Testimony of H. Singh

Rec'd 11/12/81 @4:00 p.m

Q.1. What remedial measures did the applicant propose for the Auxiliary Building?

7/85

A. (a) The original remedial measures proposed by the applicant was reported in Interim Report 6, June 11, 1979, MCAR 24, 10CFR 50.55(e). It consisted; (1) Pressure grouting to fill the void (see item 3) under the mudmat of the Control Tower; (2) removing unsuitable backfill materials from beneath the Electrical Penetration Areas (EPA) and the Feedwater Isolation Valve Pits (FWIVP), and replacing them with lean concrete with compressive strength of 2000 lbs per square inch.

(b) On 18 July, 1979, in a meeting with NRC officials in Bethesda, MD, the applicant presented a new plan for the remedial measures for the Electrical Penetration Areas. The new plan called for providing caissons at the extremeties of both the Electrical Penetration Areas. With the caissons' supports at the ends, the EPA's would act as proped cantilevers on either side of the Control Tower, relieving the fill materials under the EPA's from the pressure created by the structure loads, and transmitting them to the competent natural soils through the caissons and to the foundation of the Control Tower. The remedial measures for the Feedwater Isolation Valve Pits remained same as original.

(c) On 5 May 1981, in its meeting with NRC the applicant presented another remedial action plan for the Electrical Penetration Areas. This plan consisted of providing solid concrete support instead of the caissons as mentioned in paragraph (b) at the extremeties of both the EPA's, and also to extend the solid concrete support under the nearby Turbine Building to spread the structure loads on larger foundation areas to keep the foundation pressure under permissible limits.

(d) On 1 October, 1981, in its meeting with the NRC and the Corps of Engineers officials, the applicant presented a plan for the remedial measures for the Auxiliary Building (EPA's and FWIVP's) which was different from the ones mentioned in paragraph (a), (b) and (c). This plan, the most recent one, calls for providing (1) continuous underpinning wall resting on undistrubed natural material, under the external walls of the Electrical Penetration Areas, the Control Tower, and the Feedwater Isolation Valve Pits; (2) three isolated supports to the Control Tower along a east-west line through the center of structure and parallel to its south external cross walls; and (3) underpinning wall supports to the external cross walls of the Control Tower, and also one intermediate cross wall support to each EPA. Attachment . . . . . shows the details of this remedial measures.

Q.2. Did Corps of Engineers evaluate various remedial measures proposed by the applicant, if yes, then what were the results of its reviews?

A. The Corps of Engineers entered an Interagency agreement with NRC in September 1979, to assist the NRC in evaluating the geotechnical aspects of the Midland Nuclear Power Plant. The remedial action for the Auxiliary Building under consideration of that time was to provide caisson supports at the extremities of the Electrical Penetration Areas (See paragraph b, Question No.). Therefore, Corps did not evaluate the original remedial measures proposed by the applicant on 11 June 1979. The remaining three proposals have been evaluated by the Corps of Engineers, and the following are the review comments:

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(ER 105-1-8)

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Resend

(a) Remedial action with caisson supports (proposed on 18 July 1979):

(i) This proposal had effects of transforming the continuously soil supported EPA structures into propped cantilever structures, fixed with the Control Tower at one end and supported on caissons on the other end. Consequently, approximately half of the EPA's loads (approximately 9000 kips) was going to be transferred on the Control Tower increasing the foundation pressure on the compacted fill supporting the structure resulting in additional settlements.

(ii) The design information about caissons: The capacity of each caisson to carry vertical and lateral loads, the capacity of caissons as a group (group effects), settlements of caissons' group, negative skin friction on the caissons due to future settlements of the fill materials in which caissons were to be installed, the bearing capacity and the factor of safety against shear failure of the soils supporting the caissons were not furnished. The Corps of Engineers, in paragraph d(e) of Page 6 of its letter report of 7 July, 1980, requested the applicant to furnish this information. The applicant response provided through Admendment 85 was not satisfactory. The Corps' report of 16 May 1981 (See Q. 42, Page 7) provides the reasons.

(iii) The soil parameters (shear strength parameters of fill materials and glacial till) controlling the design of caissons were not furnished. The Corps of Engineers requested the applicant through NRC to perform soil exploration testing on representative soil samples to obtain shear strength parameters.

(b) Remedial measures with solid concrete support at the extremities of the EPA's (proposed on 5 May 1981):

The applicant has not furnished any design information regarding this scheme after its brief verbal presentation of the scheme on 5 May 1981, in a meeting with NRC, in Bethesda, MD. Therefore, there were no information available to evaluate the adequacy of the scheme.

(c) Remedial measures with underpinning walls (proposed on 1 October 1981):

This is the currently proposed remedial measures. A detailed evaluation of this scheme has been made in Question - 3.

Q.3. Did you evaluate the currently proposed remedial measures for the Auxiliary Building, if yes, then what are the results of your evaluation?

A. The remedial measures currently under consideration to stabilize the portions of the Auxiliary Building (EPA's, FWIVP's and Control Tower) has been described in Paragraph (d) of answer to Question No. 1. The Corps of Engineers has reviewed the applicant's technical report and associated appendices (Attachment No. . . . .) which include the design details. The results of the review are as follows:

a. Bearing capacity of underpinning walls:

(i) The bearing capacity analysis using an average of undrained shear strength of 6.6 ksf is not appropriate. While it provides a conservative design for the underpinning walls which are adjacent to Boring No COE-18, (samples from COE-18 shows shear strength more than 6.6 ksf), it overestimates the bearing capacity of the foundation soils supporting the underpinning walls adjacent to

Boring No. COE-17, since the soil samples from these borings, taken from the potential zone of influence under the footings of underpinning walls, have indicated shear strength much less than 6.6 ksf (shear strength of 5.18 ksf and less). Therefore, it is advisable to proportion the foundation width of the underpinning walls adjacent to COE-17 on the basis of shear strength obtained from tests on samples from COE-17.

(ii) The actual factor of safety against the shear failure of foundation soils under the dynamic load for various underpinning walls have not been furnished.

(iii) The bearing capacity analysis and the resulting factor of safety under drained condition have not been furnished. The consolidated undrained tests have shown that true cohesion of the foundation soils are much less than the apparent cohesion shown by undrained tests. Therefore, it is advisable to verify the ultimate bearing capacity on the basis of drained test results.

b. Settlements:

(i) The settlements for the proposed underpinning walls provided on Page 9 of the technical report have not been demonstrated to be justified by the applicant. The total settlement of foundation soils constitute three parts: (1) immediate settlement at constant volume, (2) consolidation settlement dut to change in soil volume caused by expulsion of excess pore water, and (3) secondary settlement. For highly overconsolidated soil where settlement is primarily the results of recompression, the soil would behave elastically and it would be reasonable to compute settlements using the Young's modulus of the soil. However, such settlement computation does not include the secondary settlement, therefore, secondary settlements should be computed separately using coefficient of secondary consolidation and be added to the immediate settlement.

