland site settlement have been performed.

The Constructor/Designer activities include:

a. Issued NCR-1482 (August 21, 1978)

b. Issued Management Corrective Action Report (MCAR) No. 24 (September 7, 1978)

c. Prepared a proposed corrective action option regarding placement of sand overburden surcharge to accelerate and achieve proper compaction of diesel generator building sub-soils.

d. Issued 10 CFR 50.55(e) interim report number 1 dated September 29, 1978.

e. Issued interim report No. 2 dated November 7, 1978.

f. Issued interim report No. 3 dated June 5, 1979.

g. Issued interim report No. 4 dated February 23, 1979

h. Issued interim report No. 5 dated April 30, 1979

i. Responded to NRC 10 CFR 50.54(f) request for information onsite settlement dated April 24, 1979. Subsequent revision 1 dated May 31, 1979, revision 2 dated July 9, 1979 and revision 3 dated September 13, 1979.

j. Meeting with NRC to discuss site settlement causes and proposed resolution and corrective action taken dated July 18, 1979. Information discussed at this meeting is documented in letter from CPCo to NRC dated August 10, 1979.

k. Issued interim report No. 6 dated August 10, 1979

l. Issued interim report No. 7 dated September 5, 1979

2. Review of Quality Documentation to Establish Acceptability of Equipment

The adequacy of engineering evaluation of quality documentation (test reports, etc.) to determine if the documentation establishes that the equipment meets specification and environmental requirements is of concern. The licensee, on November 13, 1978, issued a construction deficiency report (10 CFR 50.55(e)) relative to this matter. An interim report dated November 18, 1978 was received and stated Consumers Power was pursuing this matter not only for Bechtel procured equipment but also for NSS supplied equipment.

3. Source Inspection to Confirm Conformance to Specifications

The adequacy of equipment acceptance inspection by Bechtel shop inspectors has been the subject of several noncompliance/nonconformance reports. Consumers Power has put heavy reliance on the creditability of the Bechtel vendor inspection program to insure that only quality equipment has been sent to the site. However, the referenced nonconformance reports raise questions that the Bechtel vendor inspection program may not be effectively working in all disciplines for supplied equipment. Some significant examples are as follows:

(1) Decay heat removal pump being received with inadequate radiography. The pumps were returned to the vendor for re-radiography and repair. The pumps were returned to the site with one pump assembled backwards. This pump was again shipped to the vendor for reassembly. CPCo witnessed a portion of this reassembly and noted in their audit that some questionable techniques for establishing reference geometry were employed by the vendor. The pumps had been shop inspected by Bechtel.

(2) Containment personnel air lock hatches were received and installed with vendor supplied structural weld geometry which does not agree with manufacturing drawings. The personnel air lock doors had been vendor inspected.

(3) Containment electrical penetrations were received and installed with approximately 25% of the vendor installed terminations showing blatant signs of inadequate crimping. These penetrations were shop inspected by 3 or 4 Bechtel supplier quality representatives (vendor inspectors).

(4) 350 MCM, 3 phase power cable was received and installed in some safety related circuits with water being emitted from one phase.

(5) A primary coolant pump casing was received and installed without all the threads in one casing stud hole being intact. The casings were vendor inspected by both Bechtel and B&W.

Additional IE inspections will be conducted to determine if CP has thoroughly completed an overview of the Bechtel shop inspector's function and that equipment already purchased has been reviewed to confirm it meets requirements.

4. "Q" List Equipment

There have been instances wherein safety related construction components and their installation activities have not ~~been~~ identified on the "Q" list.

This shortcoming could have affected the quality of work performed during fabrication due to the absence of quality controls identified with "Q" list items. Examples of non-"Q" list activities identified which should be "Q" listed include:

Cable Trays
Components of Heating and Ventilation System

The licensee will be advised to review past as well as future construction activities to confirm that they were properly defined as "Q" list work or components.

5. Management Controls

a. Throughout the construction period CPCo has identified some of the problems that have occurred and reported them under the requirements of 10 CFR 50.55(e). Management has demonstrated an openness by promptly identifying these problems. However, CPCo has on repeated occasions not reviewed problems to the depth required for full and timely resolution. Examples are:

Rebar omissions (1974)
Tendon sheath location error (1977)
Diesel generator building settlement (1978)
Containment personnel access hatches (1978)

In each of the cases listed above the NRC in it's investigation has determined that the problem was of greater significance than first reported or the problem was more generic than identified by CPCo.

This incomplete wringing out of problems identified has been discussed with CPCo on numerous occasions in connection with CPCo's management of the Midland project.

b. There have been many cases wherein nonconformances have been identified, reviewed and accepted "as is." The extent of review given by the licensee prior to resolving problems is currently in progress. In one case dealing with the repair of airlock hatches, a determination was made that an incomplete engineering review was given the matter.

Inspection History

The construction inspection program for Midland Units 1 and 2 is approximately 60% complete. This is consistent with status of construction of the two units. (Unit 1 - 54%; Unit 2 - 61%). The licensee's QA program has repeatedly been subject to in-depth review by IE inspectors. The following highlight these inspections.

1. July 23-26 and August 8-10, 1973, inspection report Nos. 50-329/73-06 and 50-330/73-06: A detailed review was conducted relative to the implementation of the Consumers Power Company's QA manual and Bechtel Corporation's QA program for design activities at the Bechtel Ann Arbor office. The identified concerns were reported as discrepancies relative to the Part 50, Appendix B, criteria requirements.

2. September 10-11, 1973 report Nos. 50-329/73-08 and 50-330/73-08: A detailed review of the Bechtel Power Corporation QA program for Midland was performed. Noncompliances involving three separate Appendix B criteria with five different examples, were identified.

3. February 6-7, 1974, report Nos. 50-329/74-03 and 50-330/74-03: A followup inspection at the licensee's corporate office, relative to the items identified during the September 1973 inspection (above) along with other followup.

4. June 16-17, 1975, report Nos. 50-329/75-05 and 50-330/75-05: Special inspection conducted at the licensee's corporate office to review the new corporate QA program manual.

5. August 9 through September 9, 1976, report Nos. 50-329/76-08 and 50-330/76-08: Special five-week inspection regarding QA program implementation onsite primarily for rebar installation and other civil engineering work.

6. May 24-27, 1977, report Nos. 50-329/77-05 and 50-330/77-08: Special inspection conducted at the site by RIII, IE AND RI personnel to examine the QA program implementation onsite by Consumers Power Company and by Bechtel Corporation. Although five examples of noncompliance to Appendix B, Criterion V, were identified, the consensus of the inspectors involved was that the program and its implementation for Midland was considered to be adequate.

7. May 8-11, 1979, a mid-construction QA inspection covering purchase control and inspection of received materials design control and site auditing and surveillance activities was conducted by a team of inspectors. While some items will require resolution, it was concluded the program was adequate.

The licensee's Quality Assurance program has undergone a number of revisions to strengthen it's provisions. The company has expanded it's QA/QC auditing and surveillance coverage to provide extensive overview inspection coverage. This was done in 1975 with a commitment early in their experience with rebar installation problems and was further committed by the licensee in his letter of June 18, 1976, responding to report Nos. 50-329/76-04 and 50-330/76-04. This overview inspection activity by the licensee has been a positive supplement to the constructor's own program, however, currently our inspectors perceive the overview activities cover a small pe centage of the work in some disciplines. This has been brought to the licensee's attention who has responded with a revised overview plan. RIII inspectors are reviewing the plan as well as determining it's effectiveness through observation of construction work. A specific area brought to the attention of the licensee was the lack of overview in the instrumentation installation area. The licensee has responded to this matter with increased staff and this item is under review by RIII inspectors.

The RIII office of inspection and enforcement instituted an augmented onsite inspection coverage program during 1974, this program has continued in effect until the installation of the resident inspector in July 1978.

Enforcement History

a. Noncompliance Statistics

Year	Number of Noncompliances	Number of Inspections	Inspector Hours Onsite
1976	14	9	646
1977	5	12	648
1978	18	23	1180
*1979 to date	7	18	429

A resident inspector was assigned to the Midland site in July 1978. The onsite inspection hours shown above does not include his inspection time.

*Through August 1979

b. An investigation of the current soils placement/diesel generator building settlement problem has revealed the existence of a material false statement. Issuance of a Civil Penalty is currently being contemplated.

Summary and Conclusions

Since the start of construction Midland has experienced some significant problems resulting in enforcement action. These actions are related (1) to improper placement, sampling and testing of concrete and failure of QA/QC to act on identified deficiencies in September 1970; (2) to drawing control and lack of or inadequate procedures for control of design and procurement activities at the Bechtel Engineering offices in September 1973; (3) to inadequate training, procedures and inspection of cadweld activities in November 1973; (4) to a series of RIII in-depth QA inspections and meetings which identified underlying causes of weakness in the Midland QA program implementation relative to embedments in April, May and June 1976. (The noncompliance items identified involved inadequate quality inspection, corrective action, procedures and documentation, all primarily concerned with installation of reinforcement steel); (5) to tendon sheath omissions in April 1977; and (6) to plant soil foundations and excessive settlement of the Diesel Generator Building relative to inadequate compacted soil and inspection activities in August 1978 through 1979.

Following each of these problem periods, the licensee has taken action to correct the problems and to upgrade his QA program and QA/QC staff. The most prominent action has been an overview program which has been steadly expanded to cover safety related activities.

The evaluation both by the licensee and IE of the structures and equipment affected by these problems (again except the last) has established that they fully meet design requirements.

Looking at the underlying causes of these problems two common threads emerge: (1) utilities historically have tended to over rely on A-E's (in this case, Bechtel) and (2) insensitivity on the part of both Bechtel and Consumers Power to recognize the significance of isolated events or failure to adequately evaluate possible generic application of these events either of which would have led to early identification and avoidance of the problem.

Admittedly construction deficiencies have occurred which should have been identified earlier but the licensee's QA program has ultimately identified and subsequently, corrected or in process of correcting these deficienci

The RIII inspectors believe that continuation of (1) resident site coverage, (2) the licensee overview program, (3) the licensee's attention and resolution of identified problems in this report, (4) ceasing to permit work to continue when quality related problems are identified with construction activities and (5) a continuing inspection program by regional inspectors will provide adequate assurance that construction will be performed in accordance with requirements and that any significant errors and deficiencies will be identified and corrected.

Gallagher

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

EXHIBIT
CPCo 5
11-18-80 MG

OCT 1 1979

Docket No. 50-329
Docket No. 50-330

Consumers Power Company
ATTN: Mr. Stephen H. Howell
Vice President
1945 West Parnall Road
Jackson, MI 49201

Gentlemen:

This refers to the inspection conducted by Mr. E. J. Gallagher of this office on September 11-14, 1979, of activities at the Midland Nuclear Power Plant construction site authorized by NRC Construction Permits No. CPPR-81 and No. CPPR-82 and to the discussion of our findings with Mr. B. J. Marguglio and others of your staff, and others of the Midland site staff at the conclusion of the inspection.

The enclosed copy of our inspection report identifies areas examined during the inspection. Within these areas, the inspection consisted of a selective examination of procedures and representative records, observations, and interviews with personnel.

During this inspection, certain of your activities appeared to be in noncompliance with NRC requirements, as described in the enclosed Appendix A.

This notice is sent to you pursuant to the provisions of Section 2.201 of the NRC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations. Section 2.201 requires you to submit to this office within thirty days of your receipt of this notice a written statement or explanation in reply, including for each item of noncompliance: (1) corrective action taken and the results achieved; (2) corrective action to be taken to avoid further noncompliance; and (3) the date when full compliance will be achieved.

Based on our telephone discussion with you on September 21, 1979, it is our understanding that the personnel performing inspections of the prestressing system whose qualifications we consider do not meet the provisions of Regulatory Guide 1.58 and ANSI N45.2.6 have been relieved from such duties until further evaluation of the requirements and further discussion with the Region III office. Please include in your response your plans to reconfirm the qualifications of other personnel performing quality control inspections on the Midland project.

Report on Post Tensioning Work Activities

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In accordance with Section 2.790 of the NRC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations, a copy of this letter, the enclosures, and your response to this letter will be placed in the NRC's Public Document Room, except as follows. If the enclosures contain information that you or your contractors believe to be proprietary, you must apply in writing to this office, within twenty days of your receipt of this letter, to withhold such information from public disclosure. The application must include a full statement of the reasons for which the information is considered proprietary, and should be prepared so that proprietary information identified in the application is contained in an enclosure to the application.

We will gladly discuss any questions you have concerning this inspection.

Sincerely,

Gaston Fiorelli, Chief
Reactor Construction and
Engineering Support Branch

Enclosures:
1. Appendix A, Notice of Violation
2. IE Inspection Reports No. 50-329/79-19 and No. 50-330/79-19

cc w/encls:
Central Files
Reproduction Unit NRC 20b
PDR
Local PDR
NSIC
TIC
Ronald Callen, Michigan Public Service Commission
Dr. Wayne E. North
Myron M. Cherry, Chicago

RIII	RIII	RIII	RIII	RIII
Gallagher/bk	Hayes	Fiorelli	Cook	Vandel

9/24/79

Appendix A

NOTICE OF VIOLATION

Consumers Power Company

Docket No. 50-329
Docket No. 50-330

Based on the results of an NRC inspection conducted on September 11-14, 1979, it appears that certain of your activities were not conducted in full compliance with NRC requirements as noted below. These items are infractions.

1. 10 CFR 50, Appendix B, Criterion III requires, in part, that appropriate quality standards are specified and included in design documents and that deviations from such standards are controlled.

   CPCO Quality Assurance Program Policy No. 3 states, in part, that "the assigned lead design group or organization assures that the design and material are suitable and that they comply with design criteria and regulatory requirements."

   Closed 80-04

   Contrary to the above, Specification C-211, sections 8.1.2 and 8.2.4 permits the use of lean concrete as a substitute of safety-related structural backfill and compacted sand material while stating that "lean concrete shall be made of non-Q material and workmanship". This permits the use and installation of non-Q (non-safety related) material in safety-related areas without benefit of the licensee's quality assurance program. Non-Q (non-quality) lean concrete has been used in various areas of the plant fill including observed areas in the safety-related tank farm area.

2. 10 CFR 50, Appendix B, Criterion II requires, in part, that the quality assurance program provide for indoctrination and training of personnel performing activities affecting quality as necessary to assure that suitable proficiency is achieved and maintained.

   CPCO Quality Assurance Program Policy No. 2 complies with the requirements of Regulatory Guide 1.58 and ANSI N45.2.6, "Qualification of Inspection, Examination, and Testing Personnel for the Construction Phase of Nuclear Power Plants". In addition, the licensee's contractor, Bechtel Power Corporation, procedure G-8.1, section 5.2, requires specific education and experience requirements to be satisfied to be considered for certification as a Level I inspector. Those requirements include: Two years related experience or high school graduate plus one year related experience or college level work leading to associates degree in related discipline plus six months of related experience

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in equivalent testing, examination or inspection activities associated with power plants, heavy industrial facilities or other similar facilities.

Contrary to the above, five QC inspection personnel performing measurings, tests and examination of the containment prestressing system were not qualified in accordance with the above prerequisites in that they had no prior related education nor prior related work experience in equivalent testing or inspection activities.

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

REGION III

Report No. 50-329/79-19; 50-330/79-19

Docket No. 50-329; 50-330 License No. CPPR-81; CPPR-82

Licensee: Comsumer Power Company
1945 West Parnall Road
Jackson, MI 49201

Facility Name: Midland Nuclear Power Plant, Units 1 and 2

Inspection At: Midland Site, Midland, Michigan

Inspection Conducted: September 11-14, 1979

Inspector: E. J. Gallagher — 9/25/79

Approved By: D. W. Hayes, Chief — 9/25/79
Engineering Support Section 1

Inspection Summary

Inspection on September 11-14, 1979 (Report No. 50-329/79-19; 50-330/79-19)
Areas Inspected: Containment prestressing system work procedures, work activities and quality records (units 1 and 2); QC inspector qualifications; status of soils work activities and 50.55(e) reports relative to containment prestressing system and concrete expansion anchors. The inspection involved a total of 27 inspector-hours by one NRC inspector.
Results: Three areas were inspected. Two items of noncompliance were identified in the areas inspected. (Infraction - inadequate design control - Paragraph 2.a; Infraction - inadequate QC personnel qualifications - Paragraph 1.c).

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DETAILS

Persons Contacted

Principal Licensee Employees (CPCO)

*B. W. Marguglio, Director Quality Assurance
*D. M. Miller, Site Manager
*T. C. Cooke, Project Superintendent
*G. T. Black, Quality Assurance Engineer
*R. Wheeler, Staff Engineer
*J. L. Corley, Section Head - IE & TV
*D. Horn, Civil QA Supervisor

Bechtel Power Company

*J. A. Rutgers, Project Manager
*W. L. Barclay, Project Quality Control Engineer
*A. J. Boos, Project Field Engineer
*W. J. Creel, Quality Assurance Engineer
*L. A. Breisback, Project Quality Assurance Engineer

*Denotes those in attendance at exit meeting.

Licensee Action on Previously Identified Items

(Closed) Noncompliance (329/79-10-01; 330/79-10-01): Inadequate control of design interfaces; (a) Specification C-2 specified material for prestressing system sheathing to conform to ASTM A-366-66 or 68 while FSAR Section 3.8.1.6.3 required ASTM A-513, type 1, Grade 1010-1020 or A-53 type E or S, Grade B. FSAR Section 3.8.1.6.3 has been revised via amendment 22 to be compatible with specification C-2 requirements. (b) Specification C-49, Section 6.2.2 specified the chemical limitations for prestressing system corrosion protective grease to be a maximum of 5 ppm chlorides, nitrates and sulphides while FSAR table 3.8-25 required 2ppm (chloride), 4ppm (nitrates) and 2ppm (sulphide). Specification C-49 has been revised via change notice 9004 to meet the commitments in the FSAR.

(Open) Unresolved (329/79-10-02; 330/79-10-02): Unavailable quality records relative to performance tests on prestressing system; items 1 and 2 of the unresolved items remains unresolved since the quality records are being researched. Item 3 relative to buttonhead rupture tests quality records were made available and reviewed for tendon V-79, V-77, V-82, V-83 and found acceptable. Items 1 and 2 will be pursued during subsequent inspections.

Functional or Program Areas Inspected

During this inspection the containment prestressing system procedures, work activities, quality records, and inspection and testing personnel qualifications were inspected. In addition, significant construction deficiencies reportable in accordance with 10 CFR 50.55(e) relative to containment prestressing system, concrete expansion anchors for component supports and site soils and settlement were reviewed.

1. Containment Prestressing System (Unit 2)

a. Procedures

The inspector reviewed the following procedures for containment prestressing work activities:

(1) C-2, Revision 12 (May 10, 1979) including FCR C-1986 (revised stressing sequence), FCR C-2046 (calibration of stressing jacks and gauge). INRYCO had approved the changes.

(2) C-2-146-9, Field Installation Manual, including FCR Nos. 2062, 2049, 2048, 2047, 2041, 2042, and 2020.

(3) PQCI-9.10, Inspection of Post-Tensioning System

(4) C-49, Revision 2, Tendon Sheathing Filler Material and FCR 2069 SCN 9003, and SCN 9004.

The inspector indicated to the licensee at the exit meeting that PQCI-9.10 had not been revised to the revised requirements of C-2-146-9. The licensee informed the inspector that the changes would be incorporated and that the QC inspectors are aware of the field changes in effect.

b. Reportable 10 CFR 50.55(e) on Prestressing Tendons

Notification in accordance with 10 CFR 50.55(e) was made by licensee on July 26, 1979 that a number of containment prestressing tendons were fabricated and shipped to the site with indeterminant wire lengths and in violation of the 1/8 inch maximum wire differential. MCAR 33 was issued on July 27, 1979 documenting the deficiency. NCR 2373 was also issued placing the 7 vertical tendons already installed in the Unit 2 containment and 10 horizontals received in storage at the site on hold.

Inspections by the licensee at INRYCO's Melrose Park, Illinois facility and Wiremill facility in Florida were performed to investigate the cause and which facility is responsible for the fabrication of the deficient tendons. It was determined that the tendons fabricated at the Wiremill facility produced the tendon with differentiated wire due to the following reasons: (1) back tension device was switched off and not operating resulting in varying wire lengths, (2) catcher clamp was found to be damaged due to weld fatigue, and (3) limit switch had excessive travel. These three mechanical deficiencies contributed to the production of differential wires in the tendons fabricated.

A total of 38 tendons have been fabricated at the newly opened Wiremill facility. Tendons traced were as follows:

Seven vericals installed (on-hold)

Ten horizontals on-site in storage (rejected and shipped back to INRYCO)

Seven verticals (on-hold at Wiremill)

Ten horizontals (on-hold at Wiremill)

INRYCO has submitted a salvage procedure for the seven verticals installed in Unit 2. Procedure F-365-9.2 Revision 1, was currently under review and comment which proposes a method to field cut and modify to satisfy requirements.

