ENCLOSURE

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

JUL 21 1983

MEMORANDUM FOR: Darrell G. Eisenhut, Director
Division of Licensing

FROM: Richard H. Vollmer, Director
Division of Engineering

SUBJECT: EVALUATION OF LANDSMAN'S CONCERNS REGARDING DIESEL GENERATOR BUILDING AT MIDLAND

Responding to your memorandum, subject as above dated June 27, 1983, J. Knight, Assistant Director for Components & Structures Engineering, has formed a task group to re-evaluate the structural design and construction adequacy of the Midland Diesel Generator Building. The group, headed by Dr. P. T. Kuo, will review the design review documents and the construction reports; physically inspect the building; search out and interview concerned individuals, including Mr. Landsman; and prepare a final report on the adequacy of the Midland NPP Diesel Generator Building. The particulars of the groups' composition and charter are developed in more detail in the attached document. Note that we intend to use a consultant in a capacity to critique our findings on Mr. Landsman's concerns. The consultant's views will be provided in our report.

Richard H. Vollmer, Director
Division of Engineering

cc: H. Denton
J. Knight
J. Keppler
T. Novak
E. Adensam
G. Lear
P. Kuo
F. Rinaldi
D. Hood

IMPLEMENTATION CONCEPT

REVIEW OF THE MIDLAND NPP

DIESEL GENERATOR BUILDING

1. MISSION

A review will be conducted as to the structural adequacy of the Midland NPP diesel generator building. All information available from NRC regional inspectors in this matter will be obtained and the impact of that information will be fully considered in the review.

2. BACKGROUND

The NRC structural engineering staff (headquarters) has reviewed the Midland NPP diesel generator building's engineering design and construction and has indicated that the building is structurally adequate to resist its design loads. However, during hearings before a NRC Congressional Oversite Committee, the structural adequacy of the Midland NPP diesel generator building was questioned by an NRC employee, Mr. Ross Landsman, a Region III site inspector for the Midland project. It is considered prudent that a review be undertaken by a technical group to assure that Mr. Landsman's concerns are fully heard and carefully evaluated so that the adequacy of the diesel generator building may be further assured.

3. ORGANIZATION

The review group is composed of four technical members -

a group leader, two team members from the structural review staff and a structural consultant. The consultant will be asked to provide his critique of Landsman's concerns and our findings directly into the final report.

4. SUPPORT

The NRC structural review staff will provide the background technical studies, reports, and other review materials that formed the basis for their review and technical conclusions. The NRC project staff for the Midland NPP will provide general administrative arrangements to facilitate the review. Region III will provide a complete listing of Mr. Landsman's concerns.

5. SCOPE OF EFFORT

The efforts of the review group may include but will not be limited to 1) review of all pertinent technical materials, 2) on-site inspection of the diesel generator building, 3) on-site interviews with all inspection personnel that have information to contribute and 4) preparation of a technical report summarizing their activities, considerations and findings. The report will include, as a separate attachment, the opinion of the consultant group member.

6. TIMING

Review activities should be completed NLT 30 working days after receipt of a written statement of Mr. Landsman's concerns and the final report will be due to the Director, DE NLT 15 working days after completion of the review.

7. DESIRED PRODUCT

The desired final report of the review is a report that discusses each of Mr. Landsman's concerns, as well as any other concerns that might be offered during the review, and provide a basis for acceptance or rejection of each concern. A technical review of the adequacy of the diesel generator building should then be presented that is reflective of the groups' final recommendations in this matter in light of new information furnished by Mr. Landsman and others.

APPENDIX II

SUMMARY OF MEETINGS

August Meeting with Applicant and Site Visit

On August 24, 1983 members of the Task Group met with Bechtel and Consumers Power Co. staff in the Bechtel, Ann Arbor, Michigan offices. At this meeting, presentations were made by the applicant and their consultants to provide background on the history of the DGB construction original design philosophy and the analyses done to demonstrate the adequacy of the structure following settlement.

On the evening of August 24 and during the morning of August 25, 1983 the members of the Task Group visited the Midland site to observe the DGB. The Task Group members observed the cracks in the DGB and held discussions with construction personnel to determine the sequence of concrete placement during construction of the DGB. At the site crack maps of the DGB were provided by the Applicant.

Task Group Interviews With Original Reviewers

On September 8, 1983 the Task Group met individually with the original NRC staff reviewers responsible for the Geotechnical and Structural Engineering evaluation of the Midland DGB. The persons interviewed were: Dr. Harry Singh of the U.S. Army Corps of Engineers, Chicago (geotechnical engineering consultant); Mr. Joseph Kane of the Geotechnical Engineering Section, SGEB; Dr. Lyman Heller, Geotechnical Engineering Section Leader, SGEB; Mr. Frank Rinaldi, Structural Engineering Section B, SGEB, Mr. John Matra, Naval Surface Weapons Center, (structural engineering consultant); and Dr. Gunnar Harstead, Harstead Associates (structural engineering consultant. The purpose of the interviews was to gain an understanding and/or clarification of the concerns each reviewer had regarding the Midland DGB.

Dr. Harry Singh was retained by the Geotechnical Engineering Section after discovery of the soils problems existing at the Midland site. Dr. Singh was concerned that the structural analysis of the DGB did not take into account the settlement data as measured. Dr. Singh was concerned with the appropriateness of using crack widths to evaluate rebar stress due to settlement; although he did recommend that the cracks should be monitored as a measure of the DGB's structural adequacy. Generally, Dr. Singh expressed his opinion that the cracks in the DGB were much more extensive than one sees in normal concrete work. Dr. Singh is of the opinion that the DGB is in secondary settlement and that future long term settlement would be about 1-1/4 inches over 30-40 years.

The primary concern of Mr. Joseph Kane involved the Applicant's assumption of a straight line, rigid body motion in the structural evaluation of the effects of settlement on the DGB. Mr. Kane was of the opinion that the settlement values measured by the applicant are appropriate to use in the structural analysis because the building did settle as the soil conditions would have indicated (i.e., nonuniform). Furthermore, Mr. Kane was not concerned about the accuracy of the settlement data because they are the best data available from the Applicant and were more appropriate to use than to assume straight line settlement. With regard to the structural analyses using actual settlement data, Mr. Kane observed 70-80% of the cracks to be in areas where the analyses indicated areas of high stress. Mr. Kane has documented his concerns in memos dated August 2, 1983 and are included in Attachments 1 and 2.

Dr. Lyman Heller met with the Task Group to express his concurrence with the concerns expressed by Mr. Kane. Dr. Heller also offered an explanation as to why cracks were observed in areas where the analyses of the DGB indicated low stresses. The explanation offered was that the settlement of the concrete forms (i.e., yielding) during the pour created discontinuities in the finished concrete which served as preferred paths for the development of cracks.

Dr. Gunnar Harstead, Mr. John Matra and Mr. Frank Rinaldi were interviewed together. Mr. Rinaldi, Mr. Matra and Dr. Harstead maintained that use of the measured settlements would be inappropriate given the accuracy between survey measurements of + or - 1/8". Such inaccuracies in the survey data would result in unrealistic concrete stresses. Mr. Matra discussed the finite element models he prepared and executed for various stages of construction using the settlement measurements as inputs.

He indicated that there was not sufficient settlement data points to make a reasonable stress analysis. To obtain the required input, Mr. Matra stated that he linearly interpolated between the measured settlement data points. As expected there was extremely high stress in areas where no cracks in concrete were observed. Both Dr. Harstead and Mr. Matra mentioned that stresses depended on higher order derivatives. These higher order derivatives cannot be determined accurately from the five measured data points. Mr. Rinaldi indicated the most appropriate method of estimating rebar stresses due to settlement was to estimate stresses from crack widths. This method produced rebar stresses of about 5 ksi which when added to the stresses from the controlling load cases was less than the 54 ksi allowable. Mr. Rinaldi described the crack monitoring program the Applicant agreed to (0.05 /10' as alert limit and 0.06" or 0.020"/10' as action limit). Finally, Mr. Rinaldi and Mr. Matra indicated that the controlling load case for the DGB was tornado depressurization which assumed the DGB to be unvented which is conservative considering the building is vented. Mr. Rinaldi documented his response to Landsman's concerns in a memo in Attachment 3.

Task Group Audit of Design Calculation

The Task Group visited the Bechtel, Ann Arbor, Michigan offices on September 12 and 13, 1983. The purpose of the visit was to conduct an audit of the structural design calculations of the Midland DGB.

On Monday, September 12, 1983 the NRC Task Group reviewed the following DGB calculations:

- concrete/rebar stresses using settlement data by Karl Wiedner;
- straight line (rigid body) settlement by Karl Wiedner;
- concrete/rebar stresses assuming the DGB is supported at four points;
- stress totals from all load combinations;
- finite element modal for DGB.

On Tuesday, September 13, 1983, the NRC Task Group discussed with Dr. Mete Sozen the calculations he did on rebar stresses estimated from concrete crack widths. Dr. Sozen had made calculations estimating rebar stresses from crack widths for the center cross wall only. A call was made to Mr. Rinaldi in Bethesda to verify how he made his calculations on the other walls. Mr. Rinaldi indicated he did the same type of analysis using Dr. Sozen's approach for other walls. However, Mr. Rinaldi did not document the details of his analysis.

Landsman Interview

The Task Group interviewed Dr. Landsman on September 13, 1983 for about 3 hours. Dr. Landsman discussed each of his concerns at length. During the interview, potential resolution of the problem of the DGB cracks was discussed. DR. Landsman agreed that stresses determined from analysis of crack widths would be acceptable, provided that:

(1) these calculations were sufficiently documented; and
(2) an acceptable crack monitoring program was specified and implemented.