The applicant's computations for settlements appear to be based on the assumptions that soil is highly overconsolidated, and the settlements will be the results of recompression of foundation soils. However, the applicant has not computed and presented the preconsolidation pressures for the foundation soil to demonstrate that the foundation soils are overconsolidated. Therefore, whether the elastic approach used by the applicant to compute settlements is applicable or not is not known.

(ii) Methods of computing secondary settlements are not presented in the report. It is our understanding the the applicant has used coefficients of secondary consolidation, , determined by the consolidation tests to determine the secondary settlement. However, as mentioned earlier in answer to Question . . . ., since results of consolidation tests are questionable, the determined from consolidation tests are not appropriate for computing secondary consolidation.

(iii) Settlement monitoring during construction:

The applicant's program to insure stability of the existing structures, (EPA's and Control Tower) during the period when some of the soils underlying their foundations will be removed to make room for construction of underpinning walls, consists of monitoring the settlements of the structures at critical points. The applicant's monitoring program presented in its technical report has been reviewed by the Corps of Engineers and the NRC and their review comments were transmitted to the applicant on 30 October, 1981 through a telephone conference (Attachment . . . .).

Q.4. Did you review the Woodward-Clyde consultants' report which included the results of soil exploration and testings of samples taken from the area of the Auxiliary Building? If yes, then what information was included in the report, and what are the review comments?

Ans. a. The volume I of the Woodward-Clyde report concerning the Auxiliary Building was received in last week of September 1981. The report contains the following information:

(1) Boring log information for Boring No. COE-17 and COE-18.

(2) Results of gradation tests of soils from these borings.

(3) Results of unconsolidated undrained (UU) tests.

(4) Results of consolidated undrained ($\overline{CIU}$) tests.

(5) Results of consolidation tests.

(6) Backup materials for UU tests.

(7) Backup materials for $\overline{CIU}$ tests.

(8) Backup materials for consolidation tests.

b. The results of the UU tests on representative soil samples taken from the potential zone of influence (between EL-560 and 570) of the underpinning wall foundations, indicate that soils of Boring No. COE-17 have lower shear strength than those of Boring No. COE-18. Therefore, it will be appropriate to proportion the foundation for the underpinning walls for Unit - 1 EPA and FWIVP, which are closer to COE-17, using the lower shear valve from COE-17. However, the lowest shear strength valve of 2.[illegible] ksf obtained from sample no. S-[illegible] is not correct; the Corps of Engineers concurs with the Woodward-Clyde remark that the low shear strength is the result of sample disturbance. This valve should be disregarded.

c. The drained shear strength parameters (true cohesion C and $\bar{\phi}$) obtained from the $\overline{CIU}$ tests indicate that shear strength of soils, at normal stress at potential failure plane, is lower than their undrained shear strength (Su = 5.18 ksf and more), therefore, in our opinion the bearing capacity of foundation soils should be checked using drained shear strength.

d. Preconsolidation pressures and the over consolidation ratio for the soils in the zone of influence of the underpinning walls have not been determined. Therefore, use of the elastic approach to compute the settlements, which is applicable in the cases where soil is highly over consolidated and the settlement would be the results of recompression, has not been resolved. No volume change during UU tests and development of zero [illegible] to slight negative value for pore pressure parameter, A, at failure loads, indicates indirectly that the soil is moderately over consolidated, however, their definite values are not known.

e. The e-log p curves for the consolidation tests indicate that the inundations of consolidation samples were done at 21 tsf stress. This appears to have considerably influenced the shape of e-log p curves and such the results of the consolidation tests. According to the Corps of Engineers manual EM 1110-2-1906, Page VIII-8, the specimen should be inundated immediately after applying first load increment of .25 tsf. If swelling occurs apply additional load [illegible] until swelling ceases.

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[illegible]	[illegible]	7-5722	[illegible]

On 4 November, 1981, in a meeting with NRC and Corps officials, the applicant clarified some of the discrepancies, however, probably due to lack of time, the applicant was not ready to respond some of the questions which are critical to the safety of the structure during the construction of the underpinning walls. Therefore, the staff could not reach an agreement with the applicant on the adequacy of its settlement monitoring program. The applicant response to question No. 9, 15, 18, 20, 23, 24, 25, 27, 28, 29 and 30 of Attachment No. 4. . ., and their evaluation by the Corps are necessary before providing its concurrence to the proposed settlement monitoring program.

(iv) Long-term differential settlements:

Most of the computed settlement under the underpinngin walls would occur prior to the permanently transfer of the structure loads on the underpinning wall. Nevertheless, because of secondary settlement and part of primary settlement the structures (EPA's and Control Tower) would undergo some differential settlements creating some additional stresses in the structure. The applicant must evaluate these differential settlements and effects such settlement on the structure. In Question 14 of Attachment - 1, Corps of Engineers has requested the applicant to establish the soil spring constant which would help evaluate the stresses due to differential settlement?

Conclusions:

a. The overall concept of the currently proposed remedial measures appears to be satisfactory. The remedial measures, if built satisfactorily, would transmit the structure loads ~~satisfactorily~~ to the competent soil layers, relieving the fill materials from any external load. It will also eliminate the problem of overstressing the foundation soils of the Control Tower, which was inevitable with the previously proposed caisson support. However, a proper foundation design based on actual soil parameters, as mentioned in portions of Paragraph a(i), is essential and the Corps of Engineers would like to review the final design before giving its concurrence.

b. Evaluation of long-term differential settlements based on elastic theory using Young's modulus of the soils is applicable to highly over consolidated soils. The applicant has not yet demonstrated that soils under the underpinning walls are preconsolidated sufficient enough that settlements produced by the load imposed on the underpinning walls will be the results of recompression only, and therefore, the use of elastic theory is justified. Further, the Young's modulus of soils to be used in settlement analysis should be determined from a stress-strain curved obtained from drained tests.

c. Although, the magnitudes and the methods of computing secondary settlements were discussed in 4 November, 1981, meeting in Bethesda, they have not been documented in the technical report. It is advisable to document the analyses including values of "C_α", stresses and thickness of compressible material considered in the analysis.

d. Monitoring of settlements of the structures to be underpinned, and determination of acceptance criteria for settlements, during the construction are of paramount importance for preserving the structural integrity of the EPA's and Control Tower. Therefore, resolution of questions raised by the Corps and NRC staff regarding monitoring program is essential.

