J. Kane

APR 30 1981

Docket Nos. 50-329/330

MEMORANDUM FOR: Frank J. Miraglia, Chief
Licensing Branch No. 3
Division of Licensing

THRU: James P. Knight, Assistant Director
for Components and Structures Engineering
Division of Engineering

FROM: George Lear, Chief
Hydrologic and Geotechnical Engineering Branch
Division of Engineering

SUBJECT: REVIEW REPORT OF AMENDMENT 85 - GEOTECHNICAL ENGINEERING

Plant Name: Midland Plants, Units 1 and 2
Licensing Stage: Post CP
Docket Numbers: 50-329/330
Responsible Branch: LB-3; D. Hood, LPM
Review Status: Continuing

The enclosed report, dated April 21, 1981, received from our consultant, the U.S. Army Corps of Engineers, is forwarded to DL for docketing.

The enclosed Corps report need not be transmitted to Consumers Power Company for their response at this time because we are presently coordinating this report with other involved NRC Branches and plan to use this report as the basis for discussions with Consumers at the meetings scheduled for May 5 - 7, 1981 in Bethesda. However, Consumers Power Company does have a copy of the report obtained via Deposition of J. Kane on March 26, 1981. See Notice of Meeting, Hood to Miraglia, dated April 16, 1981.

We intend to forward to DL, following the May meetings, a memorandum which modifies the enclosed report based on the results of DE internal coordination and the meeting discussions. Copies of the enclosed report have been provided by J. Kane (HGEB) to the following DE reviewers: A. Cappuci (MEB), F. Rinaldi (SEB), J. Kimball (GSB) and R. Gonzales (HGEB).

Original signed by George Lear

George Lear, Chief
Hydrologic and Geotechnical
Engineering Branch
Division of Engineering

Enclosure: As stated

cc: See page 2

	HGEB:DE	HGEB:DE	HGEB:DE	A/D:CSE:DE
SURNAME	JKane/mc	LHeltemes	GLear	JPKnight
DATE	4/21/81	4/29/81	4/29/81	4/ 7 /81

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APR 30 1981

cc: w/o enclosure
R. Vollmer
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W. Paton
R. Gonzales
F. Rinaldi
A. Cappucci
J. Kimball
J. Kane

w/enclosure
G. Lear
H. Levin
D. Hood

DEPARTMENT OF THE ARMY
NORTH CENTRAL DIVISION, CORPS OF ENGINEERS
536 SOUTH CLARK STREET
CHICAGO, ILLINOIS 60605

NCDED-G

21 APR 1981

Mr. George Lear
U.S. Nuclear Regulatory Commission
Division of Engineering
Mail Stop P-214
Washington, DC 20555

Dear Mr. Lear:

The inclosure containing review comments prepared by the Detroit District regarding Amendment 85 on the Midland Nuclear Generating Plant in partial completion of Interagency Agreement No. NRC-03-79-167 is hereby transmitted to you.

Sincerely,

ZANE M. GOODWIN, P.E.
Chief, Engineering Division

1 Incl
As Stated

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NCDED-G

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As Stated

ZANE M. GOODWIN, P.E.
Chief, Engineering Division

DEPARTMENT OF THE ARMY
DETROIT DISTRICT, CORPS OF ENGINEERS
BOX 1027
DETROIT, MICHIGAN 48231

REPLY TO
ATTENTION OF

16 APR 1981

NCEED-T

SUBJECT: Interagency Agreement No. NRC-03-79-167, Task No. 1 - Midland Plant, Unit 1 and 2, Subtask No. 3 - Review Comments on Amendment 85

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

TO: Mr. George Lear
U.S. Nuclear Regulatory Commission
Chief, Hydrologic & Geotechnical Engr. Br.
Division of Engineering
Mail Stop P-214
Washington, DC 20555

1. The Detroit District has reviewed the information received from the applicant through Amendment 85 to the operating license request, Revision 10 to the 10 CFR 50.54(f) requests. The information received addresses all the questions (Question 39 thru 48) raised by the Corps of Engineers in their letter report which was forwarded to the Nuclear Regulatory Commission on 7 July 1980, which subsequently was transmitted to the applicant on 4 August 1980 for his response.

2. The review comments are inclosed. The purpose of these review comments is to identify the discrepancies noted in the applicant's response and apprise the NRC of the Corps of Engineers views as to the safety of the foundations of the structures deriving support from fill as well as from natural soil.

3. A listing of the specific discrepancies noticed during the review are as follows:

a. The shear strength parameters used in the analyses are not the representative parameters for the soils for which the analyses have been performed. The bearing capacity of the foundation soils for the Borated Water Tanks and the Diesel Generator Building appears to have been done on the basis of the shear strength parameters obtained from the test results on the soil samples which do not represent the soil conditions prevailing beneath these structures.

b. The evaluation of the settlements for the Borated Water Tanks, Diesel Generator Building, Service Water Structure and the Reactor Buildings have

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been based on either assumed values of the Young's modulus or on compressibility coefficients obtained from the questionable preload test.

c. In most of the cases of the settlement evaluations, only the immediate settlements have been considered. The consolidation and the secondary settlements have not been considered. (Reactor Buildings, Service Water Building Foundation, etc.)

4. A listing of the specific discrepancies in the applicants response to Question 39 through 48 are given.

Question 39 - Reactor Building Foundation

(1) Settlement/Consolidation. The applicant's response to Question 39(1) indicates that the settlements due to the dewatering have been computed on the basis of the Young's Modulus of the soil determined from the load-settlement relations between May 17, 1977 and March 11, 1978. The determination of the Young's Modulus using load-settlement requires use of the soil's poisson ratio and the influence factor of the footing. Further, the settlement that occurred immediately after the application of the load should be known and be used. The applicant has not explained how these parameters were determined. The Young's Moduli determined by the procedure shown on page 39-8, should have been used to determine the settlements due to the dewatering instead of using constrained modulus used by the applicant. The Young's Modulus obtained by backfiguring is based on the appropriate confining pressure and as such is appropriate for computing the settlements caused by dewatering load. The consolidation and the secondary settlements have not been added to the total settlement. The applicant should address the primary consolidation settlements and the time for them to occur due to the load caused by the dewatering. Presently, we are not certain whether the information provided in FSAR is enough to evaluate the time-settlement relation or additional consolidation tests will be required. Identify the consolidation test results being used in the determination of the primary consolidation settlements. The applicant should also address the secondary consolidation settlements due to the dewatering load, even though such settlements appear to be negligible due to the high overconsolidation ratio of the glacial till over which the Reactor Buildings are founded.

The applicant should update the observed settlements and loading records as promised in response to Question 362.9 and compare the observed settlements with predicted settlements. He should also develop a technical specification for monitoring settlements, which should establish tolerable, total, and differential settlement limits during the plant operation.

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SUBJECT: Interagency Agreement No. NRC-03-79-167, Task No. 1 - Midland Plant, Unit 1 and 2, Subtask No. 3 - Review Comments on Amendment 85

(2) Bearing Capacity. The shear strength values used in the analysis of the bearing capacity of the soil under the Reactor Buildings were taken from the weighted average of the undrained shear strength of the soil samples obtained mostly from the cooling pond dikes area. A review of Table 2.5-6, (FSAR Volume 3) and the borings by the Michigan Drilling Company indicates that of all the samples tested for undrained shear strength, only one was taken from the area of the Reactor Buildings. Therefore, the shear strength used for the bearing capacity analysis is not representative of the soils on which the Reactor Building is founded. The drained shear strength parameters ($\emptyset$ = 32°, C = 590 PSF) used in design of bearing capacity under static loads, also appear to be based on the average of the shear tests on the samples obtained from the entire plant area. In view of these facts, the response of the applicant is not satisfactory. The applicant must evaluate the shear strength parameters from the soil samples obtained from the soil mass below or near the Reactor Building foundation. The information obtained from the Dames & Moore boring Nos. 1, 2, 3, 4 and 15 might be used to determine shear strength parameters for the bearing capacity analyses of the Reactor Buildings. Limited information available from the tests performed on the samples obtained from these borings are presented in FSAR Volume 4. The applicant might choose to use this information provided he can demonstrate that the test results available are within the depth of influence for estimating bearing capacity.

