[redacted]

MIDLAND 3/5/79

1) NRC Question:

What is the condition of the soils under all other plant areas of the site?

Response:

Concurrent with the review of the diesel generator building settlement, a review was initiated of other plant structures and system foundations. This review considered both available settlement data and soil boring information. Review of other plant area structures and system foundations is still in process.

Beginning in 1977, permanent benchmarks have been installed in accordance with project Specification 7220-C-76 and are presently used to monitor building settlement. Prior to the benchmarks, construction marks (i.e., scribes) were used in some areas of the auxiliary, containment, and turbine buildings, and can be used to identify settlement. Figure 2 provides a comparison of recorded versus predicted settlement, and Figure 3, Sheets 1 through 4, shows time/settlement graphs for selected benchmarks. The settlement of Seismic Category I items is also discussed in interim Reports 3 and 4 for MCAR 24.

Additional borings were made in 1978 to confirm the plant area fill in areas adjacent to Seismic Category I items and other major structures. The locations of these borings are shown in FSAR Figure 2.5-40A and the blowcount/material type summary is listed in FSAR Table 2.5-25.

Figure 1 identifies the foundation materials (i.e., glacial till or plant fill) of the major plant structures, tanks, and pipe/duct runs for both Seismic Category I and II items. Most of the major plant structures (including the containment buildings, circulating water intake and discharge structures, river makeup intake structure, and parts of the auxiliary, turbine, and service water pump structures) are founded on glacial till or compact original soils. The glacial till stratum was identified by borings made at the start of the job (1968-1969) and generally confirmed by later excavation work. The settlement measurements of structures founded on glacial till or other original soils are small and are consistent with the predicted values in FSAR Figure 2.5-48. It was concluded that structures on glacial till or other original ground have no identified foundation problems.

The remaining structures, tanks, and systems are founded on plant area fill. These include:

Seismic Category I

a. Part of the auxiliary building
b. Part of the service water pump structure
c. Part of the retaining wall at service water pump structure
d. Borated water tanks
e. Emergency diesel generator fuel oil storage tanks
f. Service water pipe lines
g. Various other Category I pipe and electrical duct runs
h. The diesel generator building (not discussed in this response)

Seismic Category II

a. Part of the turbine building
b. Administration building
c. Radwaste building
d. Evaporator building
e. Combination shop
f. Cooling towers

g. Oily waste facility

h. Transformer areas

i. Part of the retaining wall adjacent to intake structure

j. Chlorination building

k. Guardhouse

l. Condensate storage tanks

A summary of soil conditions for structure and system foundations on plant fill follows:

Seismic Category I

a. Auxiliary Building Partially Supported on Lean Concrete or Plant Fill - In several areas of the auxiliary building, side slopes for deep excavations required partial removal of adjacent glacial till material. Later, these areas were backfilled using lean concrete and/or plant fill. Settlements of the auxiliary building, including those areas founded on lean concrete or plant fill, are small (i.e., less than 0.5 inch for the 3- to 5-year periods when most building loads were added). Because the settlement data is consistent with the predicted settlement values, no foundation problems were indicated.

b. Service Water Pump Structure partially supported on Plant Fill - Several borings in this area indicate loose to dense sand backfill exists adjacent to the building. No significant settlement has been noted to date. However, the area is under further review to assertain the extent of any loose material, and will require additional borings to complete the evaluation.

c. Retaining Wall Adjacent to the Service Water Pumphouse and Partially Supported on Plant Fill - A 0.25 inch differential settlement between retaining wall sections founded on original soil versus plant fill was recorded during an 18-month period; recent benchmark measurements indicate a small, uniform settlement of the wall. Borings in the retaining wall areas indicate that this wall may be supported by stiff to very stiff clay backfill over natural soils. The wall will continue to be monitored.

d. Tank Farm North of the Auxiliary Building - The two borated water storage tanks are Seismic Category I, the remaining tanks are not. The ring foundations and valve pits are constructed, and surveys of the permanent benchmarks show minimal settlement. Field studies in the tank farm area show generally stiff to very stiff clay backfill with some zones of soft clay and occasional medium to very dense sand backfill over natural soils. Current plans involve filling the tanks and measuring the structure settlements. Loading duration will be determined based on predictions of future settlements. No surcharge in addition to tank loading is planned, but settlement measurements will be continued after completion of preloading.

e. Diesel Fuel Oil Storage Tanks - Field studies adjacent to the diesel fuel tanks show loose to dense sand backfill and stiff to very stiff clay backfill with some soft zones over natural soils. These tanks will be filled with water. Settlement will be monitored during preload to observe the behavior of the tanks.

f. Service Water Pipes East and North of Power Block - Borings adjacent to the service water pipes showed soft to very stiff clay backfill with occasional dense sand and backfill over natural soils. Borings indicated some very soft clay backfill. These conditions are under evaluation. The pipes will be monitored for settlement.

g. Other Pipe and Electrical Duct Runs - For Seismic Category I pipes other than service water lines (discussed in Paragraph f above), as well as Seismic Category I yard electrical ducts, the evaluation is not complete. Checks on the duct runs (e.g., using a rabbit) show no blockages. This item will be monitored as work on these items continues, and will be coordinated with the results of the service water pipe review.

Seismic Category II

a. Turbine Building Partially Supported on Plant Fill -As noted, part of the turbine building is founded on plant fill. No unusual settlement has been noted. Settlement of 3/4 inch or less has been recorded during 2 years of benchmarks. The settlement data is reasonable when compared to the predicted settlement values, and no foundation problems are indicated.

b. Administration Building - During earlier construction of this building, significant settlement was noted in a localized area of reexcavated and rebackfilled material. This fill was removed and replaced with lean concrete. To confirm the adequacy of the remaining areas under the administration building, load tests were performed and additional soil borings were made. No further settlement problems have been identified.

c. Radwaste Building - Borings in the radwaste building area generally showed stiff to hard clay fill beneath the foundation level; however, some soft clay was encountered. One boring adjacent to the south side of the building showed loose to medium dense sand above foundation levels. Settlements to date are nominal; monitoring of the building will be continued. At present, no foundation problems are indicated.

d. Evaporator Building - Settlement data is within the expected range. Borings made adjacent to the evaporator building showed medium dense to dense clayey sand fill and stiff to hard clay fill over hard clay and silt. No foundation problems have been identified.

e. Combination Shop - No foundation problems for this building have been identified.

f. Cooling Tower - One boring was made at the cooling tower location. This boring showed very stiff to hard clay fill and dense sand fill over hard clay.

g. Oily Waste Storage Facility - Construction of this facility has not been started to date. A boring(s) will be made to confirm foundation adequacy before work proceeds.

h. Transformer Foundations Adjacent to Diesel Generator Building - Borings made in the transformer areas showed stiff to hard clay fill and dense to very dense sand fill with occasional soft clay fill, over very dense sand and hard clay. One boring adjacent to the Unit 1 transformer area showed about 2 feet of loose sand immediately below the foundation level. There is a potential differential settlement of the Unit 1 transformer foundation; accordingly, this area will be loaded with a 5-foot surcharge and monitored to allow further evaluation. No settlement problems for the Unit 2 transformer foundation have been identified.

i. Retaining Walls Adjacent to the Intake Structure and Partially Supported on Plant Fill - Settlement measurements indicate an approximate 1.4-inch differential settlement between portions of the retaining wall founded on original soil versus plant fill recorded during the last 18 months. Borings made adjacent to this wall showed stiff clay fill and medium dense sand fill over hard clay and/or medium dense sand below foundation level. Monitoring of the settlement will be continued.

j. Chlorination Building - Studies made adjacent to the chlorination building showed soft to very stiff clay fill over hard clay. The superstructure is very light, and the borings do not indicate any additional action is required.

k. Guardhouse - Borings made in this area showed stiff to very stiff clay fill with occasional soft clay fill over hard clay. Dense sand was found in one boring between el 613' and el 618'. This area is under further review.

l. Condensate Storage Tanks - Studies made in this area show stiff to hard clay fill with zones of soft clay ranging from 5 to 10 feet thick. Fill in this area has settled under its own weight. This item is under further review. A suggested resolution includes placing a 10-foot surcharge load extending to a distance of 20 feet from the tanks.

2) NRC Question:

If soil conditions are not as required, what will be done to correct the conditions?

Response:

As described in the response to Question 1, the plant area fill review has identified several additional areas of concern. Resolution of the foundation problems include:

a. Tank Farm North of Auxiliary Building - The settlement will be monitored, and the tanks will be prefilled to effect an early preload.

b. Service Water Building Area on Plant Fill - This condition is still under evaluation.

c. Service Water Lines - This condition is still under evaluation. A review will be made of any secondary pipe stresses and requirements for slopes in these pipe lines.

d. Transformer Foundations - A 5-foot surcharge will be placed in the area of Unit 1 transformer foundations.

e. Guardhouse - This area is still under evaluation.

f. Condensate Storage Tanks - This condition is still under evaluation; consideration being given to placing a 10-foot surcharge load extending 20 feet from the tanks.