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

J. Hart 5/85

NOV 23 1981

P-214

Docket Nos. 50-329 OM, OL
and 50-330 OM, OL

APPLICANT: Consumers Power Company

FACILITY: Midland Plant, Units 1 & 2

SUBJECT: SUMMARY OF NOVEMBER 12, 1981 MEETING ON CONSTRUCTION SCHEDULES FOR FOUNDATION MODIFICATIONS TO AUXILIARY BUILDING

On November 12, 1981, the NRC staff met in Bethesda, MD, with Consumers Power Company (CPCo) to discuss construction schedules needed for the planned remedial actions to the Auxiliary Building at the Midland plant. The remedial action, underpinning, results from the settlement potential of the backfill soils beneath the control tower and electrical penetrations area of that structure. Similar action is planned for the adjacent Feedwater Isolation Valve Pits and was included in the meeting discussions. Meeting attendees are listed in Enclosure 1.

Vice President J. Cook of CPCo reviewed the development history for the proposed remedial action which had initially been based upon use of jacking caissons, but which by September 1981, had been changed to a structural wall extending to the glacial till. Mr. Cook emphasized that the construction schedule for the Auxiliary Building underpinning was critical to the July 1983 fuel load date for Unit 2. For this reason, Consumers had earlier asked the Licensing Board to rearrange the hearing sessions to consider the Auxiliary Building before the Diesel Generator Building session. To prepare for implementing the underpinning, a vertical access shaft on the east and west ends of the auxiliary building and adjacent to each feedwater isolation valve pit and the turbine building needs to be started by mid-December 1981, and a freezewall by December 29, 1981. Staff approval of these two matters were requested by Mr. Cook's letter of October 28, 1981. The schedule for start of drifting beneath the structures is February 15, 1982. Mr. Cook further emphasized that continuing staff review throughout the underpinning process was needed, rather than a traditional two-step staff approval process. He felt that more staff review and observation in the field should be considered to expedite the review process. Review procedures such as that which had been followed during the staff's structural design audit at Anne Arbor, Michigan, in May 20 - 24, 1981, were also recommended.

Mr. D. Eisenhut agreed that staff approval prior to implementing the fix was needed. In view of the construction schedule, he suggested specific approval points by the staff or other conditions be defined based upon the planned construction activities and sequences comprising the underpinning scheme. He noted that establishment of acceptable conditions could assist in the authorization to proceed. It was agreed that a working meeting the following week would be scheduled to this end. To the extent possible, such conditions would be reflected in hearing testimony.

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6 pp.

Mr. M. Miller, Esq., noted that conditions could not be established within the existing schedule for filing testimony (due November 17, 1981) and that Consumers would like to ask the Board to accept a delay of a few days in the filing date. Mr. W. Olmstead, Esq., replied that the staff would not object to such a request.

Messrs. G. Keeley and D. Budzik of CPCo described the preliminary analysis of the Auxiliary Building to be provided for staff review on November 20, 1981. The preliminary analysis will consider selected critical structural members and selected loading combinations. An analysis of the construction sequence for the underpinning scheme will be completed January 1, 1982. The final analysis will be provided for staff review February 15, 1982. It was noted that the latter date corresponds to the start of drifting beneath the structure. The final analysis is primarily for the electrical penetration area and control tower portions of the structure. The analyses for the overall structure will be completed April 15, 1982. June 1, 1982 is the earlist date that the FSAR can be updated to reflect the results of the completed analyses.

At the conclusion of the meeting, and in preparation of the working session planned for November 17, 1981, Mr. Budzik provided the following schedule drawings to the staff's project manager:

(1) Drawing 7220-PPS-020, Revision 0, dated 11/06/81, "Project Production Schedule: Auxiliary Building Underpinning Schedule", sheets 1 and 2.

(2) Drawing 7220-PPS-021, Revision 0, dated 11/06/81, "Service Water Pump Structure Remedial Action - (Underpinning Wall)".

Darl Hood, Project Manager
Licensing Branch #4
Division of Licensing

Enclosure:
As stated

cc: See next page

OFFICE	DL:LB#4 DSH	DL:LB#4	DL:LB#4				
SURNAME	DHood:lb	BDuncam	EAdensam				
DATE	11/18/81	11/19/81	11/19/81				