A copy of Dr. Landsman's memo of July 19, 1983 documenting his concerns on the Midland Diesel Generator Building is included as Appendix IV.

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APPENDIX III

Review of Diesel Generator Building

at Midland Plant

by

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Structural Analysis Division

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Brookhaven National Laboratory

Upton, NY 11973

October, 1983

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1.0 INTRODUCTION

This report describes a study undertaken by Brookhaven National Laboratory (BNL) to evaluate the extent to which settlement cracks observed in the Diesel Generator Building (DGB) at the Midland Nuclear Power Plant impact on the ability of the building to satisfy design requirements. Dr. R.B Landsman, of Region III, has raised questions regarding this safety issue (Ref. 1). The specific objective of this study is to assess the significance of his comments and to prepare a written response.

This objective was achieved by reviewing the existing pertinent work (published reports, testimony and analytical studies), and by interviewing key personnel so that a correct interpretation of the work performed could be made. Additional calculations were specifically omitted from the scope of this study. All of the conclusions drawn in this report are based on an assessment of calculations and studies performed by others.

The study described herein was carried out during the period of August through September 1983. On August 4, a meeting was held at NRC to discuss the problem and to obtain some of the pertinent literature. Some of this literature was carried back to BNL while other documents were mailed to NRC during the following week. Appendix A contains a listing of all reports used during the program. On August 24, a meeting was held at Bechtel Corporation offices in Ann Arbor, Michigan. Presentations were made by Bechtel and Consumers Power staff summarizing the work performed by project personnel to demonstrate the adequacy of the DGB. Their consultant's (Dr. M. Sozen of the University of Illinois and Dr. G. Corley of Construction Technology Laboratories) also discussed their work. An inspection of the DGB was held on the evening of August 24 and during the morning of August 25. At this inspection, the cracks were observed although no new detailed crack maps were made. Discussions were held with construction personnel to determine the sequence of concrete placement.

Further interviews were held at NRC on September 8. Individual interviews were held with Dr. Harry Singh (soils consultant for NRC from the Army Corps of Engineers), Joseph Kane (NRC staff), and Lyman Heller (NRC staff).

A combined interview was also conducted with Frank Rinaldi (NRC staff), John Matra (structural consultant for NRC from Naval Special Weapons Center), and Dr. Gunnar Haarstead (structural consultant for NRC). The purpose of these interviews was to explore the role each played in the design and analysis of the DGB and to learn of their concerns regarding the adequacy of the DGB.

An audit of the DGB calculations by the task group was held at Bechtel's Ann Arbor offices on September 12 and 13. Dr. Sozen was present on September 13. The following items were reviewed in detail during this audit: numerical models used by Bechtel to calculate stresses in the DGB due to settlement; the magnitude of stresses due to the various load cases; the method of determining stresses from crack data; the accuracy of the survey methods used to monitor settlments; and the concrete pour data. A meeting was held with Dr. Landsman of Region III on September 13, at which time his specific concerns raised in Ref. 1 were discussed.

This report is organized as follows. An evaluation of the literature is presented in Section 2 of the report. Section 3 contains BNL's assessment of the adequacy of the DGB, while specific responses to Dr. Landsman's concerns are given in Section 4. Conclusions are listed in Section 5.

2.0 EVALUATION OF PERTINENT WORK

The material on the DGB which was reviewed during the course of this study is divided into six categories; namely, historical description of the structure and its settelment behavior; developed crack patterns; structural analyses to evaluate settelment stresses; treatment of other loads and stresses; and survey data. The material in each category is described and evaluated in this section of the report.

2.1 History of Structure

The DGB is a reinforced concrete shear wall building consisting of five cross walls connecting a north and south wall. The interior walls are 18" thick while the exterior walls are 30" thick. The structure is 155' by 70' in plan and is 51' high with an intermediate floor slab located 35' above the foundation. Wall footings are located under each of the walls, the footings being 10' wide and 30" deep. The building is founded on about 30' of various fills overlying the natural glacial till.

The fill was placed from 1975 through 1977 with construction of the DGB begun in October 1977. Concrete was placed in 6 lifts as follows:

October	1977	-	to Elev. 630.5 (foundation)
December	1977	-	to Elev. 635.0
March	1978	-	to Elev. 654.0
August	1978	-	to Elev. 662.0
December	1978	-	to Elev. 664.0
February	1979	-	to Elev. 678.3

Within each lift the pours were generally made from east to west. Construction joints occur in the middle of the cross walls and at the west end of each bay for the north and south walls.

Large settlements and cracks in the concrete were noticed while the lift going to Elev. 662 was being poured. Construction was halted while the problem was being studied. It was concluded that the large settlement was due to poor compaction of the fill material. This settlement caused the structure to "hang up" on the duct banks which penetrate the footings on the cross walls. The duct banks were cut loose from the DGB foundation in November 1978 and construction of the building restarted. In January 1979, 20' of sand surcharge was placed on the site to consolidate the fill. This remained in place until August 1979. In September 1980, a permanent dewatering system was installed to maintain the water table below Elev. 610.

2.2 Settlement History

The DGB is founded on approximately 30' of fill material, underlain by a very stiff glacial till about 190 feet thick. A dense sand layer about 140' thick lies below the till, which is in turn underlain by bedrock. The majority of the fill was placed at the site between 1975 and 1977, with actual foundation construction completed by January 1978. During July 1978, settlements of the order of 3.5 inches (Ref. 7) were noted which were greater than the original 40 year predicted settlements. Apparently consolidation of the fill was taking place as structural dead loads were applied. In addition, the four electrical duct banks under the structural crosswalls were acting as hard points to the foundation since they were in turn being supported by the stiff natural soils below the fill. This caused rotation of the building about the duct banks.

Construction was halted during August 1978, a soil boring program undertaken to determine the problem with the fill and Drs. R.B. Peck and A.J. Hendron retained to advise on the remedial action. The exploratory program consisted of 32 borings (with no undisturbed sampling) and 14 Dutch cone penetrometers. These confirmed that the fill had been improperly placed (in an extremely variable density state) and consisted of varying amounts of cohesive as well as granular backfill. Lean concrete was also encountered in the backfill. The thickness of silty clay backfill was found to be greater under the south-east side of the building leading to the generally larger settlements on this side.

A surcharge program was implemented to attempt to consolidate the fill more uniformly. In addition, the duct banks were cut loose from the foundation in November 1978 to eliminate the foundation hard points. Surcharging began in January 1979 and remained in place until August 1979, when it was determined that primary consolidation had been completed. Instrumentation (primarily settlement plates and Borros anchors) placed in the fill was used to arrive at this conclusion. It should be noted that the consolidation test results, obtained from undisturbed samples taken after completion of the surcharge program, did not confirm this conclusion. Data was sufficiently scattered to indicate that the fill may not be uniformly consolidated. Unfortunately, the boring program conducted after the surcharge program was completed, did not include cone penetrometer soundings for comparison with the readings taken before the surcharge was applied.

At the completion of the surcharge program, it was decided that since loose sands still existed in the fill, a permanent dewatering system would be installed to preclude the potential for soil liquefaction during a seismic event. This dewatering caused additional settlements to be developed at the site, but apparently these were related to deep seated consolidation of the natural soils under the fill, and would be more uniform than the settlements caused by the fill consolidation.

It is questionable whether the piezometer data was of any significance in analyzing the excess pore pressure condition developed in the fill during the consolidation process. The readings indicate generally very low pore pressures, about 1/20 the magnitude of the applied surcharge pressures. It is not clear in fact whether the fill was ever fully saturated at the time of the surcharge program.

Peak settlements anticipated at the end of 2025 (actual settlements to date plus secondary settlements from now till then) are specified in Ref. 7 to vary from 4.79 inches (under the NW corner) to 9.33 inches (under the SE corner). However, it should be mentioned that the exact settlement history at the various settlement markers at the DGB is open to question. For example, it is mentioned in Ref. 7 that the maximum settlements in August 1978 were about 3.5 inches. Yet the data used in the stress analyses for the presurcharge period (Figures ES-14 of Ref. 7) indicates peak settlements of only 1.99 inches. It was stated at one of the Bechtel presentations that prior to cutting the duct banks loose from the footing, footings along the North wall actually lifted off from the soil, with the DGB rotating about the duct banks. There is no indication of this behavior in any of the settlement data used in the computations. Ref. 8 lists the settlement increment from 8/79 to 12/2025 to be 2.36 inches under the SE corner of the building. For the same period Ref. 7 lists this data as 1.89 inches. Thus some inconsistencies appear to exist in the various documents.

2.3 Crack Patterns

After it was determined that settlement was a problem, Bechtel initiated a program to monitor cracks in the structure. In general cracks were visually observed and an optical comparator used to determine crack width. Crack widths greater than 10 mils were of specific interest as this corresponds to reinforcing stresses of about 10 ksi. Crack maps were prepared based on surveys conducted during December 1978, September 1979, February 1980 and July 1981. Dr. Corely observed the cracking in January 1982 (Ref. 6) and confirmed that the general pattern of cracks agreed with the July 1981 Bechtel crack maps. He prepared a detailed crack map for the center interior wall. A comparison of this center wall map (Fig. 4.21 of Ref. 6) with that prepared by Bechtel in July 1981 (Fig. 4.17) indicates that more cracking had occurred although the widths of the cracks appear to be about the same.

Cracks were observed during the BNL inspection of the plant on August 25, 1983 and some photographs taken. In general the pattern of cracks appears to be similar to the previously mapped cracks. However cracks, which had not been shown on any of the Bechtel cracks maps, were noted in both the north and south walls. These additional cracks are in the lower level (up to Elev. 664) and run at 45 degree angles to the horizontal up to the cross walls.