In addition to the specific items mentioned above, the settlement monitoring will be continued, and additional borings will be made as necessary.

A further study of plant area fill includes the review of field density tests performed in this area. Drawings in 3-foot segments are currently under preparation to show location, elevation, and density test results. These drawings will be useful in identifying areas, if any, for which further evaluation of compaction conditions is required.

3) <u>NRC Question</u>:

If answers to 1 and 2 are not known, what is the risk in allowing construction to continue? Provide specific reasons why work should be allowed to continue and why the subsoil condition is considered adequate.

<u>Response</u>:

With the exception of the several aboveground tanks, and the Seismic Category II cooling tower superstructures, oily waste facilities, and guardhouse, the construction (i.e., civil work) of the plant structures is complete. However, there is also a variety of mechanical equipment, piping, and electrical items yet to be installed. The mechanical and electrical work to go will add only nominal loadings to the foundations, and should have minimal impact on future foundation settlements.

For the tank areas, preloading by either filling with water or by surcharge are expected to consolidate the foundation materials. If this method is not completely satisfactory, other corrective measures can be reasonably implemented. For the service water pump structure, the civil construction is complete. Remedial measures to the fill, if required, will be performed irrespective of any nonstructural work (i.e., mechanical and electrical items) installed in the following months. For the cooling tower, no foundation problems have been identified. No construction will proceed for the guardhouse until any identified problem is resolved. Finally, for the oily waste system facilities, construction will not proceed until the additional boring(s) confirm the adequacy of the fill materials.

Continuing scheduled construction work--primarily mechanical and electrical items--will not compromise the committed evaluations or remedial actions, nor make irrevocable any conditions which do not fully satisfy FSAR and other licensing requirements. For example, a spare conduit is available or a conduit will be left unfilled until the adequacy of an electrical duct bank is evaluated. Corrective measures can be done if the licensing commitments are not satisfied, e.g., the pipe can be replaced or structural modifications performed around and/or after the equipment is removed. Accessibility to questionable fill conditions will not be changed until the evaluation confirms the adequacy of the foundation or remedial measures are undertaken. Therefore, there is no licensing risk in allowing the present construction activities to continue.

The nonconforming fill conditions relate primarily to the compaction of the material. The type of plant fill (i.e., random onsite fill) is consistent with the soils consultant recommendations. As described earlier, there is an existing settlement monitoring program which will identify any future areas of concern. The conditions of the plant fill have been or will be evaluated for all major Seismic Category I and II structures or systems. Corrective measures as required must be completed before plant completion. Therefore, the fill condition either presently meets or will be corrected to a safe and adequate condition.

In summary, it is recommended that the construction work be continued. There is no licensing risk, and no compromise to provide a safe and adequate plant.

~~NRC Exhibit~~ # Heller's Deposition #4 J Kane

(15)

JUN 3 0 1980

Docket Nos.: 50-329/330

Mr. J. W. Cook
Vice President
Consumers Power Company
1945 West Parnall Road
Jackson, Michigan 49201

Dear Mr. Cook:

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION REGARDING PLANT FILL

We have reviewed your responses to our requests of November 19, 1979 regarding the quality of plant fill, effects and remedial actions resulting therefrom. Our review is being performed with the assistance of the U. S. Army Corps of Engineers. We and they find that the results of additional explorations and laboratory testing identified in Enclosure 1 (Request 37) are needed to support required geotechnical engineering studies. Details on the extent of these studies will be provided shortly by separate correspondence. Enclosure 1 is provided in order that you may initiate planning of the required explorations in a timely manner. However we suggest you await receipt of these further details prior to physically beginning the explorations. Enclosure 1 (Footnote 4 of Table 37-1) also includes requests for advanced notification of the availability of certain samples.

As noted in our Request 37 of Enclosure 1, your position in previous responses to Requests 5 and 35 not to complete additional explorations, sampling and laboratory testing after preloading continues to be unacceptable to us. So that you might better understand our position, we offer the following observations:

(1) The preload program as completed on the heterogeneous materials which were placed for the purpose of structural fill is not necessarily an improvement, nor does it necessarily produce foundation soils of more uniform engineering properties, compared to the soil performance which would have resulted if the material had been properly compacted to the original requirements established in the Midland PSAR.

(2) To develop reasonable assurance of plant safety, the required studies are needed to serve as an independent verification of the predictions of future settlements and the conclusions of the preload program.

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OFFICE ▶						
SURNAME ▶						
DATE ▶						

(3) The required studies will permit an estimate of total and differential settlement for involved structures and systems following drawdown with the proposed permanent dewatering system.

(4) Certain aspects of the preload program, such as the complication introduced by the simultaneous raising of the cooling pond reservoir, present difficulties in our full acceptance of your conclusion of the preload program.

Enclosure 1 also includes other requests for information which we and the U. S. Army Corps of Engineers need to continue our review.

We would appreciate your response to Enclosure 1 at your earliest opportunity. A partial reply based upon data already available should be submitted rather than to await the results of new borings and tests contained in parts of Enclosure 1. Should you require clarifications of these requests and positions, please contact us.

Sincerely,

/S/

A. Schwencer, Acting Chief
Licensing Branch No. 3
Division of Licensing

Enclosure:
As stated

cc: See next page

OFFICE	DL:LB #3	DE:H&G	DL:LB #3			
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DATE	6/27/80	6/27/80	6/27/80			

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ADDITIONAL REQUESTS REGARDING PLANT FILL

36. We have reviewed your response to Request 24 and find that information from additional boring logs is needed.

Provide the boring logs for the following explorations:

a. Pull down holes PD-1 thru PD-27 (35 holes that include 8A, 20A, 20B, 20C, 15A, 15B, 15C and 27A)
b. LOW-1 thru LOW-14 (14 holes)
c. TW-1 thru TW-5 and PZ-1 thru PZ-48 (55 holes)
d. OW-1 thru OW-5 (5 holes)
e. TEW-1 thru TEW-8 (8 holes)

The logs should include date and method of drilling, the type and location of samples attempted. Also provide the locations, boring logs and available test data of any exploration completed in 1979 and 1980 which has not yet been submitted.

37. (RSP) Your position in previous responses to Requests 5 and 35 not to complete additional explorations, sampling and laboratory testing following the preload program continues to be unacceptable. We require that you complete as a minimum, the exploration and testing program indicated by Table 37-1.

38. Discuss the foundation design for any seismic safety-related piping and conduit connected to or located under the Radwaste Building and Turbine Building where piping and conduit have been placed on plant fill.

Table 37-1

Request for Additional Explorations, Sampling and Testing

Location 1/	Depth 2/	Sampling 3/	Lab Testing 4/	Anticipated Geotechnical 6/ Engineering Studies to be Required
Diesel Generator Building (6 holes along perimeter)	Thru fill and a minimum of 5' into natural glacial till soils	Classify samples according to Unified Soils Classification System	For cohesive soils C-D (Consolidated-Drained) C-U (Consolidated-Undrained) Consolidation 5/ For sands Drained Direct Shear on both loose & dense specimens Relative Density	Bearing Capacity Settlement - Primary Reason Piping Distortion
2 Auxiliary Building (2 holes)	Same as above	Same as above	Same as above except add U-U (Unconsolidated-Undrained for cohesive soils	Caisson Foundation Design (Vertical and Lateral Load Support)
Service Water Pump (1 hole) Structure and Retaining Walls (2 holes)	Same as above	Same as above	Same as above except consolidation testing would be limited to samples in retaining wall foundations.	Pile Foundation Design (Vertical and Lateral Load Support) Retaining Wall Stability & Settlement.
Cooling Pond Embankments (7 holes along perimeter)	Extend thru fill and a minimum of 5' into natural residual soils except hole no. 5 which should extend to bottom elevation of cooling pond.	Same as above	For cohesive soils C-D (Consolidated-Drained) C-U (Consolidated-Undrained) U-U (Unconsolidated-Undrained)	Slope Stability Fill compaction adequacy

NOTES: See page 2

Table 37-1 (continued)

NOTES:

1/ See attached Figs. 37-1 and 37-2 for approximate boring location. Holes to be accurately located in the field to avoid obstructions, underground piping and conduits and slurry trench area.

2/ No boring is to be terminated in loose or soft soils.

3/ Continuous split spoon sampling using SPT is required. Holes are to be held open using either casing or hollow stem auger. Additional borings to obtain representative undisturbed samples for detailed laboratory testing should be located at the completion and elevation of the split spoon sampling program. The groundwater level should be recorded at the completion of drilling in all borings once the level has stabilized.

4/ Normal classification (e.g., gradation, Atterberg Limits) unit weight and moisture content testing to be performed on representative samples from each significant foundation layer. This column pertains to lab testing in addition to the above mentioned tests. It is requested that at least one week notice be provided to the NRC before opening undisturbed samples to permit on site visual observation by Corps of Engineer representative.

5/ The maximum load should be great enough to establish the straight-line portion of the void ratio-pressure curve.