ENCLOSURE

LIST OF ATTENDEES

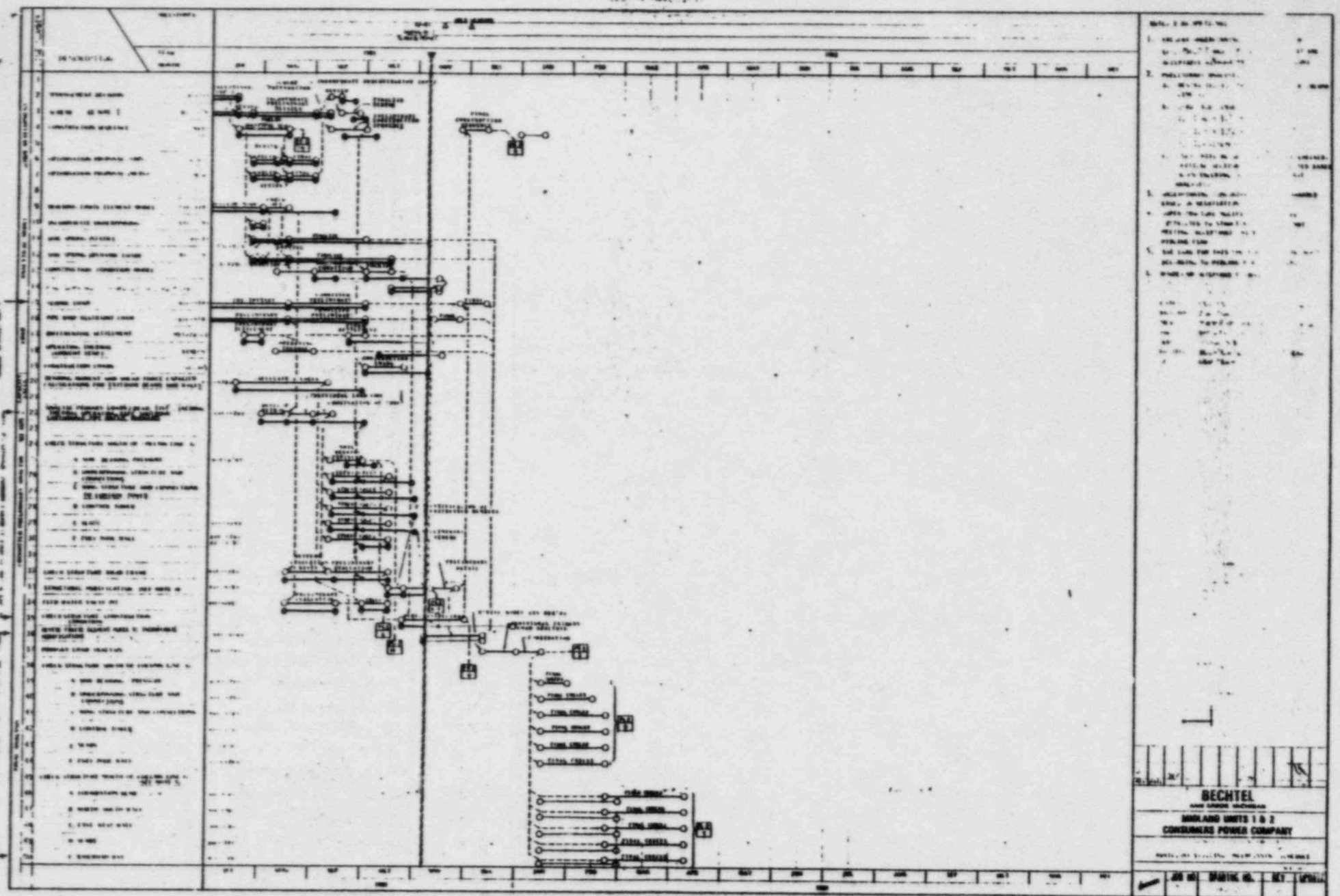
MIDLAND MEETING 11/12/81

NRC

D. Eisenhut
R. Vollmer
J. P. Knight
E. Adensam
W. Olmstead
J. Rutburg
W. Paton
D. Hood
J. Kane
F. Rinaldi
A. Cappucci
G. Lear
F. Schauer
R. Landsman

Consumers

J. Cook
D. Keeley
D. Budzik
M. Miller (IL&B)



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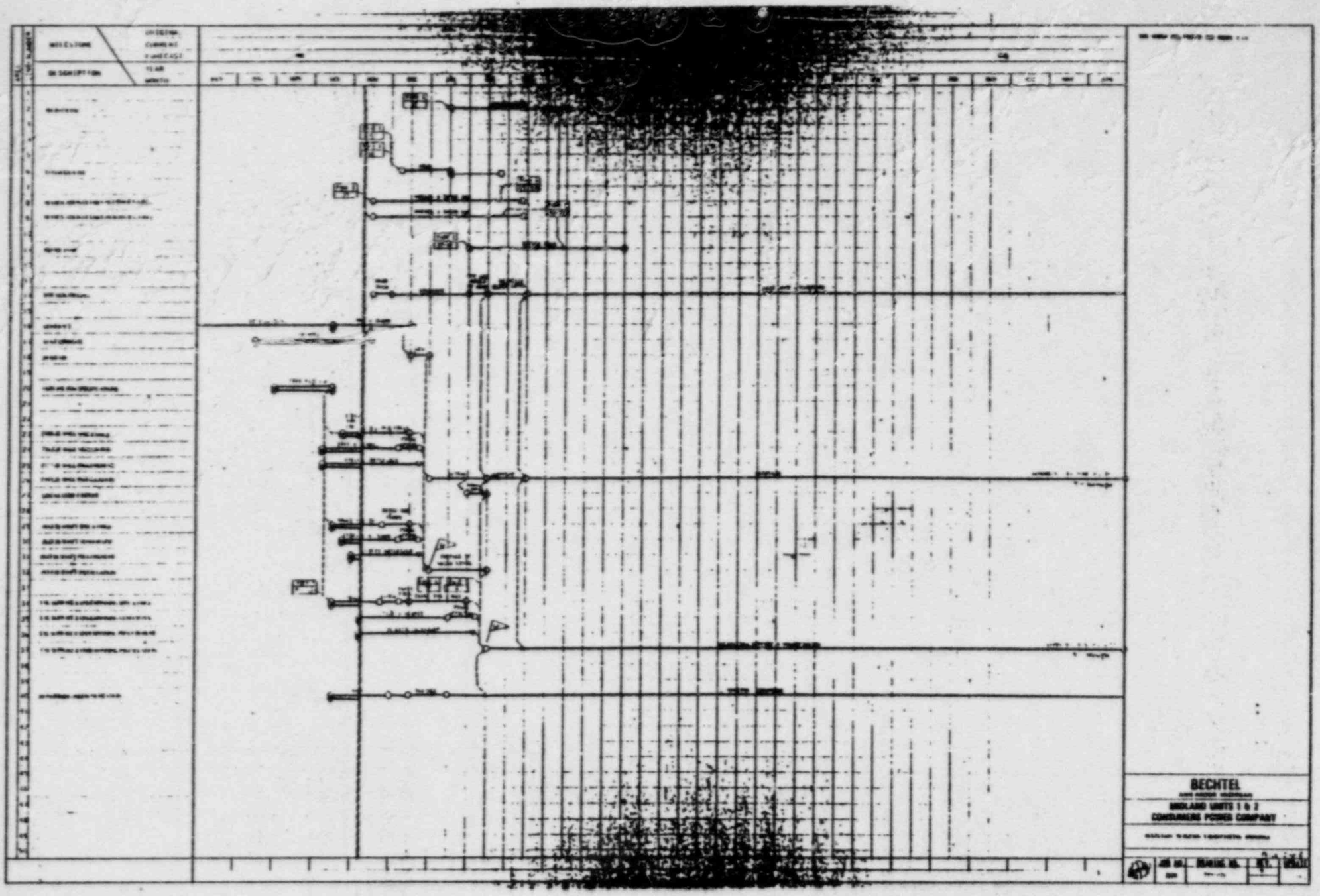
MIDLAND UNITS 1 & 2