Question 40 - Diesel Generator Building.

(1) Settlement/Consolidation. (a) The applicant has not furnished the requested information pertaining to the settlements of the Diesel Generator Building. The settlements computed on the basis of the compressibility parameters obtained from the preload test are questionable because of these reasons:

(i) There is questionable evidence to confirm that preload was held long enough to eliminate 100% of the primary consolidation.

(ii) Because of the flexibility of the footings, the surcharge loads were not evenly distributed. The foundation soils with relatively more compressible fill (southeast corner) have been subjected to a load intensity less than that of the surcharge, therefore, the applicant's statement that, "the stresses prevailing during surcharging at all depths in the fill beneath the building exceeded those that will prevail while the structure is operational," is questionable.

(iii) The sudden drop in the piezometer levels after removal of the surcharge is due to negative pore pressures as the soil tries to swell. This is a normal reaction. After swell is complete, the piezometer readings should return to the normal water level in the ground. However, in this situation, they generally return to some value greater than the ground water level which could indicate the presence of excess pore pressures.

The raise in piezometer levels to a height greater than groundwater levels after the dissipation of negative pore pressures are indicative that excess pore pressures were not completely dissipated at the time of surcharge removal. See piezometer 12, 17, 23, 25, 29, 34, 36, 40 and 43.

(2) Bearing Capacity. The bearing capacity analyses for the Diesel Generator Building furnished by the applicant are based on the shear strength parameters (Ø,C), which are not representative of the soil fill beneath the Diesel Generator Building. The numerical values of the angle of internal friction, Ø, and the cohesion, C, were determined on the basis of the results of consolidated undrained tests on five samples taken from the areas of the Tank Farm (Series T borings) and the Transformers (Series TR borings). A review of the boring logs indicates that all of the five samples were obtained from the zones of stiff to hard clay (blowcounts varies from 12 to 19), with dry densities ranging from 114.4 pcf to 117.9 pcf, liquid limits ranging from 20% to 35% and plasticity index ranging from 9 to 20. Three of the samples (T9-8, T16-5, TR2-2) had been overconsolidated to the overconsolidation ratio ranging from 1.1 to 2.2 prior to testing, which stiffened the samples and changed their shear strength characteristics in comparison to those which were not overconsolidated. The basis for doing such overconsolidation test should be given. Thus, it is evident that samples used to determine shear strength parameters are not representative and as such, the information obtained by these tests indicate a soil type which does not exist in the effective Diesel Generator Building area. The soil types beneath the Diesel Generator Building range from layers of soft to hard clay as well as loose to very dense sand. An attempt to determine shear strength parameters by mixing the soil samples from layers of various soil types would result in misleading information as to strength. Selection of samples for testing as requested in 30 June 1980 letter from A. Schwencer to J. W. Cook, should follow the guidance in Regulatory Guide 1.138 paragraph D.5.8, and cover not only the typical foundation condition, but also the extreme and critical zones. The resulting shear strength test results obtained should then be considered in evaluation of the bearing capacity for the foundation soil beneath the Diesel Generator Building.

(3) Preload Effectiveness. As discussed in our review comments on the applicant's response of Question 40-1, the preload program may have not been effective in eliminating 100% of the primary consolidation, under the surcharge load of 2.2 KSF. We are not in agreement with the applicant's statement that the preload program carried out at the Diesel Generator Building has demonstrated to have been successfully completed. The

compressibility parameters obtained from the preload test are questionable and, therefore, future settlement predictions of the Diesel Generator Building based on these parameters should be verified with the results from the requested laboratory consolidation tests. Validity of Figure 27-9 (Revision 6), in which the comparison of measured and predicted settlments is made, is questionable due to the reasons given in our review comments on the response of Question 40-1. Raising of the cooling pond's water level to elevation 627 at the beginning of April 1979, did not saturate the soil up to elevation 625 beneath the Diesel Generator Building during the surcharge, as stated by the applicant. The drops in the piezometer levels to elevation $622\pm$ on removal of surcharge indicates the water table to be at elevation $622\pm$, resulting in considerable capillary action in the fill material below the footing (el = 628). The effect of such capillary action is to resist settlement. A rise in moisture, causing saturation, such as cut-off water during rain, would decrease capillary action causing more settlement. In addition, it has not been established whether the clay fill was installed wet or dry of optimum moisture. If placed the dry side of optimum, the preload, even with the rise of the watertable, may not have consolidated the clay sufficiently to preclude further settlement.

(4) Miscellaneous. The contour map (Figure 40-9) furnished by the applicant in response to Question 40-4, clearly shows warping of both the north and the south walls indicating curvatures created by bending moments. This warping would continue to grow with time, because of the future settlements of the east and the west ends about a rigid pivot in the center provided by the condensate pipe which has been reconnected after the removal of the surcharge load. An analysis of stresses induced by the warping should be performed taking into account the differential settlement over the life span of the plant (40 years). The applicant should refer to the answers for Interrogatory 8 (Nuclear Regulatory Commission staff answer to interrogatory filed by the applicant, 25 February 1981) for the comments on the analyses which are needed to evaluate effects of structural cracks.

Question 41 - Service Water Building Foundation.

(1) Bearing Capacity. The use of drained shear strength parameters to analyze the ultimate bearing capacity of the proposed piles is not justified. The ultimate pile load capacity from the load test would simulate an undrained condition, (even a long duration pile load test would not create a drained condition at the tip of the pile in this case); a static pile load analysis should be performed using undrained parameters. The shear strength parameters used in determination of the side frictions (F_1, F_2, F_3) and point resistance (F_4) are not the representative values for the soil condition prevailing at the locations where the piles will be driven. The same values of ϕ and C are used for sand as well as clay (see sheet 2 of Attachment 41-1). The applicant has used shear parameters for a soil type

which he has created by mixing the test results of samples of Series T, TR and CT. In Attachement 41-1, the depth of fill considered in evaluating F_1 and F_2 is 27.5 feet, but the actual depth of the fill reported in Borings Logs CH-1 through CH-6A (Volume 9 of the applicant's response to 10 CFR 50.54(f) Questions) indicates approximately 45' of fill material in the area where the underpinning piles will be driven. The computations of the ultimate pile capacity should be revised using 38.5' (45'-6.5') of fill instead of 27.5' used previously. The ultimate pile load capacity from the load test, R_u, shown to be 280 tons on page 41-3 should be revised considering the increased negative skin friction due to the increase in the fill material. Further, it appears that the determination of R_u at 280 tons (page 41-1) has been computed by multiplying the design load (100 tons = normal dead plus live loads on each pile) of the piles with a factor of safety of 2.5 and then adding to this value the negative skin friction of 30 tons (computed in Attachment 41-1). However, in our opinion the above approach of evaluating the ultimate pile load capacity from the load test is not correct. The factor of safety of 2.5 must be applied to the external load of 100 tons on the pile top plus the computed skin friction and the product then be added to the skin friction again [2.5 (100 tons + NSF) + NSF].

(2) Settlements.

(a) Paragraph 1 of the applicant's response to Question 41, Part 2a indicates that vertical load on piles was calculated based on an appropriate spring stiffness of the underpinning piles and the subgrade modulus of the mat foundation resting on natural soil. However, in our opinion, the stiffness of the cantilevered portion of the Service Water Structure will be a factor in computing the underpinning pile load. Provide total computed pile loads due to dead and live loads as well as total vertical and horizontal loads due to seismic actions, along with the detailed analysis for the spring stiffnesses of the underpinning piles. The settlement values provided by the applicant indicates a time dependent settlement of 0.1 inch for the portion of the Service Water Structure founded on glacial till and 0.05 inch for the portion to be supported on underpinning piles. The analyses for these settlements have many questionable assumptions and rationalizations such as:

(i) Application of pile loads over an area of 15' x 3.5' (sheet 5 of 6 Attachment 41-2) at the tip elevation is not appropriate. According to Bjerrum et al (1957), such a simplified method underestimates the settlements.