The first crack maps prepared from the December 1978 survey indicate vertical cracks in the cross walls which begin near the bottom of the wall and run up to Elev. 664 (this was the top of the concrete pour at the time the settlement problem was first noticed). The pattern of cracking is more severe in the east side of the building. This crack pattern is compatible with the model that assumes the cracks result from flexural stresses caused by the building "hanging up on the duct banks". No crack maps were prepared for the north or south walls.

Th second set of crack maps were prepared from the September 1979 survey. In general, many of the cracks which occurred in the east wall prior to placing the surcharge do not appear on these maps. The east center and center walls show the same type of crack patterns as shown on the first crack maps except for the appearance of additional cracks. These maps also show cracks in the upper level of the building. These cracks occur near the south side of the building in the cross walls. The cracks tend to be vertical with some inclination of the cracks near the south wall. Some cracks are indicated in these maps for the south wall. Primary cracking occurs in the east side of the wall and are concentrated in the upper portion of the wall. The north wall is shown to be more severely cracked than the south wall and contains mostly vertical cracks in the upper part of the wall. The cracks appear to be centered about the three interior walls.

The third set of crack maps were prepared from the July 1981 survey. These maps indicate the same type of cracking as before although the cross wall now contain more cracking near the north side of the building than was evident before. The west wall contains many more cracks than were shown previously. These cracks run from the Elev. 664 level down to the base of the structure.

It appears that many of the cracks which have occurred may be attributed to the building resting on the duct banks. Other cracks have occurred, however, which were most likely caused by differential settlement of the wall footings. Comparison of successive crack observations generally indicates that more cracks are occurring, but that the maximum size of the cracks is still about 20 mils.

2.4 Structural Analyses

The various analyses which have been used to evaluate stresses in the DGB are discussed in this section. The first analysis described is the method used by Bechtel to estimate stresses due to settlement for use in its load combination study. This analysis makes use of the straight line approximations to the profiles of the settlements of the north and south walls. The second and third analyses described are the Bechtel and Matra studies, which attempt to use the actual measured settlements to estimate settlement stresses. These analyses, though different in detail, lead to the similar conclusion that the settlement measurements were (and continue to be) in significant error. The fourth analysis describes a cruder model which attempts to approximate an upper bound to settlement stresses by looking at the crack measurements. The first three analyses are based on detailed finite element models, while the fourth is based on crack patterns and crack widths.

2.4.1 Bechtel's Computation of Settlement Stresses (Ref. 2)

Since the building settlements occurred when the structure was in various stages of construction, the settlement stresses were evaluated for four different time periods. The first period spans from the beginning of construction through August 1978 at which time construction was halted. The second time period extends from August 1978 to January 1979 during which the duct banks were cut loose from the structure and construction resumed. The third time period extends from January 1979 to August 1979 during which time the surcharge was placed. The last time period extends to the year 2025 and includes measured settlements from August 1979 to December 1981 as well as the predicted settlements over the forty year life of the structure.

The actual measured settlements were used to calculate stresses for the first period. Stresses were calculated in each of the walls by determining the arc of a circle which fit any three adjacent measured displacements. The radius of the arc was then used to find the resulting bending moment in the wall, and the moment used to calculate stress. The maximum stress in each of the walls was assumed to exist over the entire wall. The stress in the south wall was 11.3 ksi; the east wall 6.6 ksi; and all other walls 2 ksi.

The increments in stress which occurred during each of the other three time periods were evaluated using a finite element model of the DGB. This model was constructed and run on the Bechtel version of SAP (BSAP). The building was defined with 853 nodal points. Plate elements were used to model the walls, and beam elements used for the footings. Eighty-four (84) boundary elements were used to model the vertical soil stiffness (equivalent to the coefficient of subgrade reaction). An iterative process was then used to determine the stiffness of these boundary elements. A best fit straight line was first fit through the measured settlements for the north wall and another straight line fit to the data for the south wall. It was shown that the measured displacements departure from the best fit straight lines is within the tolerance of the survey data. Dead load reactions were next estimated at each of the 84 boundary elements. The stiffness of any soil element was then determined as the ratio of the dead load reaction to the displacement of the best fit straight line. The BSAP program was run and the reaction found at each of these boundary elements. A new stiffness was then calculated as the ratio of the reaction to the displacement of the best fit straight line. This process was continued for several iterations.

It is our opinion that this model will yield unconservative estimates of stresses. If the iteration process were successfully completed, the deformation of the north and south walls will be straight lines. The only stresses that would be computed would then occur due to racking of the structure caused by the difference in the north and south wall straight lnes. It should be clear that if a best fit plane could be passed through all the settlement points under both the north and south walls, no stresses would be computed anywhere in the building. The stresses computed by this approach are a function of which iterative cycle is used to define to soil spring parameters, and bears no resemblance to the actual soil conditions at the site. There is no reason to expect that the soil stiffness should vary from point to point as shown by the analyses. We therefore conclude that this approach to compute settlement stresses is inappropriate.

2.4.2 Bechtel's Analysis Using Measured Settlements (Ref. 3)

This analysis was performed using the same finite element model described above. This time however, the known survey displacement data was input to the program at the ten (10) wall intersection points. The settlements used were the displacement increments measured for the fourth time period described above. At the remaining 74 boundary element points, the structure was allowed to deform as required to maintain equilibrium (forces equal zero). It was found that computed stresses were very high in those elements adjacent to the wall intersection, but fall off rapidly away from these points. This indicates that the analysis overly penalizes the structure by imposing large concentrated forces at the wall intersections. In fact, at some points, the soil is required to pull the structure downward to match these known displacements.

A modified analysis was performed by Bechtel at the suggestion of the task group. Rather than input only the ten known displacements, a smoothed curve was generated which matched the known settlement data, but eliminated the sharp profile changes developed in the analysis described above. A best fit polynomial was passed through both the north and south wall settlements, and displacements computed at all boundary element points of the finite element model. Comparative plots of wall profiles indicate that this approach would still yield high stresses.

2.4.3 Matra's Analysis Using Measured Settlements (Ref. 4)

The analysis performed by Matra is similar in intent to that described above. Differences between the two are as follows. First, this finite element analysis was performed for all four time periods described in Section 2.4.1. Three separate finite element models were used to define the DGB at various stages of construction. For each problem analyzed, the known settlement data at the wall intersection points was input to the models. The report does not specifically state what input was used at the remaining boundary element points between the wall intersection. However, at the interview, Matra stated that a linear displacement profile was assumed between these points. The stress results of the analyses are similar to those described above for the Bechtel study, with similar conclusions reached. In fact, it can be anticipated that the Matra stress calculations would be even higher than the corresponding Bechtel results due to the linear assumption between data points. If in fact this was done, the conclusions reached in that report would be of little value since such high bending stresses would be generated at these discontinuities.

2.4.4 Estimation of Stresses from Crack Data (Ref. 5)

Sozen considered the problem of predicting reinforcement stresses from a knowledge of the crack patterns. He observed that the usual problem is to predict crack width based upon a given reinforcement stress. When these methods are applied to the DGB center wall, a 20 ksi steel stress is consistent with a crack width of 20 mils. He also adds the crack widths for a series of cracks in the center wall and equates this to the total elongation in the reinforcement. Using an estimated gage length over which this elongation occurred he obtains an estimated stress of 24 ksi, and indicates a probable range of 20-30 ksi considering the uncertainties of the method. (This was presented by Sozen at the August 24 meeting). It is likely that these stress values would be reduced with time. A major cause of cracking was the hard points provided by the duct banks. When these were cut free, one would expect the stresses induced by the uneven support to be relieved. Creep in the concrete would also tend to relieve the settlement-induced stresses.

Rinaldi (pg. 11086 of the testimony) reported at the interview of September 8, that he calculated stresses using Sozen's method in each of the 5 cross walls, as well as the north and south walls. He then added these stresses to the maximum stress reported in each of the walls by Bechtel. The resultant maximum reinforcement stress was found to be less than 54 ksi (the allowable limit). It was noted that the Bechtel stresses already included settlement stresses (to an unknown degree however) from the analyses described in 2.4.1. The crack-based estimates of settlement stresses were added to the maximum of the Bechtel stresses without regard to where they occurred. While this is a conservative approach, there is no documentation of the computations. It should be noted that there would be some question in the application of this method on those walls where relatively few cracks occurred.

2.5 Stress Totals

The finite element model described in 2.4.1 was used to calculate wall forces from all loadings except for the seismic loading. A lumped mass model was used to determine forces resulting from the seismic loading. These forces were then combined according to the load combinations required in ACI 318 and ACI 349. Critical elements were then identified in each of the walls and Bechtel's program OPTCON used to evaluate reinforcement stresses. OPTCON determines the reinforcement stress resulting from out-of-plane bending moment plus in-plane shear loading. The shear capacity of the concrete is deducted from the total shear load with the difference assumed to be carried by the reinforcement. The following are peak reinforcement stresses reported by Bechtel for the critical load cases: north wall - 22 ksi; south wall - 34 ksi; west wall - 29 ksi; east wall - 23 ksi; and interior walls - 20 ksi. The allowable steel streess is 54 ksi.

2.6 Survey Data

Bechtel reports that the accuracy of the survey data describing the DGB settlements is 1/8" until the surcharge was removed and 1/16" since that time. Standard survey techniques and equipment were used.

