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

SEP 30 1983

MEMORANDUM FOR: William D. Paton, Attorney
Office of the Executive Legal Director

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

SUBJECT: GEOTECHNICAL ENGINEERING REVIEW COMMENTS ON THE APPLICANT'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW - MIDLAND PLANT

We have enclosed the second phase of geotechnical engineering input on Midland's Finding of Fact in response to OELD request. Comments 1 through 6 were provided in my memo to you on September 27, 1983. The enclosed comments cover our review of the Applicant's Findings on the Auxiliary Building and Service Water Pump Structure.

In our review of the findings on the remaining portions of the diesel generator building (DGB) (from page 98 to 157) we have concluded there are several areas of significant differences with the applicant's proposed findings that require joint resolution with Structural Engineering. We plan to address these portions at a later date.

A large portion of the Applicant's Findings provides unnecessarily detailed information on many topics that are informative but irrelevant. This encumbers our "piggyback" work toward an agreeable findings of fact and conclusions on issues before the Board. We would welcome the opportunity to discuss this problem with OELD and other staff reviewers to determine how NRC findings can overcome this problem.

As previously agreed upon, the next submittal of our input to OELD will be by October 15, 1983. By that date, we plan to have completed our review of the applicant's Findings.

The enclosure includes input from our consultants and was prepared by Joseph Kane (28153) who may be contacted for any questions that you may have on the enclosed geotechnical engineering input.

George Lear

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

Enclosure: As stated

cc: See page 2

8312070262 XA
6pp.

cc: w/enclosure
R. Vollmer
J. Knight
E. Sullivan
E. Adensam
G. Lear
L. Heller
P. Kuo
D. Hood
N. Wright
M. Wilcove
R. Gonzales
J. Kimball
F. Rinaldi
H. Singh, COE
S. Poulos, GEI
J. Kane

ADDITIONAL REVIEW COMMENTS ON CPC FINDINGS OF FACT
MIDLAND PROJECT - 50-329/330

PREPARED BY: JOSEPH KANE, NRR, DE, SGEB

AUXILIARY BUILDING

7. (Page 162, End of Par. 215) In addition to the Applicant's statements, NRC findings should also indicate that the initially proposed remedial measure for the Auxiliary Building, that of underpinning the EPA extremities with caissons, did not address the capability of the Control Tower's foundation to carry the additional load which would result if this remedial scheme were adopted. This recognition of additional load on the Control Tower was brought to the attention of the Applicant by the Corps of Engineers and was another factor that caused the underpinning efforts to be extended to the Control Tower. Refer to November 20, 1981 testimony of D. Hood, J. Kane and H. Singh (Page 13 and 14) concerning the remedial underpinning of the Auxiliary Building Area and the ASLB hearing session (December 3, 1981) transcripts which covered the subject.

8. (Page 163, Par. 216, Line 7) The Staff and its consultant feel the Applicant's statement that settlements at the Auxiliary Building have not been excessive or unusual is misleading. We recommend that the actual differential settlements which are identified in SSER No. 2 (Page 2-40) be included in the findings. We believe Par. 216 should also reflect that the Staff was concerned that the differential settlements which had already occurred may have resulted in cracking (SSER #2, Page 2-17) and was an indicator of possible distress (Page 9 of Hood, Kane and Singh testimony, dated November 20, 1981) to the Auxiliary Building structure.

9. (Page 163, Par. 217, Line 5) The Staff does not agree that "The cracks which have been observed in the Auxiliary Building can all be attributed to normal volume change in the concrete". Refer to Page 9 of Hood, Kane and Singh testimony, dated November 20, 1981. The transcript records of December 1 and 2, 1981 (Pages 5573 to 5680) indicate that the Applicant's witness, Dr. Corley, attributes the cracking to volume change but can not rule out "other things" (Transcript Pages 5580 and 5680). We recommend that NRC findings recognize the facts that CPC has already elected to post-tension the EPA out of its concern for settlements and that cracks have developed and have been recorded at building locations where the cracks would be expected if differential settlements were occurring.

10. (Page 164, Par. 219). In addition to Page 164 in the Applicant's findings, the following pages also refer to the foundation soils beneath the main Auxiliary Building and proposed underpinning as glacial till:

    a. Page 165, Par. 220
    b. Page 169, Par. 227
    c. Page 172, Par. 233

    Because there is a significant difference in engineering properties between the Midland's glacial till and the lacustine clays, we recommend that NRC findings maintain this important distinction and correct the description at the above locations from glacial till to lacustrine clays. SSER No. 2, Pages 2-12 and 2-17 provide the recommended description for the foundation soils beneath the main Auxiliary Building and proposed underpinned structures.

11. (Page 165, End of Par. 219) The Applicant's Findings indicate the four foot gap around the containment structures will be filled with compacted sand fill. It is our understanding the Applicant has revised this plan to now require concrete instead of the compacted sand fill.

12. (Page 170, Par. 228) This paragraph should also describe the pier load test and its purpose (SSER No. 2, Page 2-51).

13. (Page 170, Par. 229) This paragraph should note that the anticipated long-term differential settlements used in design will be checked by extrapolation of the trend of the measured differential settlements, while the jacks are still active, to estimate future differential settlements during years of plant operation.

14. (Page 170, Par. 229) Discussions at the September 14 and 15, 1983 design audit revealed to the Staff and its consultants, that our understanding of the locations where the .25 inch differential settlement was being assumed to occur was not the same as what had been actually used in the analysis of the structures. This difference is significant and results in less conservatism, and does affect the Staff's conclusion on the reasonableness of the 0.25 inch described in SSER No. 2, Page 2-40. Our understanding of where the differential settlement was assumed to occur comes from our evaluation of the testimony of Burke, Corley, Gould, Johnson and Sozen on the Auxiliary Building.

15. (Page 172, Par. 233) The Applicant's Findings incorrectly give the compaction control for the replacement fill beneath the FIVPs. The correct compaction criteria is given in SSER No. 2, page 2-17.

OK See OELD Draft of 11/9/83

16. (Page 174, Par. 237, Line 9) The statement by the Applicant that "All the instrumentation is installed away from the immediate area of any construction activities ..." is potentially misleading. It would be more accurate to state that the instrumentation is installed in the area of construction and is protected within metal cases.

OK - Decided not necessary to incorporate in Findings

17. (Page 176, Par. 238) The Staff does not share the Applicant's opinion that the action levels for deflection are "very conservative". On Page 2-23 of SSER No. 2 we describe the instrumentation to monitor underpinning as conservative. We are now finding in our evaluation of actual field readings during underpinning that induced tensile stresses, as reflected by measured strain levels, agree very closely with vertical movements that are being measured and which are the movement values restrictd by the alert and action limits. This close agreement is not indicative of a "very conservative" analysis.

OK See OELD Draft of 11/9/83

SERVICE WATER PUMP STRUCTURE

18. (Page 180, Par. 247) The Applicant's statement that the base slab of the overhanging portion of the SWPS is supported by "a triangular wedge of soil backfill" is incorrect. The NRC attorney by his questions attempted to correct CPC testimony at the SWPS hearing, and this resulted in the Applicant's submittal of Exhibit 28. The triangular wedge shown on Exhibit 28 does not correctly identify the limits of the soil fill placed beneath the overhanging portion.

OK See OELD draft of 11/9/83

19. (Page 181, Par. 248) We believe the SSER No. 2 in the second and third sentences in the last paragraph on Page 2-23, and Page 2-41 more appropriately reflect the Staff and its consultant position on SWPS settlements and their relationship to cracking than does Paragraph 248.

OK See OELD draft of 11/9/83

20. (Page 182, Par. 250) There is inconsistency in the Applicant's findings on line 3 of this paragraph and the last sentence in the preceding paragraph. The Staff recommends retention of the wording on line 3 which is in better agreement with our previous comment in Item 19 above.

OK See OELD draft of 11/9/83

21. (Page 184, Par. 254) The Staff prefers the wording in SSER No. 2, Page 2-51 for groundwater control criteria. In the SSER we indicate the two foot depth is a minimum level below the bottom of the pier excavation.

OK See OELD draft of 11/9/83

22. (Page 185, Par. 258) This paragraph should also mention the pier load testing to be completed at the SWPS (SSER No. 2, Page 2-51) which is intended to verify the design estimated compressibility and bearing capacity characteristics of the foundation soil.

OK See OELD draft of 11/9/83

23. (Page 186, Par. 260) The transcript records of the November 20, 1982 (Pages 9692, 9723-9727) hearing session do not support the conclusion in the Applicant's Findings at the end of this paragraph. We recommend a revision to this paragraph which provides a conclusion consistent with the hearing record.

OK See OELD draft of 11/9/83 w/ word modifications

J. Kane
P-214

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

November 15, 1983

Charles Bechhoefer, Esq.
Administrative Judge
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dr. Jerry Harbour
Administrative Judge
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dr. Frederick P. Cowan
Administrative Judge
6152 N. Verde Trail
Apt. B-125
Boca Raton, Florida 33433

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

Dear Administrative Judges:

Enclosed are the "NRC Staff Responsive Findings to Applicant's Proposed Findings of Fact and Conclusions of Law." With the Board's consent, these responsive findings do not address the diesel generator building. As was discussed at the hearing session of November 9, 1983, the Staff will advise the Board by December 1, 1983, of its position on the need to reopen the record on the Special Task Force's re-look at the DGB. In the event that the Staff takes the position that the record need not be re-opened, the Staff is currently scheduled to file on December 9, 1983, responsive findings with respect to the DGB.

CPC submitted an affidavit by Dr. Shunmugavel, dated August 2, 1983 regarding the use of ethafoam. The Staff is unaware of any commitment to reply to Dr. Shunmugavel's affidavit. Based on its review to date, the Staff has no disagreements with the affidavit and does not anticipate any. Should the Staff, however, encounter any significant difficulties with the affidavit, we will advise the Board.

Sincerely,

Michael N. Wilcove
Counsel for NRC Staff

Enclosures: As stated

cc: See page 2

~~8312050230~~ 2pp.

cc: Frank J. Kelley
Ms. Mary Sinclair
Ronald G. Zamarin, Esq.
James E. Brunner, Esq.
James R. Kates
Wayne Hearn
Myron M. Cherry
T. J. Creswell
Steve J. Gadler
Frederick C. Williams
Samuel A. Haubold, Esq.
Howard A. Levin
Steward H. Freeman
Michael I. Miller, Esq.
Alan S. Farnell, Esq.
Ms. Barbara Stamiris
Wendell H. Marshall
Paul C. Rau
Peter Flynn
Atomic Safety & Licensing Board
Atomic Safety & Licensing Appeal Panel
Lynne Bernabei
Docketing & Service Section

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

NRC STAFF RESPONSIVE FINDINGS TO APPLICANT'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW ON REMEDIAL SOILS ISSUES

William D. Paton
Counsel for NRC Staff

Michael N. Wilcove
Counsel for NRC Staff

November 15, 1983

TABLE OF CONTENTS

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

NRC STAFF RESPONSIVE FINDINGS TO APPLICANT'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW ON REMEDIAL SOILS ISSUES[1/]

I. The Staff does not contest this proposed finding.

II. The Staff does not contest this proposed finding except for the following. We would replace footnote i with the following:

> i. A surcharge or preload is a pressure that is applied to the ground surface for the purpose of stressing the subsoil to some desirable extent. In connection with the DGB, the specific purpose of the surcharge was to accelerate the settlement process so as to substantially reduce settlement that will take place after the building has been put into service. Peck, Tr. 3212. See also paragraphs 93-138 below.