Bechtel has performed two quality program verification surveys of the INRYCO facilities. Results are documented in QPVS No. 9Q and 10Q. In addition, a Bechtel inspector is stationed at the Wiremill facility to perform continued inspection of the tendon fabrication.

The NRC regional office will review the final 50.55(e) report upon receipt.

c. Qualifications of QC Inspectors for Prestressing Work Activity

During a May 14-17, 1979 inspection (report No. 329/79-10; 330/79-10; page 4) the NRC inspector had indicated to the licensee that none of the Bechtel QC inspectors to be assigned the inspection and testing of the containment prestressing system has any prior related work experience on prestressing systems nor construction of power facilities. At this time no work had begun on the installation of the prestressing system. The inspector, indicated that this matter would be reviewed during followup inspections.

During this inspection the matter of qualification of quality control inspection and testing personnel was once again reviewed.

The personnel qualification and training records of eleven quality control personnel were reviewed and compared to the requirements of Regulatory Guide 1.58 and ANSI N45.2.6. It was concluded that five of the individuals certified as level I inspectors were not qualified in accordance with the above standards as well as Bechtel program requirements contained in PSP-G-8.1, Qualification, Evaluation, Examination, Training and Certification of Construction Quality Control Personnel.

Section 5.2 (Education and Experience Requirements) of G-8.1 requires that one of the following requirements be satisfied in order for an individual to be considered for certification as a level I inspector:

(1) Two years related experience in equivalent testing, examination or inspection activities associated with power plants, heavy industrial facilities or other similar facilities.

(2) High school graduate and one year of related experience in equivalent testing, examination or inspection activities associated with power plants. . .

(3) Completion of college level work leading to an Associate Degree in a related discipline plus six months of related experience in equivalent testing, examination or inspection activities associated with power plants. . .

It is important to note that the above requirements are also included in Regulatory Guide 1.58 and ANSI N45.2.6 and requires education in a related discipline (i.e. technical, engineering, etc.) and prior work experience in a related field of testing, examination or inspection activities (i.e. concrete, soils, prestressing, etc.)

The personnel qualifications of five of the QC inspectors certified as level I indicated no prior related education nor prior related work experience nor prior related construction experience. A summary of the individuals qualifications are contained in Appendix I. These individuals have performed various QC inspections on the Unit 2 containment prestressing system. It is important to note that the remaining six QC inspectors have not had any prior experience with prestressing systems, however, they have had prior construction experience.

Discussions with the licensee's contractor Project Quality Control Engineer (PQCE) indicated that an attempt was made to secure fully qualified personnel through the corporate office. However, that office was unable to supply the requested personnel based on comments by the PQCE.

The licensee's contractor (Bechtel) informed the NRC inspector that Section 5.1.2 of program G-8.1 states, "The education and experience requirements specified below shall not be treated as absolute. These requirements may be altered when other factors provided reasonable assurances to the supervisor responsible for certifying a lower level candidate that the person can competently perform a particular task." The license indicated relaxation of the education and experience requirements was exercised based on the above provisions.

The inspector informed the licensee that while it was fully recognized that the requirements for education and experience are not absolute, the intent of the Regulatory Guide 1.58 and ANSI N45.2.6 was that the individual has prior related education and related experience while perhaps not the exact length of time.

The inspector indicated to the licensee that the liberal interpretation of the requirements were unacceptable and considered to be an item of noncompliance with 10 CFR 50, Appendix B, Criterion II. (329/79-19-01; 330/79-19-01)

d. Observation of Prestressing System Work Activities (Unit 2)

The inspector observed selected work activities relative to the Unit 2 prestressing system. The following specific items were observed:

(1) Tendon D124 stressing using calibrated Jack No. 1 and Gauge No. 191; Bushing ID MW-303, Beaning Plate GM-257; lock off load and tendon elongation were within predicated range.

(2) Grease tank temperature 152°F; required temperature is 140° to 210°F.

(3) Tendon D-112 stressing; Field Anchor ID MQ-120; Bearing Plate GS-136.

(4) Completed Tendon D-124 and D-312

The above work was observed to be performed according to the prescribed work procedures.

e. Quality Records for Prestressing System (Unit 2)

The following prestressing system qyality records were reviewed:

(1) Nonconformance Reports

NCR-2205 (Open) Lack of acceptance/rejection criteria for rust and bent wires on tendons H13-252 and H13-24.

NCR-2505 (Open) Tendon D-301-2 had 5 wires broken during stressing.

NCR-2372 (Open) Issued 50.55(e) on differential wire lengths.

NCR-2382 (Closed) One wire on shop-end buttonheaded but sent to site - wire repaired.

NCR-2383 (Open) Tendon H21-234 and H21-236 inspected with "E" rust status - unacceptable rust - wires pulled for testing.

The above NCR's will be reviewed when fully dispositioned by the licensee.

(2) Buttonhead Repair Log

This log tracks the buttonheads inspected and indicates the number defective and repaired in order to meet specification requirements on permissible number of buttonheads defective. Tendon V-90 indicated six buttonheads were defective after repairs made. Specification C-2 permits only four. The licensee indicated V-90 is being reviewed and repairs to be recommended by engineering.

(3) Stressing Gauge Dial Comparison

The stressing gauges are compared to a master gauge once daily. If the gauge is determined to be out of calibration the last tendon stressed is completely restressed with a calibrated gauge. The new stressing valves are then compared to the work performed with the uncalibrated gauges and evaluated to determine if other tendons require work.

Tendon D-321, V-28 and D-121 were restressed due to gauges being out-of-calibration.

(4) Field Buttonhead Records - Tendons V2-2, V3-2, V13-2, V14-2 and V54-2 were reviewed and found acceptable.

The inspector indicated to the licensee that the quality for the tendons completed to date have not been completely assembled in order to perform a complete review of each tendon. Various inspection and quality documentation is located in various files without a complete review of an individual package as required by the Field Inspection report.

The licensee indicated the completed tendon package would be assembled and reviewed prior to final acceptance of the work.

2. Review of S... Soils and Settlement

a. Backfilling Procedure

Specification C-211(Q), Revision 7, Structural Backfill, Section 8.1.2 and 8.2.4 permits the use of lean concrete in lieu of structural backfill and sand backfill material. This specification is used for placement of safety-related soils. The above sections state, "Lean concrete shall be made of non-Q (non-safety related) material and workmanship."

The inspector observed lean concrete material placed adjacent to the borated water storage tanks in the tank farm area which is designated as a safety-related "Q" area. The licensee informed the inspector that previously placed lean concrete material in safety-related areas were also designated and placed as non-safety related material.

Closed report 80-04

10 CFR 50, Appendix B, Criteria III requires that appropriate quality standards are specified and that deviations from such standards are controlled. Contrary to the above, materials being used in safety-related structures were specified and permitted to be of non-safety related material and workmanship. The quality assurance program has not provided control over this safety-related work activity.

This is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion III (329/79-19-02; 330/79-19-02)

b. Placement of Soils

Specification C-211, Section 8.5.1 requires that equipment being used to compact soils be qualified prior to use. Quality control initiated NCR 2492 on August 30, 1979 due to Bechtel construction use of an unqualified type of handheld compaction equipment ("po-go stick") in safety-related "Q" areas. The Bechtel project field engineer dispositioned the NCR as not being valid while being aware of the specification requirement.

The "po-go stick" was again later used in safety-related areas. Bechtel QA department subsequently issued Stop work report No. 6 for use of such equipment until such time that the nonconformance was resolved.

The licensee has indicated that Bechtel Geotech has directed the field to qualify the equipment as required prior to any further use.

The NRC inspector questioned the licensee why the project field engineer was permitted to disposition the NCR as invalid and again permit the use of the equipment in violation of the requirements. The licensee indicated that the quality management personnel would take appropriate action to preclude such events and that QA acted promptly in issuing the stop work report.

c. Status of Site Settlement

The surcharge load in and around the diesel generator building has been removed as of the end of August, 1979. Soil response to the removal of the surcharge is being monitored. Discussion with the licensee, Bechtel Geotech and DR. Dunnicliff indicated that the soil has rebound approximately 3/16 of an inch; expected rebound is predicted to be on the order of 1/2 inch or less.

Temporary dewatering system in the vicinity of the Unit 1 and 2 valve pits have been installed, however no pumping or drawdown of the ground water had begun at the time of this inspection.

Pile tests are being planned in the vicinity of the service water pumphouse structure. Tests are to begin in early October by Bechtel Consultants.

Excavation of soft-material in the borated water storage tank farm was in progress with placement of sand material inside and around the tank foundations. Sand was being placed using qualified handheld compaction equipment to 85% relative density for support of structures and 80% relative density for areas other than under structures.

3. Review of 50.55(e) on Concrete Expansion Anchors

Specification C-305, Revision 9, Section 6.2.2 requires shell type expansion anchors to be tension tested to the specified loads. In addition, in-process inspection is required. Because in-process inspection had not always been performed it was requested to randomly select 60 anchors to verify adequacy of past installations.

After testing 32 of the anchors, the results indicated nine failures where the anchor slipped prior to achieving the test load. At this time MCAR 34 was issued on August 21, 2979. Results are documented on NCR-2461 and NCR-2481.

Engineering requested another 100 anchors to be inspected (TWX-5383 dated August 24, 1979) for proper setting and tension tests. The results of the additional tests are documented on QCFM-6560/AI-667 dated September 6, 1979. Visual results indicate 20 acceptable and 8? unacceptable (i.e. not fully set). Twenty-three (23) could be reset. Sixty (60) 3/8 inch anchors were tension tested of which two failed while 37 1/2 inch and five 5/8 inch were tensioned and found acceptable.

The licensee indicated that approximately 900 of the shell type anchors have been installed prior to identifying the deficiency. Because of the above information the licensee reported the deficiency in accordance with the requirements of 10 CFR 50.55(e).

The licensee is continuing to evaluate the results of the testing and what corrective action is required to resolve the deficiency. The final 50.55(e) report will be reviewed upon receipt by the NRC.

Exit Interview

The inspector met with the licensee representatives (denoted under Persons Contacted) on September 14, 1979. The inspector summarized the scope and findings of the inspection. The findings were also discussed via telephone with Mr. B. Marguglio and management of RIII NRC on September 17, 1979. The licensee acknowledged the findings as reported.

Attachment: Appendix I

APPENDIX I

PRESTRESSING SYSTEM QC PERSONNEL QUALIFICATIONS

Individual	Bechtel Employee	Certified Level 1	Related Education	Related Experience	On-Site Training	Areas of Inspection
A	7-12-79	8-6-79	none- high school	none-janitor, cook, IGA	25 hours	Tendon insertion, buttonheading, stressing, greasing (1st shift)
B	7-12-79	8-6-79	none- high school	none- Ramada Inn, printer	23 hours	Tendon insertion, buttonheading, stressing, greasing (1st shift)
C	7-12-79	8-6-79	none- 3 year college	none- student last	26 hours	Tendon insertion, buttonheading, stressing, greasing(2nd shift)
D	7-16-79	8-6-79	none- B. A. Business	none- student last	26 hours	Tendon insertion, buttonheading, stressing, greasing (1st shift)
E	7-12-79	8-6-79	none- high school	none- bar tender	28 hours	Terminated on 8-10-79

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

EXHIBIT
CPCo 6
11-18-80 mg

SEP 15 1980

Docket No. 50-329
Docket No. 50-330

Consumers Power Company
ATTN: Mr. James W. Cook
Vice President
Midland Project
1945 West Parnall Road
Jackson, MI 49201

Gentlemen:

This refers to the inspection conducted by Messrs. E. T. Gallagher and R. B. Landsman of this office on August 27-29, 1980, of activities at the Midland Nuclear Plant, Units 1 and 2, authorized by NRC Construction Permit Nos. CPPR-81 and CPPR-82 and to the discussion of our findings with Mr. J. L. Corely at the conclusion of the inspection.

The enclosed copy of our inspection report identifies areas examined during the inspection. Within these areas, the inspection consisted of a selective examination of procedures and representative records, observations, and interviews with personnel.

No items of noncompliance with NRC requirements were identified during the course of this inspection.

In accordance with Section 2.790 of the NRC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations, a copy of this letter and the enclosed inspection report will be placed in the NRC's Public Document Room, except as follows. If this report contains information that you or your contractors believe to be proprietary, you must apply in writing to this office, within twenty days of your receipt of this letter, to withhold such information from public disclosure. The application must include a full statement of the reasons for which the information is considered proprietary, and should be prepared so that proprietary information identified in the application is contained in an enclosure to the application.

8010240325

We will gladly discuss any questions you have concerning this inspection.

Sincerely,

G. Fiorelli, Chief
Reactor Construction and
Engineering Support Branch

Enclosure: IE Inspection
Reports No. 50-329/80-25
and No. 50-330/80-26

cc w/encl:
Central Files
Reproduction Unit NRC 20b
PDR
Local PDR
NSIC
TIC
Ronald Callen, Michigan
Public Service Commission
Myron M. Cherry, Chicago

RIII	RIII	RIII	RIII	RIII	RIII	RIII
Gallagher/cw	Hayes	Cook	Sutphin	Knop	Fiorelli	Landsman
9/11/80	9/12/80					9-12-80

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

REGION III

Report Nos. 50-329/80-25; 50-330/80-26

Docket Nos. 50-329; 50-330 License Nos. CPPR-81; CPPR-82

Licensee: Consumers Power Company
1945 Parnall Road
Jackson, MI 49201

Facility Name: Midland Nuclear Power Plant, Units 1 and 2

Inspection At: Midland Site, Midland, MI

Inspection Conducted: August 27-29, 1980

Inspectors: E. J. Gallagher DW Hayes/for 9/12/80

R. B. Landsman RB Landsman 9/12/80

Approved By: D. W. Hayes, Chief DW Hayes 9/12/80
Engineering Support Section 1

Inspection Summary

Inspection on August 27-29, 1980 (Report Nos. 50-329/80-25; 50-330/80-26).
Areas Inspected: Containment prestressing system work activities, procedures, and quality records; meeting held on August 29, 1980 regarding Midland soil issues. The inspection involved a total of 40 inspector hours by two NRC inspectors.
Results: No items of noncompliance or deviations were identified in the areas inspected.

8010240330

DETAILS

Persons Contacted

Principal Licensee Personnel (CPCo)

*J. L. Corley, Site Quality Assurance Superintendent
*D. J. Vokal, Supervisory Engineer, PMO

Bechtel Power Company

*R. Sevo, Quality Assurance Engineer
*E. Smith, Project Field QC Engineer
*P. Corcoran, Resident Ass't. Project Engineer
*J. L. Hoekwater, Resident Civil Engineer
*J. Betts, Field Civil Engineer
*J. E. Russell, Ass'T. Project Field QC Engineer
*P. Van der Veer, Quality Control

NRC Resident

R. Cook

*Denotes those in attendance at the exit meeting held on August 29, 1980.

Licensee Action on Previously Identified Items

(Closed) Unresolved Item (329/80-01-07; 330/80-01-08); Inryco had not included complete calibration records for prestressing system jacks. Inryco has now supplied the required calibration records for Prescon jacks #1 and #3 and Dugdeon jack #'s 8780, 8778, 8783, and 8784. In addition, Bechtel letter LAD-1551 states that the jacks are considered "Q" equipment and records are required to be maintained in permanent QC files. Spec C2-146, Section 12.1 has been revised to specify the jack calibration as "Q" and records reviewed accordingly. This item is considered closed.

(Closed) Unresolved Item (330/80-09-01); Tendon H-21-234 had 2 button-headed wires that had not seated upon restressing. NCR No. 2964 was issued and required the tendon to be removed and replaced. It was verified that tendon H-21-234 had been replaced. This item is considered closed.

(Closed) Unresolved Item (329/80-04-01; 330/80-04-01); Unit 2 prestressing system quality control records were found to be inaccurate in a number of cases where incorrect anchor head identification was noted and incorrect tendon elongation calculated. A review of the completed Unit 2 stressing cards was performed and correction has been completed. This item is considered closed.

Functional or Program Areas Inspected

During this inspection, the containment prestressing system procedures, work activities and quality records were reviewed. In addition, the inspectors attended a public meeting held at Consumers Power Company offices in Midland, MI. The meeting concerned CPCo's appeal the NRC staff's request for additional soil borings in the plant fill and cooling lake dike. The appeal was made to the Director and Assistant Director of Engineering in the office of Nuclear Reactor Regulatory (NRR).

1. Containment Prestressing System

   a. Prestressing System Work Activities (Unit 1)

   The inspector observed selected work activities relative to the tendon insertion and buttonheading on the Unit 1 containment. The following specific items were observed:

   (1) Tendon Insertion: Tendons V-34-1, V-107-1, V-105-1, V-28-1, V-83-1 and V-85-1 were observed being installed. The tendons were in acceptable condition with no signs or corrosion along the tendon lengths.

   (2) Tendon Buttonheading - Tendon V-14-1 was observed being buttonheaded in the Unit 1 tendon access tunnel. Bechtel QC inspector was present and was performing 100% buttonhead inspection with calibrated GO-NO-GO gauge, dial indicator, and optical comparator.

   Tendon stressing and greasing operations were not in progress during the inspection.

   b. Prestressing System Material Records (Unit 1)

   Material certification records for Unit 1 vertical tendons observed being installed were reviewed and compared to the material requirements of ASTMA-421 BA wire. The following tendon records were reviewed:

   V-84-1 thru V-89
   V-80-1 thru V-83-1
   V-107-1 thru V-110-1

   The material records were found to be in accordance with requirements.

c. Review of Nonconformance Reports (Unit 1)

The following nonconformance reports were reviewed in order to verify adequate resolution of each identified deviation:

NCR NO.	Status
2933	Closed
2974	"
2979	"
2981	"
2984	"
2994	"
3032	"
3035	"
3081	"
3093	"
3100	"

Open nonconformance reports are to be reviewed during a subsequent inspection. The NCR's closed were identified and resolved in an acceptable manner.

d. Stressing Sequence - Inryco drawing C-2-170, Revision 4b was reviewed. It was noted that the stressing sequence has been modified a number of times to accommodate field installation due to availability of tendons. FSAR Section 3.8.1.6.3.2 states, "a detailted sequence of tensioning each tendon is developed by the tendon supplier". The prestressing system supplied at Midland is Inryco. FCR 2412 requrested engineering to revise the stressing sequence. Bechtel letter dated May 19, 1980 requested Inryco concurrence on the change. Inryco responded on July 7, 1980 with acceptance of the revised sequence. In addition, Bechtel had available the supporting documentation in evaluating the revised stressing sequence with reference to the original design guide.

e. Review of Quality Records (Units 1 and 2)

The inspector reviewed the quality records relative to containment prestressing system for Units 1 and 2. The records contained completed inspection report, tendon pulling card, buttonheading card, stressing records and greasing card. The following specific records were reviewed:

(1) Unit 1 - Dome tendons D-301-1 thru D-306-1, D-201-1, D-202-1, D-309-1, D-311-1 and D-312-1.

(2) Unit 2 - Tendons D-212-2, D-209-2, V-74, 75, 82, 78, 79, and 109, V-80, V-85, and V-77.

The above records were complete and in satisfactory condition.

No items of noncompliance were identified in the above areas inspected.

2. Meeting on Soils Issue at CPCo Office

A meeting was held between Consumers Power Company and NRC staff on August 29, 1980 to provide CPCo the opportunity to appeal to the NRC Division Director of Engineering a staff position requiring additional exploration and testing of soils at the Midland plant site. The CPCo consultants provided a statement to the NRC staff which indicated that further soil exploration would not be necessary since the engineering properties of the fill material have been identified since the surcharge in the Diesel generator building area. The NRC staff also made a presentation indicating the reasons for requesting the additional tests. After the two presentations were completed, the NRC Division Director indicated that a final decision would be made after the licensee submitted additional information that had not yet bebeen submitted to the NRC staff for review. This information would be made available by September 15, 1980 at which time a final decision regarding the licensee request not to take any additional soil borings or tests would be made.

Exit Interview

The inspectors met with licensee representatives (denoted in the Persons Contacted paragraph) at various times during their inspection activities. The scope and purpose of the inspections were outlined along with the findings of the inspection. The licensee representatives acknowledged the indicated results.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

MAR 2 9 1979

EXHIBIT
CPC 7
11-3-80

Docket No. 50-329
Docket No. 50-330

2/7/79

Consumers Power Company
ATTN: Mr. Stephen H. Howell
Vice President
1945 West Parnall Road
Jackson, MI 49201

Gentlemen:

This refers to a special announced inspection meeting with corporate management conducted on February 7, 1979, by Mr. J. G. Keppler and staff members of this office with you, members of your staff and members of your contractors staff at the Midland site.