(ii) It is not known whether the soil moduli used in the analyses are for drained or undrained conditions. For a long term settlement, soil modulus for drained condition should be used.

(iii) The simplified approach used by the applicant is used in conjunction with one dimensional consolidation theory.

(iv) Secondary settlement has not been considered in evaluation of long term settlement.

(v) The applicant's planning to jack the underpinning piles after the dewatering settlement takes place is not realistic. Dewatering settlement is a time-dependent settlement and it might take many years to complete. The dewatering settlement of the area under the pile tip is estimated to be 0.48 inch (sheet 3 of 6 Attachment 41-2, Line 2), but it is not known what compressibility parameters were used to compute this settlement. In view of these facts, the differential settlement problem still remains unresolved. The approach outlined for computing settlement of pile group in Pile Foundation Analysis and Design, Paulos and Davis, John Wiley and Sons, may be used.

(b) The analyses indicating a factor of safety of 2.2 against failure for the slope behind the retaining wall near the Circulating Water Intake Structure is based on soil parameters that may not be applicable to the type of fill material behind the wall. The applicant should base the analyses on the representative shear strength parameters from the test results on samples taken near the retaining walls. A thirty feet (30') distance between the top edge of the failure plane and the nearest safety related Diesel Fuel Storage Tanks shown in Figure 41-4 does not appear adequate. Provide, (1) the groundwater condition considered in the analysis, (2) loading conditions (e.g. earthquake, seepage, drawdown, etc.) considered in the slope analysis which resulted in the safety factor of 2.2, (3) the identifications of boring logs, soil samples and the laboratory test results which are the basis for the allowable shear strength parameters provided on page 41-6.

(3) Seismic Analysis.

(a) and (b). The analyses furnished and the additional work the applicant has committed to perform would insure the seismic safety of the foundations, provided the representative soil parameters have been used in the analyses.

Question 42 - Auxiliary Building, Electrical Penetration Areas and Feedwater Isolation Valve Pits.

(1) Settlement. The applicant's response that "Settlement of the Feedwater Isolation Valve Pit (FIVP) and the caisson of the Electrical Penetration Area (EPA) will be identical" is not correct. The caissons of the EPA and the concrete fill of the FIVP would not act monolithically. The continuity of the top few feet of the FIVP concrete fill around the casings of

the caissons in the FPA would not establish adequate structural bond between concrete fill and the caissons. In the case it happens, the poor soil fill around the caissons below the concrete fill is still compressible and the problem still remains unsolved.

(2) (a) Temporary Dewatering System - The Corps is in agreement with the applicant's response.

(b) Figure 42-68 shows the location of the access shaft. However, the location and the dimensions of the drift are not shown. The technical specifications for the work provided in Attachment 42-2 do not specify anything about the drifts. Item 3b of Attachment 42-2 indicates that the caissons will be extended at least 4' into the till; with this constraint the caissons' tip might end up with different elevations because of the sloping natural till surface caused by the foundation excavation of the containment buildings. In the design of the bearing capacity of the soils under the caissons tip, the effect of this factor has not been considered. Item 3d, states that the caissons should have a vertical resistance capacity sufficient to produce a static moment of at least 325,000 foot-kips at column rows 5.3 and 7.8. The meaning of this statement is not clear. Item 4 of Attachment 42-2 provides a very brief outline of caisson load testing. But it is not clear what remedial measures will be taken if a completed caisson fails to meet the load test. A caisson filled with concrete cannot be driven further. An empty shell test (EST) by loading to 1.0 times the design load prior to placing concrete appears unrealistic, because with only 4' penetration in glacial till it is not possible to obtain frictional resistance adequate to perform load test with 1.0 times the design load (frictional resistance of fill should be neglected for load test). In item 5.2.1e, the applicant proposes to complete, test and wedge each caisson tight to the structure under a load equal to 1.5 times the design load, on a one by one basis. This procedure does not appear feasible; a previously wedged caisson under the bottom of the structure might be released when jacking for next caisson is applied under the structure.

(c) Temporary Surface Support - The response of the applicant for the temporary support system for the valve pit is vague. Additional design information should be provided to assess the stresses on members required for temporary support.

(d) The applicant's response indicates that the caissons capacities have been determined on the basis of the shear strength parameters, determined from the soil samples obtained from other areas. On sheet 3 of 6 Attachment 42-3, in the equation for ultimate bearing capacity, Q_f, the last term accounts for the contribution due to adhesion between the caisson surface and the soil. The cohesion value 6 K.S.I. used in this term must be

NCEED-T
SUBJECT: Interagency Agreement No. NRC-03-79-167, Task No. 1 - Midland Plant, Unit 1 and 2, Subtask No. 3 - Review Comments on Amendment 85

multiplied by a reduction factor, α, to obtain the adhesion. For stiff clay as encountered at the tip of the caissons, using the full value of the cohesion as adhesion is not justified. Also, in computing load at the base of each caisson, the concrete fill and the soil between the caissons should be considered. This will have an effect of reducing the factor of safety. In case of an earthquake, an undrained condition would prevail in the soil around the caissons, therefore, an analysis for the caissons' group capacity and factor of safety based on an undrained condition are required. The applicant has not performed analysis for the caissons group capacity, considering the SSE earthquake. It is our understanding that the 4,000 kips, which the caissons have to transmit to the glacial till, do not include dynamic load due to a potential earthquake.

(e) Settlement of Auxiliary Building due to change in water level during dewatering. See review comment of 42(1).

(f) The applicant's response is acceptable.

(g) The applicant's response is acceptable.

Questions 43 - Borated Water Tanks.

(1) Settlement. Since the soils beneath the tanks consists of not only granular type but also clay, the major part of the settlement will be consolidation settlement and secondary settlement. Consolidation and secondary settlements are time-dependent and might continue for the full operation life of the tanks. Therefore, settlement measured from full scale load test, as proposed by the applicant would not provide the accurate settlement. To accelerate the settlements, the tank must be surcharged with a load considerably more than the load which it has been designed to carry. However, because of the tanks fixed volumetric capacity, the surcharge load cannot be increased in excess of its design load. Blowcount plots shown in Figures 31-3 and 31-4 show variations in blowcounts from a minimum of 6 to a maximum of 43 in the area of the East Borated Water Tank, and from a minimum of 4 to a maximum 57 in the area of the West Borated Water Tank, indicating that soil layers of variable density and consistency exist under the tanks. Therefore, the information obtained from plate load tests cannot be used to determine the settlements. The application of the theory of elasticity requires soil moduli for drained and undrained conditions to determine time dependent and immediate settlements. It is not known what values the applicant has used to determine the differential settlements. To review the differential settlements, the numerical values of Young's modulus of the soils and the methods used to determine them are required. Secondary settlements also need to be evaluated to determine the structural adequacy of the tank bottoms.

NCEED-T
SUBJECT: Interagency Agreement No. NRC-03-79-167, Task No. 1 - Midland Plant, Unit 1 and 2, Subtask No. 3 - Review Comments on Amendment 85

(b) The differential settlement of 1-1/2", using elastic plate theory, appears to be computed on assumed value of soil moduli; therefore, it does not present the potential differential settlement. The soil moduli ranging from 260 kips per cubic foot to 490 kips per cubic foot used to determine differential settlements for the ring walls are not realistic for the soil conditions prevailing under the tanks. The above values of soil moduli are applicable to soils with consistencies ranging from very stiff to very hard. Under the Borated Water Tanks, the soil consistencies vary from soft to very stiff. Provide actual settlement records of the Borated Water Tanks, and indicate the effect the settlement has on the piping between the tanks and the Auxiliary Building. The records should include the loading history.

