50-329/330 OM, OL
Midland

Exhibits During
Oral Deposition of
Frank Rinaldi
on
1/6/81

Exhibits 1- 16

8102270072 XA

Frank Rinaldi, P.E.
Structural Engineering Branch
Division of Engineering
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission

My name is Frank Rinaldi. I presently reside at 5506 Beech Ridge Drive, Fairfax, Virginia 22030 and I am employeed as a Senior Structural Engineer in the Structural Engineering Branch, Division of Engineering, Office of Reactor Regulation, Washington, D. C. 20555.

Professional Qualification

I received a B. S. degree in Civil Engineering from the City College of New York (1966) and a M.S. degree in Civil Engineering from Maryland University (1974).

I am a registered Professional Engineer in the Commonwealth of Virginia (1972).

I am a member of the Main Committee of the ACI-ASME Committee on Concrete Pressure Components for Nuclear Service (Concrete Reactor Vessels and Containments).

I have been employed by the NRC - Structural Engineering Branch since 1974 as a Senior Structural Engineer. My duties include development of design criteria for nuclear structures and participation in the formulation of safety criteria. Duties also involve safety-related review of structural and seismic design criteria (Safety Analysis Reports & Topical Reports) for power systems and the evaluation of nuclear containment structures, reactor vessels and other structures and components.

The following is a summary of my previous professional experience:

1971-1974	U. S. Atomic Energy Commission Fuel Fabrication and Transportation Branch (Structural Engineer).
1970-1971	Naval Facilities Engineering Command-Division of Research Development and Testing and Evaluation (General Engineer).
1968-1971	Naval Facilities Engineering Command-Electronics Facilities Support Branch (Structural Engineer).
1966-1968	Naval Facilities Engineering Command-Chesapeake Division (Civil Engineer).

Exhibit
Midland Depisition of
Rinaldi Depo Ex 1
1-6-81 CAB

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KANE x492-8162

① OUR INTRESS IS WHAT IS THE DESIGN INPUT TO THE STRUCTURE. SINCE THE DESIGN IS BASED ON AN EFFECTIVE DEWATERING SYSTEM AND WITH ASSURANCE THAT THE BACK UP SYSTEM WILL GUARNTEE THE VALIDITY OF THE DESIGN INPUTS; WE WOULD LIKE TO KNOW THE RELAINCE OF THE COMPLETE SYSTEM.

⑤ SEISMIC RE-ANALYSIS OF ALL CATEGORY I STRUCTURES DUE TO PLANT FILL CONDITIONS ARE REQUIRED.

[illegible] 2
1-6-81 [illegible]

• DARL HOOD

• CONSUM.
POWE

MIDLAND NPP
Midland Michigan

2-11-80 Initial transfer of Project from Lipinski – He is to be my consultant on Settlement Problem for the time being

Previous Reviewers were: A. Hafiz
R. Lipinski K. Kapur (R.G.)

Mtg @ Midland for General Orientation 2-27/28-1980
Consultant will Attend : NWSC Dr. Pao Huang
Mr. John Matra

2-13-80 Concrete Pipes identified as possible problem in Consideration of Soil Settlement
Previous Work 9-29-1975

2-26-80 Discussed w/ Ron Lipinski the settlement problem investigated during his review. Left for site visit @ Midland

2-27-80 Site Visit

~~Deposition~~

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1-6-81

Midland NPP

Settlement

- There are no concrete pipes only steel Invest.
  - One concrete pipe Service water
- Backfill not compacted as per specs
  Excessive settlement on some structures
  NRC request 50.54 f investigate structures on backfill (22 Questions) (SEB /Geotech)
- Applicant submits report
  - Diesel Generator (Fill Fix) NG — Differential Settlement Maximum "
  - Service Water Structure (Piles) NG — Part of struct. on fill
  - Tank farm (Erosion Base Mat Support) no action
  - Auxiliary Bldg. Jacket ~~[illegible]~~ — Feed Water Isolation Valve Re-analyze structure (# [illegible] NG!)
  - Emergency Diesel Fuel Oil Storage Tank

Re-Evaluate for Seismic

Stress due to settlement to be used as [illegible] check w/ Code 349 + SRP + RG. 1.142

G-Value not as per RG 1.60 

Load Combination [illegible] as per SRP 3.8.1
3.8.3
3.8.4

$\frac{1.9E}{1.4E}$ → 1.4 E

1-6-81

9/78? DIESEL GENERATOR BLDG.