The purpose of the meeting was to review the Midland project status, the settlement of the diesel generator building, inform you of changes in the organization of this office and to confirm commitments regarding continuing Quality Assurance, Quality Control coverage for the Midland project.

The enclosed copy of our inspection report summarizes the discussion.

In accordance with Section 2.790 of the NRC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations, a copy of this letter and the enclosed inspection report will be placed in the NRC's Public Document Room, except as follows. If this report contains information that you or your contractors believe to be proprietary, you must apply in writing to this office, within twenty days of your receipt of this letter, to withhold such information from public disclosure. The application must include a full statement of the reasons for which the information is considered proprietary, and should be prepared so that proprietary information identified in the application is contained in an enclosure to the application.

7905250283

We appreciate having the opportunity to meet with members of your corporate management and Midland staff. We will gladly discuss any questions you have concerning this inspection.

Sincerely,

G. Fiorelli, Chief
Reactor Construction and
Engineering Support Branch

Enclosure: IE Inspection
Rpt No. 50-329/79-04
and No. 50-330/79-04

cc w/encl:
Central Files
Reproduction Unit NRC 20b
PDR
Local PDR
NSIC
TIC
Ronald Callen, Michigan Public
Service Commission
Dr. Wayne E. North
Myron M. Cherry, Chicago

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

Report No. 50-329/79-04; 50-330/79-04

Docket No. 50-329; 50-330 License No. CPPR-81; CPPR-82

Licensee: Consumers Power Company
1945 West Parnall Road
Jackson, MI 49201

Facility Name: Midland Nuclear Power Plant, Units 1 and 2

Inspection At: Midland Site, Midland, MI

Inspection Conducted: February 7, 1979

Inspectors: R. J. Cook (signed for) 3/27/79

W. A. Hansen 3-27-79

T. E. Vandel 3-27-79

Approved By: R. C. Knop, Chief (signed for) 3/27/79
Projects Section

Inspection Summary

Inspection on February 7, 1979 (Report Nos. 50-329/79-04 and 50-330/79-04).
Areas Discussed: Special, announced meeting between NRC, RIII inspection staff, Consumers Power Company corporate management representatives, and Bechtel Power Corporation Midland staff representatives to discuss the project status, concerns regarding recent developments onsite, and upcoming inspection activity. The meeting involved 28 manhours of regional staff time at the Midland construction site by NRC representatives.
Results: The project status and major problems were discussed.

7905250296

DETAILS

Persons Present during Management Meeting

Consumers Power Company

S. H. Howell, Senior Vice President
G. Keeley, Project Manager
D. B. Miller, Jr., Site Manager
B. W. Marguglio, Director Quality Assurance
W. R. Bird, Section Head QA Engineering
J. L. Corley, Section Head I,E&T Verification

Bechtel Power Corporation

P. A. Martinez, Project Manager
R. L. Castleberry, Project Engineer
J. F. Mewgen, Project Superintendent
John Milandin, QA Manager
Len Dreisbach, Project QA Engineer
*Howard Wall, Vice President Ann Arbor

*part time

U.S. Nuclear Regulatory Commission

J. G. Keppler, Regional Director
R. F. Heishman, Chief, Reactor Operations and Nuclear Support Branch
R. C. Knop, Section Chief, Reactor Projects Section 1
D. W. Hayes, Section Chief, Projects Section
R. J. Cook, Resident Inspector
W. A. Hansen, Reactor Inspector
T. E. Vandel, Reactor Inspector

Results of Inspection Meeting

1. Mr. Keppler described the upcoming changes in the NRC organization in that Mr. R. F. Heishman, Chief, Reactor Construction and Engineering Support Branch will become Chief, Reactor Operations and Nuclear Support Branch and Mr. G. Fiorelli, who presently has that position will become Chief, Reactor Construction and Engineering Support Branch; Mr. R. L. Spessard, Chief, Construction Engineering Support Section 1 will become Chief, Reactor Projects Section 1 of the Operations Branch and Mr. R. C. Knop, who presently has that position will become Chief, Construction Projects Section; and Mr. D. W. Hayes will become Chief, Construction Engineering Support Section 1. These changes are effective February 11, 1979.

2. Mr. Keppler discussed in broad terms the inspection status. The construction program, although starting slow and haltingly (with work stopped in 1973 in the concrete area) has proceeded with no problems so severe that construction was stopped. Two serious problems exist however, and each has the potential for regulatory action up to stopping work.

   a. The diesel generator building sinking is the most serious problem that Consumers Power Company must face and has the potential of drastic regulatory action.

   b. The next most serious problem is to insure that material received for use meets the purchase specification. Material must be adequately inspected to insure that it is acceptable.

3. Other topics discussed were as follows:

   a. Mr. Hayes commented on the importance of upcoming work such as:

      (1) Installation of the Reactor Vessel Internals.

      (2) Piping work.

      (3) Electrical cable installation and connecting.

      (4) The seismic and environmental qualification of equipment and material.

   b. Mr. Heishman commented regarding the Quality Assurance, Quality Control program in that:

      (1) A Quality Assurance program review will be performed by NRC, RIII in the near future. The intent is a thorough review of quality assurance/control activity.

      (2) Consumers Power Company inspection overview was an important part of the quality program at Midland. The overview program was then the subject of a general discussion which included:

         (a) Consumers Power Company performed complete overview inspection of structural concrete reinforcement installation and concrete placement.

         (b) Consumers Power Company is performing and intends to continue an overview of the mechanical and electrical areas of work. The decision was made to inspect these areas during the initial phase of work so that faulty work could be detected and corrected early in the work phase. The plan was to inspect more work in the electrical and mechanical areas early in the work process than had been done initially in the structural concrete phase of construction. The intend is to act early enough to avoid problems and then be forced to increase the overview program in the mechanical and electrical areas. The NRC commented that it appeared that there would be a problem if the overview program was changed to reduce inspection in that most of the significant problems identified at Midland were a result of the overview program.

Conclusion

Mr. Keppler stated in conclusion that the Midland units were greater 50% complete, the number of noncompliance items found by NRC inspectors was comparable to other construction sites, although significant problems were identified years ago, with the exception of the diesel building, most of the problems appeared to be resolved. The Consumers Power Company Quality Assurance overview is very important and Consumers Power Company has done a good job of reporting the 10 CFR 50.55(e) items. This reporting demonstrated an openness in the program rather than attempting to hide any deficient conditions that were found.

Comments on test program not stated & NRC response that test program could replace some of the overview

EXHIBIT
CPCo 8
11-18-86 mg

EUGENE J. GALLAGHER, P.E.
CIVIL ENGINEER

EDUCATION

BS IN CIVIL ENGINEERING, VILLANOVA UNIVERSITY, 1973
MS IN STRUCTURAL ENGINEERING, POLYTECHNIC INSTITUTE OF NEW YORK, 1974

REGISTRATION: PROFESSIONAL ENGINEER

STATE OF ILLINOIS, NO. 37828
STATE OF FLORIDA, NO. 29114
STATE OF LOUISIANA, NO. 16376

PROFESSIONAL RECOGNITION

AMERICAN SOCIETY OF CIVIL ENGINEERS
AMERICAN CONCRETE INSTITUTE
TAU BETA PI NATIONAL ENGINEERING HONOR SOCIETY

PROFESSIONAL EXPERIENCE

1978 - PRESENT	U.S. NUCLEAR REGULATORY COMMISSION, OFFICE OF INSPECTION AND ENFORCEMENT, REGION III, GLEN ELLYN, ILLINOIS
1973 - 1978	EBASCO SERVICES, INC., CIVIL ENGINEERING DEPT., NEW YORK, N.Y.
1972 - 1973	VALLEY FORGE LABORATORY, CONCRETE AND SOILS LAB, VALLEY FORGE, PA.

SUMMARY OF EXPERIENCE

DESIGN OF REINFORCED CONCRETE AND STEEL STRUCTURES.
FOUNDATION DESIGN AND SOILS INVESTIGATIONS.
LABORATORY TESTING AND INSPECTION OF CONCRETE, STEEL, AND SOILS.
INSPECTION OF URANIUM MINE EARTH EMBANKMENTS AND DAMS.
INSPECTION OF STRUCTURES UNDER CONSTRUCTION.
INSPECTION OF MATERIAL SOURCES.
DESIGN OF HYDRAULIC AND WATER SUPPLY SYSTEMS.
DESIGN AND INSPECTION OF PIPING SYSTEMS.
RESIDENT CIVIL ENGINEER ON POWER PLANT CONSTRUCTION PROJECTS.
REVIEW OF MANAGEMENT CONTROLS FOR CONSTRUCTION PROJECTS.
QUALITY ASSURANCE PROGRAM REVIEWS.
DEVELOPMENT OF BUILDING CODES, STANDARDS, AND REGULATORY GUIDES.

ADDITIONAL TRAINING

FUNDAMENTALS OF INSPECTION, NRC, FEBRUARY 1978 (40 HOURS)
BWR FUNDAMENTALS COURSE, NRC, MARCH 1978 (40 HOURS)
CONCRETE TECHNOLOGY AND CODES, PORTLAND CEMENT ASSOC., MAY 1978 (80 HOURS)
QUALITY ASSURANCE COURSE, NRC, AUGUST 1978 (40 HOURS)
NONDESTRUCTIVE EXAMINATION AND CODES, ROCKWELL INT'L., AUGUST 1978 (120 HOURS)
PWR FUNDAMENTALS COURSE, NRC, NOVEMBER 1978 (40 HOURS)
WELDING METALLURGY, OHIO STATE UNIVERSITY, SEPTEMBER 1980 (80 HOURS)

Mc

Ferris Dep. 5x1 12-10-80

NAME FERRIS WALTER R. DATE 2/25/80

2-1/2" x 2-1/2" GLOSSY

PHOTO DATE

CLASSIFICATION Chief Soil Engineer GRADE

ORGANIZATION & LOCATION Eng. - Soils

45/31/B37 - San Francisco

BIRTHDATE 4/12/24 CITIZENSHIP U.S.A.

ORIGINAL BECHTEL EMPLOYMENT DATE 8/03/59

RE-EMPLOYMENT DATE(S)

SPOUSE'S NAME Almirah Janette Ferris "Jan"

CHILDREN BIRTHDATES

MILITARY SERVICE & RANK Captain

PROFESSIONAL LICENSES AND SOCIETIES

California State (14233) Civil
Minnesota (12201) Civil
U. S. Committee on Large Dams

American Society of Civil Engineers
Boston Society of Civil Engineers
International Society for Soil Mechanics and Foundation Engineering

EDUCATION AND PERSONAL DEVELOPMENT PROGRAMS

DEGREE, CERTIFICATE, ETC.	SCHOOL	MAJOR (OR SUBJECT)	DATE
B.S.	Queens University, Belfast, Ireland	Struct. Hydraulics	June 195[illegible]
S.M	Harvard Univ., Cambridge	Soil Mechanics	June 195[illegible]

OTHER SIGNIFICANT INFORMATION (Refer to instructions before completing)

(USE SUPPLEMENTAL PAGE, IF REQUIRED)

WORK HISTORY

DATES MO.-YR. FROM	TO	COMPANY, DIVISION OR DEPARTMENT; LOCATION AND SUPERIOR	POSITION HELD, SUMMARY OF RESPONSIBILITIES AND SIGNIFICANT ACCOMPLISHMENTS
Dec 1941	Jan 1948	Royal Engineers (UK)	Released as Captain (1948)
July 1951	Mar 1952	Sir Wm. Halcrow & Partns. London, U.K.	Designed two concrete dams and a side channel spillway on North of Scotland Hydro Works (Design Engineer)
Apr '52	Mar '53	Power Corp of Canada Montreal	Designed Fishway and Bridge on New Brunswick Hydro Project (Design Engineer)
Mar '53	Sep '54	H. G. Acres & Co. Niagara Falls, Canada	Designed a high rockfill dam in Quebec, investigated a landslide in British Columbia, and was in charge of inspecto[illegible] on construction of 7 mile of dikes for [illegible] hydro project in Manitoba. Participated in investigations of foundations for a highway and for a sugar refinery. (Desig[illegible] Engineer)
Sep '55	July '59	Harvard Univ.	On faculty of Div. of Eng. and Applied Science. (Lecturer) Participated in wor[illegible] connected with consulting Assignments of A-L Casagrande and K. Tarzaghi. Work included seepage and settlement of dams in British Columbia, setting up soils laboratory for railroad fill exploration and design (Great Salt Lake), ovaluation of anchored bulkhead, and building foundation investigations for several la[illegible] buildings in Boston including the Prudential Building.

(USE SUPPLEMENTAL PAGE, IF REQUI

DATES MONTH FROM	TO	COMPANY, DIVISION OR DEPARTMENT; LOCATION AND SUPERVISOR	POSITION HELD, SUMMARY OF RESPONSIBILITIES AND SIGNIFICANT ACCOMPLISHMENTS
Aug '59	Present	Bechtel, Inc. H&CF Div. San Francisco	Performed soil and foundation analyses for dams in California, Oregon, Minnesota and Colorado. Performed soil and foundation analyses fo a feasibility study for the BART Trans Bay Tube. Performed soil and foundation analyses and prepared and/or reviewed soils secti of Safety Analysis Reports for at least 1 nuclear power plants in the USA. Prepared soil reports for siting studies for nuclear power plants in the southeastern, central and northwestern USA. Carried out studies and prepared designs for foundations for structures at taconit plants in Michigan and Minnesota and for copper facilities in Michigan, Utah, New Mexico and Arizona. This included tailings dam design, thickener and ore storage facilities. Performed soil and foundation analyses fo fossil fuel plants in the western USA. Presented soils information to Atomic Energy Comm. on a number of nuclear plant

(Sorrio) Aff 2 12-10-80

sri

SOIL & ROCK INSTRUMENTATION

GEOTECH
GEOTECHNICAL INSTRUMENTATION DIVISION OF GOLDBERG • ZOINO • DUNNICLIFF & ASSOCIATES, INC.
REC'D OCT 30 1979

October 19, 1979
File No. D-2010

Dr. Sherif Afifi,
Bechtel Associates Professional Corporation,
P.O. Box 1000,
Ann Arbor, Michigan 48106

Re: Midland Units 1 & 2
Diesel Generator Building
Settlement Measurements

Dear Sherif:

In response to your request, I have reviewed your plots of initial elevation versus settlement at the 14 Borros anchor and settlement platform clusters sent to me on 9/20/79. The last date on these plots appears to be 6/15/79.

Cluster Plots

My approach has been:

(a) To look for irregularities in the cluster plots, recognizing particularly that, unless arching is taking place, settlement at a particular elevation must be greater than settlement at a point below that elevation.

(b) To judge irregularities on the basis of instrument plan positions: i.e. we should not expect a smooth cluster plot if the instruments are widespread in plan.

(c) To judge irregularities on the basis of anomolies noted on the installation record.

My review is summarized on Table 1. Note that I can in no case provide a conclusive explanation, but I believe the review does provide input to judging data quality.

30 TOWER RD. • NEWTON UPPER FALLS • MASS. 02164 • 617-965-3700

Settlement Below Elevation 600 Ft.

During a telephone discussion on 9/20/79 you gave me the following data:

Elevation	Number of Anchors	Settlement Through 7/27/79
599'	2	0.8", 1.3"
592'	3	0.7", 0.7", 1.3"
585'	2	0.4", 0.5"

and questioned the scatter of data. I have evaluated as follows. Judge data on basis of regularity on cluster plot and notes on installation logs, and then assess data validity. The review is summarized on Table 2. As can be seen, there is reason to favor the smaller values of settlement and question the 1.3", 0.8" and 1.3" measurements.

Sincerely,

John Dunnicliff

JD:mc

/John Dunnicliff
Geotechnical Instrumentation Consultant

cc: Walter R. Ferris, Bechtel, San Francisco
William R. Beloff

)This letter supersedes
)my review dated
October 11, 1979.

TABLE 1. REVIEW OF CLUSTER PLOTS

CLUSTER NO.	IRREGULARITIES	POSSIBLE EXPLANATION
1	None	--
2	BA-40	Error in computation of initial survey data (1)
2	PL-22, 45	Platforms not settling with top of fill (2)
3	PL-23, 46	Platforms not settling with top of fill (2). Note also that BA-59 is noted on installation log as "readings may be less accurate than normal", but for marginal reason of smaller than normal anchor drive. BA-59 data appears to be reasonable.
4	BA-47	Error in computation of initial survey data (1).
5	BA-44	Error in computation of survey data (1), downdrag on outer pipe (3).
6	BA-19 on 2/16/79	Minor survey inaccuracy.
6	PL-16	Platform not settling with top of fill (2).
7	BA-49	Noted on installation log as "readings may be less accurate than normal", due to anchor prongs being expelled only 1.5".
7	PL-17, 48 on 2/16/79	Platform not settling with top of fill (2).
8	BA-4	Noted on installation log as "readings may be less accurate than normal", due to grout in outer pipe.
9	BA-22,23,24	BA-24 is not at same plan location as BA-22,23. However, BA-22 and 23 are close together, and data are inconsistent. No explanation for this but suggest you check computations from survey data (1).
10	BA-12	Error in computation of initial survey data (1), downdrag on outer pipe(3).
12	BA-53	Noted on installation log as "readings may be less accurate than normal", due to anchor prongs being expelled only 1".

SB802197

CLUSTER NO.	IRREGULARITIES	POSSIBLE EXPLANATIONS
..12	BA-51 on 2/16/79 and 3/15/79	No explanation, but subsequent data appear reasonable.
13	BA-6 on 6/15/79	Minor survey inaccuracy.
14	Throughout	Large spread of cluster in plan. Justified only in comparing BA-55 with BA-56, and that comparison appears reasonable. Interesting to note that the cluster with largest spread in plan gives the most irregular plot, as would be expected.

NOTES:

(1) I recommend you check calculations, going back to raw data in the survey books. The initial readings appear to be the most questionable, because later incremental settlement generally look reasonable. If that does not reveal an error, I can think of no explanation for this irregularity.

(2) I understood that some settlement platforms were seated on the structure, some on the mud mat, some on the fill. If any of these platforms were not seated on the fill, and the fill settled away from the platform, data would be as shown on the cluster plots (i.e. platform settlement less than lower anchor settlement). I do not have enough data to evaluate this, but you can do so on the basis of

(a) Platform elevations with respect to structure elevations - see Table 2 in SRI DGB draft instrument report dated February 1979.

(b) Platform size. Platforms were 6" x 6", 1' x 1', or 2' x 2', depending I believe on underlying material (check with Austin Marshall). Sizes of platforms in question are:

PL-22	2' x 2'
PL-45	2' x 2'
PL-23	6" x 6"
PL-46	2' x 2'
PL-16	Not noted on log
PL-17	2' x 2'
PL-48	2' x 2'

(3) This is merely looking for a hypothesis that fits the data, and is not a sure explanation. If the bottom of the outer 1" pipe does not slide freely over the inner ¼" riser rod (i.e. if the greased hose plug does not prevent the annular space being plugged by soil), downdrag on the outer pipe will result in anchor settlement, and if the anchor is deep it will indicate large settlement.

TABLE 2. REV[illegible] OF SETTLEMENT BELOW ELEVATION 600 FT. AS GIVEN BY BORROS ANCHOR DATA

ANCHOR NO. (1)	ELEV. FT.	CLUSTER NO.	EVALUATION OF DATA ON BASIS OF			APPROX. SETTLEMENT THROUGH 6/15/79 Inches
			Cluster Pattern	Installation Log	Overall	
49	599.5	7	bad	bad	bad	1.3
44	599.1	5	bad (2)	good	bad (2)	0.8
53	598.0	12	good	bad	questionable	0.7
59	595.5	3	good	questionable	probably good?	0.2
8	594.3	13	good	good	good	0.6
12	591.5	10	bad (2)	good	bad (2)	1.3
42	591.4	2	good	good	good	0.7
52	586.0	9	good	good	good	0.5
17	584.5	6	good	good	good	0.4

NOTE: (1) In decreasing elevation order.

(2) May be able to determine more reliable value of settlement if review of raw survey data and computations reveals an error. See notes in Table 1.

N

File - CE

12-11-80

RESUME

THIRU R. THIRUVENGADAM

2124 Glencoe Hills Dr., Apt. 9
Ann Arbor, Michigan 48104

Telephone: Home: (313) 971-8051
Office: (313) ~~769-9700~~ 994-7770

OBJECTIVE Structural Engineer; Supervisor-Lead Engineer

EMPLOYMENT

Bechtel Corporation, Ann Arbor, Michigan: 49
From October 1973 -- continuing at present (~~17~~ months).
Lead Engineer of the Containment Subgroup of the Reactor Building for the Midland Nuclear Power Plant. Complete responsibility for the analysis, design and production of working drawings for the Prestressed Concrete Containment. In addition, responsible for supervision of engineering/drafting personnel assigned to the group, project correspondence in terms of client-vendor-construction communication, specifications, preparation of bids, bid evaluation and writing of purchase orders, PSAR/FSAR participation and AEC communication, project scheduling, manpower estimates, drawing control and personnel evaluation.