CONSUMERS POWER COMPANY



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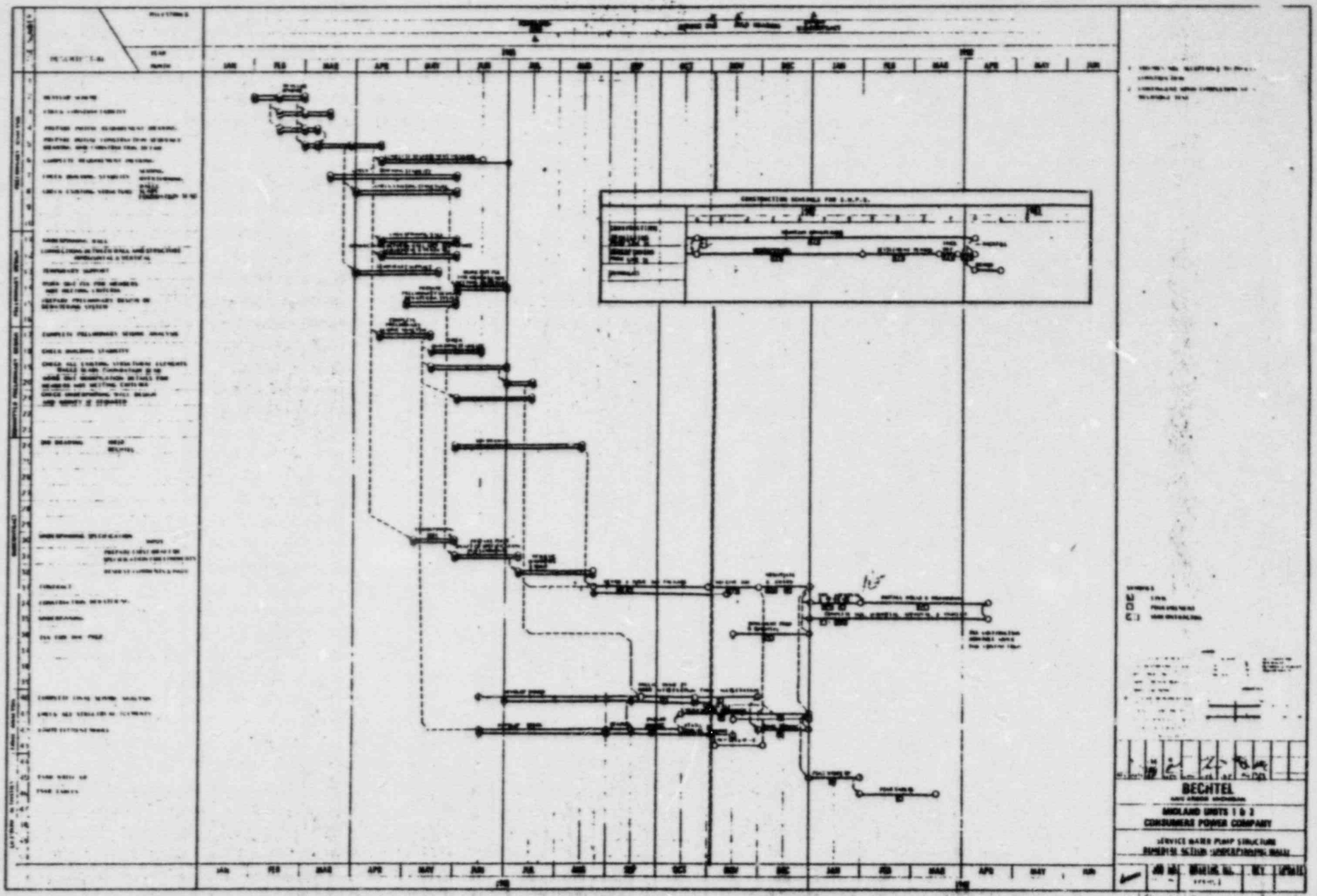
CONSUMERS POWER COMPANY



BECHTEL

MIDLAND UNITS 1 & 2

CONSUMERS POWER COMPANY

MIDLAND - AUXILIARY BUILDING
- Problem w/seismic model between main part of AUXIL. BLDG. & Control Tower

9/B5

Consumers Power Company

James W Cook
Vice President - Projects, Engineering and Construction

General Offices: 1945 West Parnall Road, Jackson, MI 49201 • (517) 788-0453

May 29, 1981

81-02 #3

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

MIDLAND PROJECT -
DOCKET NOS 50-329, 50-330
AUXILIARY BUILDING SEISMIC ANALYSIS
FILE: 0.4.9.48 UFI: 73*10*01, 70*01*11*03, 45*05*20 SERIAL: 12008

Reference: CPCo letters to J G Keppler, Same Subject:

1) Serial No 11200, dated February 20, 1981
2) Serial No 11972, dated April 16, 1981

This letter, as were the referenced letters, is an interim 50.55(e) report concerning the auxiliary building seismic analysis. Attachment 1 provides a status of the planned corrective actions.

Another report, either interim or final, will be sent on or before July 31, 1981.

James W Cook

WRB/lr

Attachment 1: MCAR-47, Interim Report No 3, dated May 15, 1981
"Auxiliary Building Seismic Analysis"

CC: Director of Office of Inspection & Enforcement
Att Mr Victor Stello, USNRC (15)

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

RJCook, USNRC Resident Inspector
Midland Nuclear Plant (1)

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CC: CBechhoefer, ASLB Panel
RSDecker, ASLB Panel
FPCowan, ASLB Panel
AS&L Appeal Panel
MACherry, Esq
MSinclair
CRStephens, USNRC
WDPaton, Esq, USNRC
FJKelly, Esq, Attorney General
SHFreeman, Esq, Asst Attorney General
GTTaylor, Esq, Asst Attorney General
WHMarshall
GJMerritt, Esq, TNKLJ

CC: CBechhoefer, ASLB Panel
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CRStephens, USNRC
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FJKelly, Esq, Attorney General
SHFreeman, Esq, Asst Attorney General
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Bechtel Associates Professional Corporation

030698

SUBJECT: MCAR 47 (Issued 1/29/81)

Auxiliary Building Seismic Analysis

INTERIM REPORT 3

DATE: May 15, 1981

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

Description

During a seismic reanalysis associated with the 10 CFR 50.54(f) plant fill issue, it was noted that the 1977 auxiliary building seismic model considered the control tower and the main portion of the auxiliary building as an integral unit between el 614' and 659'. This assumption may not be appropriate for the north-south direction because of the connection between the control tower and the main structure, which consists primarily of reinforced concrete slabs. The auxiliary building and the control tower were structurally designed to a 1974 seismic model which included flexibility at the connection between the control tower and main structure. Equipment and systems have been seismically qualified using output from both the 1974 and 1977 seismic models.

Potential Safety Implications

This item does not have a safety impact on the stability of the auxiliary building, equipment, structural steel superstructure, or the structure of the main part of the auxiliary building. Potential safety implications have not yet been determined for the control tower, its connections to the main auxiliary building, the electrical penetration areas, or the piping systems.

Investigation

The investigation presented is limited to the new definition of the north-south, 1977 seismic model (FSAR Figure 3.7-10) initiated solely to determine the safety impact of the condition. Because the control tower and the main auxiliary building (el 614' to 659') were modeled as two separate structures connected by a flexible link, this investigation considers possible changes in the building forces and floor response spectra curves. The structural behavior in the east-west and vertical directions would not be affected by this change in the model.