6/ Details on the extent of geotechnical engineering studies to be completed using the results of field and lab testing work will be provided in a separate letter.

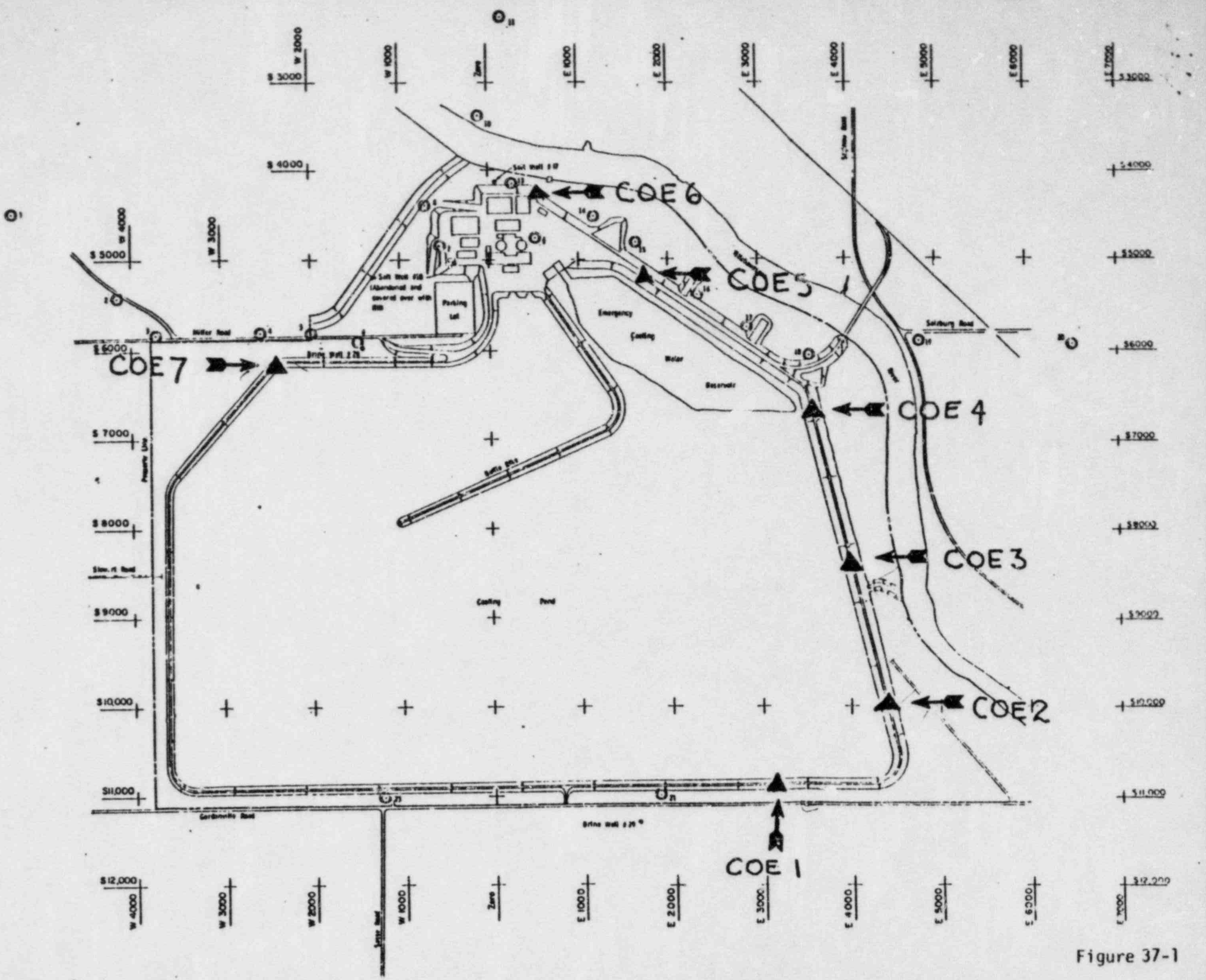
COE 1
COE 2
COE 3
COE 4
COE 5
COE 6
COE 7
Emergency Cooling Water Reservoir
Cooling Pond
Parking Lot
Miller Road
Salzburg Road
Gordonville Road
S 3000
S 4000
S 5000
S 6000
S 7000
S 8000
S 9000
S 10,000
S 11,000
S 12,000
W 4000
W 3000
W 2000
W 1000
Zero
E 1000
E 2000
E 3000
E 4000
E 5000
E 6000
E 7000

Figure 37-1

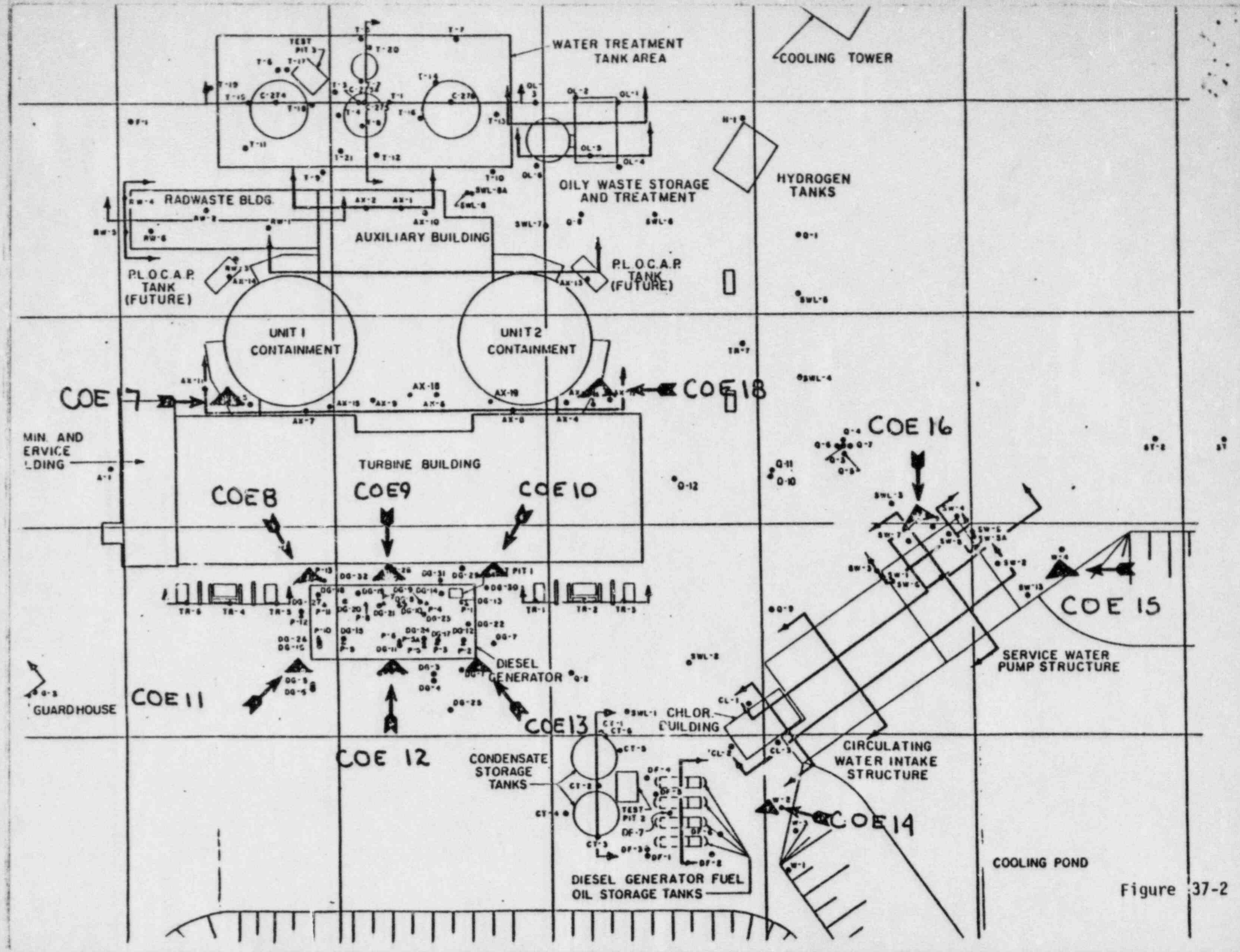
WATER TREATMENT TANK AREA
COOLING TOWER
HYDROGEN TANKS
OILY WASTE STORAGE AND TREATMENT
RADWASTE BLDG.
AUXILIARY BUILDING
P.L.O.C.A.P. TANK (FUTURE)
P.L.O.C.A.P. TANK (FUTURE)
UNIT 1 CONTAINMENT
UNIT 2 CONTAINMENT
COE17
COE18
COE16
MIN. AND ERVICE LDING
TURBINE BUILDING
COE8
COE9
COE10
COE15
SERVICE WATER PUMP STRUCTURE
DIESEL GENERATOR
COE11
GUARDHOUSE
COE13
CHLOR. BUILDING
COE 12
CONDENSATE STORAGE TANKS
CIRCULATING WATER INTAKE STRUCTURE
COE14
COOLING POND
DIESEL GENERATOR FUEL OIL STORAGE TANKS

Figure 37-2

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

AUG 4 1980

Docket Nos.: 50-329/330

Mr. J. W. Cook
Vice President
Consumers Power Company
1945 West Parnall Road
Jackson, Michigan 49201

Dear Mr. Cook:

SUBJECT: CORP OF ENGINEERS REPORT AND REQUEST FOR ADDITIONAL INFORMATION ON PLANT FILL

My letter of June 30, 1980 requested the results of additional explorations and laboratory testing needed to support certain geotechnical engineering studies on the Midland plant fill and associated remedial actions. That letter noted that details on the extent of these studies would be provided by separate correspondence. Enclosure 1 is a letter report of July 7, 1980 by our consultant, the U.S. Army Corps of Engineers, and is forwarded to this end.