III-VI. The Staff does not contest these proposed findings.

VII. The Staff would replace the text of this proposed finding with the following. We do not contest the footnotes.

Applicant's remedial actions for DGB had already been carried out prior to issuance of the Modification Order.

1/ On November 9, 1983, during the evidentiary hearing, the Licensing Board permitted the Staff to postpone filing its proposed findings of fact and conclusions of law with respect to the diesel generator building. These findings, therefore, do not address that structure.

Even though by requesting a hearing Applicant stayed the effectiveness of the Modification Order, in February 1980 Applicant voluntarily agreed not to proceed with certain further soils remedial actions without NRC staff review and concurrence. As indicated below, CPC's voluntary commitment did not cover all activities prohibited by the Modification Order. On April 30, 1982 we issued a Memorandum and Order (Imposing Certain Interim Conditions Pending Issuance of Partial Initial Decision), LBP-82-35, 15 NRC 1060, which required Applicant to obtain explicit prior approval from the NRC staff (to the extent such approval had not already been obtained) before proceeding with further soils remedial actions. As explained at greater length in LBP-82-35, we found no indication in the record that Applicant had failed to honor its commitment. However, we were concerned that there might be certain activities, such as work associated with underground piping, outside the scope of Applicant's commitment but within the coverage of the prohibition in the Modification Order that should be subject to Staff approval. In addition, we had some doubt whether, in the absence of Staff review and approval, Applicant would carry out certain remedial soils activities using appropriate QA procedures and principles. The effect of issuing LBP-82-35 was to update the requirements of the Modification Order to reflect developments since December 6, 1979 and sustain those updated requirements on an interim basis. The only exception is the requirement for submission and approval of amendments to the applications for construction permits, a procedural requirement which was not necessary to attain the safety goals which we believed should be achieved.

VIII-X. The Staff does not contest these proposed findings.

SEISMOLOGY AND SEISMIC MODELS

A. INTRODUCTION

1 & 2. The Staff does not contest these proposed findings.

3. The Staff does not contest this proposed finding, but adds the following. In footnote 7, CPC discusses the difference between magnitude and intensity, referencing exhibit 4 to the prepared testimony of Holt (fol. Tr. 4539). The Staff notes that the same subject is addressed on page 8 of the prepared testimony of Staff witness Kimball (fol. Tr. 4690). The Staff discussion does not differ from CPC's discussion in any material way.

4. The Staff does not contest this proposed finding except as follows. In footnote 9, CPC states that the two alternative proposals for establishing an SSE which were set forth in the October 14, 1980, Tedesco letter (Holt exhibit 3) used as a controlling earthquake, the 1937 Anna, Ohio event. The Tedesco letter actually stated that the controlling earthquake the Staff would require to be used in determining the SSE for Midland is "similar" to that which occurred in Anna, Ohio in March, 1937 and has a body wave magnitude of 5.3 m_{blg} and a MMI of VII-VIII. As discussed at page 5 of Mr. Kimball's testimony, the Staff did not rely solely on the 1937 Anna, Ohio event, but also considered the several other events described by Mr. Kimball.

5-7. The Staff does not contest these proposed findings.

B. THE CONFORMANCE OF THE SITE SPECIFIC RESPONSE APPROACH WITH 10 C.F.R. PART 100, APPENDIX A

8. The Staff does not contest this proposed finding.

9. The Staff does not contest this proposed finding, but adds the following. At the end of footnote 17 on page 16 of CPC's proposed findings, CPC cites Holt and Kimball in support of a statement that extensive investigations have established that there are no capable faults or tectonic structures in the vicinity of the Midland site. The extensive investigations referred to are discussed in the Staff's Safety Evaluation Report (Staff exhibit 14) at pages 2-41 through 2-44. The Staff agrees that those investigations have established that there are no capable faults or tectonic structures in the vicinity of the Midland site.

10. The Staff does not contest this proposed finding except as follows. CPC states that seismicity, which it defines as the relative frequency of earthquakes in a particular region, is a probabilistic consideration. The authority cited for that statement is 10 C.F.R. Part 100, Appendix A, Section V(a). The Staff does not believe that the authority cited supports that definition. 10 C.F.R. Part 100, Appendix A, Section V(a) does not define seismicity. The Staff does not agree that, within the context of the regulation, seismicity is solely the relative frequency of earthquakes in a particular region and therefore only a probablistic consideration. To the extent that the regulation would assist in defining seismicity, the Staff notes that CPC has ignored the deterministic considerations of seismic history. The Staff believes it appropriate to make this clarification because of the Board's expressed concerns as to whether probabilistic considerations used in connection with the site specific response

spectra are appropriate under 10 C.F.R. Part 100, Appendix A. This matter is addressed further in ¶ 14 of the Staff's proposed findings.

In footnote 21 of ¶ 10, CPC cites the October 14, 1980 Tedesco letter as authority for its statement that both the NRC staff and the Applicant agreed that while Appendix A contemplates a deterministic or "cookbook" approach to establish the SSE which involves defining tectonic provinces and maximum potential earthquakes, it does not bar the use of any seismological information, including seismicity and other probabilistic considerations, in making the judgments about tetonic province boundaries and maximum potential earthquakes within such tectonic provinces. The Staff finds no support in the October 14, 1980 Tedesco letter for CPC's assumption that a deterministic approach is the same as a "cookbook" approach. The Staff also does not believe that the Tedesco letter supports Applicant's implication that seismicity is a probabilistic consideration (implied in their clause "including seismicity and other probabilistic considerations").

In footnote 22 of ¶ 10, CPC cites Holt and Kimball in support of a statement that because empirical methods for ascertaining geologic structure at depths are not well developed, historic seismicity affords one of the most accurate means available for inferring information about the geologic structural features of a site. Further support for this statement can be found at pages 3-4 and 20 of Mr. Kimball's prepared testimony (fol. Tr. 4690).

11. The Staff does not contest this proposed finding except as follows. The citation in footnote 23 should be 10 C.F.R. Part 100, Appendix A, § V(a)(1)(iv). The citation in footnote 24 should be 10 C.F.R. Part 100, Appendix A, § VI(a)(1).

The last sentence in ¶ 11 of CPC's proposed findings states that when scaled to an assumed zero period ground acceleration value (0.19g) representative of a VII-VIII or Magnitude 5.3 earthquake, as suggested as in the October 14, 1980 Tedesco letter, the Regulatory Guide 1.60 response spectrum generally defines a level of ground motion in excess of that which the site would experience due to the occurrence of such an earthquake at the site. The Tedesco letter does not state or suggest that an assumed zero period ground acceleration of 0.19g is representative of a VII-VIII or magnitude 5.3 earthquake. (The Staff set forth its views as to the application of Regulatory Guide 1.60 at pages 10-12 of its "NRC Staff Brief in Support of the Use of a Site Specific Response Spectrum to Comply with the Requirements of 10 C.F.R. Part 100, Appendix A" filed on September 29, 1981.) If the Board agrees with CPC and the Staff that the site specific response spectra is appropriate at Midland, CPC's statement is moot.

12. The Staff does not contest this proposed finding except as follows. CPC cites Holt exhibit 3 in support of its statement that site specific response spectra corresponding to specific site foundation conditions can be constructed for most sites. Holt exhibit 3, which is the October 14, 1980 Tedesco letter, does not contain such a statement.

13. The Staff does not contest this proposed finding, but adds the following. CPC cites Holt, prepared testimony on Midland SSRS at pages 6-7, fol. Tr. 4539 and Holt exhibit 3 for its statement that the October 14, 1980 Tedesco letter dictates the use of a magnitude range of 5.3 ± 0.5 m_{blg}, epicentral distances of less than 25 kilometers, and recording instruments on soil. Those matters are also discussed at pages 6 and 7 of the prepared testimony of Staff witness Kimball (fol. Tr. 4690). The Staff discussion does not differ from CPC's in any material way.

14. The Staff does not contest this proposed finding except as follows. Starting in the seventh line of the paragraph, through the end of the paragraph CPC tries to support its opinion that the construction of response spectra is a probabilistic analysis. The citation given is "Applicant's Brief, at page 11." The Staff does not agree with CPC's position and believes that for NRC's position and legal argument on such issues the Board should refer to the brief filed by the Staff (referenced in ¶ 11 above). (CPC filed "Applicant's Brief On Compatibility Of Site Specific Response Spectra Approach With 10 C.F.R. Part 100, Appendix A" on September 29, 1981).

15. The Staff does not contest this proposed finding except as follows. The Staff does not agree with the last sentence of Applicant's proposed findings which states that the SSRS methodology, because it attempts to match earthquake records to site conditions, is actually more consistent with Appendix A than is use of the site independent Regulatory Guide 1.60 response spectrum. CPC cites no authority for that statement. The Staff maintains the position it took in its September 29, 1981 brief at page 10, which is that both methodologies for designing and applying a response spectrum are consistent with the requirements of Appendix A (both methodologies being (1) a site independent response spectrum as defined in Regulatory Guide 1.60 and (2) the site specific response spectrum suggested by the Staff for use in this proceeding). The Staff does not believe there is any record evidence in this case to support Applicant's claim that SSRS methodology is more consistent with Appendix A than the use of the site independent Regulatory Guide 1.60 response spectrum.

16. The Staff does not contest this proposed finding, but adds the following. In footnote 32, CPC discusses the methodology used by the Staff

in developing site specific response spectra for the Staff's Systematic Evaluation Program (SEP), citing Applicant's brief at page 6, note 3. The Staff notes that a similar (consistent) discussion is contained on page 14 of the Staff brief.

C. THE SELECTION OF THE PROPER TECTONIC PROVINCE AND APPROPRIATE CONTROLLING EARTHQUAKE FOR MIDLAND

17-19. The Staff does not contest these proposed findings.