3.0 ASSESSMENT OF THE DIESEL GENERATOR BUILDING

The DGB has undergone very large settlements which have undoubtedly caused serious structural distress. This distress is manifested in the cracks which have occurred in the building. The purpose of this section of the report is to give an opinion as to (1) whether the building is structurally sound and (2) whether the building still meets the criteria as stated in the FSAR.

An important issue is whether the major part of the settlement has occurred. The settlement data indicate that settlements are well into the secondary consolidation phase so that large additional settlements would not be anticipated. This leads to confidence that predictions of the adequacy of the structure based on settlements which have taken place to date should hold for the life of the structure. Certainly, settlements should be monitored and the problem reconsidered should more than the anticpated additional settlements occur. Relative settlements of points on the structure of .005" are significant. The accuracy of the settlement measurements should be refined to reflect this requirement.

While significant cracking has occurred in the structure, it would appear that there is little evidence to indicate that the structure is unsound. The structure is very massive and is not subjected to large loadings. Even the tornado and seismic loadings do not introduce large stresses and usually these stresses occur at locations that are not critical locations for the settlement stresses.

It is difficult to show that the stresses in the DGB meet the criteria of the FSAR. Bechtel's straight line analysis (see 2.4.1) is based on the claim that the settlement survey data is not sufficiently accurate to calculate structural stresses. The adjustment they make to account for this inaccuracy gives results that are likely unconservative. If conservative assumptions are made then the calculated stresses are too large to satisfy the criteria and not consistent with the crack patterns observed in the structure (see 2.4.2). It is doubtful whether any analysis could now be developed which would provide more realistic estimates of settlement stresses with the required degree of confidence.

The most likely source for obtaining reasonable estimates of settlement stresses are the crack studies (see 2.4.4). However, these studies must be documented much more completely than has been done to date. It is imperative that significantly better methods be used to monitor crack growth than is currently being considered. Whitemore strain gages should be used extensively. Plugs are attached to the concrete on a 2" gage. An instrument is then used to measure the distance between the plugs. Accuracies of .0001" is routine. Such gages would give a good picture of the overall behavior of the cracks. It should be noted that the repair of cracks would not interfere with the use of these instruments. No special "windows" need to be maintained during the crack repair program. This program of crack monitoring is also important because there is some indication that cracks in the DGB have not stabilized and that the number of cracks may in fact be increasing.

4.0 RESPONSE TO CONCERNS OF R.B. LANDSMAN

The Region III inspector has raised four concerns (Ref. 1) regarding the adequacy of the DGB. Each of these is addressed in the following.

Concern 1: FINITE ELEMENT ANALYSIS

The first concern deals with the Bechtel finite element models (see 2.4.1 and 2.4.2) of the DGB used to evaluate stresses due to settlement. There are four objections made to the models.

Concern is raised with regard to the use of uncracked section properties while the concrete is known to be cracked. All concrete structures are cracked and it is standard practice (specifically permitted in the ACI code) to determine forces in concrete structures based on gross section properties (i.e., neglect the cracks in the concrete and the reinforcement). If cracked section properties were used then the stresses calculated by Bechtel (2.4.1) would have been smaller. Therefore neglecting cracks in this analysis is a conservative approximation. On the other hand, the analysis reported in 2.4.2 was used to show that the measured settlements result in stresses which are so high that much more severe cracking would be expected than was observed. It was then argued that the measured values must be in error. If cracked sections were assumed for this analysis the calculated stresses would have been smaller, but probably still not consistent with the observed crack patterns.

The straight line representation of the settlements along the north and south wall for the analysis reported in 2.4.1 is said to be in error. As indicated in that section of this report, it is our opinion that this analysis will result in unconservative predictions of stresses due to settlements. As such, it is considered to be an inappropriate analysis.

The third part of this concern raises questions regarding the time effects of the settlements. Bechtel does calculate stresses for different phases of the settlement. The structure was changing during the significant settlement period. Construction was still in progress during the largest settlements. Therefore the structural geometry changed as did the concrete properties (while maturing). The Bechtel models did not account for these changes. This would have been conservative for the calculation of stresses, but would result in lower stresses in the analyses performed using the measured settlements as input.

The fourth objection deals with the claim that the NRC staff did not approve of the Bechtel analysis. It appears that this is the case and the intention of the staff was to use settlement stress data based on an analysis of the cracks rather than the finite element analyses.

Concern 2: RELIABILITY OF MEASURED SETTLEMENT VALUES

The analyses reported in 2.4.2 and 2.4.3 were used to show that stresses computed from structural models subjected to the measured settlements are very high and would indicate cracking in the structure where no cracks are observed. The objection is raised that a linear model was used and that a nonlinear model accounting for plastic effects would result in a redistribution of stresses and the same conclusion may not apply. This observation is true, but by itself would not change the conclusions drawn from these analyses.

As stated above, however, there are other factors which when coupled with this objection may result in a different conclusion. The other important factors are: the assumed shape of the settlement between the measured points; and the differing geometry of the DGB when the various phases of settlement occurred.

Concern 3: STRESSES DETERMINED FROM CRACK SIZES

If the finite element analyses are not reliable then one alternative approach is to find settlement stresses from a study of the crack sizes. The objection raised is that this approach is not consistent with normal engineering practice and that there are no equations available to evaluate stresses from crack data when the stress fields are as complex as occur in the DGB. It is true that this would not be standard practice, but "non-standard" analyses may be used provided they are sufficiently documented and shown to give results that are conservative.

An approach that could predict approximate settlement stresses in the DGB could probably be used to demonstrate its adequacy. This is true for two reasons. First, stresses in the structure due to other loadings are rather low and there is a large reserve for settlement stresses. Second, if large settlement stresses and local yielding of the reinforcement occurs, the resulting deformations of the structure will reduce the settlement induced loadings.

The documentation of the crack analyses used to determine stresses is not sufficient. There is no calculation on record which calculates stresses in all of the walls using this method. There is also no written justification showing that the method may be used for structures like the DGB.

Concern 4: CRACK MONITORING

This concern deals with the lack of a good crack monitoring system and specification of action to be taken if the cracks exceed certain limits. As stated in Section 3.0, it is our opinion that the planned crack monitoring system is not adequate. More reliable gages (e.g., Whitemore Strain Gages) should be placed in areas where cracking is now evident. These gages can be used even after crack repairs are made.

Two limits are now defined in the current crack monitoring program. If the crack width reaches .05" (Action Limit) a meeting will be held to evaluate what steps to take when the cracks reach the next limit. The next upset limit is set at .06" (Alert Limit). It is our opinion that the form of this plan is adequate, but that the specific threshold numbers must be based on a resolution of the current settlement stresses. A safety margin must be left for the other potential loading events, such as tornado or seismic loads, with the remaining allowable stress allocated to future potential settelments.

Once this limit was reached the only solution would be to make a structural repair. The exact form of this repair would depend on the location and extent of the crack which exceeded the limit. The planned response could not specify the nature of the repair, but could indicate that an exceedance of the Alert Limit would result in a structural repair rather than performing additional analyses.

5.0 CONCLUSIONS

Based on the review of the studies performed to demonstrate the adequacy of the DGB, the following conclusions are drawn:

1. The settlement data indicates that primary consolidation of the fill is completed. However, it is recommended that the anomolies in the documentation of the settlement history be resolved. (See last paragraph of Section 2.2).

2. It is unlikely that a satisfactory stress analysis can be performed based on the measured settlement data. It is recommended that settlement stresses be estimated from the crack width data. The existing work that has been done in this area must be completely documented.

3. It appears that the number of cracks in the DGB are continuing to increase. It is essential that a better crack monitoring program be established as outlined in Section 3.0.

4. The upset crack width levels specified in the crack monitoring program should be chosen so that a sufficient stress margin is available to resist the critical load combinations.

5. If the Alert Limit (in crack width) were exceeded, specific structural repairs should be mandated.

6. While significant cracking has occurred in the DGB, it is our opinion that the structure will continue to fulfill its functional requirement. This conclusion is based on the fact that stresses induced in the structure by all other extreme loadings are small.

REFERENCES

1. Memorandum for R.F. Warnick through J.J. Harrison from R.B. Landsman, Subject Diesel Generator Building Concerns at Midland, dated July 19, 1983.

2. Bechtel Calculation No. DQ-52.0 (Q), Rev. 2.

3. Bechtel Calculation No. DQ-52.7 (Q) - Finite Element Calculation of Settlement Stresses Using Actual Displacements.

4. Structural Reanalysis of Diesel Generator Building Utilizing Actual Measured Deflections as Load Input, by John Matra, Naval Surface Weapons Center.

5. Evaluation of the Effect on Structural Strength of Cracks in the Walls of the Diesel Generator Building Midland Plant Units 1 and 2, by Mete Sosen, February 11, 1982.

6. Effects of Cracks on Serviceability of Structures at Midland Plant, by W.G. Corely, A.E. Fiorato, and D.C. Stark, April 19, 1982.

7. Executive Summary, Diesel Generator Building, Midland Plants Units 1 and 2, August 1983.

8. Letter from CPCo to NRR dated October 21, 1981; Enclosure 1, Tech. Report, Structural Stresses Induced by Differential Settlement of the DGB.