(2) Bearing Capacity. The shear strengths used in the analysis of the bearing capacity of the soils under the Borated Water Tanks are not appropriate to the soils conditions prevailing under the tanks. Figure 35-3, used to obtain the undrained shear strength, was constructed from the results obtained from the tests on the soil samples taken from the various locations of the plant area. These samples had densities ranging from 114.6 pcf to 131.3 pcf, water content 9.3% to 16.2%, and liquid limits ranging from 18% to 35%. Thus, the samples were not identical, and therefore, shear strengths obtained from Figure 35-3 are misleading. It is advisable to compute the bearing capacity of the soils using the soil parameters of the soil beneath the tanks. Attachment 43-1 shows the bearing capacity analyses. On sheet 2 of Attachment 43-1, there appears to be some computational error in evaluating effective confining pressure. The $\bar{\sigma}_v$ (617) should be the average of pressure at elevation 600 (bottom of fill) and elevation 635 (top of fill). Also, the numerical value of 0.55 for the coefficient of lateral pressure at rest, K_o, is for over consolidation ratio (OCR) 2 which should not be used for fill material. A OCR of 1 is appropriate for the fill material, the K_o for this OCR is 0.49. The applicant should perform analysis for the factor of safety using the results from the shear testing of the soil samples taken near the Borated Water Tanks area and within the depth zone influenced by the bearing capacity analysis.

Question 44 - Underground Diesel Fuel Tank Foundation Design

(1) Bearing Capacity. The applicant's response is acceptable.

(2) Settlement: Although the soil under the Diesel Generator Building and under the Diesel Fuel Storage Tanks are of the same classifications, their strengths, compressibilities and the permeabilities are not necessarily the same in numerical values. The use of classifications to evaluate the fundamental properties (shear strengths, compressibilities, and permeabilities) is not a sound engineering practice, particularly for the use in design of a Category I Structure of a nuclear power plant. The settlement

evaluation of the Diesel Fuel Storage Tanks performed by the applicant by comparing the soil classifications under the Diesel Fuel Storage Tanks with those under the Diesel Generator Building are not acceptable. In addition, boring log DF-5 (Figure 33-1) indicates a layer of loose sand below the pads, which is susceptible to densification resulting in some settlement under a dynamic load. Therefore, settlements due to dynamic load should be estimated.

(3) Uplift Pressure on Tanks. The applicant has not performed any analyses to demonstrate the effect of uplift pressure on the stability of the tanks. The stability of the tanks in uplift cannot be assured unless the applicant can demonstrate, by analysis, that an acceptable factor of safety against uplift of the tanks does exist. The applicant is requested to provide the results of the analysis for uplift resistance.

Question 45 - Underground Utilities

(1) (a) Settlement - From the applicant's reponse it appears that it has no plan to perrorm inspection of the interior of the water circulating pipings for cracks and openings after the removal of the surcharge load as requested in part (1)(a) of Questions 45. The applicant has made reference to the measurements of the deformations during surcharge for line 96-2YBJ-4, which was reported in response to Questions 19, 10 CFR 50-54(f). However, it has made no attempt to compute the pipe stresses from the measured deformations, and as such the measured deformations do not provide any information regarding the adequacy of the pipe. In absence of the requested information, it is not possible to check the adequacy of the pipings which were affected by the surcharging of the Diesel Generator Building.

(b) Duct Banks - The applicant's response to Question 7, 10 CFR 50.54(f), indicates that reinforcing bars in the duct banks had exceeded the yield strain under the building load which the duct banks carried prior to their isolation from the walls of the Diesel Generator Building. This implies that permanent deformations have occurred in the reinforcing bars and cracks wider than normally permitted in reinforced concrete structures have already developed in the duct banks. In response to Question 30, 10 CFR 50.54(f), the applicant has provided the results of its seismic analyses for the duct banks, but it is not known whether or not it has taken into account the effects of permanent strains in the reinforcing bars created by the previous load. This aspect should be further reviewed by the appropriate engineering section of the Nuclear Regulatory Commission.

(c) Buried Piping - Applicant has stated it will respond after cousultation with the NRC.

NCEED-T
SUBJECT: Interagency Agreement No. NRC-03-79-167, Task No. 1 - Midland Plant, Unit 1 and 2, Subtask No. 3 - Review Comments on Amendment 85

(d) We concur with the applicant's response, except the response to Question 45(d)(1). In the applicant's response to Question 45(d)(1), the last column in Table 45-1, which is entitled "Building Displacement to Pipe (1)," gives minimum rattlespace requirements at penetrations of Category I free-field piping supported on plant fill into various structures. In that column of the table, the quantities given for the eight penetrations of the Diesel Generator Building are "V < .015 inch and H < 0.03 inch." For the nine penetrations for the Auxiliary Building, the quantities given are "V < .036 inch and H < 0.129 inch." These numbers seem much too small. What the ranges imply is that less than 1/8 inch relative displacement is expected between the building and the nearby free field. The applicant should provide detailed information as to (a) the sources of the numbers mentioned above, (b) describe how they were computed, (c) what percentage of the free-field maximum displacement implicit in the shock spectrum or of the displacement obtained by double integration of the free-field acceleration are these rattlespace values. In addition, we are addressing the following two review comments to the applicant for his response.

(1) Since the structures are quite stiff, most of the relative movement between the pipe and the structure that would occur in a seismic event would be due to relative movements between the base of the structure and the free-field at the elevation of the penetration. Relative movements of the free-field at the two levels could be roughly estimated by $H\ V_{max}/V_s$ where H is the vertical distance between the base of the structure and the penetration, V_{max} is the free-field maximum particle velocity, and V_s is the shear wave velocity of the fill. Alternatively, the effect of an H/V_s time shift in a free-field ground motion vs time plot could be used to compute relative displacement of two points in the free-field. In addition, for heavy structures the question of whether the structure foundation moves with the free field should be considered.

(2) Table 45-1 indicates that everywhere there is much more than the applicant's stated minimum rattlespace requirements, but there are a few places where clearances "C" are less than 1 inch. This is an unacceptable situation, in our opinion. Some future settlement of the plant fill (under its own weight) in the nonsurcharged areas is to be expected. The pipes will move downward further reducing "C." After consideration of the original source for minimum clearances given in Table 45-1 and the range of numbers for the analyses suggested above, the applicant is requested to provide revised minimum clearances and state the action to be taken to achieve them.

(e) The applicant's response that "the analysis of the settlement stresses in the piping is unrelated to the properties of the supporting materials" is correct. The evaluation of the stresses using the radius of

curvature computed from the measured deflections of the piping from their original positions, does not require soil properties of the bedding on which the pipes are laid. However, to review of the stabilities of the pipes near supports it is necessary to know the support conditions. Therefore, we are reiterating our request that the applicant should furnish the requested information in Question 45(1)(e).

(f) The applicant's response to Question 45(1)(f) is not satisfactory. The shear strength parameters used in the analysis of slope stability of the dikes may not be representative values for the soil conditions prevailing in the soil mass of the dikes. The value of the angle of internal friction, Ø, used in the total stress analysis has been manipulated from the Ø (drained condition) given in FSAR Table 2.5-22 rather than using the actual value obtained from the test results on samples taken from the dikes, or from the test results of the record samplings. The values of the shear strength parameters provided in Table 45-2, page 45-7, are basically taken from the FSAR Table 2.5-22, which are assumed values for the design. Thus, the applicant has not demonstrated that the shear strength parameters of the soil mass in the dikes are identical or better than those of the assumed values for the design of the dikes. The applicant has further attempted to justify the soil parameters selected on the basis of the average blowcounts (Figures 45-4 thru 45-10) of the standard penetration test (SPT). The tests for this area (except boring No. P2-5) do not provide blowcount information for top 15' height of the dikes. As a matter of fact, except boring Series P2 involving five borings across one particular cross section of the emergency cooling pond dike, all of these tests were carried out in the natural soil, therefore, they provide no information about the fill material of the dikes.