20. The Staff does not contest this proposed finding except as follows. The first sentence of ¶ 20 of CPC's proposed findings states that the NRC staff was reluctant at first to accept the Applicant's designation of the Michigan Basin as the proper tectonic province for Midland. The Staff wants to negate the inference that could be read into that statement that ultimately the Staff did accept CPC's designation of the Michigan Basin as a proper tectonic province for Midland. The Staff's seismotectonic province for Midland does not coincide with the tectonic province that was submitted by the applicant; i.e., the Michigan Basin. (See discussion in ¶ 23)

In the last sentence of ¶ 20 of CPC's proposed findings, it again states (erroneously) that the 1937 Anna, Ohio earthquake is the controlling earthquake for Midland. As discussed in ¶ 4 of the Staff's findings, the 1937 Anna, Ohio earthquake is not the controlling earthquake for Midland. As stated on page 1 of Holt exhibit 3 (the October 14, 1980 Tedesco letter) the controlling earthquake is "similar" to the Anna, Ohio earthquake.

21 & 22. The Staff does not contest these proposed findings.

23. The Staff does not contest this proposed finding except as follows. In the last sentence of CPC's proposed findings, CPC states that the Staff

eventually concurred with the Applicant that the Central Stable Region could be subdivided into a smaller tectonic province including the Midland site. The Staff consistently used the expression seismotectonic province as opposed to tectonic province. See Kimball prepared testimony page 4 and page 20. The Staff testified that it equated these two terms, Tr. 4699 and 4757-58. The Staff would make the same comment in response to CPC's proposed findings in the first sentence of ¶ 23, and ¶¶ 28 and 29.

24 & 25. The Staff does not contest these proposed findings.

26. The Staff does not contest this proposed finding except as follows. In footnote 52 CPC cites the prepared testimony of Holt and Kimball in support of its statement that the Applicant's formal probabilistic analysis confirms that the Midland site is in an area of relatively lower seismic hazard as compared to other sites surrounding the Michigan Basin in the Central Stable Region. The citation to the prepared testimony of Staff witness Kimball is incorrect. At page 18 of his prepared testimony, Staff witness Kimball concluded, after examining the seismic hazard analysis performed by the Applicant for five sites, that the Midland site has lower expected intensities than the other five sites at all exceedence probabilities and, therefore, the Midland site is associated with lower seismic hazard than other parts of the Central Stable Region. Mr. Kimball did not reference the Michigan Basin in his testimony, and the above noted comparisons were not performed to define the Michigan Basin.

27. The Staff does not contest this proposed finding.

28. The Staff does not contest this proposed finding, but adds the following. In footnote 61 the Applicant cites Tr. 4769 and 4787 in support of its statement that Mr. Kimball testified that the largest historical

earthquakes for the Staff's seismotectonic province have a magnitude range of 4.7 to 5.0 with a maximum intensity of VII or less. The Staff notes that a consistent discussion is found in Mr. Kimball's prepared testimony at page 20 and 21 where he lists the largest events in the Staff's seismotectonic province.

29. The Staff does not contest this proposed finding except as follows. In footnote 64 CPC cites the testimony of its witness Holt and Staff witness Kimball in support of a statement that the Anna, Ohio earthquake may be reasonably related to tectonic structures, in which case Appendix A would not require postulating it to occur at the boundary of the tectonic province. The cited transcript pages (4715-16), clarify that the Staff is reluctant to conclude that the Anna, Ohio earthquake is tied to a local tectonic structure in the vicinity of Anna, Ohio.

30. The Staff does not contest this proposed finding.

D. THE CHARACTERIZATION OF GROUND MOTION FOR MIDLAND

31. The Staff does not contest this proposed finding except as follows. In footnote 71 CPC provides a considerable number of citations to support its statement that there was initial disagreement as to the appropriate spectral level at which the response spectra generated from different records should be statistically combined to form the SSRS. The Staff does not believe the citations provided support that statement. Further, the testimony of Applicants' witness Holt demonstrates that this discussion is moot. At Tr. 4594 Applicant's witness Holt was asked, in light of the agreement that the safe shutdown earthquake should be a 5.0 magnitude

event, whether he agreed that the 84 percentile spectra drawn to that event would be an appropriate representation of ground motion. Mr. Holt agreed that the 84 percentile was appropriate.

32. The Staff does not contest this proposed finding except as follows. In its discussion of the criteria for selecting earthquake records to construct the SSRS for Midland, CPC refers to the epicentral distance of less than 25 kilometers which it states is dictated by the Tedesco letter. CPC states that the epicentral distance of 25 kilometers or less was selected to simulate the occurrence of the selected earthquake "at the site" of the nuclear power plant. In support of that statement CPC cites the prepared testimony of its witness Holt and Holt exhibit 3. The Staff notes that at Tr. 4729-4734 the Board and parties interrogated Staff witness Kimball as to the Staff interpretation of the expression "at the site" (found at 10 C.F.R. Part 100, Appendix A § V(a)(1)(ii)). The discussion of the expression "at the site" relates to the regulatory requirement that an earthquake within a tectonic province that is not associated with structure should be assumed to take place "at the site". The Staff explained that it interpreted that expression to mean, where no capable faults have been identified, that the earthquake would be assumed to occur very close to the site.

33-44. The Staff does not contest these proposed findings.

I. THE USE OF THE PARKFIELD RECORDS

45 & 46. The Staff does not contest these proposed findings.

47-50. The Staff adopts CPC's proposed findings in ¶¶ 47 through 50 except where the Applicant sets forth in each of these paragraphs reasons that it believes the Parkfield records should not be included in developing a site specific response spectrum for an Anna type event at Midland. As set forth by Staff witness Kimball at pages 13 through 16 of his prepared testimony, the Staff believes that in the event it was appropriate to develop a site specific spectrum for an Anna type event at Midland, it would be appropriate to include the Parkfield records.

51-54. The Staff does not contest these proposed findings.

II. SELECTION OF THE 84TH PERCENTILE AS THE REPRESENTATIVE SPECTRAL LEVEL

55-57. The Staff does not contest these proposed findings.

58. The Staff does not contest this proposed finding except as follows. In the event the Board is not able to subdivide the Central Stable Region and concur with the Applicant and the Staff that a magnitude 5.0 event is appropriate, the Staff submits that the 84th percentile spectrum with the Parkfield records included is a conservative representation of ground motion for the Midland site. Prepared testimony of J. Kimball, page 10.

E. THE DEVELOPMENT OF DYNAMIC MATHEMATICAL MODELS FOR THE AUXILIARY BUILDING, SWPS AND BWST

59-76. The Staff does not contest these proposed findings.

F. APPLICANT'S USE OF 1.5 x FSAR SSE RESPONSE SPECTRA AS SUBSTITUTE FOR SSRS

77-78. The Staff does not contest these proposed findings.

DIESEL GENERATOR BUILDING

79-209. On November 9, 1983, during the evidentiary hearing, the Licensing Board permitted the Staff to postpone filing its proposed findings of fact and conclusions of law with respect to the diesel generator building. These findings, therefore, do not address that structure.

AUXILIARY BUILDING

210-214. The Staff does not contest these proposed findings.

215. The Staff does not contest this proposed finding except as follows. In the last two sentences of ¶ 215, CPC reports that the NRC staff's review of the borings taken to evaluate the backfill of the north and south ends of the auxiliary building led the Staff to conclude that the plant fill was inadequately compacted, not only beneath the FIVP's and the electrical penetration areas, but also beneath the control tower. CPC then states "in particular, a one-foot deep void was discovered in one of the borings beneath the mud mat under the control tower". The Staff is concerned that the last sentence could lead the Board into believing that the one foot deep void was the only cause for the Staff's concern with respect to the foundation capability of the fill beneath the control tower.

The Staff was also concerned that the remedial fix for the auxiliary building not impose additional loads which the control tower would be unable to carry. In evaluating an earlier proposed remedial fix, requiring caisson support of the EPAs, the Staff determined that the plan did not satisfactorily address the ability of the control tower to safely carry the additional load imposed by underpinning the extremeties of the EPAs with caissons. (Testimony of Darl Hood, Joseph Kane and Hari Singh concerning the Remedial Underpinning of the Auxiliary Building. fol. Tr. 5839, pages 13-14, 19). The problem of overstressing the fill foundation soils of the control tower has been eliminated by the current underpinning proposal, which requires the new foundations to be placed deeper on the

the natural hard lacustrine clay.[2/] (Id. at 19). Nonetheless, in assessing the fill under the control tower, the Staff's concerns were not limited to the deep void beneath the mudmat.

216-218. The Staff does not contest these findings except as follows. In ¶ 218 the Applicant indicates that when the unsatisfactory fill conditions were discovered, there were concerns about future differential settlement and its causing stresses in the structure. Because of cracking at several locations at the auxiliary building, along with the differential settlement that had occurred,[3/] the Staff was also concerned that the auxiliary building already was distressed. (SSER #2, § 2.5.4.4.1, page 2-17, Kane, Tr. 5882).

The Staff's assessment of the cracks in the auxiliary building differs from the Applicant's analysis. Contrary to the implication in footnote 416, the Staff has never concluded that all of the cracks in the auxiliary building can be attributed to volume changes. The CPC relies upon §§ 2.5.4.4.1 (page 2-17) and 3.8.3.5 (page 3-28) of SSER #2 as support for that claim. Neither section contains any assertion that all of the cracks in the auxiliary building were due to normal volume changes.

The Staff was unwilling to discount the cracks in the auxiliary building based on the Applicant's determination that all of the cracks

---

2/ See Staff response to ¶ 219 for a discussion of the difference between natural hard lacustrine clay and glacial till.

3/ The following differential settlements have been recorded in the auxiliary building area from July 1978 to August 1981: (1) southern end of the control tower relative to south end of the spent fuel pool in the auxiliary building - 0.24 inch with reasonable expectations that it has been as much as 0.5 to 1 inch from the beginning of loading, (2) east end of EPA relative to the control tower - 0.2 inch (SSER #2 § 2.5.4.5.2, page 2-40).

stemmed from shrinkage. Rather, we required an evaluation of the effect of the cracks on the structures. (SSER #2, § 3.8.3.5. page 3-27). Such an analysis of the cracks in the auxiliary building was done, and the Staff found it acceptable. (Id. at 3-27 to 3-28). Hence, in discussing its evaluation of the Applicant's crack assessment, the Staff does not dwell on the cause of the cracks. (Id.) Since concerns about differential settlement have been addressed by the remedial measures, the Staff submits that dwelling on the causes of the cracks is not necessary. Rather, the Staff directed its attention to determining that the available tensile capacity of the structural reinforcement crossing the cracks exceeded the tensile capacity that uncracked concrete is assumed to carry. (Id. at 3-28). Based on the above, the Staff submits that the Board should not make a finding that all of the cracks in the auxiliary building stemmed from volume changes. Rather, the Board should find that the cracks do not significantly affect the strength of the auxiliary building.

Furthermore, as with the Service Water Pump Structure, CPC has developed a crack monitoring program and repair program which the Staff finds acceptable. If a new crack exceeds 0.01 inches or an existing crack exceeds 0.03 inches, an evaluation will be made to determine whether underpinning procedures should be altered or continued. (SSER #2, page 2-49.) The crack repair program applies to the control tower, electrical penetration areas and feedwater isolation valves pit areas. Except for coating with waterproof compounds, the repair program is similar to that required for the SWPS. (SSER #2, page 3-29, Staff response to ¶ 249.)