The investigation presented herein does not include the model modification in process to resolve analysis necessary for the 10 FCR 50.54(f) plant fill issue.

The investigation with this model considers:

1) A response spectrum analysis to develop building responses

2) A time-history analysis to develop instructure floor response spectra at selected locations

3) Comparison of building responses to values calculated in 1974 and 1977, and to allowable forces if necessary

4) Comparison of instructure floor response spectra to those generated in 1977, at selected locations, and comparison of loads in selected piping systems and equipment systems to allowable loads if necessary.

The current status of this investigation follows.

1) The response spectrum analysis has been completed.

2) The time-history analysis and selected instructure floor response spectra have been generated.

3) A comparison of the building forces at the base has been made. The total building base moment and shear have increased by 2% and 1%, respectively, values that are not significant with respect to overall building stability. The greatest change in building forces was confined to the structural steel superstructure, the control tower, and the electrical penetration area at el 674'-6" and above. The moment and shear in the control tower, the electrical penetration area, and the slabs connecting the control tower to the main auxiliary building are under investigation. By inspection, the forces in the other portions of the building are acceptable.

4) A comparison of the instructure response spectra curves has been made and indicates that the majority of the floor spectra curves have little or no change. The greatest changes were confined to the structural steel superstructure, control tower, and electrical penetration areas at el 674'-6" and above. The frequencies most affected by this change were between 4 and 10 cps. The maximum increase in acceleration occurred at approximately 6 cps and was 1.6 times the previous spectrum value. In other areas in the building, the new instructure response spectra did not differ significantly from the existing spectra. By inspection, these areas are acceptable.

With one exception, piping systems in the area affected were found to be acceptable. The piping systems that were selected for evaluation were located in the area where the greatest change in seismic loads occurred and where the pipe or hanger stresses were close to

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the maximum allowable before checking the new seismic stresses. The auxiliary steam and turbine exhaust vent stack to the atmosphere is the only system found that will experience substantial increases in loadings. The three supports for the vent stack will need to be checked for an increase in seismic loads. The potential safety impact of the increased load on the hangers has not been determined.

Equipment systems in the area affected were found to be acceptable. Equipment was selected to be checked based on its potential for change. The revised spectra were compared to the spectra used to seismically qualify the equipment, and the equipment still met acceptance criteria.

Corrective Actions Completed

1) During the week ending January 23, 1981, the assumption that the control tower and the main portion of the auxiliary building is a nonintegral unit between el 614' and 659' was incorporated in a modified model of the auxiliary building. Accordingly, this action is complete.

2) The structural response analysis has been completed.

3) The time-history analysis and corresponding in-structure floor response spectra have been generated.

4) A sample of the existing equipment seismic qualification records have been reviewed and found to be adequate for the revised spectrum.

5) The stability of the structure is not significantly affected; therefore, it has been found to be satisfactory.

6) The structural steel superstructure has been checked and found to be adequate.

Corrective Actions to be Completed

1) Complete the investigation of the structural design in affected areas of the structure

2) A sample of the existing piping systems has been reviewed and potential safety impact on three hangers is being investigated

3) Establish whether this is "reportable" based on results of the investigation described above

Root Cause

This omission, the magnitude and implications of which are still to be determined, was not caused by a failure to follow a procedure. All procedures pertaining to the origination, checking, review, and approval of calculations had been followed.

This omission involves a subjective technical determination of the most effective way to mathematically model a physical feature of the structure. The methods and values used were judged to be appropriate for the east-west direction, but detailed design review revealed that the methods and values used did not adequately represent the structure in the north-south direction.

Because these paramaters are specifically and uniquely determined for each portion of the structure, this omission is believed to be a random occurrence with no generic implications. Therefore, there is no generic or process corrective action planned. To support this point, models used in the analysis of safety-related structures were visually inspected, and no geometric situation was identified which would lead to a similar model omission in development of beam properties. Due to the soils problem and foundation modifications, the other models are being reviewed and will be modified if necessary.

Other Activities Not Within the Scope of this MCAR

The scope of this MCAR, which was discussed in the preceding sections, was to define the root cause and conduct an investigation to determine the reportability of this situation. The following items are general descriptions of activities that have been previously identified in the Responses to NRC Requests Regarding Plant Fill. These items involve an extensive reanalysis which includes changes which will correct the omission identified in this MCAR. These activities will continue to be tracked by that previous effort, and are separate from the MCAR.

1) Continue seismic reanalysis of the auxiliary building considering the current building configuration (e.g., tornado shield), present soil conditions, and proposed plant fill remedial action (e.g., caissons under electrical penetration areas). This analysis will incorporate the modified model described in Corrective Action 3 above.

2) From Item 1 above, develop revised seismic forces, moments, and response spectra.

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3) Review existing structural designs, piping systems, mechanical systems, control systems, and equipment qualifications for adequacy to revised items listed in Item 2 above. If this action discloses discrepancies, corrective action measures will be implemented.

4) The affected FSAR Figure 3.10-7 has been identified as subject to change at a later date in the Responses to NRC Requests Regarding Plant Fill.

Reportability

This subject was reported by Consumers Power Company to the NRC as a potentially reportable 10 CFR 50.55(e) item on January 21, 1981. To date, it has not been established whether this item is "reportable" under the criteria of 10 CFR 50.55(e). Reportability will be addressed in subsequent reports based on the results contained in the section entitled "Investigation", above.

Prepared by: D.T. Scribner

Approved by: N. Swanberg

Concurrence by: K.D. Bailey

MIDLAND - SEISMIC DESIGN
AUXILIARY BUILDING

OMB/50.55(e)
10/85

Consumers Power Company

James W Cook
Vice President - Projects, Engineering and Construction

General Offices: 1945 West Parnall Road, Jackson, MI 49201 • (517) 788-0453

81-02 #1

July 31, 1981

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

MIDLAND PROJECT -
DOCKET NOS 50-329, 50-330
AUXILIARY BUILDING SEISMIC ANALYSIS
FILE: 0.4.9.48 SERIAL: 12067

Reference: CPCo letters to J G Keppler, Same Subject:

1) Serial No 11200, dated February 20, 1981
2) Serial No 11972, dated April 16, 1981
3) Serial No 12008, dated May 29, 1981

The referenced letters were interim 50.55(e) reports concerning the auxiliary building seismic analysis. This letter is the final report. Attachment 1 provides a summary of the actions which have been taken to resolve this concern. Final resolution will be demonstrated by the seismic analysis being performed in conjunction with the 50.54(f) concerning soils.