Sargent & Lundy, Chicago, Illinois:
From August 1971 to September 1973 (26 months).
Senior Structural Analyst in the Special Structures Group of the Structural Design and Drafting Division Responsibilities included complete analysis and design of Prestressed/Reinforced Concrete Containments for both PWR and BWR Reactors, Seismic Analysis of Class I structures, PSAR/FSAR documentation and other special problems such as Cooling Towers, Pipe Whip Effects and Restraints and Tornado Effects and supervision of the three to six engineers assigned to the group. Names of the projects actively participated in are: Byron/Braidwood, Illinois; Zimmer, Ohio; LaSalle County, Illinois; Bailly, Indiana; and Enrico Fermi II, Michigan.

Skidmore, Owings & Merrill, Chicago, Illinois:
From March 1969 to July 1971 (30 months).
Structural Engineer -- equivalent in position to Assistant Project Engineer. Responsible for analysis and design of several concrete and steel highrise buildings. Member of a group of four engineers who were responsible for the complete design of Sears Tower, Chicago (109 stories -- steel framed building -- tallest in the world).

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EMPLOYMENT (cont'd)

Other projects personally participated in are: One Shell Square, New Orleans, (50 stories, steel-concrete composite); First Wisconsin Center, Milwaukee, (40 stories, steel-braced building); and Bond Court, Cleveland, (20 stories, steel frame).

University of Illinois, Urbana, Illinois:
From June 1966 to August 1968 (27 months).
Civil Engineering Department. Research Assistant in the Project "Dynamic Stresses in Highway Bridges"-- Developed several Computer Programs for Dynamic Analysis of Single Span to Three Span Bridges under Moving Loads.

Tarapore & Company, Madras, India:
From December 1963 to September 1964 (10 months).
Design and Supervision of several Structures (e.g. office buildings, factory and industrial buildings, airport pavements and shell roofs).

Army School for A.M.I.E. (India) Madras, India:
From February 1964 to July 1964 (6 months).
Part Time Teaching in the Evenings for Licensiate Practicing Engineers preparing for A.M.I.E. (India) Examinations.

Madras State Electricity Board, Madras, India:
From January 1963 to July 1963 (6 months).
Practical Training as a Partial Requirement for Masters Degree in Power Engineering. Assignments in various Division of Hydroelectric Power Projects involved in Analysis and Design of Power Plant Structures, such as, Penstocks, Surgetanks, Transmission Towers and Power Station Structures.

EDUCATION

University of Illinois, Urbana, Illinois: From 9/64 to 3/69
Ph.D. Degree in Civil Engineering (Structures);
Recipient of Government of India Scholarship (64-66);
Research Assistant in Civil Engineering Department (66-68).

Indian Institute of Science, Bangalore, India: From 8/61 to 12/63
M.E. Degree in Power Engineering (Civil & Hydraulic);
Passed with Distinction

University of Madras, Madras, India: From 6/57 to 4/61.
B.E. Degree in Civil Engineering; Passed in First Class with Honours.

PROFESSIONAL SOCIETY MEMBERSHIP	American Society of Civil Engineers -- Associate Member American Concrete Institute -- Member	
PERSONAL DATA	Date of Birth:	December 15, 1940
	Height:	5 feet, 8 inches
	Weight:	175 lbs.
	Marital Status:	Single
	Health:	Excellent
	Sex:	Male
	Citizenship:	Indian (Immigrant to U.S.A.)
REFERENCES	Available on Request	
SALARY	Open	
AVAILABILITY	Four weeks after acceptance; earlier, if necessary.	

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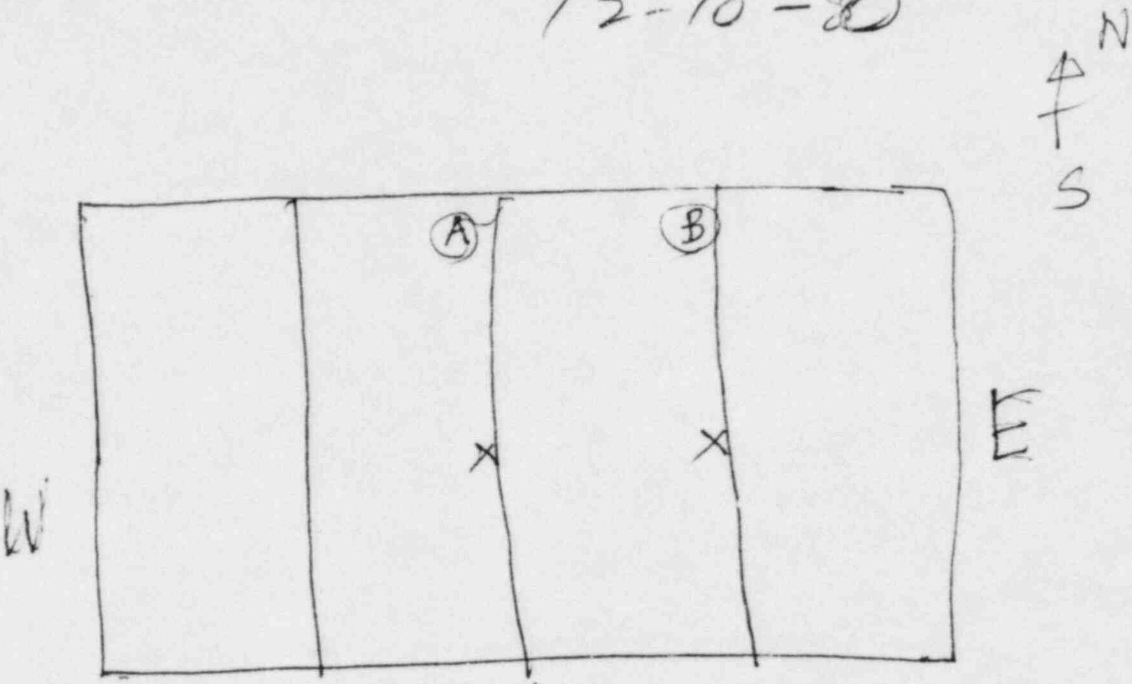
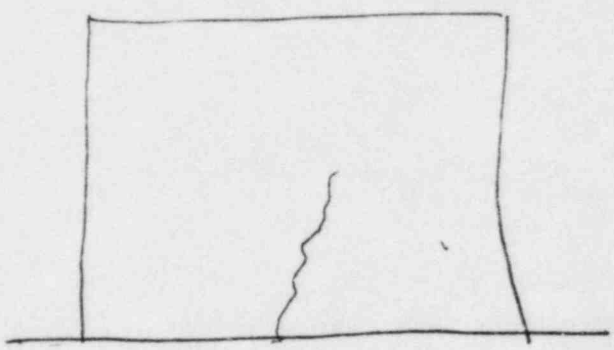
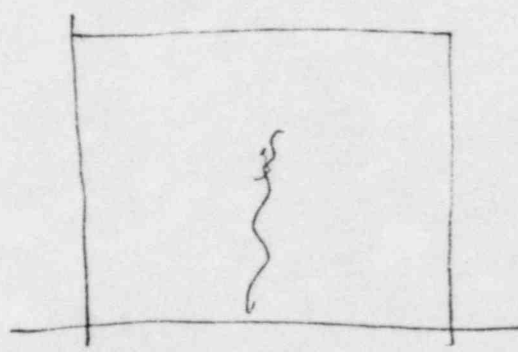
12-10-80



PLAN



Elevation Wall A



Elevation Wall B

RESUME OF JAMES W. SIMPSON

Summary of Work Experience

DATES	Positions Held PLACES	WORK	Soil & Mat.	Work Years Struct.	Civil Engr.
1949-1956	Indiana	Resident Engineer Bridge and Highway Const.			6
1956-1957	Thailand	Highway Location and Construction			2
1958	Greenland	Construction and Material Engineering	1		
1959-1962	Thailand	Soils and Material Engineering	2		
1962-1967	Indiana	Structural Engineering, Bridge Designer		5	
1967-1969	East Africa	Soils and Material Engineer	2		
1969-1971	Chicago	Soils and Foundation Engineer	3		
Mr. Simpson joined the Corps of Engineers in 1971.					
1971-1972	Chicago Dist.	Soils and Material Engineer, GS-11	2		
1972-1974	Chicago Dist.	Supervisor Soils and Material Eng., GS-12	2		
1974-1978	NCD	Soils and Material Engineer, GS-13	4		
1978-Present	NCD	Chief, Geotechnical Branch, GS-14	2		
		Total Years	18	5	8

TOTAL: 31 Years Work Experience

SLCO (Sepin) DEP. EX. NO. 1
FOR ID., AS OF 11/19/80 [illegible]

Summary of Work Experience

DATES	Positions Held PLACES	WORK	Work Years Soil & Mat.	Struct.	Civil Engr.
1949-1956	Indiana	Resident Engineer Bridge and Highway Const.			6
1956-1957	Thailand	Highway Location and Construction			2
1958	Greenland	Construction and Material Engineering	1		
1959-1962	Thailand	Soils and Material Engineering	2		
1962-1967	Indiana	Structural Engineering, Bridge Designer		5	
1967-1969	East Africa	Soils and Material Engineer	2		
1969-1971	Chicago	Soils and Foundation Engineer	3		

Mr. Simpson joined the Corps of Engineers in 1971.

1971-1972	Chicago Dist.	Soils and Material Engineer, GS-11	2		
1972-1974	Chicago Dist.	Supervisor Soils and Material Eng., GS-12	2		
1974-1978	NCD	Soils and Material Engineer, GS-13	4		
1978-Present	NCD	Chief, Geotechnical Branch, GS-14	2		
		Total Years	18	5	8

TOTAL: 31 Years Work Experience

RESUME OF ENGINEERING EXPERIENCE AND EDUCATION

NAME:	JAMES W. SIMPSON
ADDRESS:	951 Cedar Street Deerfield, Illinois 60015
TELEPHONE NOS:	
Home:	312/945-5967
Office:	312/353-5734
PERSONAL INFORMATION:	
BORN:	11 Feb 1923, in USA
DEPENDENTS:	Wife and three children
EDUCATION:	B.S.C.E. from Purdue University in 1949 Numerous courses at Universities of Purdue, California and Wisconsin, Corps of Engineer schools and elsewhere.
SPECIAL SKILLS:	Computer programming training and use.
MILITARY SERVICE:	U.S. Marines, Staff Sergeant
REGISTRATION:	Registered Professional Civil Engineer in States of Indiana and Illinois.

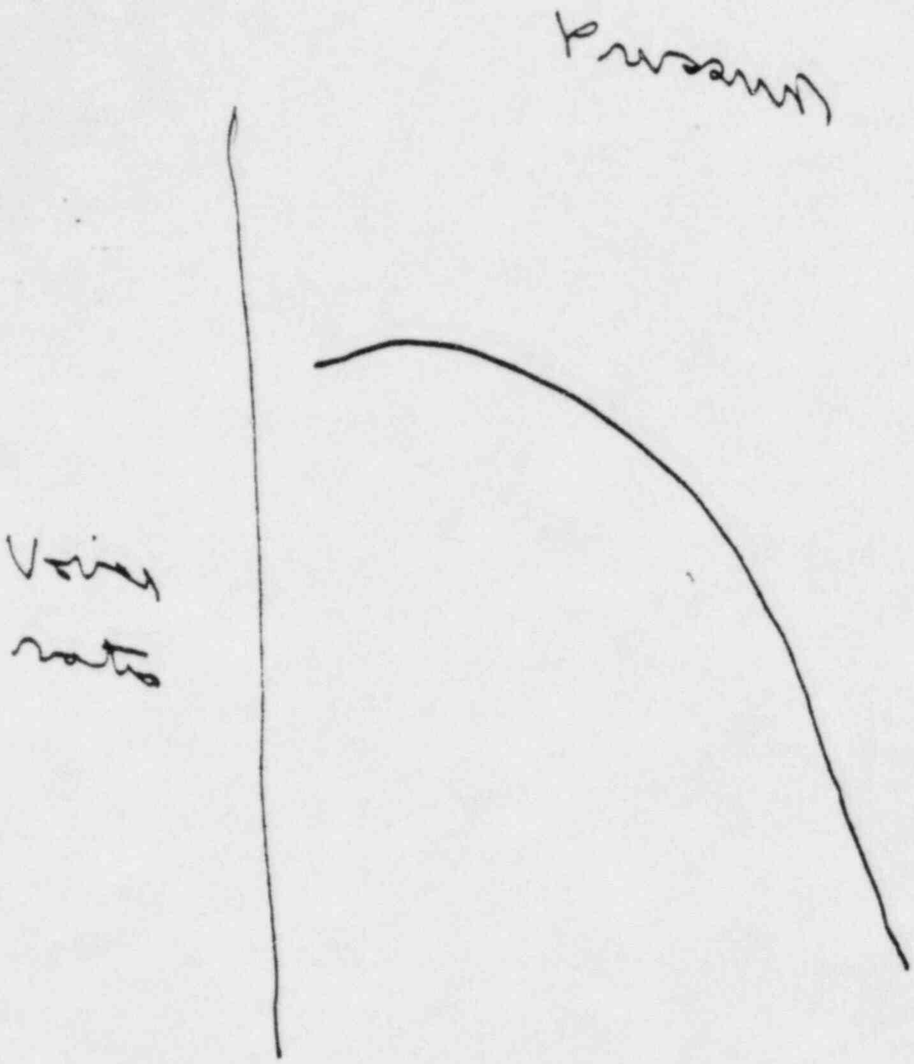
EMPLOYMENT RECORD:

Date:	1978 - Present
Employer:	Corps of Engineers
Title:	Chief of Geotechnical Branch North Central Division Chicago, Illinois
Grade:	GS-14
Work Description:	The Chief of Geotechnical Branch provides general supervision and has responsibility for all soil mechanics, geology and construction materials of five Districts including Detroit, Chicago, Rock Island, Buffalo and St. Paul. These Districts include a ten-state area (sometimes only a portion of states) extending around the Great Lakes from upstate New York to Western North Dakota. He acts as a consultant to the Districts on major problems.

RESUME OF JAMES W. SIMPSON (Cont.)

Date:	1974 - 1978
Employer:	Corps of Engineers
Title:	Civil Engineer North Central Division Chicago, Illinois
Grade:	GS-13
Work Description:	Served as staff specialist in soil mechanics and materials, reviewing all work documents, including plans and specifications within the North Central Division. Acted as consultant to Districts in the North Central Division.
Date:	1971 - 1974
Employer:	Corps of Engineers
Title:	Civil Engineer
Grade:	GS-11 and GS-12
Work Description:	Developed designs plus plans and specifications for the Chicago District in the soil mechanics and foundations area. Types of projects included dams, levees, highways, buildings, water front structures, retaining structures, breakwaters, etc.
Date:	1969 - 1971
Employer:	Soil Testing Services Chicago, Illinois
Title:	Soil Mechanics Engineer
Work Description:	Worked with this well-known consulting engineering firm on many Chicago building foundations and foundation problems including several high rise buildings in Chicago.
Date:	1967 - 1969
Employer:	Tippetts-Abbett-McCarthy-Stratton (Consulting Firm)
Title:	Soils and Material Engineer
Grade:	Supervisor
Work Description:	In charge of soils and material program (up to 25 men) with regard to 410 miles of new highway and 67 bridges in East Africa.

Date:	1962 - 1967
Employer:	Indiana State Highway Commission
Title:	Structural Engineer
Work Description:	Designer of bridges and highways.
Date:	1959 - 1962
Employer:	Transportation Consultants Inc. (Consulting Firm)
Title:	Soils and Material Engineer
Grade:	Supervisor
Work Description:	In charge of soils and material program for 100 kilometer highway project (including several bridges) in Thailand.
Date:	1958
Employer:	Greenland Contractors
Title:	Survey and Material Engineer
Work Description:	In charge of surveying, construction material and control testing.
Date:	1956 - 1957
Employer:	Sverdrup and Parcel Engineering Company (Consulting Firm)
Title:	Location and Survey Engineer
Work Description:	In charge of location and surveying for new highway in Thailand.
Date:	1949 - 1956
Employer:	Indiana State Highway Commission
Title:	Resident Engineer
Work Description:	In charge of construction control of various large bridge and highway projects.

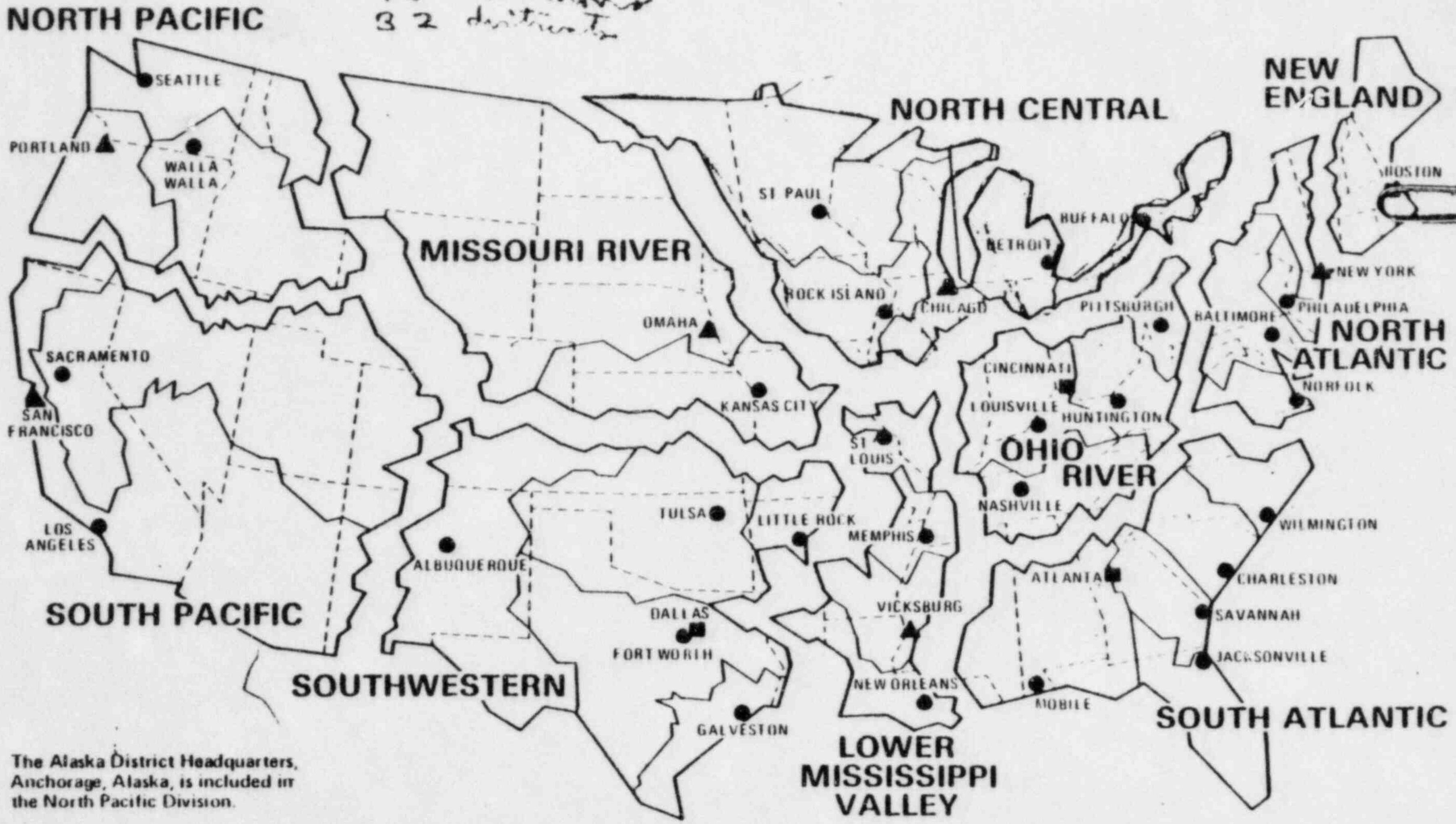


CPCO (Simmons) DEP. EX. NO. 2
FOR ID., AS OF 11/19/80 tao

DEP. EX. NO. 3
FOR ID., JF 11/19/80

DIVISIONS AND DISTRICTS for CIVIL WORKS ACTIVITIES

10 divisions
32 districts



The Alaska District Headquarters, Anchorage, Alaska, is included in the North Pacific Division.