Other comments on ¶ 218 are as follows.

In the second sentence of ¶ 218, CPC states that because the control tower and the electrical penetration areas were not designed to cantilever from the main auxiliary building, differential settlements caused by unsatisfactory plant fill could cause unacceptable stresses. The Staff notes that any differential settlement would have to be considered in connection with various combinations of dead loads; live loads; environmental loads including winds, tornadoes, OBE, and the SSE as discussed in ¶ 3.8.3 of the Staff's SER. See also the discussion of seismic analysis of the remedial measures in § 3.7.2 of SSER #2.

In the second portion of footnote 418 on page 164, CPC makes the following statement: "The Applicant initially considered a pile and corbel foundation system and then considered a partial underpinning; however, when the need to design for a larger earthquake arose, the present design was arrived at. Johnson, Tr. 5647-5668, 5729-5733. See also ¶ 232, infra." The citations stated discuss the use of caissons - not piles and corbels. CPC has apparently confused the remedial measure for the SWPS, which did involve piles and corbels, with the remedial measures at the auxiliary building which involve caissons.

219. The Staff does not contest this proposed finding but believes that a clarification of the record should be made. All parties frequently referred to the foundation soil for the auxiliary building and the service water pump structures as being "the till". As is demonstrated by Table 2.4 at page 2-15 of SSER #2, the foundation soil for the reactor and auxiliary building is the very stiff to hard clay described in that table and would more properly be defined as the lacustrine clay. The foundation soil for the service water pump structure is very stiff to hard sandy clay and is

more accurately identified as the glacial till. As is demonstrated by Table 2.4 the parameters of those two natural foundations differ. See also SSER #2, pages 2-11 to 2-12.4/

Also, the Staff advises the Board that, based on information obtained at a recent design audit, it is our understanding that CPC is planning to use lean concrete, rather than sand, to fill the four foot gaps left by the curving of the walls around the containment.

220. The Staff does not contest this proposed finding except to note the difference between lacustrine clay and glacial till described in the Staff's response to ¶ 219.

221. The Staff does not contest this proposed finding except as follows. In the first sentence of the paragraph CPC states that the FIVPs will be supported in a different manner than the control tower and the electrical penetration areas. It should be noted here (as is indicated later in CPC's footnote 425) that a beam and tie system providing temporary support for the FIVPs is already in place.

222. Footnote 422 contains descriptions of "Phase I" and "Phase II" of the underpinning process. For this proposed finding only, the Staff does not contest CPC's definition of the two phases. However, the demarcation between Phase I and Phase II is relevant to the "cable-pulling" incident discussed at hearing sessions held in June and July, 1983. By not contesting the description of the two Phases in this proposed finding, the Staff

---

4/ This clarification is also pertinent to ¶¶ 220, 227 and 233 of CPC's proposed findings. At those proposed findings the term "lacustrine clay" should replace the term "glacial till."

concedes nothing with respect to the "cable-pulling" incident. Otherwise, we do not contest this proposed finding.

223-226. The Staff does not contest these proposed findings.

227. The Staff does not contest this proposed finding except to note the difference between glacial till and lacrustrine clay as described in the Staff's response to ¶ 219.

228-230. The Staff does not contest these proposed findings, except to note the following. First, we add to ¶ 229 after the second sentence, the following discussion regarding the method of addressing long term settlement. Anticipated long term differential settlements used in design will be checked by extrapolation of the trend of the measured differential settlements, while the jacks are still active, to estimate future differential settlements during years of plant operation. (Applicant's testimony on the auxiliary building, fol. Tr. 5509, page 54 and SSER #2, page 2-50).

Second, ¶ 228 should discuss the fact that pier W-11 at the auxiliary building has been load-tested. During the pier load test, a pressure equal to 130% of the maximum predicted bearing pressure was applied to the bearing stratum. The load will eventually be lowered to the design jacking load. The Staff found these load test procedures acceptable. (SSER #2, page 2-51 and Tr. 14,370).

As was discussed by Dr. Landsman before this Board on April 27, 1983, the pier-load test at Pier W-11, completed in the Spring of 1983, did not go "the way it is supposed to." (Tr. 14,370-1). As a result, CPC reevaluated the structure using a reduced value of the soil modulus. Staff audited the calculations on September 14 and 15, 1983. The audit raised questions concerning CPC's assertion that it had adequately allowed for

differential settlement between the main portion of the auxiliary building and control tower in designing the underpinning. This matter is still being considered by NRC and CPC. The Board will be notified of the resolution of this matter.

231. The Staff does not contest this proposed finding.

232. The Staff does not contest this proposed finding but would add to the end of footnote 437 the following. The Staff now has strong evidence that the auxiliary building can withstand loads that would be imposed by a Site Specific Response Spectra Earthquake. (Testimony of Frank Rinaldi on Intervenors' Contentions, fol. Tr. 12,080 at page 8.)

233. With the following exception, the Staff does not contest this proposed finding. There is a need to correct CPC's statement that the replacement fill under the FIVPs will be compacted to a "95% relative density." Rather, the fill will be compacted to a 95% maximum dry density as determined by ASTM test D-1557 or ASTM test D-2049, whichever results in the greater maximum dry density. (SSER #2, page 2-17). We also call the Board's attention to the difference between glacial till and lacustrine clay as described in the Staff's response to ¶ 219.

234-237. The Staff does not contest these proposed findings.

238. Except for the following, the Staff does not contest this proposed finding. The Staff would agree that the action levels for deflection of the auxiliary building are "conservative", but would not go as far as to call them "very conservative." The Staff has specifically stated that the underpinning design, construction procedures, and the instrumentation to monitor underpinning are "conservative." (SSER #2, page 2-23). Instru-

mentation records and as built records will permit the Staff to continue to assess the extent of conservatism of these levels of deflection. (see SSER #2, pages 2-52 to 2-53).

239-241. The Staff does not contest these proposed findings.

242. The Staff does not contest this proposed finding except as follows. CPC states that it has adequately and conservatively taken into account the dynamic responses of the control tower, electrical penetration areas and FIVPs with regard to dewatering effects, differential soil settlement and seismic effects in the design and evaluation of those remedial soils measures. The Staff agrees, but notes that the concerns expressed by Ms. Stamiris in this and other contentions are similar to the concerns that caused the Staff to issue the December 6, 1979 Order. Also, as is discussed in the Staff's reply to ¶¶ 228-230, questions about whether the Applicant has adequately taken into account differential soils settlement at the auxiliary building were raised at a design audit on September 14 and 15, 1983. As is also discussed in the response to ¶¶ 228-230, resolution of this matter will be brought to the Board's attention.

243 & 244. The Staff does not contest these proposed findings.

SERVICE WATER PUMP STRUCTURE

245. The Staff does not contest this proposed finding.

246. Applicant's Exhibit 28 shows that the backfill extends below the line connecting points A and B. Therefore, the northern portion of the SWPS rests on more backfill than the triangular wedge described in this proposed finding and drawn on Exhibit 28. Otherwise, we do not contest this proposed finding.

247 & 248 The Staff does not contest these proposed findings.

249. We comment as follows on this proposed finding. The Staff approached the cracks in the SWPS in a different way then did CPC. We did not discount any of the cracks in the SWPS on the assumption that they were caused by shrinkage. In fact, we have noted that some of the cracks in the SWPS have appeared at locations where one would expect to find cracks caused by differential settlement. (SSER #2, pages 2-23, 3-27). In assessing the effects of cracking, we have directed our attention to whether the cracks significantly diminish the strength of the structure. (SSER #2, pp. 3-27 to 3-28). As with the auxiliary building, the Staff submits that, once concerns about future differential settlement were addressed by the remedial measures, it was no longer necessary to further address the reasons for the cracks.[5/] We base our approval of CPC's evaluation of the SWPS cracks on the fact that CPC has demonstrated

---

5/ In fact, Dr. Corley testified that since the structure will be underpinned, a more detailed analysis to determine the precise cause of the cracks was not necessary. (Corley, prep. test, fol. Tr. 11,204 at 29).

demonstrated that the cracks do not significantly affect the strength of the structure.[6/] (Id.)

In addition, CPC has developed a crack monitoring and repair program. If a new crack greater than 0.01 inch develops or if an existing crack exceeds 0.03 inch in width, an evaluation will be done to determine whether underpinning procedures should be altered or halted. (SSER #2, page 2-50). All cracks will be repaired by epoxy injection if they are 20 mils or larger. The length of the crack that will be injected will be limited to a crack width of 10 mils or larger. As for cracks which show weeping characteristics and are below the groundwater table, they will be repaired by epoxy injections regardless of their lengths. Inaccessible cracks need not be repaired. Also, the portion of the wall of the SWPS that comes into contact with cooling pond water will be coated with water proofing compounds (SSER #2, page 3-29). The Staff finds CPC's crack monitoring and repair program acceptable. (Id.)

6/ Dr. Corley testified that cracks attributable to differential settlement of the SWPS would appear in the east and west walls. (Corley, prep. test, fol. Tr. 11,204 at 25). Cracks have appeared in those walls. (See, e.g., Corley, prep. test, fol. Tr. 11,204 at 11.) Two types of analyses were performed to determine whether the cracks in the east/west walls significantly diminish the strength of the SWPS. First, the available tensile capacity of the structural reinforcement was compared to the tensile stress that uncracked concrete would be assumed to carry. For all but the center west wall, the available tensile capacity of the reinforcement exceeded the tensile stress that the uncracked concrete would be assumed to carry (Corley, prep. test, fol. Tr. 11,204 at 30-32). For the center west wall, a limit analysis showed the wall to be sound. (Id. at 33). Subsequently, at the Staff's request, limit analyses were performed for all of the east/west walls. They further confirmed that the cracks do not indicate distress to the structure. (Id., Appendix B).

Furthermore, a close look at the record indicates that it is uncertain what role differential settlement played in causing the SWPS cracks. As discussed above, the Staff believes cracks have appeared at locations where cracks induced by differential settlement would be anticipated to form. (SSER #2, page 2-23). In his analysis of Bechtel crack mappings, Dr. Corley did not see the pattern that would be expected from cracks caused by differential settlement. However, he acknowledged that certain cracks in the roof are located where one would expect to see cracks caused by differential settlement. (Corley, prep. test, fol. Tr. 11,204 at 16, 23). As for Dr. Corley's own observations of certain cracks in the SWPS, he did not see the pattern expected from cracks induced by differential settlement. However, during his inspection, access to most areas was difficult and lighting was poor. (Corley, prep. test, fol. Tr. 11,204 at 26-29). Those factors lessen the weight that can be given to Dr. Corley's personal observations of the cracks. Although Dr. Corley concludes that volume changes were the primary cause of the cracks, he repeatedly emphasizes that he cannot rule out differential settlement as causing some of the SWPS cracks. (Corley, prep. test, fol. Tr. 11,204 at 23-25, 29, 40, B1).