APPENDIX A: SOURCE MATERIAL FOR STUDY

Site Specific Response Spectra	Midland Plant Units 1 & 2 Addendum to Part 1 Response Spectra--Orginal Ground Surface Jan 81 Weston Geophysical Corp
Site Specific Response Spectra	Midland Plant Units 1 & 2 Part II Response Spectra Applicable for the top of fill material at the plant site April 81 Weston Geophysical Corp
Site Specific Response Spectra	Midland Plant Units 1 & 2 Part III Seismic Hazard Analysis Feb 81 Weston Geophysical Corp
Soil Boring and Testing Program	Midland Plant Units 1 & 2 Test Results Foundation Soils Auxiliary Building Woodward-Clyde Consultants Aug 81 Docket Nos. 50-329,50-330

Test Results Perimeter and Baffle Dike Areas Soil Boring and Testing Program
Volume II Supporting Data July 81
Docket Nos. 50-329,50-330

Test Results Perimeter and Baffle Dike Areas Soil Boring and Testing Program
Volume I
Woodward-Clyde Consultants July 81
Docket Nos. 50-329,50,330

Estimates of Maximum Past Consolidation Pressure of Cohesive Fill Materials
Diesel Generator Building
July 81 Woodward-Clyde Consultants
Docket Nos. 50-329,50-330

USA/NRC Before The Atomic Safety and Licensing Board 12/7/82
testimony of; Frank Rinaldi
John Matra
Gunnar Harstead
with respect to the Structural Adequacy of The Diesel Generator Building at Midland

Official Transcript Proceedings Before NRC Atomic Safety and Licensing Board
DKT/CASE No. 50-329,50-330 OL & OM
12/10/82 pages 11008 through 11228

Evaluation Report for Concrete Cracks in the Diesel Generator Building
Consumers Power Company 2/16/82

Evaluation of the Effect on Structural Strength of Cracks in the Walls of the Diesel Generator Building   Mete A. Sozen 2/11/82

Relationship of Observed Concrete Crack Widths and Spacing to Reinforcement Residual Stresses   Consumers Power Company 6/14/82

Observed Cracks in Walls of Midland Plant Structures   6/14/82
Corley and Fiorato
Portland Cement Association

Safety Evaluation Report related to the operation of Midland Plant
Docket Nos. 50-329 and 50-330
Consumers Power Company
USNRC 5/82

Effects of Cracks on Serviceability of Concrete Structures and Repair of Cracks
Consumers Power Company 4/30/82

Effects of Cracks on Serviceability of Structures at Midland Plant
Corley, Fiorato, Stark
Portland Cement Association

Summary of Sept. 8, 1981 Meeting on Seismic Input Parameters Midland Plant
USNRC 12/3/81

USA/NRC Before the Atomic Safety and Licensing Board 50-329,50-330
testimony of Jeffrey K. Kimball 9/29/81

NRC Atomic Safety and Licensing Board 50-329 OM,OL 50-330 OM,OL
witnesses; Johnson
Burke
Corley
Sozen
Gould

NRC Before the Atomic Safety and Licensing Board (no date)
NRC staff testimony of Joseph Kane
on Stamiris Contention 4.B
Docket Nos. 50-329 OM,OL 50-330 OM,OL

Safety Evaluation Report related to the operation of Midland Plant October 82
Docket Nos. 50-329 50-330
USNRC NUREG-0793 Supplement No. 2

Safety Evaluation Report related to the operation of Midland Plant June 82
Docket Nos. 50-329 50-330
USNRC NUREG-0793 Supplement No. 1

NRC Atomic Safety and Licensing Board   9/29/81
Applicant's Brief on Compatibility of Site Specific Response Spectra Approach with 10 CRF part 100 Appendix A

Safety Evaluation Report related to the operation of Midland Plant   May 82
Docket Nos. 50-329 50-330
NUREG-0793

Response to the NRC Staff request for Settlement Related Analyses for the Diesel Generator Building   6/1/82
Consumers

Technical Report   Structural Stresses Induced by Differential Settlement of the Diesel Generator Building
Consumers Power Company

Test Results of Soil Boring and Testing Program for Diesel Generator Building
Docket Nos. 50-329 50-330   7/31/81
Consumers Power Company

Final Results of Soil Boring and Testing Program for Perimeter and Baffle Dike Areas   7/27/81
Docket Nos. 50-329 50-330
Consumers Power Company

NRC Atomic Safety and Licensing Board   Docket Nos. 50-329 OM,OM 50-330 OM,OL
Witnesses; Hood   12/3/81
Kane
Singh
Rinaldi

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Witnesses; Kennedy   2/17/82
Campbell   Rinaldi
Kane   Matra
Hood
Singh

CSE Input to the Midland SER Supplement   Aug. 82
Geotechnical, structural, mechanical and hydrologic inputs for the Midland Ser Supplement

Transcript of Proceedings USA/NRC   1/6/81
Deposition of Frank Rinaldi

Transcript of Proceedings USA/NRC   1/9/81
Deposition of Pao C. Huang

Transcript of Proceedings USA/NRC   Docket Nos. 50-329 OM, OL 50-330 OM,OL
Deposition of John P. Matra 1/7/81

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50-330 OM-OL

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USA/NRC Before the Atomic Safety and Licensing Board Docket Nos. 50-329 OM-OL
50-330 OM-OL

Testimony of Dr. Paul F. Hadala with Respect to the Study of Amplication of Earthquake Induced Ground Motions and the Stability of the Cooling Pond Dike Slopes Under Earthquake Loading 9/29/81

USA/NRC Before the Atomic Safety and Licensing Board Docket Nos. 50-329 OM,OL
50-330 OM,OL

Witnesses; Boos
Hendron
Hanson

Testimony of Ralph B. Peck before the Atomic Safety and Licensing Board, in the the matter of Consumers Power Company (Midland Plant, Units 1 and 2), Docket Nos. 50-329 OM, 50-330 OM, 50-329 OL, 50-330 OL, notarized Nov. 3, 1982.

Letter from CPCo to H.R. Denton dated June 14, 1982 with Enclosure "Response to the NRC Staff Request for Additional Information Required for Completion of Staff Review of Soils Remedial Workd dated June 14, 1982.

Summary of August 17, 1982 Meeting on Soils-Related Construction Release, dated September 7, 1982, by Darl Hood.

"Structural Reanalysis of Diesel Generator Building Utilizing Actual Measured Deflections as Input", by John Matra.

Letter from CPCo to H.R. Denton dated October 21, 1981 with Enclosures:
"Structural Stresses Induced by Differential Settlement of DGB",
"Subgrade Modulus & Spring Constant Values for DGB Structural Analysis",
"Bearing Capacity Evaluation of DGB Foundation"
"Logterm Monitoring of Settlement for DGB",
"Relative Density and Shakedown Settelment of Sand under DGB",
"Estimates fo Relative Density of granular Fill Materials, DGB",
"Review and Control of Facility Chagnes to DGB",
"DGB Bearing Pressaure due to Equipment and Commodities",

Report form Woodward-Clyde to CPCo dated June 10, 1981, "Preliminary Test Results, Soil Boring & Testing Program, Perimeter and Baffle Dike Areas",

"Seismic Margin Review, Midland Energy Center Project": Volumne 1, Methodology and Criteria, dated February 1983, Volume V, Diesel Generator Building, dated July 1983, prepared for CPCo by Structural Mechanics Associates.

Applicant's Propsed Findings of Facts and Conclusions of Law on Remedial Soils Issue

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

Testimony of Karl Weidner for the Midland Plant Diesel Generator Building September 8, 1982

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

Find Report on the ADINA Concrete Cracking Analysis for the Diesel Generator Building by Gygna Energy Services, September 16, 1981

APPENDIX IV

ENCLOSURE

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

JUL 1 9 1983

MEMORANDUM FOR: R. F. Warnick, Director, Office of Special Cases

THRU: J. J. Harrison, Chief, Section 2, Midland

FROM: R. B. Landsman, Reactor Inspector

SUBJECT: DIESEL GENERATOR BUILDING CONCERNS AT MIDLAND

At the recent hearing before Congressman Udall's subcommittee, I expressed my concern regarding the structural adequacy of the diesel generator building because of numerous structural cracks that have occurred throughout the building over the years. I also expressed the same concern during the recent ASLB hearings. Mr. Eisenhut has requested me to document the basis of my concerns about the building so an independent review group can analyze them.

My first concern deals with the finite element analysis that Consumers Power Company (CPCo) used to show that the building is structurally sound. Their model of the building assumed a very rigid structure without any cracks. The building has numerous cracks, reducing the rigidity of the structure. The effects of these cracks have not been taken into account in the analysis. CPCo's interpretation of the settlement data as a straight line approximation always stems from their position that the building is too rigid to deform as indicated by actual settlement readings. The settlement of the building occurred over a period of time during different phases of construction. It is this time dependent effect that was also not used in their model. Even CPCo expert Dr. Corely testified at the ASLB hearings that the analysis should have "taken into account cracking and time dependent effects" in order to give correct results. Finally, the staff's official position, as stated by Dr. Schauer, on CPCo's analysis was, "The staff takes no position with regard to that analysis."

My second concern deals with the acceptance of the diesel generator building in the SSER #2 which was subject to the results of an analysis to be performed by the NRC consultants using the actual settlement values. The consultants testified at the ASLB hearing that this analysis gave unacceptable results and this portion of the SSER should be stricken. They are basing their unacceptable results and comments on their finding of

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very high stresses obtained in areas where no cracks exist. Therefore, the actual settlement values are not accurate enough (are in error) to be used in an analysis. The consultants, as well as CPCo, ran a linear analysis (structure always in the elastic range) instead of a plastic analysis which would allow a redistribution of loads in the structure. Therefore, supposed areas of high stress, where cracks are not located, may not exist due to redistribution of loads. Finally, the staff's official position, as stated by Mr. Rinaldi, on this analysis as performed by the consultants, was that the actual settlement values could not be relied upon to determine if the diesel generator building meets regulatory requirements.