— DISTRICT BOUNDARIES
■ DIVISION HEADQUARTERS
● DISTRICT HEADQUARTERS
▲ DIVISION AND DISTRICT HEADQUARTERS

The State of Hawaii and Islands in the Pacific are included in Honolulu District, Pacific Ocean Division, with Headquarters at Honolulu, Hawaii.

The Territory of Puerto Rico and adjacent Islands is included in Jacksonville District, South Atlantic Division.

SUBJECT:

Interagency Agreement No. NRC-03-79-167 with the NRC.

OBJECTIVE:

The objective of this Interagency Agreement is for the COE to furnish the service of expert technical personnel to assist the NRC's Geotechnical Engineering Section in their areas of responsibility in the review and evaluation of foundation problems associated with Midland Nuclear Plants 1 and 2 near Midland, Michigan and the Bailly Generating Station, Bailly, Indiana, near Gary.

SPECIFIC NATURE OF WORK:

The geotechnical engineering aspects of proposed/nuclear plant facilities to be evaluated generally include the stability/and settlement of safety related structures, emergency cooling water reservoirs, appurtinent, safety-related structures such as earth embankments and rock fill dams, canals, weirs, intake and discharge structures, and pipelines, under both static and dynamic conditions, including the subjection of dams, etc., to the Safe Shut-down and Operating Basis Earthquakes. The evaluation typically consists of:

1. A review of the site investigation program, both field and laboratory, to assure that an adequate determination of all subsurface conditions has been achieved including consideration of borrow sources. This may require recommendations for additional investigations to obtain the required data;

2. Evaluations and recommendations pertaining to the proposed design criteria;

3. A review of the stability and settlement analysis performed by the applicant and, in many cases, the performance of independent stability analysis. A determination that the applicant has presented adequate bases to support the design parameters used in his analysis;

4. An evaluation of stabilization techniques proposed by applicant to solve site foundation problems. The COE could be asked to provide recommendations for stabilization;

5. Field trips by COE personnel are necessary to inspect the site, to observe sampling and testing of soil and rock, and to evaluate the adequacy of techniques and equipment.

Diesel Generator Building - Settlement - Questions

1. The residual settlement of the upper sand layer was not considered in the future settlement predictions presented within the response. Calculations during review indicate about ½ inch of settlement of the upper sand zone will occur during the life of the project. Present an evaluation of this settlement with accompanying calculations and appropriate soils data.

2. The settlement patterns, or differential settlements, of the diesel generator building indicate a direct correlation with soils types and properties within the backfill material. Comprehensive boring logs are required to review the settlement (differential settlement)

CPCO Simpson DEP. EX. NO. 9
FOR ID., AS OF 11/19/80 tao

Settlement (Consolidation) Analysis of Diesel Generator Bldg.

Summary

This analysis was for settlement marker DG-3 which indicated the greatest settlement due to the building load. The settlement analysis is primarily concerned with the residual, or time-related, settlement. An [illegible] settlement analysis would be academic and not pertinent to a prediction of future settlement, as the majority of the building load is [illegible]. Consequently this analysis determines the adequacy of the surcharge program and estimates the remaining settlement.

Adequacy of Surcharge loading.

The 20 feet of sand (γ = 110 pcf) produces a surcharge [illegible] of 2200 psf over the diesel generator building. As shown by [illegible] (sheets 2-5) the [illegible] would have only needed to have been in place for 42 days to achieve the necessary degree of consolidation for the [illegible] loading. Therefore [illegible] consolidation is expected as a result of the [illegible] loading. The analysis assumed a rigid [illegible] for evaluating the stresses within the clay layer and is adequate [illegible] of the depth of the clay.

Immediate settlement of clay layer.

An immediate settlement of the clay layer had occurred prior to the consolidation by the surcharge. The clay layer was assumed to be 100% saturated; the cooling pond level was at about the top of the clay layer (elev. 622) before filling began.

Secondary Compression.

The coefficient of secondary compression, C_α = .125 for DG-3, is comparable with clays of low to medium secondary compressibility and therefore is adequate to evaluate the settlement due to secondary compression.

Consolidation of Clay Layer.

The simplified consolidation analysis of the clay layer indicates that measured settlements are within the range of calculated settlement for the surcharge loading. This consolidation analysis indicates that future settlements of the clay layer would be due to secondary compression and not to additional consolidation of the clay.

Residual settlement of the sand layer

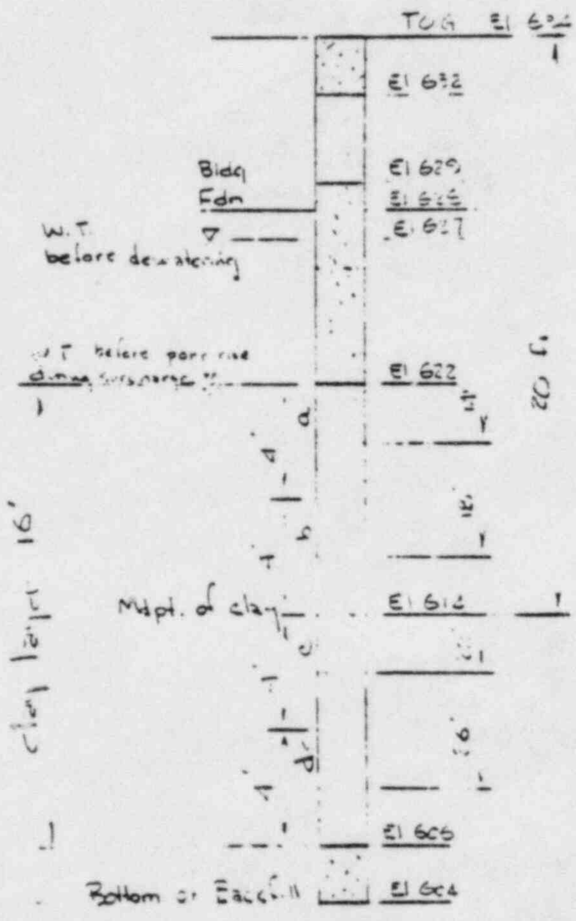
The time-related settlement of the upper sand layer would be about 1/2 inch over the life of the project. This type of settlement in sand is comparable to secondary compression within clay. This is the only settlement not previously computed, and does not appear in the response.

Differential Settlement:

The major influence upon settlement for any location within the diesel generator building is the properties and depth of the different soils at that location. As an example, DG-11 (middle of south wall) registered the most settlement during surcharge loading because the clay stratum was thickest (25 feet) at this location. In order to sufficiently review the settlement data, comprehensive boring logs are required.

Settlement Marker DG-3

Boring DG-1 (DG-7 nearby is similar)



Loading

from table 2.5-14

Building Loads

Dead & live load = [illegible] psf generator bldg. } loading of individual [illegible]

1400 psf generator [illegible]

or

3000 psf average (table 4-1A) } approx. average over area of bldg.

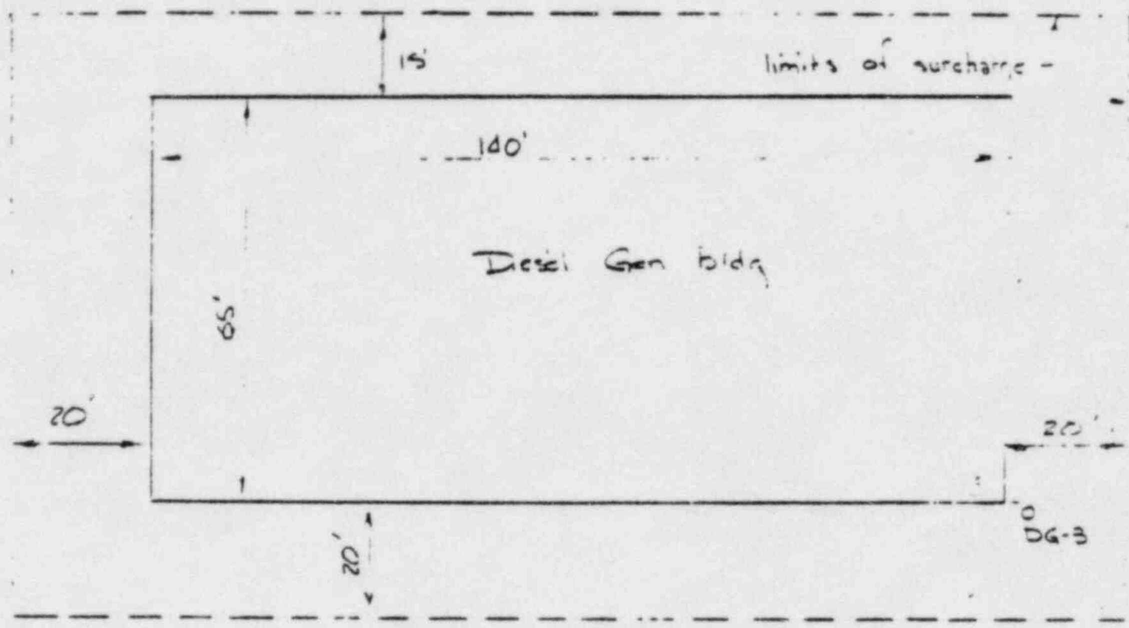
This assumes a mat [illegible], which [illegible] analysis [illegible] is a proper design assumption [illegible] (Not true [illegible])

Surcharge 20 feet of sand (γ = 110 pcf) = [illegible] psf

Increase in effective pressure as a result of [illegible]

γ_{water} [illegible] midpoint [illegible]

62.4 pcf (627 - 5[illegible]A) = 8112 psf



Determination of vertical stress at DG-3 by Boussinesq Method

From building load, $q = 2.2$ ksf (bldg not 100% [illegible])

$m = \frac{140}{20} = 7.0 \quad n = \frac{65}{20} = 3.3 \quad I_\sigma = 0.24 \quad \sigma_z = 0.53$ ksf

From surcharge, $q = 2.2$ ksf

① $m = \frac{20}{20} = 1.0 \quad n = \frac{20}{20} = 1.0 \quad I_\sigma = 0.175 \quad \sigma_z = 0.38$

② $m = \frac{20}{20} = 1.0 \quad n = \frac{160}{20} = 8.0 \quad I_\sigma = 0.20 \quad \sigma_z = 0.44$

③ $m = \frac{85}{20} = 4.25 \quad n = \frac{160}{20} = 8.0 \quad I_\sigma = 0.25 \quad \sigma_z = 0.55$

④ $m = \frac{20}{20} = 1.0 \quad n = \frac{85}{20} = 4.25 \quad I_\sigma = 0.20 \quad \sigma_z = 0.44$

total = 1.81 ksf

Total load during surcharge = 4.4 ksf

Total vertical stress at clay layer during surcharge = 2.34 ksf

0.53 ksf (bldg) + 1.81 ksf (surcharge) = 2.34 ksf

Additional vertical stress due to dewatering (infinite areal extent)

811.2 psf = 0.81 ksf over total area.

From operational bldg load $q = 3.0$ ksf

$I_{\sigma} = 0.24 \qquad \sigma_z = 0.72$ ksf

Total vertical stress during operation

0.81 ksf + 0.72 ksf = 1.53 ksf

65% of total vertical stress on clay layer during surcharge.

The above analysis assumes that any consolidating effect of the existing overburden (backfill) is balanced by the effect of establishing foundation grade 6 feet below ground surface. Also, all immediate settlement of backfill material has occurred.

The above analysis indicates final effective stress on clay layer (1.53 ksf) beyond initial overburden pressure is less (65%) than effective stress on clay layer, beyond initial overburden pressure, during surcharge loading (2.34 ksf).

Degree of consolidation which must have been achieved by surcharge

$$U_z = \frac{\sigma_f'}{\sigma_f' + \sigma_s} = \frac{1}{1 + \sigma_s/\sigma_f'}$$

where: U = degree of consolidation [illegible]

σ_f = effective stress of [illegible] = 1.5[illegible]

σ_s = stress developed by surcharge = 2.34 [illegible]

$$U_z = \frac{1}{1 + \frac{2.34}{1.50}} = 40\%$$

assume 50% as degree of consolidation

t_{50} = 42 days

because of inaccuracies which may exist in [illegible] use [illegible] to achieve required degree of consolidation of 42 days.

This analysis indicates that the required degree of [illegible] the foundation by the surcharge for the time that was achieved [illegible] preloading.

Residual settlement on sand

The time-dependent settlement of the sand layer would be about ½ of the estimated immediate settlement of the sand layer [illegible] or

$$S = \frac{5p \cdot C_t}{(N-1.5)\, C_D\, A} \qquad \text{(Meyerhof Equation)}$$

where p = stress below footing = 4.5 ksf = 2.25 tsf

N = average blow count in the sand layer = 12

C_D = correction factor for depth of [illegible] = 0.[illegible]

C_t = time rate factor (40 years) = 1.5

A = averaging factor = 3

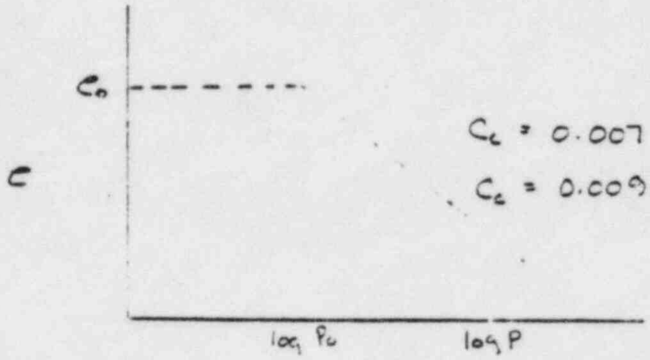
$$S = \frac{5\,(2.25)\,1.5}{(12-1.5)\,0.95\,(3)} = 0.56 \text{ inches}$$

Meyerhof's equation predicts settlements which vary from 0.9 [illegible] to 3 [illegible] the actual settlement - averaging factor to compensate [illegible]

from Duncan, J.M. and Buchignani, A.L. Engineering [illegible] for Settlement Studies. University of [illegible] [illegible], 1976.

The immediate settlement of the sand layer, as well as the clay layer, was assumed to have occurred during the initial construction phase of the diesel generator building and prior to settlement measurements and therefore is independent of this analysis.

Settlement by Consolidation of Clay Layer



$C_c = 0.007$ (LL - 10%) Duncan, etc

$C_c = 0.009$ (LL - 10%) Peck, etc

log P

<u>Variables</u>:

e_o = 0.55

P_o = 1700 psf

P = effective stress related to sequence of events

LL = 36

C_c = 0.007 (36-10) = 0.18 use 0.18

0.009 (36-10) = 0.23

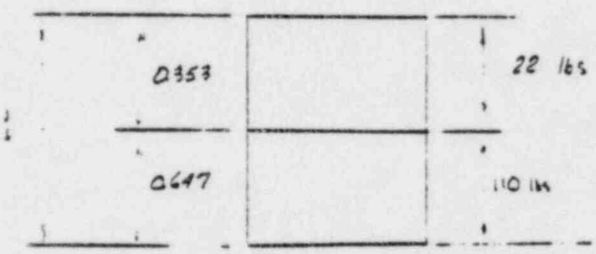
$$S = \frac{C_c}{1 + e_o} H \log_{10} \frac{P}{P_o}$$

Determination of Consolidation Variables

$LL = 36$ (Figure 2.5-30)

$\gamma_d = 110$ (Figure 2.5-33)

$w = 20\%$ (Figure 2.5-33)



$C_c = 0.55$

$G_s = 2.72$ (Calculated)

(Compare: [illegible])

P_o = overburden pressure at midpoint of clay layer = 1700 psf

El 634 – Top of ground

El 622 – Top of clay layer
w.t. before pond rise — $(634-622)\,110 = 1320$ psf

El 614 – Midpoint - clay layer — $(622-614)(110-62.4) + 1320 = 1700$

El 606 – bottom of clay layer

Settlement due to Consolidation of Clay Layer

Before settlement measurements:

assume bldg half completed when measurements began

assume ½ of total dead load of bldg.

$P = 265 \text{ psf} + 1700 \text{ psf} = 1965 \text{ psf}$

½ of stress increase [illegible] p.3

$$S = \frac{0.18}{1.55} \, 16 \text{ ft} \log \frac{1965}{1700} \, \frac{12 \text{ in}}{\text{ft}} = 1.40 \text{ inches}$$

add this amount to measured settlements for comparison

After surcharge load was removed:

(from beginning of construction to removal of surcharge)

$P = 1700 \text{ psf} + 2340 \text{ psf} = 4040 \text{ psf}$

Total stress during surcharge (2.34 ksf, p 3)

$$S = \frac{0.18}{1.55} \, 16 \text{ ft} \log \frac{4040}{1700} \, \frac{12 \text{ in}}{\text{ft}} = 8.38 \text{ inches}$$

measured settlement

$4.25 + 3.20 + 1.40 \text{ (calculated)} = 8.85 \text{ inches}$

Secondary compression.

The settlement vs log time curve exhibits the standard consolidation - secondary compression curve. The coefficient of secondary consolidation, C_α, is 1.25 inches per log cycle of time (for DG-3). For 16-foot thick clay layer,

$$C_\alpha = \frac{1.25\ in}{16\ ft} \cdot \frac{ft}{12\ in} \text{ per log cycle}$$

$$C_\alpha = 0.0065 \text{ (dimensionless)}$$

which compares favorably with the typical values for C_α of clay with a low to medium coefficient of secondary consolidation.

	C_α	Secondary compressibility
	0.002	very low
	0.004	low
DG-3 →	0.0065	
	0.008	medium
	0.016	high
	0.032	very high
	0.064	extremely high

Table from. Duncan, J.M. and Buchignani, A.L., Engineering Manual for Settlement Studies. University of California, Berkeley, June 1976

Dewatering - Questions

1. Liquefaction should be expected to occur as the backfill sands become saturated. Saturation of backfill sands would appear to begin when the groundwater table rises above the top of the natural sands, elevation 605 (Figure 24-8, boring log DG-28). Present design criteria or data which supports elevation 610 as maximum groundwater level.

2. Design of the permanent dewatering system is based upon two major findings: (1) The granular backfill materials are in hydraulic connection with an underlying discontinuous body of natural sand, and (2) Seepage from the cooling pond is restricted to the [illegible] and pump structure area. Soil profiles (Figure 24-2), pumping test time-drawdown graphs (Figure 24-14), and plotted [illegible] (Figure 24-15) indicate that south of the diesel generator building the plant fill material adjacent to the cooling pond is not an effective barrier to the inflow of cooling pond water. Reevaluate the [illegible] of this material and the effect on the permanent dewatering system. Include data, especially the recovery data from [illegible] and complete data from PD-5, for review.

CPCO (Simpson) DEP. EX. NO. 10
FOR ID., AS OF 11/19/80 [illegible]

3. During cooling pond filling the differential hydraulic head affecting the groundwater level was less than 6 feet, and somewhat obscured by pore pressure increase and subsequent dissipation caused by the surcharge loading. The rate of water level rise should be expected to be considerably less than 90 days. A more pertinent analysis might involve utilizing the recovery data from the appropriate pump tests. A new analysis is particularly warranted in view of the above questions. Include all design criteria, data, and calculations which support final answer.

4. The interceptor wells have been positioned along the northern side of the intake and pump structures. The calculations estimating the total groundwater inflow within the response indicate the structures serve as a positive cutoff. However, the isopachs of the sand (Figures 24-9 and 24-10) indicate 5 to 10 feet of remaining natural sands below these structures. The soils profile (Figure 24-2) neither agrees nor disagrees with the isopachs. The calculations for total flow, which assumed positive cutoff, reduced the length of the line source of inflow by 2/3. The calculations for the spacing and positioning of the wells assumed this reduced total flow is applied along the entire length of the structures. Clarify the existence of seepage below the structures, present supporting data and calculations, and reposition wells accordingly. Include in the supporting data the assumed drawdown elevation of the line source of inflow (slot elevation), the head increase beyond the interceptor wells, and establish an operating water level within the interceptor wells.

2. <u>Filter pack design</u>. Satisfactory design criteria for filter pack was not referenced which would insure compliance with state-of-the-art guidelines. The design and subsequent installation of the filter pack must prevent removal of fine sand and silt from the insitu materials and ultimately prevent pipes developing to the cooling pond.

3. <u>Rate of water level rise</u>. The rate of water level rise should be re-evaluated using more pertinent data. Recovery data from the pump tests might be suitable.

4. <u>Area wells</u>. The area wells require 150 days for dewatering, which may present problems during dewatering <u>after</u> a shutdown.

24 a.

Maximum Groundwater Level. Maximum groundwater level was established at elevation 610 which appears to correspond to the top of the backfill sands below the diesel generator building. The top of the natural sands appears to be at elevation 605.

Basis of Analytical Model.