250-257. The Staff does not contest these proposed findings.

258. The Staff would add the following to this proposed finding. As has been done at the auxiliary building, a pier load test will be completed at Pier 1E for the SWPS. The procedures for the load test are described at the Staff's response to ¶¶ 228-230 of the Applicant's proposed findings. However at the SWPS, an additional pier will be load

tested if the bearing level for any of the piers is on the dense sandy alluvium rather than the hard sandy clay till. (SSER #2, page 2-51). For a discussion of the acceptability of alluvial sand as a foundation footing, see CPC s prepared testimony on SWPS at pages 11, 30-31.

259. The Staff does not contest this proposed finding.

260. The Staff disagrees with the last sentence. Mr. Kane did testify that the two sections of the retaining wall are structually independent from each other and that they can settle separately. (Tr. 9725). However, he did not testify that there could be no stuctural distress to the wall if its two sections settled in different amounts. Mr. Kane did not address the question of whether there could be structural distress stemming from the two sections of the wall settling different amounts. (See Tr. 9687-9694, 9723-9738). However, as CPC indicates, Mr. Kane did testify that explorations in the area of the retaining walls did not reflect loose or soft materials and that settlement and been small. Therfore the retaining wall foundations were not a part of the problems with the plant fill. (Tr. 9692)

261-269. The Staff does not contest these proposed findings.

BORATED WATER STORAGE TANKS

270-276. The Staff does not contest these proposed findings.

277. The Staff believes that ¶ 277 of the Applicant's proposed findings does not adequately present the settlement discussions on the BWSTs and could mislead the Board. In that paragraph Applicant correctly recites that Dr. Hendron was of the opinion that the primary settlements observed for the BWST (about 1.3 inches) at the edge of the foundation, were not excessive, and that the structural cracks at the boundary between the valve pit and ring wall indicated that the foundations were not really designed to take distortions that they would get due to the fact that the valve pits were lightly loaded and the ring walls were more heavily loaded. Dr. Hendron's opinion was in response to a question by Judge Decker at Tr. 1715 asking Dr. Hendron to express his opinion whether the problems associated with the settlement of the borated storage tanks were due to poorly compacted soil or whether those problems resulted from design error. Dr. Hendron's view was that the problem was a design problem. As stated by the Applicant, Mr. Boos agreed with Dr. Hendron's evaluation.

The Staff expressed a different view. At Tr. 7449, Darl Hood expressed the Staff's view that the differential settlement at the BWST was a soils related problem. At Tr. 7451, Mr. Kane expressed his own view that the problem was a soils settlement problem.

The aspect of this finding that could mislead the Board relates to the amount of settlement involved. In expressing his opinion, Mr. Kane referred to the total settlement that the BWSTs had experienced - not just the settlement from the time the tank was filled with water. There

were 1.3 inches of settlement at BWST 1 subsequent to the time it was filled with water in October 1980. Mr. Kane's testimony, however, is that there were 1.1 inches of settlement prior to October 1980, while the tank stood empty, and that influenced his judgment that the matter was a soils related problem. (Tr. 7494). The settlement prior to October, 1980 is not mentioned by the Applicant in ¶ 277.

At Tr. 7217, Judge Harbour specifically asked Applicant's witnesses about the "absolute amount of settlement" of either of the borated water storage tanks. Judge Harbour indicated that the figure could not be determined from the testimony and he emphasized again that he was concerned with absolute settlement, not differential settlement. Applicant witness Boos referred the Board to figure BWST-8 attached to the "Testimony of Alan J. Boos and Dr. Robert Hanson on Behalf of the Applicant Regarding Remedial Measures for the Midland Plant Borated Water Storage Tank" (fol. Tr. 7173). The witness's reference to figure BWST-8 was not responsive to Dr. Harbour's question because figure BWST-8 shows 1.3 inches of settlement only after the load test started on October 8, 1980. Judge Cowan asked at Tr. 7218 whether the settlement shown on figure BWST-8 showed differential settlement or total settlement. Applicant witness Boos responded that it was a plot of total settlement for that point. (Tr. 7218).

The settlement illustrated by figure BWST-8 is not the total settlement for marker TF-1 since it presents only the settlement after the tank was filled in October 1980. As indicated in SSER #2, page 2-41, the settlement history of the BWST's is shown in FSAR figures 2E.1-17, -18, -20, and 21. FSAR figure 2E.1-17 shows 1.1 inches of settlement prior to October 8, 1980, for TF-1, the settlement marker that is reported in figure

BWST-8. The 1.1 inches of settlement reported there occurred between January 1979 and the Spring of 1980. This confirms Mr. Kane's testimony at Tr. 7494 and is a further basis for concluding the problem with the BWST was related to poorly compacted fill.

278. The Staff does not contest this proposed finding, but adds the following. Applicant correctly cites Tr. 7367 to support the view of Applicant witness Kennedy that the under-reinforcing of the ring wall, which he states to be the third of three causes of the problems at the borated water storage tanks, was the major cause of the problem. Dr. Kennedy admitted at Tr. 7366 that it was "very difficult" for him to determine which of three causes was the primary cause. The Staff differs with Dr. Kennedy's opinion as to the major cause of differential settlement. As discussed by the Staff in ¶ 279 below, differential settlement was primarily caused by inadequately compacted fill. Without the inadequately compacted fill, there would have been no significant differential settlement. It appears that Dr. Kennedy has confused the effect of differential settlement with the cause of the problem.

279. In the first sentence of ¶ 279, CPC states that Staff witness Kane expressed his opinion that inadequately compacted fill contributed to the problem for the Unit 1 BWST and stated as his basis for that, that the settlement that was experienced at the Unit 1 BWST was greater than he would have expected if the soil had been properly compacted. For a more complete statement as to the Staff's basis of its opinion that the differential settlement problem was primarily the result of inadequately compacted fill, see ¶ 2.5.4.4.3 at page 2-34 of SSER #2. The Staff states there that its conclusion is based on (1) results of the soils investigations of the

fill in the tank farm area, (2) results of plate load tests, and (3) the observed total and differential settlements that occurred.

The Staff disagrees with the implication of the second sentence of ¶ 279 in which the Applicant states that Mr. Singh, while not disagreeing with Mr. Kane that inadequately compacted fill contributed to the problem for the Unit 1 BWST, also testified that the unsymmetrical foundation design was a factor in creating the observed differential settlement. The Staff does not believe it appropriate to contrast Mr. Singh's statement with that of Mr. Kane. In response to a question (Tr. 7451), Mr. Kane was discussing the cause of the BWST settlement problem, whereas Mr. Singh, at Tr. 7477-82, was responding to a different question by testifying as to how the tank foundation had settled and how the unsymmetrical foundations of the valve pits and ring foundations have an influence on the observed differential settlements.

Applicant states that more than a year after the evidentiary hearing on the BWST was concluded, Dr. Ross Landsman, a soil specialist employed by the NRC's Office of Inspection and Enforcement, Region III, volunteered his personal opinion that the unsymmetrical BWST foundation design was a design deficiency. The statement is correct but it is not clear why the statement is in CPC's proposed findings. If the statement is there because it is perceived to relate to the debate between the Staff and the Applicant as to the primary cause of the BWST settlement problem, the statement is not probative. Even assuming the unsymmetrical BWST foundation design was a design deficiency, that fact is not probative of the primary cause of the BWST settlement problem. The Staff believes the statement should be deleted. In the last ¶ 279, CPC states that Dr. Landsman

was under the mistaken impression that this issue had not previously been addressed in the hearing and cited Tr. 16,581-91. The meaning of this last sentence is also uncertain. Dr. Landsman did state at Tr. 16,591 that the record did not show that anyone had ever said that the original designs were inadequate. Applicant's last sentence appears to be inaccurate and in any event does not lead to any resolution of issues or meaningful findings or conclusions in these proceedings and should be stricken.

280-289. The Staff does not contest these proposed findings.

290. The Staff does not contest this proposed finding. For completeness of the record, the Staff believes that the following statement from ¶ 2.5.4.4.3, page 2-35 of SSER #2 should replace the first sentence on page 206: "The Applicant has committed to providing a Technical Specification for long-term settlement monitoring during plant operation and to providing FSAR documentation of the as-built conditions for the new ring beam foundations and releveling operations, once they are completed."

291. The Staff does not contest this proposed finding.

292. CPC states that it has adequately evaluated and analyzed the dewatering, differential soil settlement and seismic effects for the remedial surcharging of valve pits, construction of a new ring beam and releveling BWST-1, contrary to Ms. Stamiris' Contention 4C(c). The Staff agrees but notes that the concerns expressed by Ms. Stamiris in this and other contentions are similar to the concerns that caused the Staff to issue the December 6, 1979 Order.

293-298. The Staff does not contest these proposed findings.

299. In the last sentence of this paragraph CPC states that Staff approved methods of monitoring the BWST's for settlement, concrete cracking

and strain provide additional assurance that any unanticipated future differential settlement would be detected and corrected before presenting any risk to the public health and safety. Pages 2-35, 2-52 and Table 2.8 of the SER Supplement #2 show that the technical specification details for future settlement monitoring remain to be resolved.

In footnote 536 CPC states that the Staff criticized Ms. Warren's definition of "backfill". The Staff does not believe such a statement is appropriate. At pages 16 through 18 of the "Testimony of Darl Hood, Hari Narain Singh, and Joseph Kane Concerning the Remedial Measures for the Borated Water Storage Tanks" (fol. Tr. 7444), the Staff attempted to indicate how a technically more accurate description of the random fill at Midland differed from the description indicated in Ms. Warren's contention. The Staff was able to understand the concerns expressed by Ms. Warren but we do not agree that we criticized her in our testimony.

The Board concludes that the primary cause of the differential settlement problem at the BWSTs was inadequately compacted fill.

DIESEL FUEL OIL TANKS

300-303. The Staff does not contest these proposed findings.

304. The Staff does not contest this proposed finding except as follows: At the end of footnote 544, CPC cites Tr. 7444 as the citation for the prepared testimony of Joseph Kane regarding the effects of the plant fill problem on foundation support for the seismic category 1 underground piping. The Staff notes, in some transcripts that testimony follows Tr. 7752.

305-308. The Staff does not contest these proposed findings.

309. The Staff concurs in CPC's proposed findings in ¶ 309 except as follows: In the second sentence the Applicant references ¶ 6 of its own findings as stating that following dewatering the tanks reached a maximum settlement of half an inch. The correct paragraph number is 304, not 6.

310-313. The Staff does not contest these proposed findings.

UNDERGROUND PIPING

A. INTRODUCTION

314-316. The Staff does not contest these proposed findings.