My third concern deals with the fact that we are not following normal engineering practice in accepting the building by using a crack analysis approach because there is no practical method available today to analyze a complex structure with cracks in it. The basis of this concern is that there are no formulas available that can estimate stresses in a complex stress field like those which exist in this building. Thus, the evaluation of the structure based on the staff's crack analysis using empirical unproven formulas to determine the rebar stresses is unacceptable.

My fourth concern deals with the staff accepting the building by relying on a crack monitoring program to evaluate the stresses during the service life of the building. If cracks exceed certain levels, recommendations will be made for maintaining the structural integrity of the building. The basis for my concern deals with the lack of crack size criteria and the lack of formulated corrective action to be taken when the allowed crack sizes are exceeded.

These concerns which I have just enumerated are also shared by members of Mr. Vollmer's engineering staff, as well as their consultant. These concerns were documented in the ASLB hearing transcripts of December 10, 1982, prior to my ever expressing my concerns before the ASLB hearing or Congressman Udall's subcommittee.

In summary, since it is impossible to analyze this severely cracked structure to the total staff's approval, I recommend some remedial structural fixes be undertaken to ensure the structural integrity of the building to provide an adequate margin of safety.

Ross B. Landsman

Ross B. Landsman
Reactor Inspector

cc: DMB/Document Control Desk (RIDS)

ATTACHMENT 1

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

MEMORANDUM FOR: George Lear, Chief
Structural and Geotechnical Engineering Branch
Division of Engineering

THRU: Lyman Heller, Leader
Geotechnical Engineering Section
Structural and Geotechnical Engineering Branch
Division of Engineering

LWH

FROM: Joseph Kane, Senior Geotechnical Engineer
Geotechnical Engineering Section
Structural and Geotechnical Engineering Branch
Division of Engineering

SUBJECT: REVIEW OF REGION III REACTOR INSPECTOR'S CONCERNS REGARDING THE DIESEL GENERATOR BUILDING AT MIDLAND

In response to your verbal request of July 27, 1983 I am providing my comments on the July 19, 1983 memorandum prepared by R. B. Landsman on his concerns for the Diesel Generator Building. Since many of the concerns covered in the July 19, 1983 memorandum had previously been expressed in the ASLB hearing sessions of December 6-10, 1983, I have attempted to identify the specific transcript pages where these issues were discussed. Hopefully this listing of transcript pages will permit the interested reviewer in recognizing and evaluating the similarities and differences with both my previously expressed views and those of GES Consultant, the U.S. Army Corps of Engineers, and those views now provided by Dr. Landsman.

Joseph D. Kane

Joseph D. Kane, Senior Geotechnical Engineer
Geotechnical Engineering Section
Structural and Geotechnical
Engineering Branch
Division of Engineering

Enclosure:
As stated

cc: See page 2

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cc: w/enclosure
R. Vollmer
J. Knight
G. Lear
P. Kuo
L. Heller
E. Adensam
T. Sullivan
D. Hood
F. Rinaldi
H. Singh, COE
R. Landsman, Region III
J. Harrison, Region III
W. Paton, OELD
J. Kane

Review Comments of

Joseph Kane

Diesel Generator Building Concerns

at Midland

Reference - July 19, 1983 Memorandum, From R. B. Landsman thru J. J. Harrison to R. F. Warnick, Subject: Diesel Generator Building Concerns at Midland.

1. First Concern - The problems and limitations inherent in the finite element analysis completed by CPC because of the effects of cracks and CPC interpretation of settlement data.

   Comment: To the best of my understanding and recollection the statements expressed in this first concern are accurate. I am in agreement with these statements except for the sentence "It is this time dependent effect that was also not used in their model." It is not clear to me what is intended by "time dependent effect". If it means the effect of cracking that resulted because of settlements, then I would agree with the statement. If it implies that time dependent settlements were not considered, then I believe the statement is in error.

   Pertinent Transcript Pages - December 10, 1982, Pages 11173 to 11203.

2. Second Concern - Problems with analysis performed by NRC Consultant, the U.S. Naval Surface Weapons Center, and statement that this analysis gave unacceptable results.

Comment: In my opinion it was very unfortunate that the study by NSWC was not provided to the NRC Staff who are affected by the study results in sufficient time to permit a full internal NRC review with opportunity for calm and deliberate discussions on its contents before this document was introduced by the Applicant into evidence before the ASLB. I personally have serious problems and questions with the NSWC report. I have not pursued my concerns with the NSWC report for two reasons. First, I was under the impression that all review issues related to the DGB had been fully addressed at the December 6 through 10, 1982 ASLB Hearing session and secondly, my understanding of the procedure used by NRC Structural Engineering Section to arrive at its conclusion as to the magnitude of the stresses induced by settlement (the crack analysis approach) does not rely on the results or conclusions of the NSWC study.

With respect to Dr. Landsman's stated second concern, I essentially am in agreement with his statements except I do not understand what is meant by the words "and this portion of the SSER should be stricken" which appears in the second sentence.

3. Third Concern - Crack analysis approach used by the Staff is not normal engineering practice.

Comment: In response to examination questions from both OELD and ASLB, both Mr. Singh and I gave our views on the crack analysis approach. An important conclusion reached by Dr. Landsman, which is different from my position, is that the Staff's crack analysis to determine rebar stresses is unacceptable. I believe a review of the transcript records will clearly show that I did not make this conclusion on unacceptability because I feel it is outside my area of responsibility and expertise.

Pertinent Transcript Pages - December 10, 1982, Pages 11187 to 11201.

4. Fourth Concern - Problems with relying on the crack monitoring program to evaluate stresses during the service life of the DGB.

Comment: The hearing transcripts will show that neither H. Singh or myself was questioned on the acceptability of the crack monitoring program for the Diesel Generator Building. The discussions that did occur in the hearings were provided by CPC consultants and NRC Structural Engineering Section. It is my impression that technical specification details still need to be resolved with the Applicant on the crack monitoring program for the DGB. Some of the details to be resolved would include the actual method to be used in measuring the cracks and the requirements for jointly coordinating and evaluating both settlement and crack readings. I share the same concern as Mr. Landsman on the "lack of formulated corrective action to be taken when the allowed crack sizes are exceeded." In addition to Mr. Landsman's concern I have problems with the following aspects of the crack monitoring program which were worked out by NRC Structural Engineering Section and the Applicant.

a. The criteria on crack widths permitted under both the alert and action limits (December 10, 1982 transcript, page 11069) are not sufficiently restrictive to prevent potential sections of the DGB from experiencing cracks where tensile stresses in the reinforcing steel would be well above the allowable stress.

b. It is not clear what is intended by the wording "summation of the increase in all the crack widths...." as it pertains to both the alert and action limits. Are the crack widths identified in transcript page 11069 to be the increases that are permitted? Increase over what existing width and date?

c. A crack monitoring program may elect to select certain wall sections for more careful measurement of cracks but it should not fail to require reasonable surveillance on other portions of the structure. My understanding of the agreed upon monitoring program for the DGB is that it is limited to localized areas on the faces of three selected walls.

d. The decision to require crack monitoring at a frequency of once in five years after yearly monitoring for the first five years should not be made at this time. The decision to significantly increase the required monitoring interval should be withheld until the initial data and trends are known and evaluated.

ATTACHMENT 2

Comments on J. Matra's Study - Structural Reanalysis of DGB

The time frames for the phases of construction (e.g. pre-surcharge, during surcharge, etc) have been selected for the convenience of major construction phases or events and to more accurately estimate the DGB's stiffness at these specific times when the effects of settlement are evaluated.

It is not clear why total settlements (Figs. 29, 34, 36, 38, 40 and 42) are being used to compute max. stresses and moments. It is my understanding that computed stresses and moments are only appropriate for the various time frames where the specific settlement increment for that time frame has been used. The comments provided in Tables 2, 3, 4, 4.5 and 5 should not be comparing stresses and moments based on total settlements when checking for areas of cracking. Need to clarify this with NSWC and reexamine computed stresses and moments with available crack mapping. On several of the walls (See Table notes) there does appear to be correlation of cracks with high stress areas. Discuss w/ NSWC.

Tables 3 and 4 provide results of NSWC on various floor and roof elevations. Since crack maps for floors and roof are not provided in the NSWC, is it intended to check study results of stresses and moments against existing cracks by a site inspection or request for additional mapping?

Tables 5 and 6 when addressing the settlements on Figs 4 and 43 in causing high stresses and moments should recognize the settlements are predicted to the year 2025. The major portion of these settlements have yet to occur, therefore, a check for cracking due to these settlements can not be made at this time.

(over)

The elements in the F.E. analysis appear to be approx. 20' in length. What effect does this 20' length have on the results of the analysis (location of high stresses and strains) recognizing that it is assumed the strain is constant over this length. Could check by using smaller elements, e.g. 5' lengths.

Explanation for "out of plane" moment?

Explanation on how allowable axial load and allowable out of plane moment were established (e.g. Table 2) for the 30" wide wall that has reinforcing of # 8 bars, 12" O.C. in both H & V directions

Following discussions with NSWC, is there a need to set up site inspection to check areas of high stress and moment with visually observed areas of cracking

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

ATTACHMENT 3

MEMORANDUM FOR: P. T. Kuo, Section Leader
Structural Engineering Section B
Structural and Geotechnical Engineering Branch
Division of Engineering

FROM: Frank Rinaldi, Structural Engineer
Structural Engineering Section B
Structural and Geotechnical Engineering Branch
Division of Engineering

SUBJECT: R. LANDSMAN'S CONCERNS ON INTEGRITY OF DIESEL GENERATOR BUILDING AT MIDLAND SITE

Enclosed please find the initial response to R. Landsman's concerns on the integrity of the Diesel Generator Building at the Midland site, as prepared during a working meeting on July 28, 1983, by myself and our consultants, John Matra and Gunnar Harstead.