Question 46 - Cooling Pond

(1) Emergency Cooling Pond. In paragraph 1 of the response, the applicant has referred to its submission of September 14, 1980, and has stated that as pointed out in the submission, the compaction to construct the cooling pond dike was different from the problem fill in the power block area. A review of the applicant's submission of 14 September 1980, indicates that it has no intention to furnish the requested information. The explanations provided in the submission against making additional borings as requested by the staff has no engineering merits. The applicant has taken no record samplings at all to verify the design assumptions as to the shear strength parameters. It has performed no field control tests for compacted soils in dikes above elevation 620±. The boring logs of the standard penetration tests (SPT), through the dike's fill material conducted for the installation of the piezometers, show no blowcount numbers above elevations 620± with one

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SUBJECT: Interagency Agreement No. NRC-03-79-167, Task No. 1 - Midland Plant, Unit 1 and 2, Subtask No. 3 - Review Comments on Amendment 85

exception which is boring No. P2-4 where a blowcount number of 7 has been recorded at elevation 625.7±. Thus, the results of the standard penetration test furnished by the applicant provide no information regarding the soil conditons for approximately the top 15' of the dikes. Further, the blowcount records from boring No. P1-2 and P1-3 (see boring logs furnished with the response to Question 46) indicate soft clay in the east dike below elevation 620. In absence of the requested information, it is not possible to review the applicant's response.

(2) Operating Cooling Pond - The applicant's response to Question 46(2) is not satisfactory. Our comments on the response to Question 46(1) are applicable to this question. In addition, the averaging of the blowcounts, which varies from a minimum of 4 (see boring log 611 in Figure 45-6) to a maximum of more than 100 for clays and silt and from a minimum of 10 to a maximum of more than 100 for sand, would provide totally misleading information as to the strength of the soils. Averaging of the blowcounts is acceptable, if all the blowcounts belong to one particular consistency or relative density group. The method adopted by the applicant would not allow for locating weak and strong stratifications of the soils.

We concur with the remaining portions of the applicant's response to Question 45(1)(f). If the appropriate values of shear strength parameters are used, the analyses performed would assure the seismic safety of the foundations of the two Category I reinforced concrete return pipes.

Question 47 - Site Dewatering

(1) (a) We concur with the applicant's response.

(b) The additional work the applicant has committed to perform in its response of this question will assure the seismic safety of the foundations of Category I structures, deriving support from the plant fill. Therefore, we concur with the response.

(c) The remedial measures completed, and the additional work the applicant has committed to perform, would provide definite data on the adequacy of the analyses that the applicant has relied on to demonstrate safety. For example, this will verify whether or not there are more than 90 days recharge time to reach elevation of 610 as calculated by the applicant in his response to Question 24(a), 10 CFR 50.54(f).

(2) In its response to Question 47(2), the applicant has presented results of the pumping tests and hydrographs (see Figures 47-7 and 47-8) to demonstrate that the plant fill south of the Diesel Generator Building is an

effective barrier to the inflow of the cooling pond water. However, none of these test results can substantiate that the plant fill is an effective barrier. The results indicate that inflows of water from the south side is less than that from the area of the Service Water Structure. However, since the applicant is planning to monitor the water elevations in plant areas, and to perform a full scale test (last paragraph of response to Question 47(1)c), the seepage from the south end will also be accounted for, and if the test indicates more than 90 days recharge time to reach the elevation of 610, the dewatering system will be acceptable.

(3) The applicant has revised the analyses for the inflow in the line-slot on the basis of a combined gravity-artesian flow to design the dewatering system. However, it has reduced the value of the permeability of the aquifer from 31' (used in the previous analysis) to 17' per day obtained from the pumping test of the well No. PD-15A which is the nearest to the locations of the proposed dewatering wells. The method of analysis furnished by the applicant is acceptable to the Corps of Engineers. But the validity of using a reduced permeability of 17' per day should be further reviewed by the appropriate section of the NRC.

(4) The filter pack gradation requirements provided on page 47-12 of the response, appears to have been designed for a aquifer material gradation determined on the basis of the boring logs of Series PD borings. What measures (established gradation of soils with depth interval of screens, modify filter pack gradation) will be required during the well installations and during production pumping to prevent infiltration of soil fines from material finer than the gradation submitted in Figure 47-12?

Acceptance criteria of sand in discharge from an individual well after the completion of its development given on page 47-14 (10 PPM or less) does not provide any information regarding the amount of erosion that will take place over the 40 year life span of the plant. Provide flow rate, sand in flow in terms of PPM (taken at some interval), and quantity of total sand pumped during the development of the wells on the basis of each individual well as well as on the basis of total number of wells. Also provide the criteria of sand in discharge related to flow rate of a single well as well as of the entire system of wells during the production pumping including an estimate of volume of sand material removed in one month and during the 40 year plant life based on your submitted criteria.

(5) We concur with the applicant's response.

(6) The quantity of chemicals in groundwater shown in Table 47-3 indicates the possibility of early incrustation (high percentage of $CaCo_3$, Ph > 7.5, etc.). Therefore, the applicant's maintenance program should also

consider periodical cleaning of the incrustations by an acceptable method. We concur with the rest of the work the applicant has committed to perform in his maintenance program.

(7) We concur with the applicant's response.

(8) We concur with major part of the applicant's responses. However, in our opinion the high percentage of $CaCo_3$ shown in Table 47-3 indicates early possibility of incrustation, and the applicant should stipulate a remedial measure in its maintenance program by periodical cleaning.

48 - Seismic Analysis of the Structures on Plant Fill Material

(1) (a)(b)(c) The seismic analyses which have been completed, and the additional work the applicant has in process, or committed to perform, will either (a) assure the seismic safety of foundations of the Category I structures deriving support from the plant fill or, (b) provide definite data on the adequacy of the analyses that the applicant has relied on to demonstrate safety. However, in case of the Diesel Fuel Storage Tank Foundation, we disagree with the applicant's response. A seismic investigation as to the settlement of the loose sand indicated by boring DF-5 needs to be investigated.

(2) (a)(b)(c) The applicant has furnished the requested information, and we are satisfied with the applicant's response.

5. If you have any question regarding our review comments, please contact Mr. H. N. Singh of our Geotechnical Section at FTS 226-2227. Resolution of discrepancies and concerns will depend on the expeditious receipt of the information mentioned in our review comments in paragraph 4.

FOR THE DISTRICT ENGINEER:

Bosey Mills for
P. McCALLISTER
Chief, Engineering Division

J Kane
Recd 2/25/81
@ 1:40 pm.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	Docket Nos. 50-329-OM
	)	50-330-OM
CONSUMERS POWER COMPANY	)	50-329-OL
(Midland Plant, Units 1 and 2)	)	50-330-OL

NRC STAFF'S ANSWERS TO INTERROGATORIES FILED BY CONSUMERS POWER COMPANY

Interrogatory 1

Define "acceptance criteria," as that term is used at page 3 of the Order.

Answer

Acceptance criteria are the standards on which a judgement or decision is based. As used in the December 6, 1979 Order on Modification, the standards to be used by the licensee to make its judgment or decision that proposed remedial measures are acceptable was sought by the NRC for its review. This information was required to be submitted by the licensee in order for the NRC to determine whether there was reasonable assurance that the facility, as modified by the proposed remedial measures, can be constructed and operated without undue risk to the health and safety of the public.

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23pp.

The NRC practice in performing radiological safety reviews is such that the term "acceptance criteria" has a wide meaning and it is this broader meaning that applies as the term is used within the Order. The NRC practice is to use a document entitled "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," NUREG-75/087, for the radiological safety review of applications for licenses of nuclear power plants such as the Midland Plant. Each section of the Standard Review Plan (SRP) is organized into four subsections, and one of these subsections is entitled "Acceptance Criteria". This subsection contains a statement of the purpose of the review and the technical basis for determining the acceptability of the design or the programs within the scope of the area of review of the SRP section. The technical bases consists of specific criteria such as NRC Regulatory Guides, General Design Criteria Codes and Standards, Branch Technical Positions, and other criteria. This subsection is further discussed in the first section of the Standard Review Plan, which is entitled "Introduction".