B. UNDERGROUND PIPING OTHER THAN SEISMIC CATEGORY I

317. The Staff does not contest this proposed finding.

318. Except as follows, the Staff does not contest this proposed finding. The diesel generator building is not supported by a base mat, but by continuous reinforced concrete wall footings. (SSER #2, 2.5.4.4.2, page 2-24, 3.8.3.4, page 3-22). Also, contrary to footnote 565, the circulating water discharge lines are not shown on Figure 2.11 of SSER #2. They are, however, shown on FSAR Figure 2.5-177.

319-323. The Staff does not contest these proposed findings.

C. SEISMIC CATEGORY I UNDERGROUND PIPING--IN GENERAL

324-331. The Staff does not contest these proposed findings.

332. The Staff does not agree that no correlation can be established between pipe settlement profiles and areas of stiff or soft foundation soils. Mr. Kane's review of pipe settlement profiles permitted him to observe a pattern by which the major settlement of pipes occurred under the greatest surcharge loading. There was one high spot in the surcharge area (where the piping experienced smaller settlement) which can be explained by recognizing that other pipes encased in concrete had put a discontinuity into the foundation support beneath the higher placed piping. (Tr. 7902-7903). Mr. Kane also explained that one reason that the Staff requested development

of soil profiles along the alignment of the underground piping was to identify the softer soil areas as evidenced by the low blow counts recorded in the soil borings that had been completed. Based on this information, the Staff was able to determine where settlement markers should be installed. (Tr. 9053, 9088, 9090).

333-335. The Staff does not contest these proposed findings.

336. The Staff disagrees with the assertion that "[t]he maximum differential settlement along the longitudional axis of buried piping is anticipated to occur at anchor points." Dr. Chen does not believe that maximum differential settlement occurs only at anchor points. Rather, he believes that, due to the variable soil properties, settlement could occur at any point along the length of the piping. (Tr. 7765-7766. See also Tr. 7864-7865). Since the Staff is satisfied with CPC's strain and settlement monitoring program, the question is moot as to precisely where one would expect to find the maximum differential settlement (See SSER #2, pages 2-52, 3-39 to 3-40). Otherwise, we do not contest this proposed finding.

D. ASSURANCE OF SERVICEABILITY OF BURIED SEISMIC CATEGORY I PIPING

1. Stress Analysis and Design Criteria

337. We comment on footnote 572 as follows. Rather than speaking of "single point differential settlement stresses", the current ASME Code addresses single deflection of a pipe through a discussion of "single nonrepeated anchor movement." (CPC's prep test on underground piping fol. Tr. 7619 at 23). Otherwise, we do not contest this proposed finding.

338. The Staff does not contest this proposed finding.

a. STRENGTH CRITERIA

339. The Staff does not contest this proposed finding.

340. The Staff does not contest this proposed finding, but comments as follows on footnote 599. Mr. Lewis testified that the underground service water piping to be re-installed underwent a dynamic seismic analysis based on the FSAR SSE earthquake. As CPC states, that piping will undergo an analysis using BC-TOP-4A techniques, using 1.5 x FSAR SSE as input. (Tr. 8941-8944). By affidavit dated January 21, 1983, Dr. Thiru Thiruvengadam demonstrated that even though it was analyzed against the FSAR SSE, the service water piping to be reinstalled exceeds current criteria. On November 2, 1983, the Staff filed an affidavit by Dr. Paul Chen indicating concurrence with Dr. Thiruvengadam's affidavit.

341. The equation for Criterion 1 is inaccurate. It should not read "SS--3Sc", but rather SS$\leqq$3Sc. (SSER #2, page 3-36). Otherwise, we do not contest this proposed finding.

b. BUCKLING CRITERIA

342. In the first sentence of this proposed finding, CPC defines buckling as "a deformation of a portion of the wall of the pipe." None of CPC's citations in support of this proposed finding offer this definition of buckling. Accordingly, the Staff would delete the first sentence. Otherwise, we do not contest this proposed finding.

343. The Staff does not contest this proposed finding but would change footnote 607 to read as follows; "Tr. 7892, SSER #2, 3.9.3.1.3, page 3-36."

344. The Staff does not contest this proposed finding.

c. MINIMUM RATTLESPACE CRITERIA

345-347. The Staff does not contest these proposed findings.

II. SERVICE WATER PIPING

a. INTRODUCTION

348. The Staff does not contest this proposed finding.

349. The Staff does not contest this proposed finding, but feels that the following clarification is necessary. The "1982 profiling" referred to in footnote 611 and the "1981 data" mentioned in the proposed finding are one and the same. Not stated on the record, the profiling data was compiled in 1981 and furnished in early 1982.

350-352. The Staff does not contest these proposed findings.

b. SCOPE OF REINSTALLATION PROGRAM

353 & 354. The Staff does not contest these proposed findings.

c. MATERIALS USED IN THE REINSTALLATION PROGRAM

355 & 356. The Staff does not contest these proposed findings.

357. In his affidavit, Dr. Shunmugavel states that ethafoam, when surrounding the 26 inch pipe encased in backfill, "[creates] a transition that will eliminate concentrated shear strain to the piping caused by differential settlement." Affidavit of Palanichamy Shunmugavel on Ethafoam, dated August 2, 1983, page 8). Dr. Shunmugavel's description of how ethafoam functions differs from the assertion in this proposed finding that ethafoam locally isolates the pipe from differential settlement and suspends the pipe at the transition from old fill to new fill. The Staff considers

Dr. Shunmuvgavel's description of how ethafoam works to be more accurate and would replace this proposed finding with the following;

> The pipe will be encased in a 6 inch thick layer of a compressible polyethylene material known as "Ethafoam", which will create a transition that will eliminate concentrated shear strain to the piping caused by differential settlement. (SSER #2 § 2.5.4.4.5, pp. 2-36 to 2-37, § 3.9.3.1.3, p. 3-39. Affidavit of Palanichamy Shunmugavel on Ethafoam, dated August 2, 1983. p. 8). By so doing, the ethafoam will minimize the effects of differential settlement.

d. REINSTALLATION PROCEDURE

358 & 359. The Staff does not contest these proposed findings.

360. The last sentence of this proposed finding needs to be clarified. The replacement of the fill will eliminate the potential for liquefaction. Encasing the pipes in ethafoam will reduce the adverse effects of differential settlement. (SSER #2, pages 2-36 to 2-39).

361. The Staff does not contest this proposed finding.

362. The Board's April 30, 1982 Order did not "establish" the Work Authorization Procedure, as CPC claims. Rather, CPC and the Staff entered into the Work Authorization Procedure as a means of implementing the requirements which the April 30, 1982 Order imposed. (Testimony of James G. Keppler With Respect to Quality Assurance, fol. Tr. 15,111, at page 6 and Attachment H.) Otherwise, we do not contest this proposed finding.

e. APPLICANT'S ASME ANALYSIS OF THE REINSTALLED PIPE

363. As discussed in our response to ¶ 337, the current ASME Code does not speak of "single point settlement stresses." Rather, it discusses "single non repeated anchor movement." (CPC's prep. test on

underground piping fol. Tr. 7619 at 23). Otherwise, we do not contest this proposed finding.

364. The Staff does not contest this proposed finding.

III. DIESEL FUEL PIPING

365-367. The Staff does not contest these proposed findings.

IV. BORATED WATER PIPING

368-369. The Staff does not contest these proposed findings.

V. CONTROL ROOM PRESSURIZATION LINES

370. We do not contest this proposed finding except to note that footnote 648 should read "SSER #2 § 3.9.3.1.1, page 3-34", not "SSER #2, § 3.9.3.1.1, page 3-24".

VI. PENETRATION PRESSURIZATION LINES

371. The Staff does not contest this proposed finding.

VII. THE MONITORING PROGRAM

a. STRAIN GAUGE MONITORING

372. The Staff does not contest this proposed finding.

373. We do not contest this proposed finding except to note a typographical error in the first sentence. The word "erived" should be "derived."

374. Mr. Kane expressed concern about whether the strain gauges would function over the forty year lifetime of the plant. (Tr. 7763-7764). For example, relaxation of the wire of the vibrating strain gauge or movement

of the anchors may impede reliable readings. (Tr. 7880-7881). While Mr. Lewis believes the strain gauges will be reliable for up to twenty years, and potentially longer, he admits a sparse data base for predicting the reliability of strain gauges for up to forty years. (Tr. 7704) CPC has committed that, during the first five years of monitoring, strain gauges providing faulty data will be replaced or repaired. (CPC proposed findings, ¶379). It is however not expected that strain monitoring will end after five years. (Chen, Tr. 9003). The Staff therefore may impose a Technical Specification requiring replacements of faulty strain gauges for a period exceeding five years. (Cf. Tr. 9007-9014). We submit that this matter may be left for the Staff and CPC to resolve later. Based on the above, the Board should find that there are concerns about whether the strain gauges will be able to function over the lifetime of the plant, but that through appropriate Technical Specifications worked out between the Staff and CPC, these concerns can be resolved.

b. CRITICAL SETTLEMENT MARKERS

375. We do not contest this proposed finding, but would add to footnote 654, "SSER #2, § 2.5.4.6.2, page 2-52."

376 & 377. The Staff does not contest these proposed findings.

c. STRAIN AND SETTLEMENT MONITORING FREQUENCY

378. We do not contest this proposed finding, but would add to footnote 657, "SSER #2, § 2.5.4.6.2, page 2-52."

d. PROPOSED TECHNICAL SPECIFICATONS ACCEPTANCE CRITERIA AND ACTIONS

379. The Staff does not contest this proposed finding.

e. RATTLESPACE MONITORING

380. There is an inconsistency between this proposed finding and ¶ 395. See Staff's response to ¶ 395.

f. LAYDOWN LOADS AND SAFETY GRADE UTILITIES

381. The Staff does not contest this proposed finding but would add the following. Mr. Kane testified that the Staff had some questions on how CPC arrived at its laydown load allowables. This issue will be considered as part of the Staff's review of CPC's technical specifications. (Tr. 8999, see also Tr. 9011-9013).

VIII. FREEZEWALL CONCERNS

382. The Staff does not contest this proposed finding.7/

7/ The Staff's concern for category I utilities crossing the freezewall was extensively discussed at the hearing sessions held November 1 - November 10, 1983.

E. CORROSION

I. INTRODUCTION

383. The Staff does not contest this proposed finding.

II. PROTECTION OF UNDERGROUND PIPING FROM EXTERNAL CORROSION

384. The Staff does not contest this proposed finding.

385. Neither Section 3.12.1 of SSER #2 nor Dr. Weeks' testimony states that an "independent check of the conditions of the pipe wrappings will be performed when the 36-inch pipes are excavated and replaced before startup of the plant." (Emphasis added) Rather, the testimony is that such a check is possible. (SSER #2, § 3.12.1, page 3-42, Weeks, Tr. 9149). Otherwise, we do not contest this proposed finding.