Frank Rinaldi

Frank Rinaldi, Structural Engineer
Structural Engineering Section B
Structural and Geotechnical
Engineering Branch
Division of Engineering

Enclosure: As stated

cc: H. Denton
D. Eisenhut
R. DeYoung
E. Christenburg
C. Bechhoefer
R. Vollmer
R. Warnick
J. Knight
G. Lear
J. Kane
R. Landsman
J. Matra
G. Harstead
F. Rinaldi

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REPLY TO R. B. LANDSMAN'S CONCERNS ON THE STRUCTURAL INTEGRITY OF THE DIESEL GENERATOR BUILDING FOR MIDLAND NUCLEAR POWER PLANT

INTRODUCTION:

The structural engineering staff and their consultants have reviewed and evaluated the structural adequacy of the Diesel Generator Building (DGB) to determine the functionality of the DGB and compliance of the design to the structural engineering requirements of NRC for the licensing of a nuclear power plant.

The Midland Nuclear Power Plant (NPP) has had a number of technical reviewers throughout the licensing period, Construction Permit (CP) and Operating License (OL) stages.

This report concentrates on the period following the determination by Consumer Power Co. (CPCo) that the fill material under the DGB did not meet the design specifications and that remedial actions were necessary. The applicant, under advice of their consultants, surcharged the structure with approximately 30 feet of sand and implemented a permanent dewatering program to correct the poor soil conditions under the DGB. In addition, electrical ducts were discovered to be supported by a competent foundation and were structurally connected to the base of the DGB. This condition imposed new loads on the structure in addition to all other design loads (Dead Loads, Live Loads, Tornado Loads, Earthquake Loads, Temperature Loads), and the abnormal differential settlement loads. Considerable cracks developed as a result of these additional loads. In order to eliminate this condition, the duct banks were released, therby removing one of the abnormal loads.

The DGB is a reinforced concrete structure with three crosswalls that divide the structure into four cells. Each cell contains a 6 ft.-6 inch-thick concrete pedestal to support a diesel generator unit. The building is supported on continuous footings that are founded at el. 628 ft. and rest on backfill that extends down to approximately el. 603 ft. This rectangular boxlike structure covers an area of approximately 70 ft. by 155 ft. The exterior walls are 30 in. thick, and the interior walls are 18 in. thick. The foundations of the exterior and interior walls of the DGB consist of continuous reinforced concrete footings, 10 ft. wide and 2 ft. 6 inch thick, with their base at el. 628 ft. The walls rise from an elevation of 628 ft. (bottom of footing) to el. 690 ft. (top of roof slab).

Sections 3.8.3.4 and 3.8.3.5 of Supplement No. 2 to the Midland NPP Safety Evaluation Report summarize the NRC structural staff and consultants evaluation of the DGB. This document was modified during the (ASLB) hearing of December 10, 1982, by the additional written testimony of Frank Rinaldi, Franz Schauer, John Matra, and Gunnar Harstead and all oral correction introduced by the same witnesses. The adequacy of the DGB is based upon many analyses, reviews, and monitoring requirements which address normal loads, settlement loads and postulated environmental loads. Due to the fact that available measured and predicted settlement data is not sufficiently refined to calculate structural component's stress by the use of a finite element analyses, the following quotations summarize the structural staff position for acceptance of the DGB:

(a) The NRC Staff believes the actual measured settlement values are the best characterization of settlement at the Midland site.

(b) The NRC Staff has not fully relied on these settlement values in any analyses to ascertain the acceptability of the DGB to withstand its design load over the lifetime of the plant. Instead, the Staff has looked at the current condition of the structure to estimate stresses due to settlement. To these it added stresses due to other design loads which are not presently on the structure but which have to be considered. The staff relied on Applicant's finite element analysis only for the latter stresses.

(c) The NRC Staff finds the DGB to be structurally acceptable.

(d) The NRC Staff is requiring a program of surveillance of the structure and for its foundation to ensure the continued safety of the structure.

(e) The NRC Staff takes no postion with respect to the acceptability of Applicant's finite element analysis of the DGB (as applicable to settlement effects).

(f) The NRC Staff's acceptance of the DGB is subject to the outcome of Seismic Margin Review.

Summary of Landsman's Concerns:

The concerns documented by R. Landsman regarding the DGB by his memorandum to R. F. Warnick, Director, Office of Special Cases, Region III, dated July 19, 1983, transmitted to D. G. Eisenhut, Director, Division of Licensing, NRR, by memorandum dated July 21, 1983, were received by the undersigned on July 27, 1983. This memorandum identifies, in general, concerns previously discussed by the staff during internal meetings and at the ASLB December 1982 hearings related to the DGB. The undersigned fail to understand why R. Landsman has not chosen to participate more fully during these meetings, or why he had not documented his concerns during the review process. The concerns identified in his July 19, 1983 memorandum in some cases are not clear, do not give specific reference to transcripts and other official documents, and in some cases, references to various statements are not fully correct. We will first summarize our understanding of his concerns and then address them in the following order:

FIRST CONCERN: Claim of inadequacy of the Finite Element (FE) Analysis performed by the applicant for the DGB as applies to the following:

(a) Effect of cracks on stiffness of DGB
(b) Validity of straight line settlement data
(c) Time dependency effects of settlements
(d) Corley statement on cracks and time dependency effects of settlement
(e) Staff's official position on FE analyses as stated by F. Schauer.

SECOND CONCERN:

(a) Claim that the analyses performed by NRC staff consultant (NSWC) is not properly documented in the SSER #2 based on their testimony at ASLB hearing.

(b) Claim that different analyses (Plastic) should have been used.

(c) Claim that F. Rinaldi stated that the staff cannot rely on the results of the NSWC analyses using actual settlement values.

THIRD CONCERN: Claim that the crack evaluation used to determine the stress in the reinforcing steel is not an adequate practical engineering approach.

FOURTH CONCERN: Claim that the crack monitoring program accepted by the staff to evaluate the rebar stresses during the service life of the building is not adequate.

SUMMARY: Recommendation for new remedial structural fixes required to ensure structural integrity and provide adequate margins of safety.

<u>Reply to Landsman's Concern:</u>

FIRST CONCERN

Part (a) In the design of reinforced concrete structures, the composite of concrete and rebars is modelled as homogeneous material with the concrete expected to crack under tensile loads. It is acceptable to assume concrete sections as uncracked for calculational purposes. The assumption of uncracked concrete neglects both the expected cracks and the stiffness of reinforcing bars which are compensating effects in the calculation of stiffness. Also, a reduced stiffness would reduce moments and forces due to settlement, therefore, reducing some conservatism from the structural analyses.

In conclusion, we find the design practice of neglecting the cracks in an analysis of the reinforced concrete structure is acceptable. Note that extensive crack evaluation efforts have been carried out by the applicant and their consultants and by the staff and our consultants, to determine the effects of cracks on the structure.

Part (b) The direct use of settlement data can give results which can be used to develop indications of the state of stress in the structure. The applicant used what they considered the best practical approach to determine the effects of the measured displacements on the structure, based on the available number of measured points and on the accuracy of the measurements.

The DGB is a stiff structure. The characterization of the boundary conditions used in the analyses should be consistent with that of a stiff structure; namely, linear. Also, settlement data has an inaccuracy inherent in the readings. The applicant's engineers claimed to have an accuracy no better than 1/8". Bending moments are proportional to the second derivative of displacement with respect to length and shear is proportional to the third derivative of displacement with respect to length. A mathematical error analysis shows that the accuracy diminishes with subsequent differentiation. Therefore, the accuracy of the moments and shears will be unreliable if the raw settlement data is used. Structural engineering judgment must be exercised in the formulation of the models and in the evaluation of the results.

The applicant performed many of the analyses to represent various stages of construction, including a completed model, a 40-year life-model and a model using no soil support in an area where we could not rely on the competence of the soil.

Attempts to directly use the raw settlement data resulted in anomalies such as tension in the soil and moments and forces in the structure that cannot be justified by prudent engineering judgment, analyses, and observations of the structure.

In conclusion we state that the use of the straight line or other representation using the available settlement data cannot produce credible results.Therefore, the staff did develop a conservative estimate of the state of stress of the structure based on the crack-evaluation and added these results to the stress levels for the environmental loads as per code requirements. However, we like to point out that several loads (DL, LL, T) were added twice. Also, the controlling load combination is the one with the tornado load. The applicant did not account for venting of the structure in their analysis, but the drawings and site visits indicated that considerable venting is provided. We like to point out that these two factors add a great deal of conservatism to the results. In addition, the effects of future settlement was considered in the applicant analysis, but the staff will rely on the monitoring program.

Part (c) The fact that settlement took place over a period of time was accounted for in the applicant's and in NSWC's analyses. Settlements that took place prior to the completion of construction has less effect on the final stresses in the structure, for the following reasons:

a. The partially constructed structure is less stiff and, therefore, moments and forces were minimized

b. reinforced concrete that had not yet been installed could not be subjected to stresses resulting from previous settlement. We, therefore, find that the time dependent effect was used to our satisfaction.

Part (d) We recommend contacting W. G. Corley and request his direct comments to R. Landsman's in First Concern Part (d).

Part (e) F. Schauer did make the statement identified by R. Landsman during the ASLB hearing of December 10, 1982 (p. 11149). However, we suggest that R. Landsman read the cross-examination by the ASLB on page 11150 of the December 10, 1983 hearing to fully understand the staff position as stated by F. Schauer.