1. The source of recharge to the backfill sands does not appear to be limited to the area of the service water pump structure and circulating water intake structure as stated in the response. The cone of influence for Well PD-5C (Figure 24-[illegible]) indicates a recharge boundary on the south side of the cone, adjacent to the cooling pond. This recharge boundary is verified by the cone of influence of PD-20. The drawdown of pump well PD-20 as measured in observation well PD-5 indicates steady drawdown and [illegible] [illegible] [illegible] recharge [illegible]. (Figure 24-1A).

2. Direct comparisons between groundwater levels and cooling pond filling may be obscured by pore pressure [illegible], and subsequent dissipation, as a result of the surcharge loading. A small differential hydraulic head exists between the cooling pond surface and the groundwater level during cooling pond filling. In the event of a malfunction of the permanent dewatering system during plant operation, the differential hydraulic head would be about 32 feet (elevation 627 minus elevation 595), and the rate of water level rise to the maximum groundwater level would be considerably quicker than 90 days.

3. The seepage flowpath is through the natural sand with hydraulic connection to the backfill sand.

Calibration of Apparent Permeability.

The response analysis to determine permeability may have been obscured by the effects of the surcharge loading. A more appropriate analysis would involve the transmissivity of the seepage flowpath as determined from the pump tests. The transmissivity as determined by Jacobs Modified Method is about .650 gpd/ft which, for a 20-foot average flow depth, translates to a coefficient of permeability of about 11 feet/day.

Rate of Water Level Rise.

Equation 2 (page 24.3) yields over 90 days before the groundwater level rises to the maximum groundwater level, elevation 610. This time, 90 days, is based on unsupported data and design criteria.

Shear Wave Velocity. The equation relating shear wave velocity to void ratio and average effective confining pressure (page 24.5) is printed incorrectly. The correct equation is $V_s = (159 - 53.5e)\,\bar{\sigma}_o$ [illegible]

24 b.

Permanent Dewatering (PD) Series Pumping Tests.

PD-20 Pumping Test.

During pump test, observation well PD-3, 210 feet from pump well and adjacent to cooling pond, indicated steady drawdown. PD-3 did not indicate a recharge boundary, cooling pond, nor did PD-3 indicate a barrier boundary, impermeable soils. Recovery data from PD-3 and complete data from PD-5 should be included for review.

PD-15 A Pumping Test.

Observation well Q-1 indicates a significant barrier boundary north of the pump well.

Permanent Dewatering System.

Design of the permanent dewatering system is based on two major findings: (1) The granular backfill materials are in hydraulic connection with an underlying discontinuous body of natural sand, and (2) seepage from the cooling pond is restricted to the intake and pump structure area. The back-up data as presented supporting finding (2), is not sufficiently detailed to review this finding.

Cone of influence, pump test obs PD-3, soils logs indicate possible groundwater movement through. See A-A, Figures E4-1 and E4-2 which is not included in interceptor well plan

Interceptor Well Design.

The design presentation places the interceptor wells along the landward side of the intake and pump structures. Calculations to estimate the total flow to the interceptor wells reduced the flow 2/3 because of these structures. The isopachs of the sands (Figures 24-9 and 24-10) indicate 5 to 10 feet of remaining natural sands below these structures. The cross-section soils profile through these structures does not agree with the isopach. The soils data included with the response is not adequate enough to support or refute the existance of a significant seepage path below the structures. If the structures serve as a significant cutoff, shouldn't the wells be moved southwest to intercept seepage through the natural sand deposits indicated on the cross-section? If the length of the slot is indeed reduced by 2/3, the 20-foot spacing of the wells may result in a major head increase downstream of the wells or may result in overloading the capacity of the wells.

Area Wells.

The time required for the area wells to remove the estimated quantity of water is 139 days.

1. Would seepage occur within the natural sand below the intake structure?
2. If intake structure serves as positive cutoff, Interceptor wells should be positioned accordingly.
3. At 20 ft spacing Q_w (individual well) = 20-25 gpm (Overload?) and head increase d.s. of wells is 9.1 ft compared to 6.2 ft. (Assuming only 1/3 of wells would be in seepage path.)

Would the dewatering time of 139 days be a problem?

Well Design - as presented

Q. Gravity Flow TM 5-818-5 Dewatering and Groundwater Cont.

$$Q = \frac{kx}{2L}(H^2 - h_o^2) \qquad IV\text{-}3 \qquad p\ 128$$

where: x = 400 ft = slot length
L = 150 ft = distance from source
k = 31 ft/day = max permeability
H = 47 ft = pond elev 627 - base elev 580
h_o = 15 ft = operating elev 595 - base elev 580
reduce Q by 1/3 for conc. structures

$$Q = \frac{31\ ft/day\ 400\ ft\ (47^2 - 15^2)\ ft^2}{2\ (150\ ft)\ 3} \cdot \frac{day}{1440\ min} \cdot \frac{7.48\ gal}{ft^3}$$

Q = 141 gpm   total flow use 150 gpm

Spacing

assume 20 wells

$$150/20 = \frac{31\ ft/day\ a\ (47^2 - 15^2)\ ft^2}{2\ (150)\ 3\ ft} \cdot \frac{day}{1440\ min} \cdot 7.48\ gal/ft^3$$

a = 21.1 ft

Head Increase D/S of wells

$$\Delta h_o^2 = \frac{Q_w}{\pi k} \ln \frac{a}{2\pi r_w}$$

Eq. IV-84, p 149

where Q_w = 7.5 gpm
k = 31 ft/day
a = 21 ft
r_w = 0.25 ft

$$\Delta h_o^2 = \frac{7.5 \frac{gal}{min} \; 1440 \frac{min}{day}}{\pi \; 31 \; ^{ft}/_{day} \; 7.48 \; ^{gal}/_{ft^3}} \; \ln \frac{21 \text{ ft}}{2\pi \; 0.25 \text{ ft}} = 38.4$$

$\Delta h_o = 6.2$ ft $\qquad \Delta h_m = 7.0$ ft

Based on this analysis the groundwater level [illegible] of the wells is at elevation 601.2

If h_o in Equation IV.3 is reduced to 9 feet, and the slot elevation becomes 589, Q = 150 gpm spacing, well size, number of wells remain unchanged.

The significant item which is brought out is that the drawdown within the wells must be 6.0± feet below the operating level or elevation 589.

The above analysis assumes Q_{total} is uniformly distributed along the 400 ft slot. If Q_{total} is assumed to be [illegible] along 1/3 of the slot (intake structure [illegible]), the revisions are:

Concentration of flow along slot may cause overload or failure of dewatering system. Proposed pumps with 8-15 gpm pumping rate.

Flow at Well, Q_w	Head [illegible] drawdown, Δh_o
x = 135 ft	Q_w = 22.5 gpm
h_o = 9 ft	a = 20 ft
a = 20 ft	r_w = 0.5
Q = 22.5 gpm	Δh_o = 9.1 ft
Q > pump capacity	

Area Well Design - as presented

Total Volume = 22 x 10^7 gal

Pumping time = $\frac{22 \times 10^7 \text{ gal}}{5 \text{ gal/min}} \cdot \frac{}{22 \text{ wells}} \cdot \frac{\text{day}}{1440 \text{ m}}$ = 139 days

22 wells

2 additional wells for surface infiltration and pipe leakage.

24 wells total

24 c Other alternatives to timers and float devices to activate the pumps:

1. Self-cooling pumps with cooling systems similar to vacuum well point pumps,
2. Discharge valves at each pump to tune the discharge flow of the pump to the inflow of the well.

The pump will might [illegible] [illegible] the [illegible] riser. Turbulence created by a 8-[illegible] [illegible] submersible pump in a 8-in [illegible] well should not be [illegible] during monitoring of the [illegible]. This could eliminate the small diameter [illegible] [illegible] to be placed within the filter pack to monitor the general condition of the pump well. Eliminating [illegible] [illegible] related disturbance of the filter pack will reduce the [illegible] of failure of the well liner.

24 d.

The filter pack design should be based on the size of the well screen openings, and on the gradation curve of the aquifer. Filter material with a uniformity coefficient less than 2.5 ($C_u = D_{60}/D_{10}$) may not be graded sufficiently to restrict movement of aquifer fines without causing major head loss within the filter. The filter pack should be designed as outlined in TM 5-818-5 Dewatering and Groundwater Control for Deep Excavations.

The maximum sand content of the discharge water is set at 20 parts per million. At a constant pumping rate of 5 gpm and an average sand content of 20 ppm, one cubic yard of sand would be discharged in less than 4 years.

Design criteria which established the sand content and for sand removal should be referenced.

24 c Retaining Walls as regarding Dewatering System

Dewatering system design does not relate to integrity of [illegible] walls - retaining walls not considered in analysis. The intake and pump structures were considered in analysis.

24 9.

The adequacy of the proposed permanent dewatering system in maintaining the groundwater level beneath the plant site below an established limit so that granular backfill materials are not subjected to liquefaction during the SSE has not been demonstrated.

The following design assumptions are not verified by supporting data:

1. <u>Location of seepage path</u>. The data presented do not support the location of the seepage path [illegible] does not support the location of the [illegible] wells. [illegible] the length of the slot by [illegible] is justified for calculation of total flow if the intake structure effectively restricts seepage down to the base of the natural sand. For positioning of the [illegible] wells, a more detailed analysis should be attempted. The [illegible] analysis and accompanying data indicate the major seepage [illegible] would be concentrated southwest of the intake structure, and a spacing of 210 feet between wells would [illegible] to [illegible] the flow and maintain minimum [illegible]. [illegible] the interceptor wells have not been positioned in relation to the assumed seepage path. Furthermore, [illegible] movements indicate some degree of permeability within the backfill and fill material along the north bank of the cooling pond (Cross section A-H, Figures 24-1 and 24-2). Groundwater movement through this area may require additional interceptor and reserve wells.

interceptor wells [illegible] assumed seepage [illegible] not comp[illegible] [illegible] lining [illegible].

No gndwater analysis of effect of cutoff on River

24 f.

While the dewatering system should have no effect on the Tittabawassee River (barrier boundaries were indicated by observation well G-1), the overall effect of the cutoff and slurry trench walls have not been evaluated. The reduction in recharge from the groundwater system to the river may have some effect upon the quantity and quality of river channel flow. The analysis should include loss of water through cooling [illegible] the cooling pond. The initial condition of the groundwater level would be [illegible] the effect of the cooling pond which would be a higher elevation.

Service Water Structure - Pile Support - Questions

1. A preliminary review of the proposed pile support system for the north wall of the service water structure indicates the system is inadequate to support the required loading. The limited information available for review analysis was found primarily in MCAR 24 Interim Report 6. A detailed pile design based upon available soils data should be developed in order to more effectively evaluate the proposed pile support system prior to load testing of a test pile.

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FOR ID., AS OF 11/10/80 tao

Service Water Structure - Pile Support

1. Proposed loading. The north wall of the service water structure is planned to be supported by piles to glacial till because of the inadequate compaction of the backfill material. The total load to be supported by the piles is about 1600 tons, or 100 tons per pile for 16 piles. The piles would be predrilled through the backfill material, then driven into the glacial till.

2. Allowable loading. Vertical displacements of the predrilled piles would be small and therefore no shearing forces would be mobilized along the shaft through the backfill material. Continued settlement of backfill should be greater than settlement or deformation of the piles, and downdrag (negative skin friction) could develop along the pile shaft increasing the load on the pile. Downdrag could balance any skin friction developed by driving the pile into the glacial till. If no accumulative side resistance along the shaft develops, the proper design would be a point bearing pile (pier). The presumptive bearing value for glacial till from regional building codes is not greater than 10 tsf.

3. Proposed design. The piles are to be designed and installed as outlined in ACI 543. A load test of a test pile is to be conducted following the guidelines of ASTM D 1143. Pile design has been submitted to date.

4. Indicated design. The detail drawing on Figure 83 (GR) indicates a proposed pile would be one foot diameter, which provides a cross sectional area of about 0.8 square foot. With the proposed

loading of 100 tons per pile, the contact stress at the bottom of the pile becomes 125 tsf. Punching failure probable under this stress.

5 Design. A preliminary design of a support structure, whether piles, piers, or other devices, is warranted to determine the feasibility of conducting a load test of a test pile or to determine the feasibility of a pile system altogether. The information concerning the proposed piles as given or implied in the various reports indicate that these piles would not be adequate to support the structure. The purpose of a pile load test is to refine a design not initiate it.

6 Indicated Design Evaluation. The ultimate load of an individual pier (predrilled pile) is given by

$$Q_u = \bar{C}_b \, \omega \, N_c \, A_b + \alpha \, \bar{C}_s \, A_s$$

where: $\bar{C}_b$ = undrained strength of soil below base = 4 tsf (S_u 8 ksf from Figure 2.5-33)

ω = coefficient for fissures = 1 (no fissures)

N_c = bearing capacity factor = 9 (deep foundations)

A_b = area of tip = $\frac{1}{4}\pi D^2$ = 0.79 ft^2

α = correction factor for difference between adhesion and undrained shear = 0.6

C_s = undrained adhesion along shaft = 3 tsf

A_s = peripheral area of shaft = πDL = $(1)(7)$ 22 ft^2

$$Q_u = \bar{C}_b \, \omega \, N_c \, A_b + \alpha \, C_s \, A_s$$

$$Q_u = \frac{4 \text{ tons}}{\text{ft}^2}(1)(9)\,0.79 \text{ ft}^2 + (0.6)\,\frac{3 \text{ tons}}{\text{ft}^2}\,22 \text{ ft}^2$$

$$Q_u = 68.04 \text{ tons}$$

The allowable load of an individual pier is given by

$$Q_a = Q_u / F.S.$$

where F.S. = Factor of Safety > 2

$\therefore$ $Q_a < 34$ tons without downdrag

With downdrag

$$\text{Downdrag} = \alpha \, C_s \, A_s$$

where α = correction factor = 0.6

C_s = 0.3 tsf (residual [illegible])

$A_s = \pi D L = \pi(1)(43) = 43\pi \text{ ft}^2$

$$\text{Downdrag} = (0.6)\ 0.3 \text{ tsf } (43\pi \text{ ft}^2) = 24.32 \text{ tons}$$

[illegible] $Q_u = 68.04 - 24.32 = 43.72 = 44$ tons

$Q_a < 22$ tons per pile

This mathematical analysis is very generalized and is intended only as preliminary review of proposed piles. The values for some of the soils parameters were estimated based upon soils type and the results of tests on similar material. This analysis points out that the proposed piers as indicated within the version [illegible] would not be adequate without major modifications, and these modifications should be adopted prior to any load test.

7. <u>Conclusions</u>. Information pertaining to soils properties and to the proposed pile system was insufficient for detailed review. Research and analysis of implied and generalized data indicates inadequacies within the proposal. The reasoning of using the implied pile system to support the northwall of the service water structure is questionable, based on the information provided. If larger predrilled piles (piers) are used the connection at the wall may not be adequate to resist the larger moments which would develop as a result of the increased eccentricity.

NO DISCUSSION ON FEAR OF EFFECTS OF [illegible] [illegible] CAUSED BY PILE DRIVING OPERATIONS

27 May 1980

Mr. Otto,

I am sending completed analyses of Borated Water Tanks, Soil Structure Interaction Analyses, and Underpinning of Auxiliary Building. Also included is typed sheets of previous analyses of Dewatering System, Diesel Generator Building, and Service Water Structure.

A more comprehensive analysis of the underpinning of the auxiliary building was attempted but contractor's proposal is not sufficiently detailed to date. Interim Report 8 states that this underpinning shall be addressed in subsequent reports. A copy of the chapter on underpinning from Foundation Engineering Handbook is included.

I enjoyed this assignment and working with you and your staff. If you need any assistance please don't hesitate to call.

Thank You,

WILLIS WALKER

DEWATERING-QUESTIONS

1. Liquefaction should be expected to occur as the backfill sands become saturated. Saturation of backfill sands would appear to begin when the groundwater table rises above the top of the natural sands, elevation 6[illegible] (Figure 24-8, boring log DG-26). Present design criteria or data which supports elevation 610 as maximum groundwater level.

2. Design of the permanent dewatering system is based upon two major findings: (1) The granular backfill materials are in hydraulic connection with an underlying discontinuous body of natural sand, and (2) Seepage from the cooling pond is restricted to the intake and pump structure area. Soil profiles (Figure 24-2), pumping test time-drawdown graphs (Figure 24-14), and plotted cones of influence (Figure 24-15) indicate that south of the diesel generator building the plant fill material adjacent to the cooling pond is not an effective barrier to the inflow of cooling pond water. Reevaluate the permeability of this material and the effect on the permanent dewatering system. Include data, especially the recovery data from PD-3 and complete data from PD-5, for review.

3. During cooling pond filling the differential hydraulic head affecting the groundwater level was less than 6 feet, and somewhat obscured by pore pressure increase and subsequent dissipation caused by the surcharge loading. The rate of water level rise should be expected to be considerably less than 90 days. A more pertinent analysis might involve utilizing the recovery data from the appropriate pump tests. A new analysis is particularly warranted in view of the above questions. Include all design criteria, data, and calculations which support final answer.

4. The interceptor wells have been positioned along the northern side of the intake and pump structures. The calculations estimating the total groundwater inflow within the response indicate the structures serve as a positive cutoff. However, the isopachs of the sand (Figures 24-9) and 24-10) indicate 5 to 10 feet of remaining natural sands below these structures. The soils profile (Figure 24-2) neither agrees nor disagrees with the isopachs. The calculations for total flow, which assumed positive cutoff, reduced the length of the line source of inflow by 2/3. The calculations for the spacing and positioning of the wells assumed this reduced total flow is applied along the entire length of the structures. Clarify the existance of seepage below the structures, present supporting data and calculations, and reposition wells accordingly. Include in the supporting data the assumed drawdown elevation of the line source of inflow (slot elevation), the head increase beyond the interceptor wells, and establish an operating water level within the interceptor wells.

5. The filter pack design should be based upon the size of the well screen openings and on the gradation curve of the aquifer. Present the gradation curve limits of the designed filter pack with sufficient gradation curves of the insitu material and with the design screen

openings. Also include a proposed method of sampling and testing at the individual well locations which will verify the filter pack design. The installation of an observation well within the filter pack could greatly reduce the effectiveness of the filter pack thereby inducing piping of the silt and fine sands. Reevaluate the proposed well monitoring system as well as the activation system. Turbulence created by an 8 to 10 gpm submersible pump within a 6-inch diameter well should not be bothersome during direct monitoring of the well. A sediment content monitoring program should be conducted, but the filter pack design and installation criteria should be zero sediment content in the discharge water.

24 a.

Maximum Groundwater Level. Maximum groundwater level was established at elevation 610 which appears to correspond to the top of the backfill sands below the diesel generator building. The top of the natural sands appears to be at elevation 605.

Basic of Analytical Model.

1. The source of recharge of the backfill sands does not appear to be limited to the area of the service water pump structure and circulating water intake structure as stated in the response. The cone of influence for Well PD-5C (Figure 24-15) indicates a recharge boundary on the south side of the cone, adjacent to the cooling pond. This recharge boundary is verified by the cone of influence of PD-20. The drawdown of pump well PD-20 as measured in observation well PD-3 indicates steady drawdown and neither a barrier nor recharge boundary (Figure 24-15).

2. Direct comparisons between groundwater levels and cooling pond filling may be obscured by pore pressure increases, and subsequent dissipation, as a result of the surchage loading. A small differential hydraulic head existed between the cooling pond surface and the groundwater level during cooling pond filling. In the event of a malfunction of the permanent dewatering system during plant operation, the differential hydraulic head would be about 32 feet (elevation 627 minus elevation 595), and the rate of water level rise to the maximum groundwater level would be considerably quicker than 90 days.

3. The seepage flowpath is through the natural sand with hydraulic connection to the backfill sand.

Calibration of Apparent Permeability.

The response analysis to determine permeability may have been obscured by the effects of the surcharge loading. A more appropriate analysis would involve the transmissivity of the seepage flowpath as determined from the pump tests. The transmissivity as determined by Jacob's Modified Method is about 1650 gpd/ft which, for a 20-foot average flow depth, translate to a coefficient of permeability of about 11 feet/day.

Rate of Water Level Rise.

Equation 2 (page 24-3) yields over 90 days before the groundwater level rises to the maximum groundwater level, elevation 610. This time, 90 days, is based on unsupported data and/or design criteria.

Shear Wave Velocity.

The equation relating shear wave velocity to void ratio and average effective confining pressure (page 24-5) is printed incorrectly. The correct equation is $V_s = (159-53.5e)\,\bar{\sigma}_o^{1/4}$

$$(159-53.5e)(\bar{\sigma}_o)^{\frac{1}{4}}$$

24 b

Permanent Dewatering (PD) Series Pumping Tests.

PD-20 Pumping Test.