To illustrate the term "acceptance criteria," refer to SRP Section 2.5.4II, page 2.5.4-3 and Section 2.5.5II, page 2.5.5-1. SRP Section 2.5.4 is entitled "Stability of Subsurface Materials and Foundations," and SRP Section 2.5.5 is entitled "Stability of Slopes." From these examples it is seen that "acceptance criteria" for the pertinent geotechnical review areas would include, for each specific and important engineering feature, a thorough evaluation of the particular engineering aspect based on analyses of basic data that support all conclusions. These analyses and basic support data are required to allow the Staff to conduct independent analyses and reach

independent conclusions on whether reasonable assurance of plant safety exists.

Interrogatory 2

State which "of the Staff's requests were directed [as of or before December 6, 1979] to the determination and justification of acceptance criteria to be applied to various remedial measures taken" (Order at page 3) and which portion of each request was so directed.

Answer

Attached Table 2-1 lists Staff's requests that were directed to the determination and justification of acceptance criteria to be applied to various remedial measures taken and proposed by Consumers. As of December 6, 1979, the only remedial action that had been taken was the placement of the sand surcharge inside and around the Diesel Generator Building, which had reached the maximum height of 20 feet above final plant grade on April 7, 1979[1/] and which had been removed by August 31, 1979.[2/] The requests in Table 2-1 relevant to the remedial action for the Diesel Generator were Requests number 4, 5, 8, 12, 13, 14, 18, 19, 20, 21(c), 25, 26, 27, 28, 30, and 35.

1/ S. Howell letter of April 30 1979 to J. Keppler, forwarding MCAR 24 Interim Report 5.

2/ S. Howell letter of November 2, 1979 to J. Keppler, forwarding MCAR 24 Interim Report 8.

Staff's 50.54(f) Request No.	Signatory/Date of Request Letter	Applicable Portion of Request [1/]
20	"	All
21	"	Subparagraph (c)
24	L.S. Rubenstein, 11/19/79	All
25	"	All
26	"	All
27	"	All
28	"	All
29	"	All
30	"	All
31	"	All
34	"	All
35	"	All

NOTES:
1/ Portion of Staff's request directed to the determination and justification of acceptance criteria to be applied to various remedial measures taken or proposed.

APPENDIX A

NRC REQUESTS PRIOR TO DECEMBER 6, 1979 OTHER THAN 50.54(f) REQUESTS

Staff Request	Signatory/ Date of Request Letter	Applicable Portion of Request [1/]
130.21	S. Varga, 12/11/78	All
362.12	"	First sentence
362.13	"	All but last sentence

Staff Request	Signatory/ Date of Request Letter	Applicable Portion[1/] of Request
40.106	S. Varga, 1/18/79	All
130.23	"	All, with respect to Category I structures other than Containment.
130.24	"	All, with respect to Category I structures other than Containment.
362.14	"	All
362.15	"	All
362.16	"	All
362.17	"	All

NOTES:

1/ Portion of Staff's request directed to the determination and justification of acceptance criteria to be applied to various remedial measures taken and proposed.

Interrogatory 3

State and explain the reasons why "such [acceptance criteria], coupled with the details of the remedial action, are necessary for the Staff to evaluate the technical adequacy and proper implementation of the proposed action." (Order at page 3.)

Answer

Technical adequacy and proper implementation are two of the principal ingredients necessary to the Staff conclusion regarding reasonable assurance as to whether the facility as proposed to be modified can be constructed and

operated without undue risk to the health and safety of the public. The licensee's criteria, as defined in response to Interrogatory 1, and the specific details of the remedial action constitute the basis of review from which such conclusions by the Staff are derived.

Interrogatory 4

State and explain the basis for the statement, at page 3 of the Order, that "the information provided by the licensee fails to provide such criteria." (Acceptance criteria.) (Order at page 3.)

Answer

The reply to Interrogatory 6(d) identifies which of the licensee's responses the Staff found to be inadequate as of December 6, 1979, and the response to Interrogatory 6(f) explains why. The responses were inadequate, in part, because they did not provide the acceptance criteria, as defined in the response to Interrogatory 1, which the Staff requires for its radiological safety review. Consider, for example, 50.54(f) Request 4 which on March 21, 1979 in part asked (1) what criteria the licensee would use to judge the acceptability of fill, structures, and utilities upon conclusion of the preload program, (2) what extent of residual settlement would be permitted, and (3) the basis for the limit. The licensee's most recent reply prior to December 6, 1979 (Revision 3 to Amendment 72 dated September 13, 1979) stated that the criteria and the extent to which residual settlements would

be permitted would be provided by December 1979.[3/] Therefore, the licensee's reply did not include acceptance criteria and the Staff considered the response to be inadequate and the matter remains unresolved. For further examples, refer to the response to Interrogatory 6(f).

Interrogatory 5

State with particularity each item of information the Staff requested up and until December 6, 1979 with regard to acceptance criteria.

Answer

The items of information the Staff requested up and until December 6, 1979 with regard to acceptance criteria are given in the reply to Interrogatory 2.

Interrogatory 6

With regard to each item of information identified in response to Interrogatory 5, state: (a) the identity of the request; (b) whether Consumers responded to that request; (c) the identity of the communication that the Staff considered Consumers response to the request; (d) whether the Staff considered the response adequate; (e) the identity of the communication by which the Staff communicated its position as to the adequacy or inadequacy of the response; (f) the basis for the Staff's position regarding

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3/ The licensee's response was ultimately submitted February 28, 1980 by Amendment 74; or about 10 months after the full surcharge for the Diesel Generator Building had been placed and 6 months after the surcharge had been completely removed.

adequacy or inadequacy of Consumers response; and (g) the Staff personnel responsible for determining whether Consumers' response was adequate or inadequate.

Answer

With regard to each item of information identitifed in response to Interrogatory 5 (which in turn refers to the answer to Interrogatory 2), Table 6-1 ~~hereto~~ responds to parts (a), (b), (c), (d), (e) and (g) of Interrogatory 6. Answers to parts (e) and (f) of Interrogatory 6 follow.

For those requests shown in Table 6-1 to be issued before December 6, 1979, but for which replies were initially made after December 6, 1979, refer to the answer to Interrogatory 8.

Similar information for requests identified in Appendix A is provided by Appendix B.

Regarding part (e) of Interrogatory 6, the means by which the Staff communicated its position as to the inadequacy of the licensee's response was primarily by the issuance of additional questions on the same subject. These followup requests are listed in Table 6-1. For example, 50.54(f) Request 35 specifically indicated the response to previous Request 5 was unacceptable. It is not Staff practice to indicate acceptable responses to licensees, except by seperate request on a case-by-case basis. Such indication of acceptance is typically left for issuance of the Staff's safety evaluation report for those responses which are of significance to that report.

The basis for the Staff position of inadequacy shown by part (f) of Interrogatory 6 is that the licensee's response failed to meet the Staff's acceptance criteria as defined in response to Interrogatory 1. Specific reasons for failing are given below, and typically include not being fully responsive to the Staff's requests or insufficient submittal of basic data to support the conclusions or positions submitted by the licensee.

Consumer's responses to 50.54(f) Requests 4, 5, 6, 12 and 21(c) were inadequate because of missing information or data or the responses raised additional questions. The portions of these requests which were inadequate are identified by the following requests listed under Column 6(e) of Table 6-1.

The response to 50.54(f) Request 13 is inadequate because Consumers has not completed its analysis of the Category I structures affected by the settlement factoring in the effects of settlement. (ie. cracks, modeling changes, material properties changes). Consumers acknowledges the Staff's conclusion in their answer to question 13.