The answers provided on that page of the transcripts states that one cannot fully rely on all of the analyses, and that engineering judgment needs to be exercized.

Second Concern

Part (a) The summary report of the NSWC analyses was entered into evidence at the ASLB, December 10, 1982, hearing. It was discussed in detail by J. Matra and commented on by F. Rinaldi, G. Harstead, and F. Schauer. In summary, that report stated the following points:

1. The behavior of this structure as shown by the results of the analyses is inconsistent with respect to the actual observations in the structure as far as crack locations. (Not for duct bank impingement consideration).

2. Analyses of the partial structure, including duct impingement, resulted in very high stresses in the walls at the duct banks. With these stresses over twenty times yield, a great possibility of cracks in these areas existed. A comparison between the crack mapping survey at this time of construction (3/78 to 1/79) and the analyses are in good agreement as far as the location of structural cracks in the area of the duct banks are concerned. However, the analyses show that other areas of the DGB walls still have high stresses and in probability should also be cracked. But no cracks were observed in these areas.

3. In all cases where the duct banks have been released, the measured or predicted settlement values imposed on the analytical models resulted in very high stresses in areas where no cracks now exist. Thus, indicating that these settlement values as such were not seen by this structure.

4. Imposing the measured settlement values on a partially completed model, and then considering these values as part of the total settlement values for the completed structure, without considering the following effects:

   (a) redistribution of loads once yield is reached,

   (b) the relaxation effects,

   (c) the accuracy of the measured data, and

   (d) the location of the measured settlement value relative to the footings where the actual displaced values were input are discussed, but not actually input into the analysis,

   can and does lead to large errors. Thus, this structure will never undergo the differential settlements as predicted nor the patterns of settlement indicated in the measured and or predicted settlements.

Also, as indicated in the reply to First Concern Part (b), the results indicate tension in the soil and moments and forces in the structure that cannot be accounted for using sound engineering practice.

The analyses indicated that the direct use of the limited number of actual measured settlement data in the engineering analyses cannot be used without proper structural engineering judgment. The analyses were used in selecting a crack monitoring point for the service life of the DGB (a location of high stress as per these analyses, but having no major cracks was selected).

Part (b) The elastic analyses performed by the applicant give correct and conservative indications of stress for non-settlement loads. This is concluded after having reviewed the structural model, the analyses and the results. If an elastic analysis shows a region of high bending moment such that reinforcing bar stresses exceed their yield stress, the section may then be considered plastic; i.e., increasing rotation will not increase moments or stresses. However, there is no indication of yielding rebars or spalling of concrete which would indicate that a portion of the structure has become plastic. In fact, the formation of plastic sections in a structure mitigates the secondary stress effects of conditions such as differential settlement. To state that "supposed areas of high stress, where cracks are not located, may not exist due to redistribution of loads," is inconsistent with the mechanism of redistribution of stresses.

Part (c) The claim that F. Rinaldi stated, "that the actual settlement values could not be relied upon to determine if the DGB meets the regulatory requirements" is not complete. The additional testimony clearly states that the applicant's analyses using linear settlement data were not fully relied upon in our evaluation. This is stated on pages 11084 - 11087 of the ASLB hearing transcripts, dated December 10, 1982. The staff performed an additional crack evaluation as stated in our written testimony presented on the pages following page 11086 of the above mentioned ASLB hearings. All stress levels were below code allowable. Therefore, we found the concrete cracking levels in the DGB, as reported by the applicant, acceptable. The proposed crack monitoring will provide controls over potential future crack-patterns.

Third Concern

The evaluation of cracks as performed by the Staff is not a structural analysis, but rather a method of estimating upper bound stresses in the rebars of an existing reinforced concrete structure. These values were used as conservative values for stress due to differential settlement, shrinkage and other secondary effects. These stresses were conservatively added to total stresses developed by the applicant.

The structural analyses of the DGB were performed by the applicant considering all load combinations as documented in their report, "Structural Stresses Induced by Differential Settlement of the DGB."

The results are documented in the additional written testimony. See transcripts for the ASLB hearing of December 10, 1982.

The DGB is not a complex structure, instead, it is a simple box-like structure. Also, all reinforced concrete structures have cracks and we disagree with the statement that "there is no practical method available today to analyze a complex structure with cracks in it." Note that the applicant's structural consultants and our structural staff and their consultants have performed several evaluations of the DGB without finding any unresolved concerns.

Fourth Concern

The DGB was not accepted by the staff soley by relying on a crack monitoring program. On the contrary, the acceptance was based upon reviews of the analyses and designs prepared by the applicant as well as independent calculations. Furthermore, the stresses caused by settlements are secondary stresses. Secondary stresses are defined as those stresses which can exist in a structural material which do not impair that capability of the structural material to carry primary stresses, provided the secondary stresses do not cause rupture or gross distortions of the structural material. From a variety of evaluations, the indications are that the stresses in the reinforcing bars are well below yield and far from rupture. The compressive stresses in the concrete are very low. There are no indications of gross distortions of the structure. Therefore, the cracks that have occurred merely indicate that the reinforcing bars will carry imposed tensile forces while imposed compressive forces will cause the cracks to close. While there are no expectations of rupture or gross distortions in the future, a crack monitoring program has been established to provide engineers with information to assess the condition of the structure, as a prudent measure.

The criteria for the monitoring program is identified as ASLB exhibit #29. It contains specific requirements for Alert and Action levels for the monitoring of single and collective crack widths.

Reply to Summary:

It is surprising that, with all of the data and information available on the subject of DGB there still exists such a misunderstanding. Beyond this response we would respectfully direct R. Landsman to evaluate all of the information currently available in the field of structural analysis and specifically to that available in the docket of the Midland project.

It is our conclusion that all analyses, designs, crack mapping and evaluations and the monitoring program are adequate to establish the structural integrity of the DGB. Only unexpected results during the monitoring program would necessitate a reassessment of the DGB.

Gunnar Harstead

Gunnar Harstead, Consultant
Structural & Geotechnical
Engineering Branch

John P. Matra Jr.

John Matra, Consultant
Structural & Geotechnical
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Frank Rinaldi

Frank Rinaldi, Structural Engineer
Midland Project,
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Engineering Branch

~~(1) RFW~~
(2) File -
Bd. Not.

OCT 1 7 1983

MEMORANDUM FOR: D. G. Eisenhut, Director, Division of Licensing, NRR

FROM: R. F. Warnick, Director, Office of Special Cases

SUBJECT: RECOMMENDATION FOR NOTIFICATION OF LICENSING BOARD

In accordance with present NRC procedures regarding Board Notifications, the following information is being provided as constituting new information relevant and material to the Midland OM/OL proceedings. This information deals with Babcock and Wilcox's (B&W) October 5, 1983, decision to stop all of its Class I (safety-related) pipe hanger and snubber activities. The stop-work applies to both small bore and large bore piping and has resulted in the lay-off of 132 craft and support personnel. The pertinent facts that relate to the stop work are as follows:

> A sampling of B&W pipe support hangers by the Bechtel Corporation, the Midland constructor, identified various discrepancies in the manufacture and installation of the hangers. Bechtel notified B&W, and it in turn took a sample of about 40 hangers for reinspection. B&W found a number of deficiencies, including welding and bolting problems during the inspection.
>
> Both Bechtel and the licensee said that the stop-work order will not be lifted until they have approved a B&W employee training program, and that the appropriate personnel have been retrained. They also will not lift the stop-work until corrective action is proposed by B&W to resolve any deficiencies in the hanger supports.

If you have any questions or desire further information regarding this matter, please call me.

"Original signed by R. F. Warnick"

R. F. Warnick, Director
Office of Special Cases

~~8311020378~~

RIII			
RBL	RNG	HH	RFW
Landsman/ls	Gardner	Harrison	Warnick
10/17/83		10/17/83	10/17

PRINCIPAL STAFF			
RA		DRSS	
D/RA		DE	
A/RA		DRMSP	
RC			
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SGA			
ENF			

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

October 11, 1983

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

MEMORANDUM FOR: The Atomic Safety and Licensing Board for the Midland Plant, Units 1 & 2

FROM: Thomas M. Novak, Assistant Director for Licensing
Division of Licensing

SUBJECT: SUPPLEMENTARY NOTIFICATION REGARDING DR. LANDSMAN'S CONCERNS FOR THE MIDLAND DIESEL GENERATOR BUILDING (BN 83-153)

Board Notifications 83-109 and 83-142 have transmitted the NRC staff's plan to address the concerns of Dr. Ross Landsman of Region III regarding the structural adequacy of the Midland Diesel Generator Building (DGB). These Notifications are deemed to provide information material and relevant to safety issues in the Midland OM/OL proceeding, including testimony by members of the NRC staff and staff consultants during the December 10, 1982, hearing session.

This Board Notification 83-153 further supplements the information regarding Dr. Landsman's concern, and is provided for your information. Enclosure 1 provides a reply by Mr. J. P. Knight to inquiries (Enclosure 1 to Knight's memorandum) by Mr. R. Vollmer as to (1) whether or not any members of Mr. Knight's staff, or consultants thereto, share Dr. Landsman's concerns that the DGB is inadequate to return to service from a safety point of view, and (2) whether or not any of these individuals share Dr. Landsman's specific technical concerns, notwithstanding their judgement that the building is safe for operation.

George W. Knighton
for Thomas M. Novak, Assistant Director
for Licensing
Division of Licensing

Enclosures:
As stated

~~8308300767~~

OCT 17 1983

DISTRIBUTION LIST FOR BOARD NOTIFICATION

Midland Units 1&2,
Docket Nos. 50-329/330

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