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Kane



DEPARTMENT OF THE ARMY

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

REPLY TO
ATTENTION OF

NCEED-T

SUBJECT: Four Memoranda Providing Reviews of Applicant's Submissions regarding the Midland Nuclear Power Plant.

16 JUN 1982

Mr. George Lear
U.S. Nuclear Regulatory Commission
Ch, Hydrologic & Geotech. Engrg Br.
Division of Engineering
Mail Stop P-214
Washington, DC 20555

Dear Mr. Lear:

Attached are four memoranda providing Corps of Engineers comments regarding the Applicant's submissions concerning the Midland Nuclear Power Plant. These submissions are summarized below:

| <u>Submission Date</u> | <u>Topic</u> |
|------------------------|--|
| 16 Feb 82 | Cracks in D.G.B. |
| 20 Apr 82 | Fixation of cracks in BWST |
| 22 Apr 82 | BWST & underpinning SWPS |
| 30 Apr 82 | Effects of cracks on Serviceability of Conc. Structures & Repair of Cracks |

Sincerely,

Handwritten Signature

P. McCALLISTER, P.E.
Chief, Engineering Division

4 Incl
as

HC85D-7

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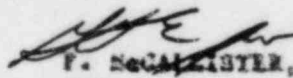
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Sincerely,


F. McMASTER, P.E.
Chief, Engineering Division

4 Incl
as

SUBJECT: Midland Nuclear Power Plant - Review of Applicant's Submission of February 16, 1982 Regarding Concrete Cracks in the Diesel Generator Building (DGB)

The subject report has been reviewed by the Corps of Engineers, and the following are the comments:

Q.1. (Page 5, para 1) - The Applicant's statement, "Distribution of the settlement observations made indicated a slight tilt of the building," is not totally correct. The Corps of Engineers review of the settlement distributions indicates tilting as well as warping of the foundation. The warping of the foundation has been produced due to curvature resulting in settlement stresses in the footings. The Applicant has not addressed to these stresses in the report.

Q.2. (Page 5, para 3) - In this paragraph, it has been stated that "cracks on the west wall, which did not have a duct-bank below it, are of the type clearly attributable to ordinary volume change effect of the concrete." Apparently the applicant's consultant has not given thought to the shear stress developed in the wall due to the relatively larger settlement of the south end of the wall with respect to north end. The cracks on the west wall have drooped towards the south indicating the shear stress has influence on those cracks.

Q.3. (Page 6, para 1) - The orientation of the cracks in inclined position drooping towards the point of maximum settlement, which has caused vertical shear stresses in the east wall, indicate that the predominant factor responsible for those cracks are the shear stress caused by the settlement rather than volume change effects of the concrete.

Q.4. (Pages 6, 7, 8, & Figures 7 & 8) - The modeling of one of the cross walls, previously supported by a duct bank, as shown in Figures 7 and 8 and described in pages 6, 7, and 8 for the purpose of determining the stresses is due to duct bank support, has many shortcomings: (a) The justification for selecting 200 kips edge load which results in tensile stresses in range corresponding to the cracking stress of the concrete, (b) justification for using 12.5 KSI superimposed on the top of the wall, why not consider solid wall all the way to the top of portion C (Fig-7) for the purpose of analysis, (c) the problem has been over simplified by assuming that there is no soil support underneath the wall north of the duct bank support. In view of the above facts the results of the computer output shown in Fig. 9 are questionable.

Most of the cracks, which are the matter of concern in this review, have developed during and after the surcharging, the Applicant's consultant has not considered these cracks. I do not know whether the consultant was aware of these cracks at the time of writing his report. The Corps of Engineers considers those cracks which have developed after December 1978, when the building was released from the duct banks, as results of the differential settlement, and therefore must be evaluated considering the soil condition or pre-determined settlements.

Q.5. (Page 9, last para) - In the last sentence, the Applicant's consultant states "It should, however, be remembered that the walls of the Diesel Generator Building are not likely to be subject to flexural stresses of this magnitude in their normal function because the duct banks have been separated from the footing and because the building is now complete." It should be mentioned here that building has undergone considerable differential settlement and according to the predicted future settlement additional differential settlement would occur. The effects of these settlements might be much more severe than those produced by the duct banks. Therefore, the Corps of Engineers disagree with the statement made by the Applicant's consultant.

Q.6. (Page 10, para 2) - The errors involved in the analyses due to several assumptions would obscure any comparison of the observed cracks with those obtained by the analysis.

H.N. Singh

H.N. SING, P.E.

Lead Reviewer, Midland Nuclear Plant

SUBJECT: Midland Nuclear Power Plant - Review of the Applicant's Submission of 22 April on Borated Water Storage Tanks (BWST) and Underpinning of the Service Water Pump Structure (SWPS)

The Corps of Engineers has reviewed the Subject Submission and the following are the comments:

Q.1. (Page 1, last para) - The lifting of the tanks by hydraulic jacks as shown in Fig. BWST-1 will produce concentrated eccentric loads on the tanks' wall. The structural response of the tanks' wall should be evaluated to make sure that the stresses in the walls remain under allowable limit.

Q.2. (Page 1, last para) - Referring to the last sentence of the page, where Applicant has started to monitor the strain gages to confirm that tanks' stresses remain within allowable limit, what course of action will be taken if strain gages indicate stresses exceeding the permissible limits?