The response to 50.54(f) Request 14 is inadequate because Consumers has not completed its analysis of the Category I structures affected by the settlement, factoring the effects of the settlement (ie. cracks, modeling changes, material properties changes). Consumers has provided some information on the cracks present in most Category I structures, but has not determined the related load and the related changes to analytical models and material properties. In addition Consumers has not determined if the cracks will continue to propagate.

The response to 50.54(f) Request 15 is inadequate because Consumers has not acknowledged the fact that differential settlement as used in the load

combinations is not a self-limiting effect. In addition we have not accepted the proposed fixes.

The response to 50.54(f) Request 16, although responsive, is of a nature that additional work by Consumers is required for an acceptable reply.

50.54(f) Request 17 asked how code-allowable conditions of underground Category I piping will be assured throughout plant life. The reply contains no commitment to use the 3.05c limit of part NC-3652.3 of Section III of the ASME Code, Division 1. However, the response, in Table 17-2, does indicate that the Code calculations were used. The response provides a comparison of the ASME Code limit to the calculated pipe stresses resulting from settlement. From the response, it was not clear whether this response to the Code was for illustrative purposes only, or whether it was intended to represent Consumer's criteria. The reply provided no acceptance criteria for inclusion of future settlement of buried piping over the life of the plant. Also, no acceptance criteria was provided for cases where the allowable stresses were exceeded.

50.54(f) Request 18 asked for an identification and description of evaluations of seismic Category I piping to assure that it can withstand increased differential settlement between buildings, within the same building, or within the piping systems itself without exceeding code-allowable stress criteria. Request 18 also asked for the licensee's plans to assure compliance with code allowable stress criteria throughout the life of the plant. The response for seismic Category I piping between structures makes

a general reference to applicable codes, but provides no indication as to which codes or as to what specific acceptance criteria the piping is to meet. Therefore, more specific criteria as to the stress limits to be used are required.

50.54(f) Request 20 asked for acceptance criteria required to define acceptable loads or components and supports produced by pipe deformations due to settlement. The reply defined no acceptance criteria, but only stated that the loads on components were within the allowables. The reply provides no acceptance criteria as to when flanged joints will be disassembled and the methods for determining nozzle loads. Acceptance criteria for the allowable differential settlement for the 2-inch and smaller diesel generator fuel oil lines was not addressed.

As noted in Appendix B, the response to Staff Request 40.106 was considered to be inadequate. The response was in conflict with the response to Request 20. Specifically, the response to Request 20 indicated that a stress analysis for the diesel generator fuel oil lines was unnecessary because of the inherent flexibility of small piping (1 1/2" to 2" diameter); whereas the response to Request 40.106 indicates an extensive program for monitoring and analysis of this same piping would be performed. Consumers position needs to be clarified.

For reasons indicated by follup Requests 25 and 26, the response to Request 130.21 as noted in Appendix B was inadequate. Consumers did not complete the answer to this question to our satisfaction. Consumer's response refered to other 10 CFR 50.54 questions and response. The evaluations of Category I structures have not been performed to our satisfaction.

The applicant has not justified in full the proposed fixes and has not provided a detailed evaluation of its analysis and design.

The response to Request 130.23 as noted in Appendix B was inadequate because the current criteria requires the use of ACI 349 as supplemented by Regulatory Guide 1.142. In addition the effects of the settlement (i.e., cracks, change in modeling, change in material properties) need to be factored in the analysis and design of these Category I structures. Furthermore, the answer addressed only the internal structures to the containment building and the auxiliary building but deferred any consideration for other Category I structures.

The response to Request 130.24 as noted in Appendix B was inadequate because Consumers did not complete its evaluation of all Category I structures for the effect of the use of Regulatory Guides 1.60 and 1.61 in place of its proposed seismic response spectra and related damping values. The effect of settlement should be factored into Consumer's reevaluation.

~~As noted in Appendix B, certain Consumer's responses were indicated to be inadequate.~~ Consumer's responses to requests 362.13, 362.14 and 362.16 were inadequate because the Staff concern raised in these FSAR questions were not to be fully resolved until Consumers completed additional field and laboratory work. Ultimately these issues have been pursued by the Staff in subsequent 50.54(f) questions as identified in Appendix B table.

The portions of the response to request 362.17 which deal with predicted settlement are similar to the above in that field work had to be completed before the issue could be resolved. The portion of the response pertaining to induced vertical stresses versus depth was unresponsive in providing needed specific data and results.

TABLE 6-1

Identity of 50.54 (f) Request	Whether Consumer Responded as of 12/6/79	Response Identification as of 12/6/79	Staff's Consideration of Response Adequacy as of 12/6/79	Follow-up Requests	Responsible Staff Personnel
6 (a)	6 (b)	6 (c)	6 (d)	6 (e)	6 (g)
4	Yes	Rev. 3, 9/13/79, Responses to NRC Requests Regarding Plant Fill	Inadequate	27, 40	L. Heller & D. Gillen
5	Yes	Rev. 0, 4/24/79, Responses to NRC Requests Regarding Plant Fill	Inadequate	35, 37	L. Heller & D. Gillen
6	Yes	Rev. 3, 9/13/79, Responses to NRC Requests Regarding Plant Fill	Inadequate	31, 33, 43	L. Heller & D. Gillen
8	Yes	Rev. 0, 4/24/79 Responses to NRC Requests Regarding Plant Fill	Adequate		H. Balujian L. Heller D. ~~Gillen~~ Hood
9	Yes	Rev. 0, 4/24/79, Responses to NRC Requests Regarding Plant Fill	Response referred to Question 12	Refer to Request ~~12~~ 1	L. Heller & D. Gillen
10	Yes	Rev. 0, 4/24/79 Responses to NRC Requests Regarding Plant Fill	Response referred to Question 12	Refer to Request 12	L. Heller & D. Gillen
11	Yes	Rev. 0, 4/24/79 Responses to NRC Requests Regarding Plant Fill	Adequate		L. Heller & D. Gillen

TABLE 6-1

Identity of 50.54 (f) Request	Whether Consumer Responded as of 12/6/79	Response Identification as of 12/6/79	Staff's Consideration of Response Adequacy as of 12/6/79	Follow-up Requests	Responsible Staff Personnel
6 (a)	6 (b)	6 (c)	6 (d)	6 (e)	6 (g)
12	Yes	Rev. 3, 9/13/79, Responses to NRC Requests Regarding Plant Fill	Inadequate	38,39,41,42,43, 44,45,46,47,48	L. Heller & D. Gillen
13	Yes	Rev. 1, 5/31/79 Responses to NRC Requests Regarding Plant Fill	Inadequate	25,48	R. Lipinski F. Rinaldi F. Schauer
14	Yes	Rev. 3, 9/13/79 Responses to NRC Requests Regarding Plant Fill	Inadequate	25, 28, 29	R. Lipinski F. Rinaldi F. Schauer
15	Yes	Rev. 3, 9/13/79 Responses to NRC Requests Regarding Plant Fill	Inadequate	25, 26	R. Lipinski F. Rinaldi F. Schauer
16	Yes	Rev. 0, 4/24/79 Responses to NRC Requests Regarding Plant Fill	Responsive but additional work by Consumers required to resolve	34	L. Heller & D. Gillen
17	Yes	Rev. 2, 7/9/79, Responses to NRC Requests Regarding Plant Fill	Inadequate	45 1/	R. Stephens A. Cappucci
18	Yes	Rev. 0, 4/24/79, Responses to NRC Requests Regarding Plant Fill	Inadequate	1/	R. Stephens A. Cappucci

TABLE 6-1

Identity of 50.54 (f) Request	Whether Consumer Responded as of 12/6/79	Response Identification as of 12/6/79	Staff's Consideration of Response Adequacy as of 12/6/79	Follow-up Requests	Responsible Staff Personnel
6 (a)	6 (b)	6 (c)	6 (d)	6 (e)	6 (g)
19	Yes	Rev. 0, 4/24/79, Responses to NRC Requests Regarding Plant Fill	Not determined (and presently under review)	1/	R. Stephens A. Cappucci
20	Yes	Rev. 2, 7/9/79, Responses to NRC Requests Regarding Plant Fill	Inadequate (and presently under review)	1/	R. Stephens A. Cappucci
21(c)	Yes	Rev. 0, 4/24/79, Responses to NRC Requests Regarding Plant Fill	Responsive but Inadequate	35,37,40	L. Heller ~~J. Kane~~ D Hood D. Gillen
24 through 31	No (after 12/6/79)				
34,35	No (after 12/6/79)				

P32 & 33 Not acceptance criteria

Notes:

1/ See Enclosure 3 to "Summary of January 16, 1980 Meeting on Supplemental Requests Regarding Plant Fill," dated February 4, 1980.