Paragraph 4 of the Corps report identifies additional information needed to resolve specific problems identified in paragraph 3. For purposes of control, we have re-numbered the subparagraphs of paragraph 4 to be sequential with our prior requests on this matter. They have also been marked to reflect the results of NRR review. Your reply should reference the revised numbering system and should address the requests as marked to reflect our changes.

Subparagraph 4j of the Corps report entitled Liquefaction Potential, is not included in our re-numbering since it represents an evaluation rather than a request. We consider this evaluation to be tentative at this time since it is subject to the determination of suitable seismic design input for the site. We will address this matter shortly by separate correspondence.

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We would appreciate your reply at your earliest opportunity. Should you need clarification of these requests for additional information, please contact us.

Sincerely,

A. Schwencer

A. Schwencer, Acting Chief
Licensing Branch No. 3
Division of Licensing

Enclosure:
COE Letter Report
dated 7/7/80

cc: See next page

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DEPARTMENT ...

DETROIT DISTRICT, CORPS OF ENGINEERS
BOX 1027
DETROIT, MICHIGAN 48231

ENCLOSURE 1

REPLY TO ATTENTION OF

NCEED-T

7 JUL 1980

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

THRU: Division Engineer, North Central
ATTN: NCDED-G (James Simpson)

TO: U.S. Nuclear Regulatory Commission
ATTN: Dr. Robert E. Jackson
Division of Systems Safety
Mail Stop P-314
Washington, D. C. 20555

1. The Detroit District hereby submits this letter report with regard to completion of subtask No. 1 of the subject Interagency Agreement concerning the Midland Nuclear Plant, Units 1 and 2. The purpose of this report is to identify unresolved issues and make recommendations on a course of action and/or cite additional information necessary to settle these matters prior to preparation of the Safety Evaluation Report.

2. The Detroit District's team providing geotechnical engineering support to the NRC to date has made a review of furnished documents concerning foundations for structures, has jointly participated in briefing meetings with the NRC staff, Consumers Power Company (the applicant) and personnel from North Central Division of the Corps of Engineers and has made detailed site inspections. The data reviewed includes all documents received through Amendment 78 to the operating license request, Revision 28 of the FSAR, Revision 7 to the 10 CFR 50.54(f) requests and MCAR No. 24 through Interim Report No. 8. Generally, each structure within the complex was studied as a separate entity.

3. A listing of specific problems in review of Midland Units 1 and 2 follows for Category I structures. The issues are unresolved in many instances, because of inadequate or missing information. The structures to be addressed follow the description of the problem.

a. Inadequate presentation of subsurface information from completed borings on meaningful profiles and sectional views. All structures.

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b. Discrepancies between soil descriptions and classifications on boring logs with submitted laboratory test results summaries. Examples of such discrepancies are found in boring T-14 (Borated water tank) which shows stiff to very stiff clay where laboratory tests indicate soft clay with shear strength of only 500 p.s.f. The log of boring T-15 shows stiff, silty clay, while the lab tests show soft, clayey sand with shear strength of 120 p.s.f. All structures.

c. Lack of discussion about the criteria used to select soil samples for lab testing. Also, identification of the basis for selecting specific values for the various parameters used in foundation design from the lab test results. All structures.

d. The inability to completely identify the soil behavior from lab testing (prior to design and construction) of individual samples, because in general, only final test values in summary form have been provided. All structures.

(1) Lack of site specific information in estimating allowable bearing pressures. Only textbook type information has been provided. If necessary, bearing capacity should be revised based on latest soils data. All structures on, or partially on, fill.

(2) Additional information is needed to indicate the design methods used, design assumptions and computations in estimating settlement for safety related structures and systems. All structures except Diesel Generator Building where surcharging was performed.

e. A complete detailed presentation of foundation design regarding remedial measures for structures undergoing distress is required. Areas of remedial measures except Diesel Generator Building.

f. There are inconsistencies in presentation of seismic design information as affected by changes due to poor compaction of plant fill. Response to NRC question 35 (10 CFR 50.54f) indicates that the lower bound of shear wave velocity is 500 feet per second. We understand that the same velocity will be used to analyze the dynamic response of structures built on fill. However, from information provided by the applicant at the site meeting on 27 and 28 February 1980, it was stated that, except for the Diesel Generator Building, higher shear wave velocities are being used to re-evaluate the dynamic response of the structures on fill material. Structures on fill or partially on fill except Diesel Generator Building.

4. A listing of specific issues and information necessary to resolve them.

39. a. Reactor Building Foundation

(1) Settlement/Consolidation. Basis for settlement/consolidation of the reactor foundation as discussed in the FSAR assumes the plant site would

not be dewatered. Discuss and furnish computation for settlement of the Reactor Buildings in respect to the changed water table level as the result of site dewatering. Include the effects of bouyancy, which were used in previous calculations, and fluctuations in water table which could happen if the dewatering system became inoperable.

(2) Bearing Capacity. Bearing capacity computations should be provided and should include method used, foundation design, design assumptions, adopted soil properties, and basis for selecting ultimate bearing capacity and resulting factor of safety.

40. ~~b~~. Diesel Generator Building.

(1) Settlement/Consolidation. In the response to NRC Question 4 and 27, (10 CFR 50.54f), the applicant has furnished the results of his computed settlements due to various kinds of loading conditions. From his explanation of the results, it appears that compressibility parameters obtained by the preload tests have been used to compute the static settlements. Information pertaining to dynamic response including the amplitude of vibration of generator pedestals have also been furnished. The observed settlement pattern of the Diesel Generator Building indicates a direct correlation with soil types and properties within the backfill material. To verify the preload test settlement predictions, compute settlements based on test results on samples from new borings which we have requested in a separate memo and present the results. Reduced ground water levels resulting from dewatering and diesel plus seismic vibration should be considered in settlement and seismic analysis. Furnish the computation details for evaluating amplitude of vibration for diesel generator pedestals including magnitude of exciting forces, whether they are constant or frequency dependent.

(2) Bearing Capacity. Applicant's response to NRC Question 35 (10 CFR 50.54f) relative to bearing capacity of soil is not satisfactory. Figure 35-3, which has been the basis of selection of shear strength for computing bearing capacity does not reflect the characteristics of the soils under the Diesel Generator Building. A bearing capacity computation should be submitted based on the test results of samples from new borings which we have requested in a separate memo. This information should include method used, foundation design assumptions, adopted soil properties and basis for selection, ultimate bearing capacity and resulting factor of safety.

(3) Preload Effectiveness. The effectiveness of the preload should be studied with regard to the moisture content of the fill at the time of preloading. The height of the water table, its time duration at this level, and whether the plant fill was placed wet or dry of optimum would be all important considerations.

(a) Granular Soils.

When sufficient load is applied to granular soils it usually causes a reorientation of grains and movement of particles into more stable positions plus (at high stresses) fracturing of particles at their points of contact. Reorientation and breakage creates a chain reaction among these and adjacent particles resulting in settlement. Reorientation is resisted by friction between particles. Capillary tension would tend to increase this friction. A moisture increase causing saturation, such as a rise in the water table as occurred here, would decrease capillary tension resulting in more compaction. Present a discussion on the water table and capillary water effect on the granular portion of the plant fill both above and below the water table during and after the preload.

(b) Impervious and/or Clay Soils.

Clay fill placed dry of optimum would not compact and voids could exist between particles and/or chunks. In this situation SPT blow counts would give misleading information as to strength. Discuss the raising of the water table and determine if the time of saturation was long enough to saturate possible clay lumps so that the consolidation could take place that would preclude further settlement.

Discuss the preload effect on clay soils lying above the water table (7 feet ±) that were possibly compacted dry of optimum. It would appear only limited consolidation from the preload could take place in this situation and the potential for further settlement would exist.

Discuss the effect of the preload on clays placed wet of optimum. It would appear consolidation along with a gain in strength would take place. Determine if the new soil strength is adequate for bearing capacity.