Q.3. (Page 2, para 2) - It appears that the Applicant is proposing to provide additional sand fill under the tanks' foundation. This additional new sand fill must be compacted to a relative density of 85% to comply with the requirements. The Applicant should provide the method which it proposes to use to densify the new sand fill.

Q.4. (Pages 3 & 4, last para. of page 3) - Averaging of strain over a length of 20' would provide a misleading result, if the cracks are widely spaced (more than 3' apart). If the number of cracks are limited to one or two, the averaging would underestimate the strain to an unacceptable range. In our opinion, it will be more appropriate to provide more than one gage with lengths varying from 5' to 20' (maximum difference not more than 5').

Q.5. (Page 4, Frequency of Monitoring) - The frequency of monitoring should not be spaced more than 1 year.

Q.6. (Page 5, para 2) - The existing stress in the structure must be known, to determine the capacity of the structure to sustain additional stress during the construction of the proposed underpinning. Existing settlement or the Moduli of subgrade reaction of foundation soils should be the parameters for determining the stresses due to differential settlement.

Q.7. (Page 6, Response to Confirmatory Issue 3) - As stated in Question 4, averaging of strains over 20' length would provide misleading results, therefore, acceptance criteria based on the results of averaging of strains of 20' gage length is not acceptable. Gages of various lengths varying from 5' to 20' with 5' interval should be installed side by side and the maximum strain of the four gages should be used to develop acceptance criteria. Further, this criteria must be complemented by an acceptance criteria on the basis of settlement observation.

Q.8. (Page 7, Confirmatory Issue 6) - The information provided is not adequate to evaluate the sliding stability.

Q.9 (Page 11, last para) - Any excavation within 3 times the depth of the excavation from an existing pier must be properly protected by bracing the vertical sides of cuts. Therefore, we do not concur with the Applicants statement given in this paragraph.

Q.10 (Page 19, Confirmatory Issue 24, para 1, 2) - Although the construction dewatering system is temporary, it involves pumping of a large volume of water, because the water level has to be lowered to 582.00 (8' Lower than the permanent dewatering) from the existing 627.00. Thus during pumping, considerable amount of fines (all silt fraction less than .05mm) could be pumped if restriction on fines in pumped water is limited to .05mm as proposed by the Applicant. The particle size distribution curves for the soils near the SWPS show considerable amount of silt fraction which might be pumped out with water without being detected by the .05mm filter to be used to screen the pumping water. Therefore, in the opinion of the Corps of Engineers the restriction of fines pumped during the construction dewatering must be placed at 10ppm of .005mm size.

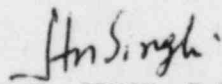
H.N. Singh

H.N. SINGH, P.E.
Lead Reviewer
Midland Nuclear Plant

SUBJECT: Midland Nuclear Power Plant - Review of Applicant's Submission of April 30, 1982 on Effects of Cracks on Serviceability of Concrete Structures and Repair of Cracks.

The subject report has been reviewed by the Corps of Engineers and listed below are the review comments:

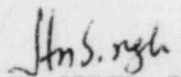
1. (Page 3, para 1) - Several cracks in the walls of the Diesel Generator Building have appeared after the building was released from the duct banks. These cracks show a definite pattern of drooping towards the regions where comparatively lower soil supports were available to the structure indicating shear stress has played predominant role in causing these cracks. The writer has simply speculated without any engineering investigation that those cracks are due to volume change. Similarly cracks in the walls of the Service Water Pump Structure have been caused by the shear and the bending created by reduced support offered by the fill material under the cantilever portion of the Service Water Pump Structure.
2. (Pages 4 & 5) - The writers statements in these pages are vague and inconclusive. He mixes various aspects of cracking with a vague conclusion. In my opinion, to limit the crack width to .012' or less is important for the durability of the concrete. We totally disagree with the writers' opinion that .025' crack widths on the walls of the various structures of the plants are within tolerable crack width. Even in ordinary structures like a warehouse, a crack width of .025" should be considered detrimental to the structure.
3. (Pages 6 & 7, Freeze and Thawing) - Freeze and thaw in the vertical walls occur if there is crack in the wall to hold water. This phenomena is very common in bridge structures. The cracks on the walls of the various structures of the Midland Plant are capable of holding water and the concrete of the structures would be subjected to disintegration due to freeze and thaw cycles.
4. (Page 11, last para) - We disagree with the statement made in the last paragraph that no conclusive evidence has been found to indicate that any relationship exists between crack width and corrosion. It depends on the environment. If the bars are exposed, ions conducive to corrosion would reach the reinforcing bar through rain water if not by air. No matter how narrow the cracks are, water will carry the ions to the reinforcing bars.


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1. (Page 4, Item c) - Lifting of tanks with 12 to 16 concentrated loads might create severe stresses in the tanks' wall. Please make sure by stress analysis that these jacking loads would not produce undue stresses in the tanks.
2. (Page 4, Item g) - Please explain how the required relative density of the new sand fill under the tanks bottom would be achieved.
3. (Page 5, para 2) - The frequency of settlement monitoring at 5 year intervals is too wide a interval. The tanks' settlement should be monitored at close intervals of one year or less. Also, the Applicant should develop an acceptance criteria for each year of settlement. Each year, the observed settlement should be compared with the predicted settlement of that particular year, and in case of discrepancy indicating excessive settlement, the matter be reported in the NRC.


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
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