APPENDIX B

Identity of Request	Whether Consumer Responded as of 12/6/79	Communication Identification as of 12/6/79	Staff's Consideration of Response Adequacy as of 12/6/79	Follow-up Request	Responsible Staff Personnel
6 (a)	6 (b)	6 (c)	6 (d)	6 (e)	6 (g)
362.12	Yes	FSAR Rev. 24, 9/79, Responses to NRC Questions	Adequate		L. Heller D. Gillen
362.13	Yes	FSAR Rev. 20, 4/79, Responses to NRC Questions	Inadequate	4,5,7,9,12,13,14	L. Heller D. Gillen
362.14	Postponed	FSAR Rev. 24, 9/79, Responses to NRC Questions	Inadequate. Response postponed to future date.	9 ,10 ,12 ,15	L. Heller D. Gillen
362.15	Yes	FSAR Rev.24, 9/79, Responses to NRC Questions	Adequate		L. Heller D. Gillen
362.16	Yes	FSAR Responses to NRC Questions	Responsive but submittal of needed revised settlement analysis postponed to future	4,12	L. Heller D. Gillen
362.17	Yes	FSAR Rev. 24, 9/79,	Inadequate	4,8,14	L. Heller D. Gillen
130.21	Yes	FSAR Rev. 24, 9/79, Responses to NRC Questions	Inadequate	25,26	R. Lipinski F. Rinaldi F. Schauer

Identity of Request	Whether Consumer Responded as of 12/6/79	Communication Identification as of 12/6/79	Staff's Consideration of Response Adequacy as of 12/6/79	Follow-up Request	Responsible Staff Personnel
6 (a)	6 (b)	6 (c)	6 (d)	6 (e)	6 (g)
(?) 130.23	Yes	FSAR Rev. 24, 9/79, Responses to NRC Questions	Inadequate	25,26	R. Lipinski (?) F. Rinaldi F. Schauer
(?) 130.24	Yes	FSAR Rev. 24, 9/79, Responses to NRC Questions	Inadequate	25,26	R. Lipinski (?) F. Rinaldi F. Schauer
40.106	Yes	FSAR Rev. 24, 9/79 Responses to NRC Questions	Inadequate (clarification required)	20	H. Balujian R. Stephens A. Cappucci

Interrogatory 7

State with particularity each item of information the Staff requested after December 6, 1979 with regard to acceptance criteria.

Answer

This answer is provided by Table 7-1 attached.

TABLE 7-1

Staff's Request No.	Signatory/Date of Request Communication	Applicable Portion of Request
36, 37, 38	A. Schwencer, June 30, 1980	All
39 through 48	A. Schwencer, August 4, 1980	All
49 through 53	R. Tedesco, August 27, 1980	All
Enclosure 3 to "Summary of January 16, 1980 Meeting on Supplemental Requests Regarding Plant Fill", 2/4/80	Darl S. Hood, February 4, 1980	Items 1-8
NRC Staff Interrogatories to Consumers Power Company, November 26, 1980	W. D. Paton November 26, 1980	Interrogatories 1-9

Request Copy

Interrogatory 8

With regard to each item of information identified in response to Interrogatory 7, state: (a) the identity of the request; (b) whether Consumers responded to that request; (c) the identity of the communication that the Staff considered Consumers response to the request; (d) whether the Staff considered the response adequate; (e) the identity of the communication by which the Staff communicated its position as to the adequacy or inadequacy of the response; (f) the basis for the Staff's position regarding adequacy or inadequacy of Consumers response; and (g) the Staff personnel responsible for determining whether Consumers' response was adequate or inadequate.

Answer

This answer is provided in Table 8-1. Additionally, Table 8-1 includes items of information the Staff requested before December 6, 1979 with regard to acceptance criteria, but for which the initial reply by Consumers had not been submitted as of December 6, 1979.

Regarding part (f) of Interrogatory 8, it is not Staff practice to indicate acceptable responses to licensees, except by separate request considered by the Staff on a case-by-case basis. Such indication of acceptance is the function of the Staff's safety evaluation report for those responses which are of significance to that report. The means most frequently used by the Staff to communicate its position regarding inadequate responsed during the course of the safety review is by issuance of additional questions on the same subject. Such followup requests are listed in Table 8-1.

Parts (d) and (g) of 50.54(f) Request 24 involved review by both geotechnical and hydrologic engineering disciplines. The parts of Response 24 indicated to be inadequate were the subject of followup requests or an NRC interrogatory to Consumers identified in column 8(e) of Table 8-1. These followup matters provide the basis for the conclusion regarding inadequacy by the Staff.

The response to 50.54(f) Request 25 is responsive to our request but is not complete. Consumers does not address the effects of the cracks on the load combinations, the rationale to the proposed fixes for Category I structures, the modeling to be used in the analyses, the justification for material properties used in the analyses and design and a comparison of the results with suitable acceptance criteria.

The response to 50.54(f) Response 26 is inadequate because Consumers has not considered the effects of settlement in its analysis of the Category I structures. Consumers states that the effects of differential settlement on Category I structures utilizing corrective measures are negligible while they propose further investigations for the Diesel Generator Building. We feel that the effects of differential settlement (i.e., cracks, modeling changes, material properties changes) needs to be considered for all Category I structures founded fully or partially on the fill material.

The response to 50.54(f) Response 28 is inadequate because Consumers does not address the concerns identified in our followup requests 25,28 and 29. Consumers provides additional information on crack mapping but does not address analytical considerations.

The response to 50.54(f) Response 29 is inadequate because the effects of the cracks have not been satisfactorily included in the analysis. However, Consumers attempted to identify the crack in these inaccessible areas. The Staff feels that the effect of the structural cracks in the Category I structures should be considered in the re-analysis of these structures.

The response to 50.54(f) Response 30 will be adequate if Consumers classifies the duct banks as Category I structures with no requirement for maintaining a pressure boundary for the cables within those ducts.

Missing J. Kane's comment on request 31

With regard to the response to 50.54(f) Request 34 the buckling stresses due to earth loads, vehicular and railroad traffic, are based on uniform soil properties. From the pipe profiles, it is apparent that this is not the case.

The response to 50.54(f) Request 35 is inadequate for the reasons stated in A. Schwencer's letter of June 30, 1980 and in "Summary of Appeals Meeting of August 29, 1980 Regarding Additional Explorations and Testing of Midland Plant Fill," February 10, 1981.

Items 1 through 8 on an enclosure to a summary of a 1/16/81 meeting are responded to by Consumers answers to Requests 17 and 34. In regard to the response to Request 17, the criteria does not consider the buckling or crippling stresses due to high bending stresses in the large diameter thin wall piping. Also, there was not sufficient information as to the total piping involved, the proximity of the non-profiled to the profiled piping, the percentage of piping profiled or soil characteristics in the area of

concern. Due to the changes in slope of some of the profiled piping, it would appear that soil characteristics vary.

Again with regard to 50.54(f) Request response 17 the rate of change of slope or the radius of curvature determines the bending stress more than the overall deflection. This request was made on that basis. If a satisfactory allowable stress and strain criteria is presented with an acceptable stress analysis, the criteria for the change in piping curvature would not be required. The response to Request 34 was previously discussed.

Missing →
J. Kane's comment
on requests 39 thru 48