~~Conclusion: Since the reliability of existing fill and compaction information is uncertain, additional borings and tests to determine void ratio (granular soils) relative density, moisture content, density, consolidation properties and strength (triaxial tests) would appear to be desirable in order to satisfactorily answer the above questions. Borings should be continuous push with undisturbed cohesive soil samples taken.~~ Deleted: Covered by 6/30/80 Letter

(4) Miscellaneous. A contour map, showing the settlement configuration of the Diesel Generator Building, furnished by the applicant at the meeting of 27 and 28 February 1980 indicates that the base of the building has warped due to differential settlements. Additional stresses will be induced in the various components of the structure. The applicant should evaluate these stresses due to the differential settlement and furnish the computations and results for review.

41. f. Service Water Building Foundation.

(1) Bearing Capacity. A detailed pile design based upon pertinent soil data should be developed in order to more effectively evaluate the proposed pile support system prior to load testing of test piles. Provide adopted soil properties, reference to test data on which they are based, and method and assumptions used to estimate pile design capacity including computations. Provide estimated maximum static and dynamic loads to be imposed and individual contribution (DL, LL, OBE, SSE) on the maximum loaded pile. Provide factor of safety against soil failure due to maximum pile load.

(2) Settlements.

(a) Discuss and provide analysis evaluating possible differential settlement that could occur between the pile supported end and the portion placed on fill and glacial till. Describe the impact of failure on safety related features (e.g., diesel fuel oil storage tanks) behind or near the wall.

(b) ~~Present~~ Discuss why the retaining wall adjacent to the intake structure is not required to be a Seismic Category I structure. Evaluate the observed settlement of both the service water pumphouse retaining walls and the intake structure retaining wall and the significance of the settlement including future settlement prediction on the safe operation of the Midland Nuclear Plant. This evaluation should address actual stresses induced by the settlement against allowable stresses permitted by approved codes.

(3) Seismic Analysis. Provided the proposed 100 ton ultimate pile load capacities are achieved and reasonable margin of safety is available, the vertical pile support proposed for the overhang section of the Service Water Pump Structure will provide the support necessary for the structure under combined static and seismic inertial loadings even if the soil under the overhang portion of the structure should liquefy. There is no reason to think this won't be achieved at this time, and the applicant has committed to a load test to demonstrate the pile capacity. The dynamic response of the structure, including the inertial loads for which the structure itself is designed and the mechanical equipment contained therein, would change as a result of the introduction of the piles. Therefore:

(a) Please summarize or provide copies of reports on the dynamic analysis of the structure in its old and proposed configuration. For the latter, provide detailed information on the stiffness assigned to the piles and the way in which the stiffnesses were obtained and show the largest change in interior floor vertical response spectra resulting from the proposed modification. If the proposed configuration has not yet been analyzed, describe the analyses that are to be performed giving particular attention to the basis for calculation or selection, of and the range of numerical stiffness values assigned to the vertical piles.

(b) Provide after completion of the new pile foundation, in accordance with commitment No. 6, item 125, Consumers Power Company memorandum dated 13 March 1980, the results of measurements of vertical applied load and absolute pile head vertical deformation which will be made when the structural load is jacked on the piles so that the pile stiffness can be determined and compared to that used in the dynamic analysis.

4-2. ~~f.~~ Auxiliary Building Electrical Penetration Areas and Feedwater Isolation Valve Pits.

(1) Settlement. Provide the assumptions, method, computation and estimate of expected allowable lateral and vertical deflections under static and seismic loadings.

(2) Provide the construction plans, and specifications for underpinning operations beneath the Electrical Penetration Area and Feedwater Valve Pit. The requested information to be submitted should cover the following in sufficient details for evaluation:

(a) Details of the temporary dewatering system (locations, depth, size and capacity of wells) including the monitoring program to be required, (for example, measuring drawdown, flow, frequency of observations, etc.) to evaluate the performance and adequacy of the installed system.

(b) Location, sectional views and dimensions of access shaft and drift to and below auxiliary building wings.

(c) Details of temporary surface support system for the valve pits.

~~(d)~~ Dewatering before underpinning is recommended in order to preclude differential settlement between pile and soil supported elements and negative drag forces.

(d) Provide adopted soil properties, method and assumptions used to estimate caisson and/or pile design capacities, and computational results. Provide estimated maximum static and dynamic load (compression, uplift and lateral) to be imposed and the individual contribution (DL, LL, OBE, SSE) on maximum loaded caisson and/or pile. Provide factor of safety against soil failure due to maximum pile load.

(e) Discuss and furnish computations for settlement of the portion of the Auxiliary Building (valve pits, and electrical penetration area) in respect to changed water level as a result of the site dewatering. Include the effect of bouyancy, which was used in previous calculations, and fluctuations in water table which could happen, if dewatering system becomes inoperable.

(f) Discuss protection measures to be required against corrosion, if piling is selected.

(9) Identify specific information, data and method of presentation to be submitted for regulatory review at completion of underpinning operation. This report should summarize construction activities, field inspection records, results of field load tests on caissons and piles and an evaluation of the completed fix for assuring the stable foundation.

43. Borated Water Tanks.

(1) Settlement. The settlement estimate for the Borated Water Storage Tanks furnished by the applicant in response to NRC Question 31 (10 CFR 50.54f) is based upon the results of two plate load tests conducted at the foundation elevation (EL 627.00±) of the tanks. Since a plate load test is not effective in providing information regarding the soil beyond a depth more than twice the diameter of the bearing plate used in the test, the estimate of the settlement furnished by the applicant does not include the contribution of the soft clay layers located at depth more than 5' below the bottom of the tanks (see Boring No. T-14 and T-15, and T-22 thru T-26).

(a) Compute settlements which include contribution of all the soil layers influenced by the total load on the tanks. Discuss and provide for review the analysis evaluating differential settlement that could occur between the ring (foundations) and the center of the tanks.

(b) The bottom of the borated tanks being flexible could warp under differential settlement. Evaluate what additional stresses could be induced in the ring beams, tank walls, and tank bottoms, because of the settlement, and compare with allowable stresses. Furnish the computations on stresses including method, assumptions and adopted soil properties in the analysis.

(2) Bearing Capacity. Laboratory test results on samples from boring T-15 show a soft stratum of soil below the tank bottom. Consideration has not been given to using these test results to evaluate bearing capacity information furnished by the applicant in response to NRC Question 35 (10 CFR 50.54f). Provide bearing capacity computations based on the test results of the samples from relevant borings. This information should include method used, foundation design assumptions, adopted soil properties, ultimate bearing capacity and resulting factor of safety for the static and the seismic loads.

44. Underground Diesel Fuel Tank Foundation Design

(1) Bearing capacity. Provide bearing capacity computation based on the test results of samples from relevent borings, including method used, foundation design assumptions, adopted soil properties, ultimate bearing capacity and the resulting factor of safety.

(2) Provide tank settlement analysis due to static and dynamic loads including methods, assumptions made, etc.

(3) What will be effects of uplift pressure on the stability of the tanks and the associated piping system if the dewatering system becomes inoperable?

45. ~~6.~~ Underground Utilities:

(1) Settlement

(a) Inspect the interior of water circulation piping with video cameras and sensing devices to show pipe cross section, possible areas of crackings and openings, and slopes of piping following consolidation of the plant fill beneath the imposed surcharge loading.

(b) The applicant has stated in his response to NRC Question 7 (10 CFR 50.54f) that if the duct banks remain intact after the preload program has been completed, they will be able to withstand all future operating loads. Provide the results of the observations made, during the preload test, to determine the stability of the duct banks, with your discussion regarding their reliability to perform their design functions.

(c) The response to Question 17 of "Responses to NRC Requests Regarding Plant Fill" states that "there is no reason to believe that the stresses in Seismic Category I piping systems will ever approach the Code allowable." We question the above statement based on the following:

Profile 26" - OHBC-54 on Fig. 19-1 shows a sudden drop of approx. 0.2 feet within a distance of only 20 feet. Using the procedure on p. 17-2,

$$\sigma_b = E(e) = E\left(\frac{D}{2R}\right) = E\left(\frac{D}{2}\right)\left(\frac{8\delta}{L^2}\right)$$

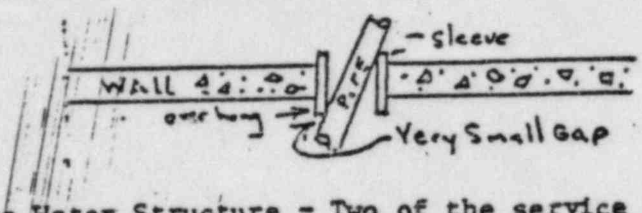
$$\sigma_b = 30000\ \left(\frac{26}{2}\right)\left[\frac{8(0.2)(12)}{(20x12)^2}\right] = 130.0 \text{ KSI}$$

~~Furthermore, the Eq. 10(a) of Article NC-3652.3, Sec. III, Division 1, of the ASME code requires that some Stress Intensification Factor "i" be assigned to all computed settlement stresses.~~ Yet, Table 17-2 lists only 52.5 KSI stress *as allowable* for this pipe. This matter requires further review. Please respond to *this* apparent discrepancy and also specify the location of each computed settlement stress at the pipeline stationing shown on the profiles. More than one critical stress location is possible along the same pipeline.