386. The Staff does not contest this proposed finding.

387 & 388. Except as follows, the Staff does not contest these proposed findings. We do not agree with the claim in ¶ 387 that concerns about encasing anodes in concrete were "groundless". It is true, and the record so reflects, that the anodes encased in concrete are presently working (Woodby, Tr. 9225, 9256, Weeks, Tr. 9303, R. Cook, Tr. 9304.[8/]) However, well-founded concerns do exist about the ability of concrete encased anodes to function in the future. One reason that the concrete encased anodes

---

8/ Two of the Applicant's citations in footnote 669 do not support the assertion in ¶ 387 that the concrete embedded anodes are performing within acceptable limits. At Tr. 9232, all Mr. Woodby says is that when the anodes were encased in concrete, they met all design requirements and technical specifications. That has nothing to do with whether the anodes are currently working. At Tr. 9238-9239, there is no testimony.

have functioned well is the high porosity of the concrete (R. Cook, Tr. 9304). Should the concrete become dry, however, it would act as an insulator, thereby defeating the purpose of the anodes. (Woodby, Tr. 9225, 9256-57).[9/] Dr. Weeks explained that the satisfactory performance of the concrete encased anodes can also be attributed to the fact that the resistivities of the soil and concrete are probably about equal. If the site were to be flooded with water of higher conductivity, the concrete encased anodes might not be as effective. (Weeks, Tr. 9303). Hence, there was a sound basis for discarding the concrete encased anodes and replacing them with anodes encased in coke breeze.

Furthermore, of the approximately 120 anodes now in place, about fourteen will be abandoned because they are encased in concrete. (Tr. 9223-9226). Hence, the Staff would replace the last sentence of this finding with the following; "Moreover, the Applicant is currently upgrading the galvanic protection system by installing about 190 new anodes in addition to the approximately 106 that will continue to be in operation." (Tr. 9223-9227).

389. The Staff does not contest this proposed finding.

390. The Staff does not contest this finding but would add the following citation to footnote 673, "Weeks, Tr. 9303-9305."

391. The Staff does not contest this proposed finding but notes that the reference in footnote 674 to "SSER #2, §3.12.1, page 3-42," is incorrect. The correct reference should be "SSER #2, 3.12.2, page 3-43."

9/ Mr. Woodby explained that the concerns about the effectiveness of the anodes encased in concrete were conveyed to him by someone else (Tr. 9289).

392. The Staff does not contest this proposed finding, but notes that the reference in footnote 676 to "SSER #2, §3.11.2, page 3-42," should be "SSER #2. §3.12.2, page 3-42 and errata page 2 (Staff Exhibit 14)."

393. This finding implies that the Staff is certain that pitting in the stainless steel piping was due to stray currents resulting from improper grounding during field welding. Rather, we assert that to be a likely reason for the pitting. (SSER #2, § 3.12.3, page 3-43, Weeks, Tr. 9174). Hence, we would replace the last sentence, "[t]he Staff has concurred with this explanation for this pitting" with the following; "The Staff believes this to be a likely explanation for the pitting." Otherwise, we do not contest this proposed finding.

394. Contrary to this proposed finding, Mr. Lewis never testified that "proper grounding of field welding equipment is now in practice at the Midland site." All Mr. Lewis testified was that "the field was advised to exercise greater care in assuring a firm grounding path existed when welding is taking place." (Tr. 8880). In fact, when questioned by the Chairman, Mr. Lewis stated that he did not know whether the field was actually following those instructions. (Id).

Also, this proposed finding should include a discussion of an examination, during the summer of 1982, of portions of a stainless steel BWST line. At that time, all portions of the line that could be readily excavated were examined. The pipe came from the same area where at least one example of pitting had previously been found. During this inspection, however, no pitting was discovered. (Weeks, Tr. 9435, 9442).

Otherwise, we do not contest this proposed finding.

395. The Staff offers the following comment on this proposed finding. As indicated earlier, there is an inconsistency between this proposed finding and ¶ 380. This proposed finding asserts that all pipes leading into the DGB will be subject to rattlespace monitoring. Paragraph 380 however states that only pipes that have not been rebedded and/or reanalyzed will be monitored for rattlespace. Staff counsel discussed this inconsistency with Applicant's counsel, who indicated that with respect to piping entering the DGB, it was CPC's intention that only service water piping that has not been rebedded or reanalyzed would be monitored for rattlespace.10/ The Staff submits that the question of precisely which pipes will be monitored for rattlespace can be resolved as part of the Staff's review of CPC's proposed technical specifications.

396-398. The Staff does not contest these proposed findings.

10/ At FSAR § 16, page 3/4.13-18, there is a table that lists the piping that will be monitored for rattlespace.

ELECTRICAL DUCT BANKS AND CONDUITS

399-405. The Staff does not contest these proposed findings.

406. The Staff does not contest these proposed findings expect as follows. In the last sentence of ¶ 406 CPC states that although voids are not expected beneath the duct banks during the life of the plant, Dr. Shunmugavel testified that the duct banks have the capacity to span distances of up to ten feet without any soil support. The Staff agrees that the record supports that statement but notes that there is nothing in the record to indicate that the statement would be true in the event of a cracked duct bank. In any event, voids beneath duct banks are not expected during the life of the plant.

407. The Staff does not contest this proposed finding.

408. The Staff does not contest this proposed finding except to note that the Staff has identified in SSER #2, page 2-36 the information required to be provided by the Applicant at freezewall crossings and to indicate the issue of duct banks crossing the freezewall was extensively covered in the November 1-10, 1983 hearing session.

409-418. The NRC staff does not contest these proposed findings.

419. The NRC staff does not contest this finding except as follows. In footnote 717 CPC refers to a NRC staff audit of Dr. Shunmugavel's analyses of category 1 buried electrical duct banks conduits and cable. Footnote 717 states that during the audit the Army Corps of Engineers, on behalf of the NRC, investigated the loads used in the evaluation, the model that was used, and finally the evaluation results in order to conclude that they were acceptable. The transcipt pages cited do not support that that

evaluation was performed by the Army Corps of Engineers. Mr. Rinaldi testified that it was performed by "one of my consultants" (Tr. 12,118).

420 & 421. The Staff does not contest these proposed findings.

LIQUEFACTION AND DEWATERING

422. The Staff does not contest this proposed finding.

423. The Staff does not contest this proposed finding except as follows. In footnote 719, CPC cites Dr. Richard D. Woods for his statement that liquefaction has not occurred at locations where there have not been several acres of liquefiable material that is in connection and fully saturated. The Staff agrees that that is the thrust of the testimony presented at Tr. 9771. Although CPC also cited transcript pages 11,550-1 in the footnote, CPC failed to indicate that at those later transcript pages Dr. Woods attempted to correct his previous testimony. At Tr. 9771 Dr. Woods testified that he suspected he examined between 50 and 100 events to determine the necessary lateral extent of the sands in order for liquefaction to occur. He particularly cited a reference by Swiger and Christian where 49 events were listed. Dr. Harbour asked, at Tr. 9771, whether it was true that in none of those cases liquefaction occurred if the extent of the sand was an acre or less. Dr. Woods responded that that was correct. At Tr. 11,550 Applicant's counsel alluded to a possible ambiguity in the record and asked Dr. Woods (Tr. 11,551) whether the Swiger and Christian reference actually included information on the lateral extent of the liquefaction incidents. Dr. Woods responded that it did not. The clarification of the record at Tr. 11,550-1 should be included in footnote 719.

At Tr. 9793, Judge Harbour interrogated NRC witness Kane concerning the necessary lateral extent of sands in order for liquefaction to occur. Mr. Kane responded that he believed liquefaction could be a problem in

areas under one acre, and that he hesitated to approach the evaluation of liquefaction on an area basis. At Tr. 9704 Mr. Kane responded that the amount of lateral strength provided by the overburden soil adjacent to a building foundation also influences whether liquefaction will occur. Mr. Kane also indicated that in the consideration of lateral restraint one is required to consider how deep the layer bed is that has potential for liquefaction and where the layer is located with respect to the structure. Mr. Kane also indicated that if a loose layer were located where it would be the layer most heavily stressed by the foundation pressures and that layer's strength was lost (due to liquefaction), then there is a risk of losing the foundation support of that structure. Mr. Kane also expressed his opinion that with the water table below 610 feet the Staff's problems with respect to liquefaction were resolved. Tr. 9795.

424. The Staff does not contest this proposed finding.

425. The Staff does not contest this proposed finding except as follows. CPC identifies two seismic category 1 structures where there was a potential for liquefaction in the event of an earthquake, because these structures are founded in part on loose sands. Those two areas are (1) the railroad bay area of the auxiliary building and (2) the diesel generator building. CPC also identified another area with pockets of loose sand near the northwestern end of the service water pump structure where category 1 service water piping is buried. The Staff believes this finding is potentially misleading in not citing the other two areas where loose granular backfill soils were discovered which were potentially liquefiable. These areas are the EPAs and the cantilevered portion of the SWPS (SSER # 2, page 2-43, 3rd paragraph). Unlike the railroad bay area and the DGB which

rely on the permanent dewatering system to eliminate the potential for liquefaction, the liquefaction problem at the EPAs and cantilevered portion of the SWPS and the service water piping was acceptably resolved by the proposed underpinning or by excavation and backfill remedial measures. (SSER # 2, page 2-43, last complete paragraph).

In footnote 721, CPC states that after the preparation of Dr. Wood's testimony, some additional borings became available which identified further isolated pockets of loose sand. They then state that one of these pockets of loose sand was located near the diesel fuel oil tanks. At Tr. 9762, Dr. Woods identifies the additional borings with loose sand pockets as ME-27B and MP-10. At Tr. 9764 their location is stated in coordinates. The testimony at Tr. 9765-66 shows, however, that these additional borings are not located in the diesel fuel oil tank area.

At Tr. 9799, Staff witness Kane identified boring DF-5 as the one that showed loose sand in the diesel fuel oil tank area. Figure 2.5-191 of the FSAR presents the soil boring information at boring DF-5. The log for boring DF-5 in Appendix 2A of the FSAR shows that DF-5 was drilled in March, 1979. It was available for a considerable time prior to November, 1982. Mr. Kane explained at Tr. 9799-9800 that the Staff has no present concerns relating to the loose sand indicated by boring DF-5.

426. The Staff does not contest this proposed finding.

427. The Staff does not contest this proposed finding except as follows. In the beginning of ¶ 427, CPC refers to pockets of loose sand which lie under and around service water piping in the vicinity of the northwestern end of the service water pump structure. In the last sentence of ¶ 427 CPC states that these pockets will be excavated and replaced with non-

liquefiable material in order to eliminate the potential for liquefaction affecting the integrity of the category 1 duct banks in this area. There is an inconsistency in CPC's description of the specific utilities that are impacted by the loose soils and liquefaction potential. The Staff recommends the last sentence of ¶ 427 be corrected to read as follows: These pockets will be excavated and replaced with nonliquefiable material in order to eliminate the potential for liquefaction affecting the integrity of the category 1 service water piping and duct banks located in this area. (underlined words added by the Staff)

428. The Staff does not contest this proposed finding. The first footnote at the bottom of the page, which is numbered 432, should be 732.