During pump test, observation well PD-3, 210 feet from pump well and adjacent to cooling pond, indicated steady drawdown. PD-3 did not indicate a recharge boundary, cooling pond, nor did PD-3 indicate a barrier boundary, impermeable soils. Recovery data from PD-3 and complete data from PD-5 should be included for review.

PD-15A Pumping Test.

Observation well O-1 indicates a significant barrier boundary north of the pump well.

Permanent Dewatering System.

Design of the permanent dewatering system is based on two major findings: (1) The granular backfill materials are in hydraulic connection with an underlying discontinuous body of natural sand, and (2) seepage from the cooling pond is restricted to the intake and pump structure area. The back-up data as presented supporting finding (2), is not sufficiently detailed to review this finding.

Interceptor Well Design.

The design presentation places the interceptor wells along the landward side of the intake and pump structures. Calculations to estimate the total flow to the interceptor wells reduced the flow 2/3 because of these structures. The isopachs of the sands (Figures 24-9 and 24-10) indicate 5 to 10 feet of remaining natural sands below these structures. The corss-section soils profile through these structures does not agree with the isopach. The soils data included within the response is not adequate enough to support or refute the existance of a significant seepage path below the structures. If the structures serve as a significatn cutoff, shouldn't the wells be moved southwest to intercept seepage through the natural sand deposits indicated on the cross-section? If the length of the slot is indeed reduced by 2/3, the 20-foot spacing of the wells may result in a major head increase downstream of the wells or may result in overloading the capacity of the wells.

Area Wells.

The time required for 22 area wells to remove the estimated quantity of water is 139 days.

Well Design - as presented

Q, Gravity Flow TM 5-818-5 Dewatering and Groundwater Control

$$Q = \frac{KX}{2L}(H^2 - h_o^2) \qquad \text{IV-3} \qquad \text{p.128}$$

Where: X = 400 ft = slot length
L = 150 ft = distance from source
K = 31 ft/day = max permeability
H = 47 ft = pond elevation 627 - base elev 580
h_o = 15 ft = operating elev 595 - base elev 580
reduce Q by 1/3 for conc. structures

$$Q = \frac{31\ \text{ft/day}\ 400\ \text{ft}}{2\ (150\ \text{ft})\ 3}(47^2 - 15^2)\text{ft}^2\ \frac{\text{day}}{1440\ \text{min}}\ \frac{7.48\ \text{gal}}{\text{ft}^3}$$

Q = 141 gpm total flow use 150 gpm

Spacing:

assume 20 wells

$$150/20 = \frac{31\ \text{ft/day}\ a}{2\ (150)\ 3}(47^2 - 15^2)\text{ft}^2\ 7.48\ \text{gal/ft}^3$$

a = 21.1 ft

Head Increase D/S of wells

$$\Delta h_w^2 = \Delta h_o^2 = \frac{Q_w}{\pi k} \ln \frac{a}{2\pi r_w}$$

where Qw = 7.5 gpm
k = 31 ft/day
a = 21 ft
r_w = 0.25 ft

Eq. IV-84, p149

$$\Delta h_o^2 = \frac{7.5\ \text{gal/min}\ 1440\ \text{min/day}}{31\ \text{ft/day}\ 7.48\ \text{gal/ft}^3} \ln \frac{21\ \text{ft}}{0.25\ \text{ft}} = 38.4$$

Δh_o = 6.2 ft Δh_m = 7.0 ft

Based on this analysis the groundwater level downstream of the wells is at elevation 601.2.

If h_o in Equation IV-3 is reduced to 9 feet, and the slot elevation becomes 589, Q = 159 gpm spacing, well size, number of wells remain unchanged.

The significant item which is brought out is that the drawdown within the wells must be 6.0± feet below the operating level or elevation 589.

The above analysis assumes Q_{TOTAL} is uniformly distributed along the 400 ft slot. If Q_{TOTAL} is assumed to be distributed along 1/3 of the slot (intake structures act as positive cutoff) the revisions are:

FLOW AT WELL Q_w	HEAD INCREASE DOWNSTREAM, h_o
$x = 135$ ft	$Q_w = 22.5$ gpm
$h_o = 9$ ft	$a = 20$ ft
$a = 20$ ft	$r_w = 0.5$
$Q = 22.5$ gpm	$h_o = 0.1$ ft
Q pump capacity	

Area Well Design - as presented

Total Volume $= 2.2 \times 10^7$ gal

Pumping time 22 wells $= \dfrac{2.2 \times 10^7 \text{ gal}}{5 \text{ gal/min } 22 \text{ wells}} \; \dfrac{\text{day}}{1440 \text{ min}} = 139$ days

2 additional wells for surface infiltration and pipe leakage.

24 wells total.

24 c Other alternatives to timers and float devices to acitivate the pumps:

1. Self-cooling pumps with cooling systems similar to vacuum well point pumps.
2. Discharge valves at each pump to tune the discharge flow of the pump to the inflow of the well.

The pump well might be monitored within the well riser. Turbulence created by a 8-10 gpm submersible pump in a 6-inch diameter well should not be bothersome during monitoring of the well. This could eliminate the small diameter observation well to be placed within the filter pack to monitor the general condition of the pump well. Elimination of this intrusion and related distrubance of the filter pack will reduce the potential of failure of the well filter.

24 d:

. The filter pack design should be based on the size of the well screen openings, and on the gradation curve of the aquifer. Filter material with a uniformity coefficient less than 2.5 ($C_u = D_{60}/D_{10}$) may not be graded sufficiently to restrict movement of aquifer fines without causing major head loss within the filter. The filter pack should be designed as outlined in TM 5-818-5 Dewatering and Groundwater Control for Deep Excavations.

The maximum sand content of the discharge water is set at 20 parts per million. At a constant pumping rate of 5 gpm and an average sand content of 20 ppm, one cubic yard of sand would be discharged in less than 4 years.

Design criteria which established the sand content and total sand removed should be referenced.

24 e Retaining Walls as regarding Dewatering System

Dewatering system design does not rely on integrity of retaining walls - retaining walls not considered in analysis. The intake and pump structures were considered in analysis.

24 f.

While the dewatering system should have no effect on the Tittabawassee river (barrier boundaries were indicated by observation well Q-1), the overall effect of the cutoff and slurry trench walls have not been evaluated. The reduction in recharge from the groundwater system to the river may have some effect upon the quantity and quality of river channel flow. The analysis should include loss of water through cooling use and at the cooling pond. The initial condition of the groundwater level would be without the effect of the cooling pond which would be a lower elevation.

24 g

The adequacy of the proposed permanent dewatering system in maintaining the groundwater level beneath the plant site below an established limit so that granular backfill materials are not subjected to liquefaction during the SSE has not been demonstrated.

The following design assumptions are not verified by supporting data:

1. Location of seepage path. The data presented does not support the location of the seepage path, or, more accurately, does not support the location of the interceptor wells. Reducing the length of the slot by 2/3 is justified for calculation of total flow if the intake structure effectively restricts seepage down to the base of the natural sand. For positioning of the interceptor wells, a more detailed analysis should be attempted. The response analysis and accompanying data indicate the major seepage flow would be concentrated southwest of the intake structure, and a spacing of 20 feet between wells would not be adequate to intercept the flow and maintain minimum head rise beyond the wells. Reiterating, the interceptor wells have not been positioned in relation to the assumed seepage path. Furthermore, analysis of groundwater movements indicate some degree of permeability within the backfill and till material along the north bank of the cooling pond (cross-section A-A, Figures 24-1 and 24-2). Groundwater movement throught this area may require additional interceptor and reserve wells.

2. Filter pack design. Satisfactory design criteria for filter patk was not referenced which would insure compliance with state-of-the-art guidelines. The design and subsequent installation of the filter pack must prevent removal of fine sand and silt from the insitu materials and ultimately prevent pipes developing to the cooling pond.

3. Rate of water level rise. The rate of water level rise should be re-evaluated using more pertinent data. Recovery data from the pump tests might be sufficient.

4. Area wells. The area wells require 139 days for dewatering, which may present problems during d-watering after a shut down.

Service Water Structure - Pile Support - Questions

1. A preliminary review of the proposed pile support system for the north wall of the service water structure indicates the system is inadequate to support the required loading. Th limited information available for review analysis was found primarily in MCAR 24 Interim Report 6. A detailed pile design based upon available soils data should be developed in order to more effectively evaluate the proposed pile support system prior to load testing of a test pile.

Service Water Structure - Pile Support

1. Proposed loading. The north wall of the service water structure is planned to be supported by piles to glacial till because of the inadequate compaction of the backfill material. The total load to be supported by the piles is about 1600 tons, or 100 tons per pile for 16 piles. The piles would be predrilled through the backfill material, then driven into the glacial till.

2. Allowable loading. Vertical displacements of the predrilled pile would be small and therefore no shearing forces would be mobilized along the shaft through the backfill material. Continued settlement of backfill should be greater than settlement or deformation of the pile, and downdrag (negative skin friction) could develop along the pile shaft increasing the load on the pile. Downdrag could balance any skin friction developed by driving the pile into the glacial till. If no accumulative side resistance along the shaft develops, the proper design would be a point bearing pile (pier). The presumptive bearing value for glacial till from regional building codes is not greater than 10 tsf.

3. Proposed design. The piles are to be designed and installed as outlined in ACI 543. A load test of a test pile is to be conducted follwoing the guidelines of ASTM D 1143. No design has been submitted to date.

4. Indicated design. The detail drawing on Figure 83 (6R) indicates a proposed pile would be one foot diameter, which provides a cross sectional area of about 0.8 square foot. With the proposed loading of 100 tons per pile, the contact stress at the bottom of the pile becomes 125 tsf. Punching failure probable under this stress.

5. Design. A preliminary design of a support structure, whether piles, piers, or other devices, is warranted to determine the feasibility of conducting a load test of a test pile or, to determine the feasibility of a pile system altogether. The information concerning the proposed piles as given or implied in the various reports indicate that these piles would not be adequate to support the structure. The purpose of a pile load test is to refine a design not initiate it.

6. <u>Indicated Design Evaluation.</u> The ultimate load of an individual pier (predrilled pile) is given by:

$$Q_u = \overline{C}\ W N_c A_t + \alpha \overline{C}\ A_s$$

Where: $\overline{C}$ = undrained strength of soil below base = 4tsf

(S_u = 8 ksf from Figure 2.5-33)

W = coefficient for fissures = 1 (no fissures)

N_c = bearing capacity factor = 9 (deep foundation failure)

A_t = area of tip = $1/4\ \pi D^2 = 0.79\ ft^2$

α = correction factor for difference between adhesion and undrained shear = 0.6

C_s = undrained adhesion along shaft = 3 tsf

A_s = periphical area of shaft = πDL = 22 ft^2

$$Q_u = \overline{C}\ W N_c A_t + \ C_s A_s$$

$$Q_u = \frac{4 \text{ tons}}{ft^2} (1)(9)\ 0.79\ ft^2 + (0.6) \frac{3 \text{ tons}}{ft^2}\ 22\ ft^2$$

$$Q_u = 68.04 \text{ tons}$$

The allowable load of an individual pier is given by:

$$Q_A = Q_u / F.S$$

Where F.S. = Factor of Safety $>$ 2

$Q_A < 34$ tons without downdrag

With downdrag:

Downdrag = $C_s\ A_s$

Where = correction factor = 0.6

C_s = 0.3 tsf (backfill material)

$A_s = \pi DL = \pi(1)(43) = 43\ ft^2$

Downdrag = (0.6) 0.3 tsf (43 ft^2) = 24.32 tons

then, Q_u = 68.04 - 24.32 = 43.72 or 44 tons

Q_A = 22 tons per pile

This mathematical analysis is very generalized and is intended only as preliminary review of proposed piles. The values for some of the soils parameters were estimated based upon soils type and the results of tests on similar material. This analysis points out that the proposed piles as indicated within the various reports would not be adequate without major modifications, and these modifications should be adopted prior to any load test.

7. Conclusions. Information pertaining to soils properties and to the proposed pile system was insufficient for detailed review. Research and analysis of implied and generalized data indicates inadequacies within the proposal. The feasibility of using the implied pile system to support the northwall of the service water structure is questionable, based on the information provided. If larger predrilled piles (piers) are used the connection at the wall may not be adequate to resist the larger moments which would develop as a result of the increased eccentricity.

Diesel Genertor Building - Settlement - Questions

1. The residual settlement of the upper sand layer was not considered in the future settlement predictions presented within the response. Calculations during review indicate about 1/2 inch of settlement of the upper sand zone will occur during the life of the project. Present an evaluation of this settlement with accompanying calculations and appropriate soils data.

2. The settlement patterns, or differential settlement, of the diesel generator building indicate a direct correlation with soils types and properties within the backfill material. Comprehensive boring logs are required to review the settlement (differential settlement).

Settlement (Consolidation) Analysis of Diesel Generator Building

Summary
This analysis was for settlement marker DG-3 which indicated the greatest settlement due to the building load. The settlement analysis is primarily concerned with the residual, or time-related, settlement. An immediate settlement analysis would be academic and not pertinent to a prediction of future settlement, as the majority of the building load is in-place. Consequently this analysis determines the adequacy of the surcharge program and estimates the remaining settlement.

Adequacy of Surcharege Loading.
The 20 feet of sand (γ = 110 pcf) produced a surcharge loading of 2200 psf over the diesel generator building. As shown by calculations (sheets 2-5) the load would have only needed to have been in-place for 42 days to achieve the necessary degree of consolidation for the final loading. Therefore no additional consolidation is expected as a result of the final loading. The analysis assumed a rigid mat foundation for evaluating the stresses within the clay layer and is adequate because of the depth of the clay.

Immediate settlement of clay layer.
An immeidate settlement of the clay layer had occurred prior to the consolidation by the surcharge. The clay layer was assumed to be 100% saturated; the cooling pond level was at about the top of the clay layer (elev. 622) before filling began.

Secondary Compression.
The coefficient of secondary compression, C = 1.25 for DG-3, is comparable with clays of low to medium secondary compressibility and therefore is adequate to evaluate the settlement due to secondary compression.

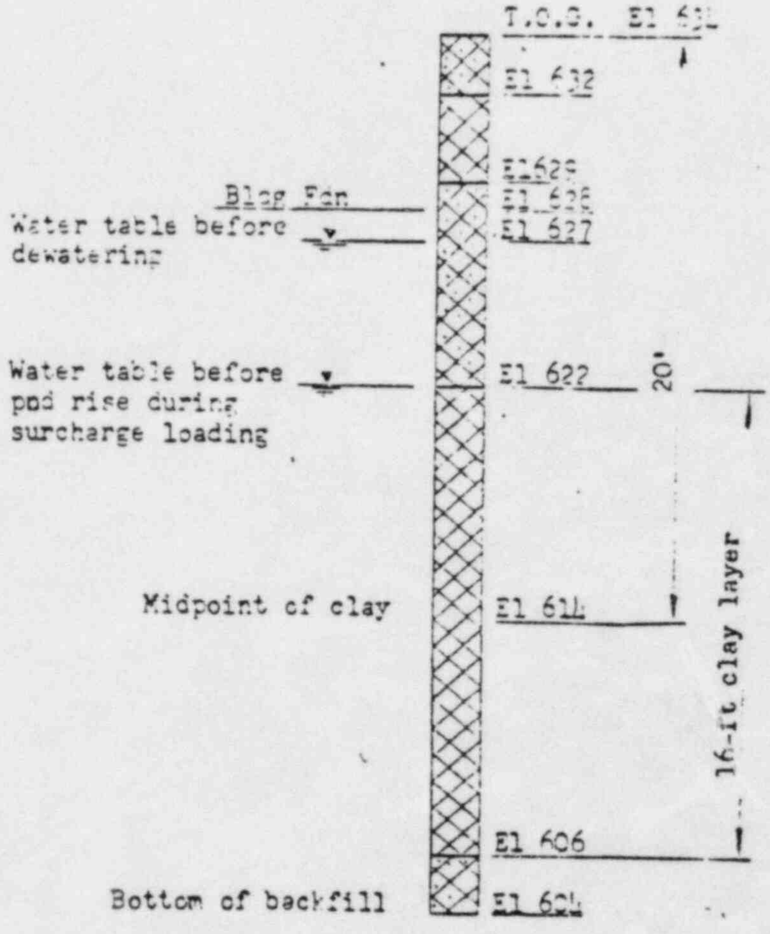
Consolidation of Clay Layer.
The simplified consolidation analysis of the clay layer indicates that measured settlements are within the range of calculated settlement for the surcharge loading. This consolidation analysis indicates that future settlements of the clay layer would be due to secondary compression and not to additional consolidation of the clay.

Residual settlement of the sand layer.
The time-related settlement of the upper sand layer would be about 1/2 inch over the life of the project. This type of settlement in sand is comparable to secondary compression within clay. This is the only settlement not previous computed, and does not appear in the response.

Differential Settlement.
The major influence upon settlement for any location within the diesel generator building is the properties and depth of the different soils at that location. As an example, DG-11 (middle of south wall) registered the most settlement during surcharge loading because the clay stratum was thickest (26 feet) at this location. In order to sufficiently review the settlement data, comprehensive boring logs are required.

Settlement Marker DG-3

Boring DG-1 (DG-7 nearby is similar)



Loading

from table 2.5-14

Building Loads

Dead & Live load = 4500 psf generator bldg

1500 psf generator bldg

or

3000 psf average (table 4-1A)

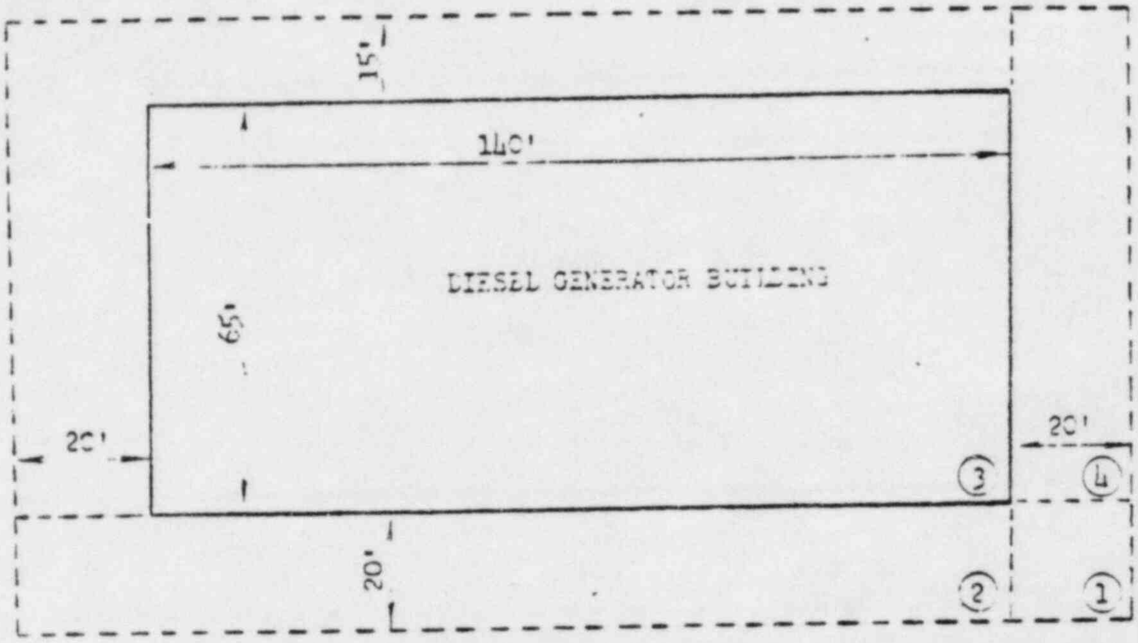
This assumes a mat foundation, which for settlement analysis of clay layer is a proper design assumption. Pressure bulbs of individual footings would affect clay layer at this depth similar to raft foundation. (Not true for shallow or very deep layers)

Surcharge 20 feet of sand (γ =110 pcf) = 2200 psf

Increase in effective pressure as a result of dewatering

γ_{water} (existing w.t. - midpoint of clay layer)

62.4 pct (627-614) = 811.2 psf



Determination of vertical stress at DG-3 by Boussinesq Method

From building load, $q = 2.2$ ksf (bldg not 100% complete do not use 3.0 ksf)

$m = \frac{140}{20} = 7.0 \quad n = \frac{65}{20} = 3.3 \quad I_\sigma = 0.24 \quad \sigma_z = 0.53$ ksf

From surcharge, = 2.2 ksf

(1) $m = \frac{20}{20} = 1.0 \quad n = \frac{20}{20} = 1.0 \quad I_\sigma = 0.175 \quad \sigma_z = 0.38$

(2) $m = \frac{20}{20} = 1.0 \quad n = \frac{160}{20} = 8.0 \quad I_\sigma = 0.20. \quad \sigma_z = 0.44$

(3) $m = \frac{85}{20} = 4.25 \quad n = \frac{160}{20} = 8.0 \quad I_\sigma = 0.25 \quad \sigma_z = 0.55$

(4) $m = \frac{20}{20} = 1.0 \quad n = \frac{85}{20} = 4.25 \quad I_\sigma = 0.20 \quad \sigma_z = 0.44$

Total = 1.81 ksf

Total load during surcharge = 4.4 ksf

Total vertical stress at clay layer during surcharge = 2.34 ksf

0.53 ksf (bldg) + 1.81 ksf (surcharge) = 2.34 ksf

Additional vertical stress due to dewatering (infinite areal extent)
811.2 psf = 0.81 ksf over total area.

from operational bldg load = 3.0 ksf

$I_c = 0.24 \quad \sigma = 0.72$ ksf

Total vertical stress during operation

0.81 ksf + 0.72 ksf = 1.53 ksf
65% of total vertical stress on clay layer during surcharge.