(d) During the site visit on 19 February 1980, we observed three instances of what appeared to be degradation of rattlespace at penetrations of Category I piping through concrete walls as follows:

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

West Borated Water Tank - in the valve pit attached to the base of the structure, a large diameter steel pipe extended through a steel sleeve placed in the wall. Because the sleeve was not cut flush with the wall, clearance between the sleeve and the pipe was very small.



Service Water Structure - Two of the service water pipes penetrating the northwest wall of the service water structure had settled differentially with respect to the structure and were resting on slightly squashed short pieces of 2 x 4 placed in the bottom of the penetration. From the inclination of the pipe, there is a suggestion that the portions of the pipe further back in the wall opening (which was not visible) were actually bearing on the invert of the opening. The bottom surface of one of the steel pipes had small surface irregularities around the edges of the area in contact with the 2 x 4. Whether these irregularities are normal manufacturing irregularities or the result of concentration of load on this temporary support caused by the settlement of the fill, was not known.

These instances are sufficient to warrant an examination of those penetrations where Category I pipe derives support from plant fill on one or both sides of a penetration. In view of the above facts, the following information is required.

(1) What is the minimum seismic rattlespace required between a Category I pipe and the sleeve through which it penetrates a wall?

(2) Identify all those locations where a Category I pipe deriving support from plant fill penetrates an exterior concrete wall. Determine and report the vertical and horizontal rattlespace presently available and the minimum required at each location and describe remedial actions planned as a result of conditions uncovered in the inspection. It is anticipated that the answer to Question (1) can be obtained without any significant additional excavation. If this is not the case, the decision regarding the necessity to obtain information at those locations requiring major excavation should be deferred until the data from the other locations have been examined.

(e) Provide details (thickness, type of material etc.) of bedding or cradle placed beneath safety related piping, conduits, and supporting structures. Provide profiles along piping, and conduits alignments showing the properties of all supporting materials to be adopted in the analysis of pipe stresses caused by settlement.

(f) The two reinforced concrete return pipes which exit the Service Water Pump Structure, run along either side of the emergency cooling water reservoir, and ultimately enter into the reservoir, are necessary for safe shutdown. These pipes are buried within or near the crest of Category I slopes that form the sides of the emergency cooling water reservoir. There is no report on, or analysis of, the seismic stability of post earthquake residual displacement for these slopes. While the limited data from this area do not raise the specter of any problem, for an important element of the plant such as this, the earthquake stability should be examined by state-of-the-art methods. Therefore, provide results of the seismic analysis of the slopes leading to an estimate of the permanent deformation of the pipes. Please provide the following: (1) a plan showing the pipe location with respect to other nearby structures, slopes of the reservoir and the coordinate system; (2) cross-sections showing the pipes, normal pool levels, slopes, subsurface conditions as interpreted from borings and/or logs of excavations at (a) a location parallel to and about 50 ft from the southeast outside wall of the service water pipe structure and (b) a location where the cross section will include both discharge structures. Actual boring logs should be shown on the profiles; their offset from the profile noted, and soils should be described using the Unified Soil Classification System; (3) discussion of available shear strength data and choice of strengths used in stability analysis; (4) determination of static factor or safety, critical earthquake acceleration, and location of critical circle; (5) calculation of residual movement by the method presented by Newmark (1965) or Makdisi and Seed (1978); and (6) a determination of whether or not the pipes can function properly after such movements.

46. ~~k~~. Cooling Pond.

(1) Emergency Cooling Pond. In recognition that the type of embankment fill and the compaction control used to construct the retention dikes for the cooling pond were the same as for the problem plant fill, we request reasonable assurance that the slopes of the Category I Emergency Cooling Pond (baffle dike and main dike) are stable under both static and dynamic loadings. We request a revised stability analysis for review, which will include identification of locations analyzed, adopted foundation and embankment conditions (stratification, seepage, etc.) and basis for selection, adopted soil properties, method of stability analysis used and resulting factor of safety with identification of sliding surfaces analyzed. Please address any potential impact on Category I pipes near the slopes, based on the results of this stability study. Recommendations for location of new exploration and testing have been provided in a separate letter.

(2) Operating Cooling Pond. A high level of safety should be required for the remaining slopes of the Operating Cooling Pond unless it can be assured that a failure will not: (a) endanger public health and properties, (b) result in an assault on environment, (c) impair needed emergency access. Recommendations for locations of new borings and laboratory tests have been submitted in a separate letter. These recommendations were made on the assumptions that the stability of the operating cooling pond dikes should be demonstrated.

47. ~~i~~. Site Dewatering Adequacy.

(1) In order to provide the necessary assurance of safety against liquefaction, it is necessary to demonstrate that the water will not rise above elevation 610 during normal operations or during a shutdown process. The applicant has decided to accomplish this by pumping from wells at the site. In the event of a failure, partial failure, or degradation of the dewatering system (and its backup system) caused by the earthquake or any other event such as equipment breakdown, the water levels will begin to rise. Depending on the answer to Question (a) below concerning the normal operating water levels in the immediate vicinity of Category I structures and pipelines founded on plant fill, different amounts of time are available to accomplish repair or shutdown. In response to Question 24 (10 CFR 50.54f) the applicant states "the operating groundwater level will be approximately el 595 ft" (page 24-1). On page 24-1 the applicant also states "Therefore el 610' is to be used in the designs of the dewatering system as the maximum permissible groundwater level elevation under SSE conditions." On page 24-15 it is stated that "The wells will fully penetrate the backfill sands and underlying natural sands in this area." The bottom of the natural sands is indicated to vary from elevation 605 to 580 within the plant fill area according to Figure 24-12. The applicant should discuss and furnish response to the following questions:

(a) Is the normal operating dewatering plan to (1) pump such that the water level in the wells being pumped is held at or below elevation 595 or (2) to pump as necessary to hold the water levels in all observation wells near Category I Structures and Category I Pipelines supported on plant fill at or below elevation 595, (3) to pump as necessary to hold water levels in the wells mentioned in (2) above at or below elevation 610, or (4) something else? If it is something else, what is it?

(b) In the event the water levels in observation wells near Category I Structures or Pipelines supported on plant fill exceed those for normal operating conditions as defined by your answeer to Question (a) what action will be taken? In the event that the water level in any of these observation wells exceeds elevation 610, what action will be taken?

(c) Where will the observation wells in the plant fill area be located that will be monitored during the plant lifetime? At what depths will the screened intervals be? Will the combination of (1) screened interval in cohesionless soil and (2) demonstration of timely response to changes in cooling pond level prior to drawdown be made a condition for selecting the observation wells? Under what conditions will the alarm mentioned on page 24-20 be triggered? What will be the response to the alarm? A worst case test of the completed permanent dewatering and groundwater level monitoring systems could be conducted to determine whether or not the time required to accomplish shutdown and cooling is available. This could be done by shutting off the entire dewatering system when the cooling pond is at elevation 627 and determining the water level versus time curve for each observation well. The test should be continued until the water level under Category I structure, whose foundations are potentially liquefiable, reaches elevation 610 (the normal water level) or the sum of the time intervals allotted for repair and the time interval needed to accomplish shutdown (should the repair prove unsuccessful) has been exceeded, whichever occurs first. In view of the heterogeneity of the fill, the likely variation of its permeability and the necessity of making several assumptions in the analysis which was presented in the applicant's response to Question 24a, a full-scale test should give more reliable information on the available time. In view of the above the applicant should furnish his response to the following:

If a dewatering system failure or degradation occurs, in order to assure that the plant is shutdown by the time water level reaches elevation 610, it is necessary to initiate shutdown earlier. In the event of a failure of the dewatering system, what is the water level or condition at which shutdown will be initiated? How is that condition determined? An acceptable method would be a full-scale worst-case test performed by shutting off the entire dewatering system with the cooling pond at elevation 627 to determine, at each Category I Structure deriving support from plant fill, the water level at which a sufficient time window still remains to accomplish shutdo_ before the water rises to elevation 610. In establishing the groundwater level or condition that will trigger shutdown, it is necessary to account for normal surface water inflow as well as groundwater recharge and to assume that any additional action taken to repair the dewatering system, beyond the point in time when the trigger condition is first reached, is unsuccessful.

(2) As per applicant response to NRC Question 24 (10 CFR 50.54f) the 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, since the plant fill south of Diesel Generator Building is an effective barrier to the inflow of the cooling pond water. However, soil profiles (Figure 24-2 in the "Response to NRC Requests Regarding Plant Fill"), pumping test time-drawdown graphs (Figure 24-14), and plotted cones of influence (Figure 24-15) indicate that south of Diesel Generator Building, the plant fill material adjacent to

the cooling pond is not an effective barrier to inflow of cooling pond water. The estimated permeability for the fill material as reported by the applicant is 8 feet/day and the transmissivities range from 29 to 102 square feet/day. Evaluate and furnish for review the recharge rate of seepage through the fill materials from the south side of the Diesel Generator Building on the permanent dewatering system. This evaluation should especially consider the recovery data from PD-3 and complete data from PD-5.