WRB/lr

Attachment 1: MCAR-47, Final Report, dated July 17, 1981
"Auxiliary Building Seismic Analysis"

CC: Director of Office of Inspection & Enforcement
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SUBJECT: MCAR 47 (Issued 1/29/81)

Auxiliary Building Seismic Analysis

FINAL REPORT

DATE: July 17, 1981

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

Description

During a seismic reanalysis associated with the 10 CFR 50.54(f) plant fill issue, it was noted that the 1977 auxiliary building seismic model considered the control tower and the main portion of the auxiliary building as an integral unit between el 614' and 6[illegible]'. This assumption is not appropriate for the north-south direction because of the connection between the control tower and the main structure, which consists primarily of reinforced concrete slabs. The auxiliary building and the control tower were structurally designed using input from a 1974 seismic model that included flexibility at the connection between the control tower and main structure. Equipment and systems have been seismically qualified using output from the 1974 or 1977 seismic models, depending on the purchase date.

Safety Implications

There is actually no potential safety impact on the auxiliary building and its contents because it will be modified under the 10 CFR 50.54(f) remedial soils action and the final design will meet acceptance criteria prior to plant operation. The investigation described in this report was initiated solely to determine the potential safety impact on the "pre" 10 CFR 50.54(f) auxiliary building structure and did not include the structural modifications in progress to resolve the 10 CFR 50.54(f) remedial soils action.

Potential safety implications on the "pre" 10 CFR 50.54(f) remedial soils action structure were determined for equipment and piping as described in this report but were not determined for the control tower, its connections to the main auxiliary building, or the electrical penetration areas.

Investigation

The investigation presented was limited to the north-south, 1977 seismic model (FSAR Figure 3.7-10) because the structural behavior due to seismic motions in the east-west and vertical directions is judged not to be influenced by this change. The control tower and the main auxiliary

building (el 614' to 659') were modeled as two separate structures connected by flexible links, this investigation considered resulting changes in the building forces and floor response spectra curves.

The investigation consisted of:

1) A response spectrum analysis to develop building forces

2) A time-history analysis to develop in-structure floor response spectra at selected locations

3) Comparison of building responses to values calculated in 1974 and 1977.

4) Comparison of instructure floor response spectra to those generated in 1977, at selected locations, and comparison of loads in selected piping systems and equipment systems to allowable loads if necessary.

The current status of this investigation follows.

1) The response spectrum analysis has been completed.

2) The time-history analysis and selected in-structure floor response spectra have been generated.

3) A comparison of the building forces has been made. The greatest change in building forces was confined to the structural steel superstructure, the control tower, and the electrical penetration areas at el 674'-6" and above. By inspection, the forces in the other portions of the building meet the acceptance criteria.

   Based on a preliminary stress analysis of the "pre" 10 CFR 50.54(f) remedial soils action structure, several areas in the control tower and its connection to the auxiliary building were calculated to be overstressed in load combinations with seismic forces. This preliminary analysis distributed the seismic forces to various structural elements using conventional long hand methods. Because this was not a definitive analysis, a conclusion regarding potential safety implication cannot be drawn. The analysis being performed for the building as modified by the 10 CFR 50.54(f) remedial soils action will demonstrate the adequacy of the final design of this structure.

4) A comparison of the in-structure response spectra curves has been made. The greatest changes were confined to the structural steel superstructure, control tower, and electrical penetration areas at el 674'-6" and above. The frequencies most affected by this change were between 4 and 10 cps. The maximum increase in acceleration

occurred at approximately 6 cps and was 1.6 times the previous spectra values. In other areas in the building, the new in-structure response spectra did not differ significantly from the existing spectra and, therefore, by inspection, the components in these areas satisfy the acceptance criteria.

A selected sample of piping systems in the affected area were checked and found to meet acceptance criteria except as noted below. The piping systems that were selected for evaluation were located in the area where the greatest change in seismic loads occurred and where the pipe or hanger stresses were close to the maximum allowable before checking the new seismic stresses. The auxiliary steam and turbine exhaust vent stack to the atmosphere is the only system found that could not meet the acceptance criteria. The analysis of the vent stack system for the increase in seismic loads identified one of the supports that did not satisfy the acceptance criteria. Because this support has a substantial factor against ultimate failure, this does not appear to have a safety impact. The analysis being performed for the 10 CFR 50.54(f) soils issue will demonstrate the adequacy of the final design of this piping system.

A selected sample of equipment in the area affected were found to satisfy acceptance criteria. Equipment was selected to be checked based on its potential for change. The revised spectra were compared to the spectra used to seismically qualify the equipment, and the equipment still satisfied acceptance criteria.

Corrective Actions Completed

1) During the week ending January 23, 1981, the assumption that the control tower and the main portion of the auxiliary building is a nonintegral unit between el 614' and 659' was incorporated in a modified model of the auxiliary building. Accordingly, this action is complete.

2) The structural response spectra analysis has been completed.

3) The time-history analysis and corresponding in-structure floor response spectra have been generated.

4) Selected equipment systems, selected piping systems, the structural steel superstructure, and the stability of the main auxiliary building have been checked.

Corrective Actions to be Completed

1) Demonstrate that the final design meets acceptance criteria. This will be done through the 50.54(f) remedial soils action. The schedule will be established in 10 CFR 50.54(f) responses.

2) FSAR Section 3.7 and Specification 7220-G-7 will be changed upon completion of the 10 CFR 50.54(f) remedial soils action.

Root Cause

This assumption was not caused by a failure to follow a procedure. All procedures pertaining to the origination, checking, review, and approval of calculations were followed.

This assumption involves a subjective technical determination of the most effective way to mathematically model a physical feature of the structure. The methods and values used were appropriate for the east-west direction, but detailed design review revealed that the methods and values used did not adequately represent the structure in the north-south direction.

Because these parameters are specifically and uniquely determined for each portion of the structure, this assumption is believed to be a random occurrence with no generic implications. Therefore, there is no generic or process corrective action planned. To support this, all models used in the analysis of Seismic Category I were visually inspected, and no geometric situation was identified which would lead to a similar model assumption in development of modal properties.

Reportability

This was reported by Consumers Power Company to the NRC as a potentially reportable 10 CFR 50.55(e) item on January 21, 1981. To date, it has not been established whether this item is "reportable" under the criteria of 10 CFR 50.55(e). The final design under the 10 CFR 50.54(f) soils issue will eliminate the safety impliciations (reportability), if any, addressed by this MCAR.