What do you mean by investigations?

What kind of pipes did you investigate?

What was the acceptance criteria?

How did you free the duct banks?

How did you ascertain that they were freed totally

Which seismic event do you consider in the fix of the service water supply bldg

Liquifaction - Dewatering Plan?

Retaining Walls?

Damage from the borings?

7 Test Pits
205 Borings
Seismic Check? What exactly did you do?

What is criteria for termination of check for Boring & Pits

Test Pads to qualify Compacting Equipment for future work 98% Qualified

Why did you dismiss Option D. It would be better than the Selected Option C

Settlement and cracks should be translated to loads on the respective effected Bldgs.

Why [illegible] Why is Settlement above the projected line

4.4 k/# During Surcharge
2.2 k/# After Removing Surcharge

Show effects on Lines due to all of the consolidations given to the Diesel Generator B..

Address Dike Wall function

Effects on Class I Tank from Failure of Non Class I Tanks

Any time we would like to check settlement by filling Tanks we should consider ground buoyancy effect

Minutes of Meeting by Bechtel 11/26/79 Item 3.0
Exceed allowables @ Elbows & Bends

El. 610 Now Liquifaction Possible
El. 595 operation To provide Margins

Wells not designed for Earthquakes [illegible]

Check if they follow the NRC position on Dewatering Systems

200-300 Dewatering Wells Planned
64 Expected to be required after the observation of current observation with 24 (approx.) for normal operation conditions

1" axial movement & 1° Rotational

Diesel Generator less than 30% of Foundation Wt

Wind Load [illegible]
Eq
Tornado

ACI 349 vs 318

100 ton Details of Pile Ties
Drilling [illegible]

Piles outside the exterior wall with tie @
transition zone

Pipe connection Bellows? Flexible for deflection

Considers settlement checks & secondary stress with
no deficiency provided

Comparison for Concrete Pipes 82%

- Ducts checked with Rabbitt
check for structural capacity? is that a way to
It only checks opening out It appears that
load carrying capacity

Fundamental [illegible] de[illegible]
Fire [illegible] [illegible] [illegible]
cracks [illegible] = reduced [illegible]

Piles out side the exterior wall with tie @ transition zone.

Pipe connection Bellows? Possible no Deficienci

Considers settlement cracks as secondary stress

no deficiency provided

Compensation for Concrete Pipes 82%

Ducts checked with Rabbitt is that a way to check for structural capacity? It appears that it only checks opening not load carrying capac

Fundamental mode decreased by 20% for the Aux. Wing due to reduced [illegible]

cracks

Midland NPP Trip Report for ORIENTATION MTG [2/27-28]

Bring myself and NSWC Consultant Up-to-date on problem

1. DIESEL GENERATOR BLDG. — Differential settlement; Pt. Load after Surcharge due to Electr. Conduits
2. AUX. BLDG WING SECTIONS NEXT TO CONTAINMENT BLDG. — Not prop. support relied by the design
3. BORATED WATER TANKS — Cracks occur due to settlement
4. SERVICE WATER INTAKE STRUCTURE — Cracks due to Flexture stresses due to poor supporting material (fill)

Problems caused by Fill Material not compacted to the construction specifications

Fix proposed by Applicant & A&E (Bechtel) considered not satisfactory

1. DIESEL GENERATOR BLDG
   (a) Surcharge, Freeing Pt. Load due to Electrical Line Conduit Rabbit run on opening of Concrete Electrical conduit are considered adequate.
   (b) Adding of a common mat that would prevent additional differential settlement was not used
   (c) Additional investigation of the concrete electrical ducts was not reported. Safety cannot be assured by just providing a duct opening for the lines
   (d) Investigation of the crack not complete. The A&E missed few through cracks. Also dismissed many as Shrinkage cracks even though they were through cracks.
   (e) Does not re-evaluate the total structure using all of the load combinations and add the effect of Settlement and Cracks
   (f) Ton no change investigate the effect of proposed effect on cracks during vibrational mode [illegible]