The above analysis assumes that any consolidating effect of the existing overburden (backfill) is balanced by the effect of establishing foundation grade 6 feet below ground surface. Also, all immediate settlement of backfill material has occurred.

The above analysis indicates final effective stress on clay layer (1.53 ksf) beyond initial overburden pressure is less (65%) than effective stress on clay layer, beyond initial overburden pressure, during surcharge loading (2.34 ksf).

Degree of consolidation which must have been achieved by surcharge

$$U_z = \frac{\sigma'_f}{\sigma'_f + \sigma_s} = \frac{1}{1 + \sigma_s/\sigma'_f}$$

Where: U = degree of consolidation of clay layer
σ'_f = effective stress of final loading = 1.53 ksf
σ_s = stress developed by srucharge = 2.34 ksf

$$U_z = \frac{1}{1 + \frac{2.34}{1.53}} = 40\%$$

Assume 50% as degree of consolidation

t_{50} = 42 days

because of inaccuracies which may exist in analysis use to achieve required degree of consolidation of 42 days.

This analysis indicates that the required degree of consolidation for preloading the foundation by the surcharge for the final load was achieved during preloading.

Residual settlement on sand

The time-dependent settlement of the sand layer would be about 1/2 of the estimated immediate settlement of the sand layer, or

$$S = \frac{\_p}{(N-1.5) C_B A} C_t \qquad \text{(Meyerhoff Equation)}$$

Where: p = stress below footing = 4.5 ksf = 2.25 tsf

N = average blow count of sand layer · 12

C_B = correction factor for depth of influence (6ft) = 0.95

C_t = time rate factor (40 years) - 1.5

A = average factor = 3

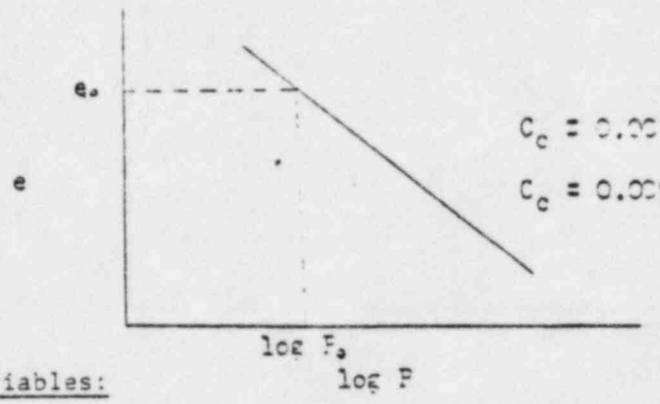
$$S = \frac{5\ (2.25)\ 1.5}{(12.1.5)\ 0.95\ (3)} = 0.5\bar{6} \text{ inches}$$

Meyerhoff's equation predicts settlements which vary from 0.9 times to 7 times the actual settlement - averaging factor to compensate for this.

from Duncan, J.M. and Buchignani, A. L. Engineering Manual for Settlement Studies. University of California, Berkeley, 1976

The immediate settlement of the sand layer, as well as the clay layer, was assumed to have occurred during the initial construction phase of the deisel generator building and prior to settlement measurements and therefore is independent of this analysis.

Settlement by Consolidation of Clay Layer



C_c = 0.007 (LL - 10%) Duncan, etc

C_c = 0.009 (LL - 10%) Peck, etc

<u>Variables:</u>

e_o = 0.55

Po = 1700 psf

P = effective stress related to sequence of events.

LL = 36

C_c = 0.007 (36-10) = 0.18 USE 0.18
0.009 (36-10) = 0.23

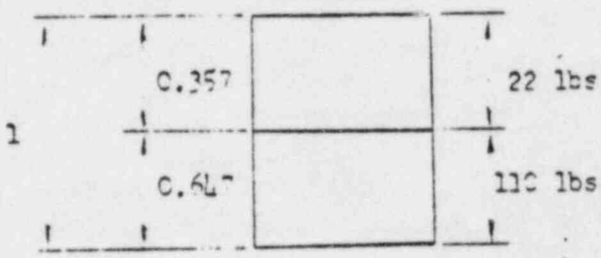
$$S = \frac{C_c}{1+e_o} H \log_{10} \frac{P}{Po}$$

Determination of Consolidation Variables

LL = 36 (Figure 2.5-30)

γ_d = 110 (Figure 2.5-33)

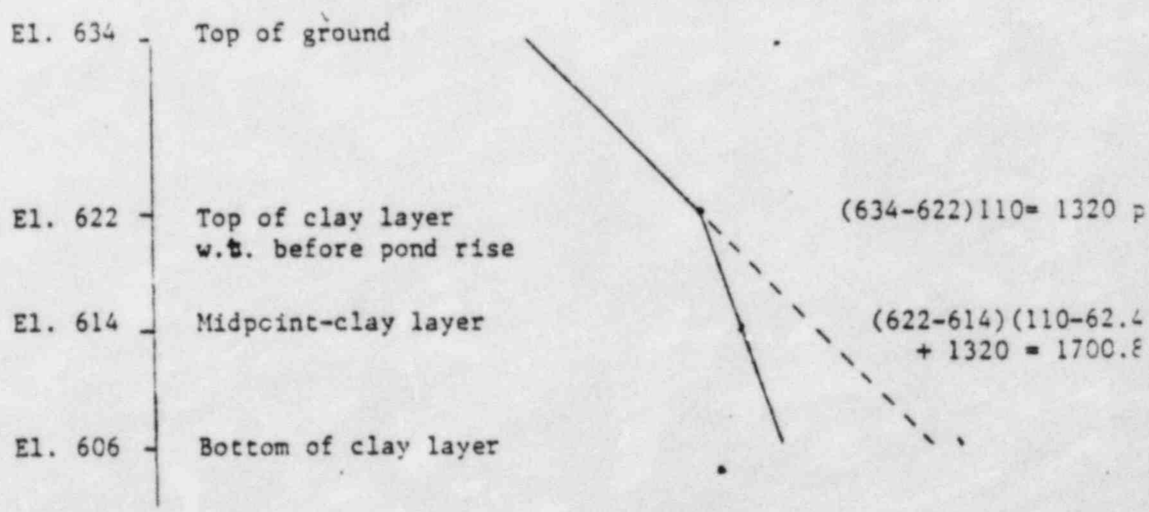
w = 20% (Figure 2.5-33)



e_o = 0.55

G_s = 2.72 (Calculated)
(Compares favorably for clay material)

P_o = overburden pressure at midpoint of clay layer = 1700 psf



Settlement due to Consolidation of Clay Layer

Before settlement measurements:

assume bldg half completed when measurements began
assume 1/2 of final dead load of bldg.

P = 265 psf + 1700 psf = 1965 psf

$$S = \frac{0.18}{1.55}\ 16ft\ \log \frac{1965}{1700}\ \frac{12\ in}{ft} = 1.40\ inches$$

Add this amount to measured settlements for comparison

After surcharge load was removed:
(from beginning of construction to removal of surcharge)

P = 1700 psf + 2340 psf = 4040 psf

Total stress during surcharge (2.34 ksf), p 3

$$S = \frac{0.18}{1.55}\ 16ft\ \log \frac{4040}{1700}\ \frac{12\ in}{ft} = 8.38\ inches$$

measured settlement
4.25 + 3.20 + 1.40 (calculated) = 8.85 inches

Secondary Compression.

The settlement vs log time curve exhibits the standard consolidation-secondary compression curve. The coefficient of secondary consolidation, C_α, is 1.25 inches per log cycle of time (for DG-3). For 16-foot thick clay layer,

$$C_\alpha = \frac{1.25 \text{ in}}{16 \text{ ft}} \quad \frac{\text{ft}}{12\text{in}} \text{ per log cycle}$$

$$C_\alpha = 0.0065 \text{ (dimensionless)}$$

Which compares favorable with the typical values for C_α of clay with a low to medium coefficient of secondary consolidation.

	C_α	Secondary compressibility
	0.002	very low
	0.004	low
DG-3 →	0.0065	
	0.008	medium
	0.016	high
	0.032	very high
	0.064	extremely high

Table from Duncan, J.M. and Buchigani, A.L., Engineering Manual for Settlement Studies. University of California, Berkeley, June 1976.

Borated Water Storage Tanks - Settlement Analysis

1. Structural Aspects. Two borated water storage tanks, a utility tank, and a primary storage tank are located in the tank farm area. Of these, only the borated water storage tanks are safety-related, Seismic Category I. Each borated water storage tank has a capacity of 500,000 gallons, is 52 feet in diameter and 32 feet in height.

2. Foundation Structure. A short concrete ring girder foundation with a strip footing is provided for each borated water storage tank. The tank is supported on the ring girder and the soil within the foundation. The tank by itself is quite flexible.

3. Foundation Materials.

a. Interim Report 7. "The borings indicate that the material below the top 4 feet is satisfactory and consistent with previous investigations at the tank farm area. The top 4 feet of material at the locations of borings T-22 through T-26, placed as temporary fill to allow access for drilling rigs, will be removed. The inspection pit shows poor material from elevation 628 to 624, and marginal material from elevation 624 to 622, which is localized to the area of the inspection pit due to previous excavation and construction activities in this area. The material was satisfactory from elevation 622 to 616 and consistent with previous material noted in the subsurface investigation at this area. The inspection pit showed no evidence of any undermining due to air bubbles. All unsuitable material, as determined by soil testing, in the tank farm area will be removed and replaced by suitable compacted fill under the supervision of the onsite geotechnical soils engineer."

b. Boring Logs. The boring logs T-22 through T-26 are in disagreement with the above summarization from Interim Report 7. Boring logs T-22, T-23, T-25, and T-26 indicate a layer of low plasticity clay immediately below elevation 622. The layer varies from about 5 feet to 10 feet thick. Blow counts within this layer from standard penetration tests are as low as 2 blows per foot of penetration and indicate a very soft to soft consistency of the clay.

4. Plate Load Test.

a. Procedure. Two plate load tests were performed in accordance with ASTM D 1195-64 (1977). Using a standard reference of 0.5 inch of settlement, analysis of the data indicated 4.8 ksf and 7 ksf for plate load tests 1 and 2, respectively. The diameter of the plate was 30 inches.

b. Evaluation of Testing Procedure. The tests as outlined in ASTM D 1195-64 (1977) are "repetitive static load tests of soils and flexible pavement components, for use in evaluation and design of airport and highway pavements." Equally appropriate tests are as outlined in ASTM D 1194-72 (1977) and are used to determine "bearing capacity of soil for static load on spread footings." The procedures are identical for the above ASTM standards. However, in ASTM 1194-72 (1977) the scope of the testing procedure states that the test "gives information on the soil only to a depth equal to about two diameters of the bearing plate, and takes into account only part of the effect of time." The soft clay layer is from 8 to 10 feet below the ground surface while twice the diameter of the bearing plate is only 5 feet. If test pit was excavated to a depth less than 3 feet, test would have no relavence to clay layer. Also settlement of the clay will be the result of consolidation which is a time-dependent settlement. With the majority of the settlement expected to occur within the clay layer, the results of the plateload tests are not applicable to settlement analyses at the tank farm area.

5. Full-Scale Load Test.

a. Procedure. To determine the suitability of the backfill material to support the borated water storage tanks, the tanks shall be constructed and filled with water in order to conduct a full-scale load test of the foundation soil. This proposed load test shall be conducted on only one tank at a time.

b. Evaluation of Proposed Procedure.

(1) Loading. Filling the tank will increase the load approximately 1 tsf. Borated water, depending upon the concentration, will have a specific gravity 5 to 10 percent greater than that of water and will produce a corresponding 5 to 10 percent increase in the future loading.

(2) Influence of Second Tank. The influence factor of the loading of one tank on the other is shown by the following diagram.

B = 2b = 52 feet   b = 26 feet
Z = 35 (maximum depth)
Z/b = 1.35
r = 26 + 130 = 156
(center of one tank to side of the other)
r/b = 6.0

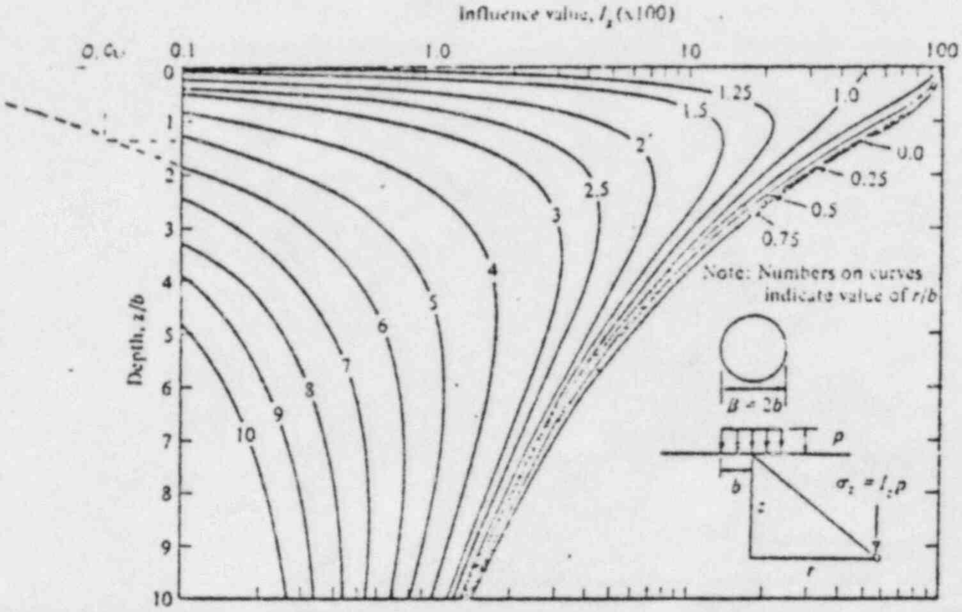


Fig. 4.17 Influence diagram for vertical normal stress σ_z at various points within an elastic half-space under a uniformly loaded circular area. (*After Foster and Ahlvin, 1954.*)

From diagram, I_z = 0.0006

3. Conclusions. Settlement during a full-scale load test of the borated water storage tanks would be primarilly by consolidation of the clay fill. Data obtained could be used to estimate the final settlement under the actual loading in the same manner as data obtained by laboratory consolidation testing. This full-scale load test should not be considered a surcharge loading program. Filling the tanks with water cannot be expected to consolidate the clay fill to the extent that future loads would cause no additional settlement, as in the case of the surcharge program for the diesel generator building. Instead only consolidation data can be expected with which the settlements under future loads can be estimated. No problems should be expected because only one tank is filled at a time. The influence factor of simultaneously loading the second tank is minimal because of the reltaively large distance between the two tanks.

6. Bearing Capacity. The bearing capacity of the backfill material may be determined from data obtained during the plate load tests. The bearing capacity of clay is essentially independent of the footing size and the bearing capacity of sand increases linearly with the footing size. The ultimate stress for the test plate corresponds to the yield point on the load-settlement curve of the test data.

Borated Water Storage Tanks - Questions

1. In Interim Report 7 the poor material from elevation 628 to elevation 622 within the inspection pit was said to be "localized to the area of the inspection pit due to previous excavation and construction activities." Explain why the inspection pit was located in this area and detail other areas in the tank farm which may be as disturbed.

2. Provide load-settlement data obtained during plate load test. Also include depth and dimension of pit which was excavated for the test plate and the type of material encountered during excavation.

3. Filling the tanks with water will serve as loading for a full scale consolidation test of the insitu material. Provide locations of settlement markers and outline procedures to monitor the test.

Settlement - Soil Structure Interaction

Soil-structure interaction, based on the theory of elasticity, can be used to compute settlements of soil for which consolidation theory does <u>not</u> apply, such as ϕ-c soils, nonsaturated clays and silts, granular soils, and the immediate settlement of saturated cohesive soils. Settlements must be elastic deflections fully recoverable upon removal of loading. Soil-structure interaction analyses would not be applicable to Midland because of the backfill conditions. Any previous soil-structure interaction analysis may be deleted because actual settlement, or the majority of the actual settlement, is not elastic. Any future analysis should be reviewed cautiously for the type of settlement being computed. Any previous soil structure interaction analyses probablly assumed the backfill material would be sufficiently compacted that consolidation would not occur, and therefore, any settlement would be elastic.

No questions are warranted at this time.

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	Comment		Investigate		Signature
	Coordination		Justify		

REMARKS

ATTACHED IS: (1.) index to 35 Questions on Plant Fill by NRC.

(2.) Comments by Willis Walker of Tulsa Dist.

I asked Becter to send you copies of Vol 1-7 of Responces to NRC Questions for Midland. They said they would.

DO NOT use this form as a RECORD of approvals, concurrences, disposals, clearances, and similar actions

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NORTH CENTRAL DIVISION

Branch/Office NCDED-G Reviewer JAMES W. SIMPSON / JOHN F. NORTON Ext. No. 35734

SUBJECT: Interagency Agreement No. NRC-03-79-167, Task No. 1 - Midland Plant Units 1 and 2, Subtask No. 1 - Letter Report (INTERIM)

DATE 21 May 80

SEC. No.	CMT. No.	Dwg. or Para. No.	COMMENT
	1.	General.	The paragraph/sentence heading and numbering system is confusing and should be revised.
	2.	Page 1, Para 3.	The unresolved issues are not the missing information. The issues are unresolved, in many instances, because of missing information.
	3.	Page 1,2, Para 3.	All expanding sentences under the number headings should be deleted here but included elsewhere, since the listing is to show "general" categories only.
	4.	Page 3, Para 4b, (1).	"Comprehensive" borings logs are not going to reveal much that is not already evident. Specific test data relevant to the problem should be requested.
	5.	Page 3, Para 4b, (2)(a).	The paragraph does not specifically point out that consolidation tests are required for a conclusive settlement analysis. It is implied that N values are important here. N values do not have a reliability level commensurate with data quality required for resolution of the settlement problem. Eliminate the 2nd sentence.
	6.	Page 3, Para 4b, (2)(b,c)	Cite the data source that generated these questions.
	7.	Page 3, Para 4b, (2)(d).	(a) It is doubtful that residual settlement would be a factor. Upon initial loading of the sand three things probably happen; grain rearrangement, grain fracture and/or crushing and grain movement or shear failure. These processes take place almost immediately, probably during construction, providing the sand is reasonably clean and pore pressures quickly dissipate (this seems to be our case). Unless the intensity of the contact pressure is later increased there would be no additional force present to again trigger these mechanisms. Restu y this paragraph and reword and/or eliminate it.

NORTH CENTRAL DIVISION

Branch/Office NCDED-G Reviewer JAMES W. SIMPSON JOHN F. NORTON Ext. No. 35734

SUBJECT: Interagency Agreement No. NRC-03-79-167, Task No. 1 - Midland Plant Units 1 and 2, Subtask No. 1 - Letter Report (INTERIM)

DATE 21 May 80

SEC. No.	CMT. No.	Dwg. or Para. No.	COMMENT
			(b) Do not list finite settlement values computed by C.O.E. or make concrete statements of what is going to occur in the future.
	8.	Page 4, Para C (1)(a).	Pipe piles with a capacity up to 200 tons+ are possible if driven to rock (see inclosure). Change this paragraph to read, "A detailed pile design should be submitted so that the proposed pile support system can be evaluated prior to load testing a pile."
			NOTE: Don't discount the consultant's plan until its submitted and studied. These guys are pretty sharp.
	9.	Page 4, Para 4C, (1)(c)	Change "underpining" to "underpinning".
	10.	Page 6, Para 4i (1)	Statement that liquifaction should be expected to occur should be deleted or qualified.
	11.	Page 6, Para i (1)	Consult with WES on the necessary depth of dewatering.
	12.		Check with WES concerning the possible need for other information on the seismic situation and include in this report.

JAMES W. SIMPSON
Chief, NCDED-G