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Rec'd 9/27/83

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September 23, 1983
Project 81907
File 2.0
Ref: 81907-29

Mr. Joseph Kane
NRP Project Officer
U. S. Nuclear Regulatory Commission
Division of Engineering, M/S P-214
Washington, D.C. 20555

Subject: Comments on Applicant's Proposed Findings of Fact and Conclusions of Law on Remedial Soils Issues, dated August 5, 1983
Before the ASLB
Midland Underpinning

Dear Mr. Kane:

Following your request we have reviewed the above-referenced document and provide our comments below on those items relating to the Auxiliary Building and the Service Water Pump Structure. The page and paragraph number referred to precedes each comment.

AUXILIARY BUILDING

#8, #9 ✓ p. 163 ¶216 - The differential settlements that have occurred to date may have developed stresses in the range of 10,000 to 25,000 psi in the reinforcing bars at critical locations in the structure. These stresses are reasonably compatible with observed cracks, with computations by the applicant and with the measured differential settlements. The amount of differential settlement causing the above stresses probably is in the range of 0.1 to 0.15 in., or more, between the north and south side of the Control Structure. Thus small differential settlements of this stiff structure cause relatively high stresses. One cannot interpret the fact that these settlements are small and not unusual as an indication of satisfactory performance without separate justification of that conclusion based on the stresses for which the structure is to be designed.

Check whether R. Landsman has testified as to the void beneath the EPA. Where? Can it be used in NRC Findings?

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#10 ✓ p. 164 ¶219 - The foundation soil of the Main Auxiliary Building and of the proposed underpinning is not a glacial till. The data available indicate that the foundation soils are clays that were deposited in a lake and subsequently loaded by the weight of a glacier. Apparently they were not sheared or otherwise disturbed by the glacial action. The vertical load of the glacier made these clays hard.

The term glacial till refers to "glacial drift deposited directly by ice, without transportation or sorting by water, consisting generally of an unstratified, unsorted...mixture of clay, sand, gravel and boulders" (Stokes and Varnes, 1955). This definition does not apply to the hard clay under the EPA's.

#11 ✓ p. 165 ¶219 - Our understanding is that the 4-ft gap under the EPA will be filled with concrete, not compacted sand, although either would be satisfactory.

#10 ✓ p. 165 ¶220 - The foundation soil of the underpinning wall for the Control Tower also is hard clay, rather than glacial till, as described above.

#10 ✓ p. 169 ¶227 - The Main Auxiliary Building is founded on hard clay, not glacial till.

#12 ✓ p. 170 ¶228 - During construction of an early pier, a load test is to be performed in situ on the bearing stratum.

& #13

The active jacking procedure will be maintained until the time settlement curve indicates that the stage of secondary consolidation has been reached. In addition, certain assumptions have been made about the anticipated long-term differential settlements. Those assumptions should be fulfilled since they are the basis for design. By extrapolation of the measured secondary settlements and the measured differential settlements while the jacks are still active, one can estimate the future differential settlements for this purpose.

✓ p. 170 ¶229 - The differential settlement of 0.25 in. was understood by the writer to mean differential settlement between the north and south sides of the Control Tower, a distance of 47 ft.

#14 [During the recent audit of September 14 and 15, 1983, data were furnished by the applicant which indicated that their previous computations of stresses in the structure were based on the assumption that the 0.25 in. differential settlement would occur between Column Line C of the Auxiliary Building and the south side of the Control Tower, a distance of 150 ft. This assumption is much less critical than that of the writer. The writer's assumption was inferred from the testimony by Burke, Corley, Gould, Johnson, and Sozen.

The implication of the above difference is that the stresses in the structure provided by the applicant for those cases that include differential settlement effects, are smaller than would be obtained if a 0.25 in. differential settlement is imposed across the Control Tower.

During the recent audit, however, the stresses due to this latter assumption were provided by the applicant. The stresses were within code limits for the loading conditions considered. However, they provided no allowance for stresses that may exist after lockoff. In addition, in the loading conditions covered, the effects of the 0.25 in. long-term differential settlement were not taken into account for accident conditions, which may or may not be significant.]

✓ p. 170 ¶230 - The applicant has taken into account only the differential settlement expected after lockoff, as described above. The stresses due to differential settlements to date have been considered to be zero after lockoff, which is not likely to be the case unless the building is lifted during underpinning. Not presently addressed in hearing record

✓ p. 172 ¶233 - The fill under the FIVP's is not expected to be compacted to 95% relative density. The criterion is: compact to 95% of the maximum density determined in accordance with ASTM D-2049 (vibration) or D-1557 (impact), whichever is larger. #15

The underpinning is founded on hard clay, not on glacial till.

The main portion of the Main Auxiliary Building is founded on hard clay, not on glacial till.

✓ p. 174 ¶237 - Not all of the instruments are installed away from the immediate area of construction activity since movements in the immediate area are required to be monitored. Care is needed during construction to avoid damage to some of the instruments. #16

✓ p. 175 ¶237 - There is one gap in the settlement data for this structure. There are no data available, to the writer's knowledge, for settlements that occurred during the first year or so after construction of the Main Auxiliary Building.

p. 176 ¶238 - The writer does not consider the analysis made to be "very conservative." [The readings that have been made to date during underpinning indicate that the computed stresses due to a given movement agree very closely with the measurements.] Some of the loading combinations considered may be considered conservative by some. #17

covered by footnote 452 p. 176

p. 176 ¶240 - It was the intent, during the audits, that if the alert level is reached, every effort should be made by the applicant to prevent the action level from being reached. If the action levels were reached nevertheless, then emergency action would be taken to prevent further displacements.

p. 178 ¶243 - The comments given above detract somewhat from the generality of this statement. In particular, if the existing stresses in the structure due to previous settlements are not removed during underpinning, then the computed stresses in the structure due to the design load combinations will be higher than those computed by the applicant in some critical locations. The underpinning system itself is designed conservatively.

SERVICE WATER PUMP STRUCTURE

#19 p. 181 ¶248 - There are zones in the SWPS where the cracking is consistent with the stresses that would be expected due to the partial weight of the overhang. The north-south differential settlement of 0.25 in. is small. However, this structure is very stiff. Therefore, the magnitude of 0.25 in. is not necessarily small for this structure.

#21 p. 184 ¶254 - The dewatering will be sufficient to prevent blowup into the excavations for the underpinning piers. The 2-ft drawdown below the excavation is the minimum drawdown.

#22 p. 185 ¶258 - A load test will be carried out in the bottom of one of the early piers to check that the compressibility and bearing capacity of the foundation soil is as expected during design.

Sincerely yours,

GEOTECHNICAL ENGINEERS INC.

Steve Poulos

Steve J. Poulos
Principal

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