(3) The interceptor wells have been positioned along the northern side of the Water Intake Structure and service water pump structures. The calculations estimating the total groundwater inflow 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 soil 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 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 the supporting data such as drawdown at the interceptor wells, at midway location between any two consecutive wells, and the increase in the water elevations downstream of the interceptor wells. The presence of structures near the cooling pond appears to have created a situation of artesian flow through the sand layer. Discuss why artesian flow was not considered in the design of the dewatering system.

(4) Provide construction plans and specification of permanent dewatering system (location, depths, size and capacity of wells, filterpack design) including required monitoring program. The information furnished in response of NRC Question 24 (10 CFR 50.54f) is not adequate to evaluate the adequacy of the system.

(5) Discuss the ramifications of plugging or leaving open the weep holes in the retaining wall at the Service Water Building.

(6) Discuss in detail the maintenance plan for the dewatering system.

(7) What are your plans for monitoring water table in the control tower area of the Auxiliary Building?

(8) What measures will be required to prevent incrustation of the pipings of the dewatering system. Identify the controls to be required during plant operation (measure of dissolved solids, chemical controls). Provide basis for established criteria in view of the results shown on Table 1, page 23 of tab 147.

(9) Upon reaching a steady state in dewatering, a groundwater survey should be made to confirm the position of the water table and to insure that no perched water tables exist.

Dewatering of the site should be scheduled with a sufficient lead time before plant start up so that the additional settlement and its effects (especially on piping) can be studied. Settlement should be closely monitored during this period.

Provide your plans for conducting this groundwater survey.

N/A

j. Liquefaction Potential.

An independent Seed-Idriss Simplified Analysis was performed for the fill area under the assumption that the groundwater table was at or below elevation 610. For 0.19 g peak ground surface acceleration, it was found that blow counts as follows were required for a factor of safety of 1.5:

Elevation ft	Minimum SPT Blow Count*[1] For F.S. = 1.5
610	14
605	16
600	17
595	19

The analysis was considered conservative for the following reasons (a) no account was taken of the weight of any structure, (b) liquefaction criteria for a magnitude 6 earthquake were used whereas an NRC memorandum of 17 Mar 80 considered nothing larger than 5.5 for an earthquake with the peak acceleration level of 0.19 g's, (c) unit weights were varied over a range broad enough to cover any uncertainty and the tabulation above is based on the most conservative set of assumptions. Out of over 250 standard penetration tests on cohesionless plant fill or natural foundation material below elevation 610, the criteria given above are not satisfied in four tests in natural materials located below the plant fill and in 23 tests located in the plant fill. These tests involve the following borings:

SW3, SW2, DG-18, AX 13, AX 4, AX 15, AX 7, AX 5, AX 11,
DG 19, DG 13, DG 7, DG 5, D 21, GT 1, 2.

Some of the tests on natural material were conducted at depths of at less than 10 ft before approximately 35 ft of fill was placed over the location. Prior to comparison with the criteria these tests should be multiplied by a factor of about 2.3 to account for the increase in effective overburden pressure that results from the placement and future dewatering of the fill.

1*For M = 7.5, blow counts would increase by 30%.

changed backfill on interior response spectra predicted by the various models can be readily seen.

(2) Category I retaining wall near the southeast corner of the Service Water Structure. This wall is experiencing some differential settlement. Boring information in Figure 24-2 (Question 24, Volume 1 Responses to NRC Requests Regarding Plant Fill) suggests the wall is founded on natural soils and backfilled with plant fill on the land side. Please furnish details clarifying the following:

(a) Is there any plant fill underneath the wall? What additional data beyond that shown in Figure 24-2 support your answer?

(b) Have or should the design seismic loads (FSAR Figure 2.5-45) be changed as a result of the changed backfill conditions?

(c) Have or should dynamic water loadings in the reservoir be considered in the seismic design of this wall? Please explain the basis of your answer.

5. In your response for the comments and questions in paragraph 4 above, if you feel that sufficiently detailed information already exists on the Midland docket that may have been overlooked, please make reference to that information. Resolution of issues and concerns will depend on the expeditious receipt of data mentioned above. Contact Mr. Neal Gehring at FTS 226-6793 regarding questions.

FOR THE DISTRICT ENGINEER:

P. McCallister

P. McCALLISTER
Chief, Engineering Division

Of the 23 tests on plant fill which fail to satisfy the criteria, most are near or under structures where remedial measures alleviating necessity for support from the fill are planned. Only 4 of the tests are under the Diesel Generator Building (which will still derive its support from the fill) and 3 others are near it. Because these locations where low blow counts were recorded are well separated from one another and are not one continuous stratum but are localized pockets of loose material, no failure mechanism is present.

In view of the large number of borings in the plant fill area and the conservatism adopted in analysis, these few isolated pockets are no threat to plant safety. The fill area is safe against liquefaction in a Magnitude 6.0 earthquake or smaller which produces a peak ground surface acceleration of 0.19 g or less provided the groundwater elevation in the fill is kept at or below elevation 610.

48. ~~x~~. Seismic analysis of structures on plant fill material.

(1) Category I Structures. From Section 3.7.2.4 of the FSAR it can be calculated that an average V_s of about 1350 ft/sec was used in the original dynamic soil structure interaction analysis of the Category I structures. This is confirmed by one of the viewgraphs used in the 28 February Bechtel presentation. Plant fill V_s is clearly much lower than this value. It is understood from the response to Question 13 (10 CFR 50.54f) concerning plant fill that the analysis of several Category I structures are underway using a lower bound average V_s = 500 ft/sec for sections supported on plant fill and that floor response spectra and design forces will be taken as the most severe of those from the new and old analysis. The questions which follow are intended to make certain if this is the case and gain an understanding of the impact of this parametric variation in foundation conditions.

(a) Discuss which Category I structures have been and/or will be reanalyzed for changes in seismic soil structure interaction due to the change in plant fill stiffness from that envisioned in the original design. Have any Category I structures deriving support from plant fill been excluded from reanalysis? On what basis?

(b) Tabulate for each old analysis and each reanalysis, the foundation parameters (v_s, ν and ρ) used and the equivalent spring and damping constants derived therefrom so the reviewer can gain an appreciation of the extent of parametric variation performed.

(c) Is it the intent to analyze the adequacy of the structures and their contents based upon the envelope of the results of the old and new analyses? For each structure analyzed, please show on the same plot the old, new, and revised enveloping floor response spectra so the effect of the

R Hall
J. Kane
(16)

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

August 27, 1980

Docket Nos. 50-329
and 50-330

Mr. J. W. Cook
Vice President
Consumers Power Company
1945 West Parnall Road
Jackson, Michigan 49201

Dear Mr. Cook:

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION REGARDING DEWATERING OF MIDLAND SITE

Amendment No. 74 to your application dated February 28, 1980, provided information regarding a permanent dewatering system proposed for the Midland site in response to Request No. 24 from Mr. L. Rubenstein's letter of November 19, 1979. The review by the hydrologic section of our Hydrologic and Geotechnical Engineering Branch indicates the need for further information regarding that response as identified in Enclosure 1. This information is in addition to related requests contained in our letter of August 4, 1980.

We would appreciate your reply to Enclosure 1 at your earliest opportunity. Should you need clarification of these requests for additional information, please contact us.

Sincerely,

R L Tedesco

Robert L. Tedesco, Assistant Director
for Licensing
Division of Licensing

Enclosure:
Request for Additional Information

cc w/encl:
See next page

~~8009120199~~ 7pp.

SUPPLEMENTAL REQUESTS REGARDING PLANT FILL

49. Your response to our Request 24 states that if the dewatering system should fail, more than 90 days would occur before groundwater levels would rise to elevation 610 feet, the groundwater elevation at which liquefaction would become a problem. We are concerned that this water level rise might occur over a period considerably less than 90 days in view of the following apparent discrepancies in equations and input parameters:

a. The error function solution to the partial differential equation describing unsteady groundwater flow which you used to determine permeability, appears to be incorrect; the correct form should have a 4 in the denominator, instead of a 2 as you have shown. The correct equation is:

$$h = H\left(1\text{-erf}\ \frac{x}{\sqrt{4K\bar{h}t/n_e}}\right)$$

where:

h = water level rise at $X=0$

H = water head at $X=0$

$\bar{h}$ = average depth of water

erf = error function

K = permeability

X = distance

t = time

n_e = effective porosity

b. In the above equation since $\bar{h}$ is the average depth, its value should lie between h and H. In applying this equation to compute a permeability K of 11 feet per second and a corresponding rebound time of 90 days, you used 0.1 foot for h, 1.6 feet for H, but 20 feet for $\bar{h}$. Use of a smaller value of $\bar{h}$ (somewhere between 0.1 and 1.6 feet) would result in a higher permeability and a rebound time considerably shorter than 90 days.

c. Your value for x in the above equation is 325 feet, which you say is the shortest distance between the critical area and the recharge source, i.e., the distance between the southeast corner of the diesel generator building and the southwest corner of the circulating water intake structure. However, Figure 24-1 shows this distance to be about 240 feet. Use of this smaller value for x will also result in a rebound time shorter than the 90 days which you have computed.