429-431. The Staff does not contest these proposed findings.

432. The Staff does not contest this proposed finding. The footnote at the end of the paragraph, which is numbered 736, should be 737.

433-456. The Staff does not contest these proposed findings.

SLOPE STABILITY OF BAFFLE AND PERIMETER DIKES

457. Applicant chose not to cite the Staff's SER in setting forth its findings on slope stability of baffle and perimeter dikes. Since the SER addresses this matter at length, we set out below the relevant sections of the SER applicable to CPC's findings. The Staff does not contest this proposed finding, but would add to Footnote 769, "SER, Par. 2.5.6.1, pages 2-47, 2-48."

458. The Staff does not contest this proposed finding.

459. The Staff does not contest this proposed finding, but would add to footnote 773, "SER, Par. 2.5.6.2, page 2-48."

460. The Staff does not contest this proposed finding, but would add to footnote 775, "SER, Par. 2.5.6.1, page 2-48."

461. The Staff does not contest this proposed finding, but would add to footnote 776, "SER, Par. 2.5.6.5, page 2-49."

462. The Staff does not contest this proposed finding, but would add to footnote 777, "SER, Par. 2.5.6.3 and Par. 2.5.6.4, pages 2-48 and 2-49."

463. The Staff does not contest this proposed finding.

464. The Staff does not contest this proposed finding, but would add to footnote 779, "SER, Par. 2.5.6.5, page 2-49."

465-467. The Staff does not contest these proposed findings.

468. The Staff does not contest this proposed finding, but would add to footnote 784, "SER, Par. 2.5.6.6, page 2-50."

469. The Staff does not contest this proposed finding, but would correct the numbering of this paragraph to 469 instead of 460 and would add to footnote 785, "SER, Par. 2.5.6.6, page 2-50.

470. The Staff does not contest this proposed finding.

471. The Staff does not contest this proposed finding, but would add to footnote 790, "SER, Par. 2.5.6.7, pages 2-50 and 2-51."

472. The Staff does not contest this proposed finding, but would add to footnote 791, "SER, Par. 2.5.6.7, page 2-50."

473. The Staff does not contest this proposed finding, but would add to footnote 793, "SER, Par. 2.5.6.7, page 2-50."

474. The Staff does not contest this proposed finding.

475. The Staff does not contest this proposed finding, but would add to footnote 797, "SER, Par. 2.5.6.7, page 2-50."

476-483. The Staff does not contest these proposed findings.

484. The Staff comments as follows on CPC's claim that Mr. Singh testified that the PMF should not cause dike slope stability problems. Based on preliminary hydrologic information about the perimeter dike, Mr. Singh was concerned that a probable maximum flood could breach the perimeter dike and thereby induce damage because of erosion. (Tr. 4118). However, as indicated by Mr. Gonzales' testimony cited in this proposed finding and by pages 2-19 to 2-20 of the SER, the Staff is now satisfied that the potential for overtopping ~~and~~ is small and any overtopping that does occur due to a PMF would not adversely affect the safe operation of the plant.

485. The Staff does not contest this proposed finding, but would add to footnote 820, "SER, Par. 2.5.6.7, page 2-50."

486. The Staff does not contest this proposed finding but would add to footnote 824, "SER, Par. 2.5.6.7, page 2-50."

487 & 488. The Staff does not contest these proposed findings.

PROPOSED CONCLUSIONS OF LAW[11/12/]

The Licensing Board has reviewed the evidence submitted by the parties in regard to Applicant's remedial soils measures, and the "Order Modifying Construction Permits" dated December 6, 1979, and Intervenors' contentions. The Board has also considered the proposed findings of fact and conclusions of law submitted by the parties on contested issues. Based on the preponderance of the reliable, probative and substantial evidence of the record in this proceeding and the foregoing findings of fact, the Board makes the following conclusions of law:

489. Applicant entered into stipulations in which it agreed, among other things, not to contest whether the NRC staff had insufficient information, as of December 6, 1979, to evaluate the adequacy of the proposed soils remedial actions, (see Joint Exhibits 2, 3, 4 and 5). Accordingly, the Board concludes that the facts set forth in Part II of the Modification

---

11/ In the Staff's proposed findings of fact, we responded to the Applicant's proposed findings of fact. We will not follow that procedure in presenting our proposed conclusions of law. Here we set forth the Staff's proposed conclusions of law. They incorporate some of the proposed conclusions of law set forth by the Applicant.

12/ In ¶ 498 of its proposed conclusions of law Applicant seeks to have the Licensing Board reconsider the ruling it made on May 5, 1981 in its Prehearing Conference Order (Ruling Upon Applicant's Motion to Defer Consideration of Seismic Issues Until the Operating License Proceeding and upon other matters). In response the Staff will follow the guidance of Maine Yankee Atomic Power Company (Maine Yankee Atomic Power Station) ALAB-166, 6 AEC 1148 at 1150 (1973). The Appeal Board noted there that it would never be necessary for a party to respond to a petition for reconsideration filed with the Appeal Board unless that Board has specifically requested it to do so.

deeper on the natural hard lacustrine clay.[2/] (Id. at 19). Nonetheless, in assessing the fill under the control tower, the Staff's concerns were not limited to the deep void beneath the mudmat.

216-218. The Staff does not contest these findings except as follows. In ¶ 218 the Applicant indicates that when the unsatisfactory fill conditions were discovered, there were concerns about future differential settlement and their causing stresses in the structure. Because of cracking at several locations at the auxiliary building, along with the differential settlement that had occurred,[3/] the Staff was also concerned that the auxiliary building already was distressed. (SSER #2, § 2.5.4.4.1, p. 2-17, Kane, Tr. 5882).

2/ See Staff response to ¶ 219 for a discussion of the difference between natural hard lacustrine clay and glacial till.

3/ The following differential settlements have been recorded in the auxiliary building area: (1) southern end of the control tower relative to south end of the spent fuel pool in the auxiliary building - 0.24 inch with reasonable expectations that it has been as much as 0.5 to 1 inch, (2) ~~total recorded settlement of the control tower and the EPAs for the period July 1978 through January 1982 has been 0.5 to 0.7 inches~~ (SSER #2 § 2.5.4.5.2, p. 2-40).

The Staff's assessment of the cracks in the auxiliary building differs from the Applicant's analysis. Contrary to the implication in footnote 416, the Staff has never concluded that all of the cracks in the auxiliary building can be attributed to volume changes. The CPC relies upon §§ 2.5.4.4.1 (p. 2-17) and 3.8.3.5 (p. 3-28) of SSER #2 as support for that claim. Neither section contains any assertion that all of the cracks in the auxiliary building were due to normal volume changes.

The Staff was unwilling to discount the cracks in the auxiliary building based on the Applicant's determination that all of the cracks stemmed from shrinkage. Rather, we required an evaluation of the effect of the cracks on the structures. (SSER #2, § 3.8.3.5. p. 3-27). Such an analysis of the cracks in the auxiliary building was done, and the Staff found it acceptable. (Id. at 3-27 to 3-28). Hence, in discussing its evaluation of the Applicant's crack assessment, the Staff does not dwell on the cause of the cracks. (Id.) Since concerns about differential settlement have been addressed by the remedial measures, the Staff submits that dwelling on the causes of the cracks is not necessary. Rather, the Staff directed its attention to determining that the available tensile capacity of the structural reinforcement crossing the cracks exceeded the tensile capacity that uncracked concrete is assumed to carry. (Id. at 3-28). Based on the above, the Staff submits that the Board should not make a finding that all of the cracks in the auxiliary building stemmed from volume changes. Rather, the Board should find that the cracks do not significantly affect the strength of the auxiliary building.

Furthermore, as with the Service Water Pump Structure, CPC has developed a crack monitoring program and repair program which the Staff finds acceptable. If a new crack exceeds 0.01 inches or an existing crack exceeds 0.03 inches, an evaluation will be made to determine whether underpinning procedures should be altered or continued. (SSER # 2, p. 2-49.) The crack repair program applies to the control tower, electrical penetration areas and feedwater isolation valves pit areas. Except for coating with waterproof compounds, the repair program is

similar to that required for the SWPS. (SSER # 2, p. 3-29, Staff response to ¶ 249.)

Other comments on ¶ 218 are as follows.

In the second sentence of ¶ 218, CPC states that because the control tower and the electrical penetration areas were not designed to cantilever from the main auxiliary building, differential settlements caused by unsatisfactory plant fill could cause unacceptable stresses. The Staff notes that any differential settlement would have to be considered in connection with various combinations of dead loads; live loads; environmental loads including winds, tornadoes, OBE, and the SSE as discussed in ¶ 3.8.3 of the Staff's SER. See also the discussion of seismic analysis of the remedial measures in § 3.7.2 of SSER #2.

In the second portion of footnote 418 on page 164, CPC makes the following statement: "The Applicant initially considered a pile and corbel foundation system and then considered a partial underpinning; nowever, when the need to design for a larger earthquake arose, the present design was arrived at. Johnson, Tr. 5647-5668, 5729-5733. See also ¶ 232, infra." The citations stated discuss the use of caissons - not piles and corbels. CPC has apparently confused the remedial measure for the SWPS, which did involve piles and corbels, with the remedial measures at the auxiliary building which involves caissons.

219. The Staff does not contest this proposed finding but believes that a clarification of the record should be made. All parties frequently referred to the foundation soil for the auxiliary building and the service water pump structures as being "the till". As is demonstrated by Table 2.4 at page 2-15 of SSER #2, the foundation soil

for the reactor and auxiliary building is the very stiff to hard clay described in that table and would more properly be defined as the lacustrine clay. The foundation soil for the service water pump structure is very stiff to hard sandy clay and is more accurately identified as the glacial till. As is demonstrated by Table 2.4 the parameters of those two natural foundations differ substantially 4/ See also SER #2, pgs. 2-11 to 2-12.

Also, the Staff advises the Board that, based on information obtained at a recent design audit, it is our understanding that CPC is planning to use lean concrete, rather than sand, to fill the four foot gaps left by the curving of the walls around the containment.

220. The Staff does not contest this proposed finding except to note the difference between lacustrine clay and glacial till described in the Staff's response to ¶ 219..

221. The Staff does not contest this proposed finding except as follows. In the first sentence of the paragraph CPC states that the FIVPs will be supported in a different manner than the control tower and the electrical penetration areas. It should be noted here (as is indicated later in CPC's footnote 425) that a beam and tie system providing temporary support for the FIVPs is already in place.

4/ This clarification is also pertinent to ¶¶ 220, 227 and 233 of CPC's proposed findings. At those proposed findings the term "lacustrine clay" should replace the term "glacial till."

222-226. The Staff does not contest these proposed findings.

227. The Staff does not contest this proposed finding except to note the difference between glacial till and lacrustrine clay as described in the Staff's response to ¶ 219.