(1) Please justify or correct the above apparent discrepancies and, if appropriate, provide revised analyses to better define the rebound time to be expected following a prolonged dewatering system failure. A more conservative analysis might involve utilizing the recovery data from the appropriate pump tests, i.e., K = 31 fps.

(2) In determining rebound time, it is our position that you should also postulate failure of non-Seismic Category I piping at critical locations. This should include the circulating water conduits.

(3) Demonstrate that there remains adequate time to install and implement a back-up dewatering system to prevent groundwater from rising above elevation 610 feet.

50. Your Response to Request 24 concludes that there is groundwater recharge from the cooling pond in the area of the intake and pump structures because pumping tests at well PD-15A resulted in very lettle drawdown at observation wells SW-1, SW-4 and RR-1. However, for several indicated reasons, you also concluded that there is very little recharge in the area of the discharge structure and one of these reasons is that there is very little drawdown at observation wells PD-3 and PD-20B as shown by Figure 24-14. These appear to be contradictory conclusions (i.e., how can very little drawdown indicate recharge at one location and no recharge at another nearby location?). Provide additional information to support and clarify your conclusion that there is negligible recharge in the area of the circulating water discharge structure. (Also see related Request 47(2)).

51. Your response to Request 24 regarding the area well dewatering system concludes that 22 wells pumping at an average rate of 5 gpm would be needed to remove groundwater stored within the backfill and natural sands. Two more wells are provided for infiltration and pipe leakage. You have not demonstrated whether 24 wells would also be a sufficient number to maintain the area groundwater at the desired elevation following removal of the groundwater already in storage. Provide

additional information to demonstrate that 24 wells will maintain groundwater levels below elevation 610 feet and provide the design basis used for this determination. Additionally, justify your use of 14 percent for an average Significant Yield Coefficient.

52. Your response to Request 24 discusses the source of groundwater which you have determined from pumping tests in the vicinity of the Service Water Pump Structure and the Circulating Water Intake and Discharge Structures. However, no tests appear to have been conducted to determine if Dow Chemical's Tertiary Water Treatment Pond, shown on FSAR Figure 2.1-1A and located just west of the nuclear plant, represents a potential source of groundwater. We are aware of your conclusion that inflow of groundwater from outside the plant area is precluded by the cooling pond dike which encompasses the nuclear plant site; however, you have provided no information to support this conclusion with respect to the Dow pond. Also lacking is information on the details of your West Plant Dike shown on FSAR Figure 2.5-46. Provide information to demonstrate whether the Dow pond is or will be a source of groundwater at your plant site. As a minimum, include the following:

(1) Provide a general description of the Dow pond (size, depth, capacity, purpose, contents, sealing method, etc.). Specify maximum elevation of the water in the Dow pond with relationship to the groundwater levels below the plant. Include a sketch showing distances and elevations of the Dow pond relative to the West Plant Dike.

(2) Provide details on your West Plant Dike. Compare the West Plant Dike to your cooling pond dike, including any similarity in their quality of construction and their source of construction materials. It appears that plant excavation extended to the area where the West Plant Dike is located; discuss whether and how excavation for the plant affected construction of the West Plant Dike.

(3) Provide as-built drawings of the West Plant Dike.

(4) Provide the results of any tests conducted to reach a conclusion on the effect of the Dow pond on the groundwater beneath the plant.

(5) If the Dow pond is a potential source of groundwater, provide analyses of the chemistry of this water (both present and future) and describe its effects on the dewatering system and other underground components (piping, tanks, etc.). Identify any agreements or plans you have to monitor and control the contents or influence of the Dow pond during plant operation.

(6) Provide groundwater elevations in the warehouse area which is located between the Dow pond and the West Plant Dike.

53. Your discussion of the interceptor well system design in response to Request 24 assumed that seepage would flow into a 400 foot slot located 150 feet from the cooling pond. You assumed that part of this slot would be ineffective because the intake and pump structures would cut off part of the seepage from the cooling pond. To account for this cut off, you assumed that the slot would be located 450 feet from the cooling pond instead of 150 feet. This assumption reduced the quantity of inflow to the slot.

Figures 24-9 and 24-10 indicate that 5 to 10 feet of natural sand exists below the intake and pump structures (See Request 47(3)). Consequently, these structures may not cut off or reduce the seepage from the cooling pond. You should therefore recompute total ground-water inflow without any reduction for the structures and recompute the number of interceptor wells required. Reposition and space wells accordingly. Alternately, provide additional information to support your conclusion that the structures serve as positive cut offs.

J. Kane

(17)

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OCT 14 1980

Docket Nos.: 50-329/330 OM

Mr. J. W. Cook
Vice President
Consumers Power Company
1945 West Parnall Road
Jackson, Michigan 49201

Dear Mr. Cook:

SUBJECT: SEISMOLOGICAL INPUT FOR THE MIDLAND SITE

One of the open items associated with our radiological safety review of your application for operating licenses for Midland Plant, Units 1 and 2, and identified in our letter of March 30, 1979, is the establishment of acceptable seismological input parameters. Resolution of this open item is also necessary for approval of the remedial actions associated with the soils settlement matter which was the subject of the December 6, 1979 Order on Modification of Construction Permits.

As noted in your response to our previous requests 361.2, 361.4, 361.5 and 361.7 (Jan 79 | 1977 | June 1979), you consider the Michigan Basin to be a distinct tectonic province for the purpose of evaluating site seismic design input, whereas during the Midland OL review, the staff has found insufficient support that the Central Stable Region can be subdivided into separate tectonic provinces. Your approach using historic seismicity in the Michigan Basin resulted in a Safe Shutdown Earthquake (SSE) characterized by Modified Mercalli Intensity (MMI) of VI, and a Modified Housner response spectra anchored at 0.12g. Discussed below is the staff's current view as to two acceptable approaches, either of which specifies the controlling earthquake from the Central Stable Region and which also requires consideration of soil amplification.

The controlling earthquake we would currently require to be used in determining the SSE for the Midland site is similar to that which occurred in Anna, Ohio in March 1937, and has a body wave magnitude of 5.3 M_{bLg}, and a MMI of VII-VIII. Nuttli, (State-of-the-Art for Assessing Earthquake Hazards in the United States, Report 12, Credible Earthquakes for the Central U. S.: Misc. Paper S-73-1 U. S. Army Engineering Waterways Experiment Station, 1978) using an alternative method has also suggested this magnitude as the "Maximum" when using residual events (those remaining after seismic zones such as Anna, Wabash Valley, etc. are removed) for the Central United States. It is important to note that the July 29, 1980 Kentucky earthquake had a magnitude of 5.1-5.4 M_{bLg} and occurred in a "residual area".

The following alternatives of characterizing the SSE would be acceptable to the staff and are consistent with the staff's Standard Review Plan (SRP) Section 2.5.2:

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The Anna, Ohio earthquake of March 9, 1937 is the largest historic earthquake in the Central Stable Region tectonic province. This earthquake had a MMI of VII-VIII and should be assumed to occur near the site (Appendix A to 10 CFR Part 100, SRP Section 2.5.2). Using this intensity one acceptable approach would be based upon the standardized response spectra of Regulatory Guide 1.60 anchored at 0.19g as determined by the trend of the means of the intensity acceleration values in Trifunac and Brady (Seismological Society of America Bull., V. 65, 1975).

An alternative method of describing the SSE and response spectra resulting from an "Anna" type earthquake assumed to occur near the site involves using the magnitude. As was indicated during the recent OL review on Sequoyah, magnitude may be a more realistic estimate of earthquake size than intensity. Therefore a description of the SSE can also be obtained by collecting representative real time histories for a magnitude of $5.3 \pm .5$ M_{bLg}, epicentral distances less than 25 kilometers at soil sites. Such a collection has been made by Lawrence Livermore Laboratory (LLL, Draft, Seismic Hazard Analysis: Site Specific Response Spectra Results, August 23, 1979) but it would be beneficial if you update this data set as appropriate. It is the staff's position that the representation appropriate for use in establishing the SSE is the 84th percentile of the response spectra as derived directly from the real time histories.

The input for the comparative analysis of your present response spectra (Modified Housner) and Regulatory Guide 1.60 both anchored at 0.12g was at the foundation level. It is our conclusion that the appropriate location for vibratory ground motion input for your Midland site be at the topeof the natural glacial till (essentially the original regional ground surface). Above this till is a thin sand layer which is highly variable in density and the compacted fill that was placed to raise plant grade. Therefore either of our above acceptable approaches will also require an assessment of soil amplification from the till surface.

We are available to meet with you at your earliest opportunity to discuss the above approach in order that acceptable data and methods of describing vibratory ground motion can be utilized for the Midland site.

Contact our project manager, Darl Hood, if you wish to arrange such a meeting or desire clarification of this letter.

Sincerely,

/s/

Robert L. Tedesco
Assistant Director for Licensing
Division of Licensing

*See previous yellow

cc: See next page

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