[illegible]

2. AUX. BLDG WING SECTIONS NEXT TO CONTAINMENT BLDG

(a) Fix appears adequate if properly implemented

(b) MUST investigate the effective damage on the Tower section for this miss loading effect during construction

(c) Must re-investigate for new situation

3. Borated Water Tanks - Re analyze for cracked consideration If cracks are not shrinkage cracks

4. SERVICE WATER INTAKE STRUCTURE

(a) Fix appears bad one bring to solid base; adequate designed foundation that simulates the design.

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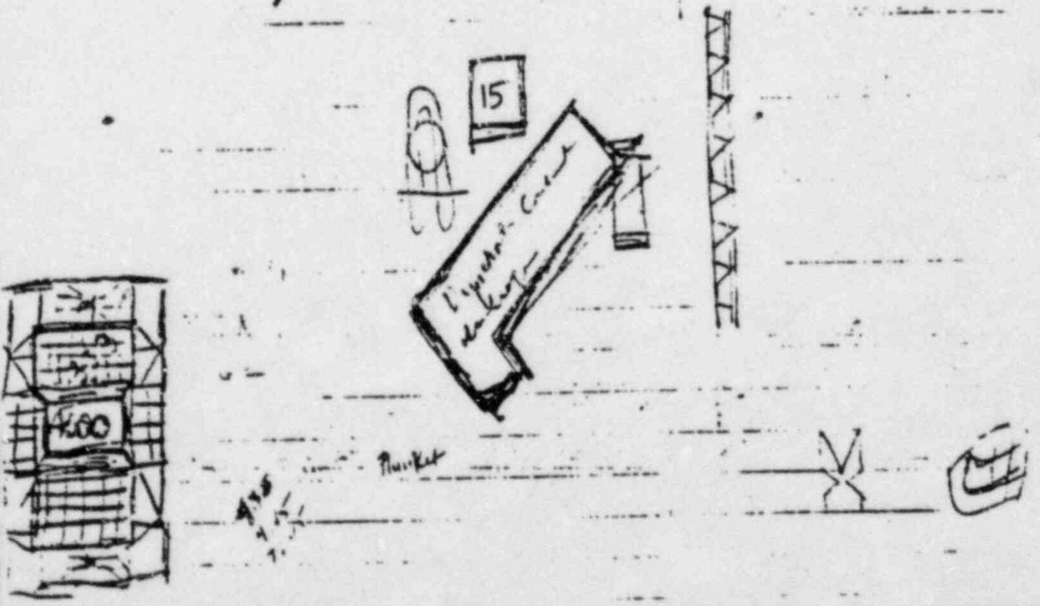
(b) When questioning the fix the Fingering Effect of some bad section of so called good soil was pointed out. Verify this give ~~evaluation~~ conclusions.



Frank - I enclose 2 copies but I dont think we should take time to send them to the Navy - if they are OK with you lets send them out please call me as soon as you read

Bill Paton
x 27543

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
) 50-330-OM
) 50-329-OL
(Midland Plant, Units 1 and 2)) 50-330-OL

NRC STAFF INTERROGATORIES TO CONSUMERS POWER COMPANY

Pursuant to 10 C.F.R. § 2.740(b), the NRC Staff serves the following interrogatories on Consumers Power Company. In several interrogatories we have included requests for documents. The requests are made in the event you will respond absent a formal Motion to Produce these Documents.

Interrogatory 1

As a result of settlement and inadequate compaction in the fill area, you have proposed remedial actions and you have agreed to re-analyze the seismic/structural analyses of the Category I structures located in this area.

(a) Have you verified and evaluated any changes in the design safety margins available for any Category I structures by performing structural re-analysis?

(b) If the answer to (a) is yes, please provide a copy of any structural re-analysis performed.

(c) If the answer to (a) is no, please state the reasons for not performing that re-analysis.

(d) If the answer to (a) is no, but you plan to make such re-analysis, please state when you plan to do so.

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(e) Have you factored into any re-analysis information contained in, or resulting from, a letter from Robert Tedesco to Vice President J. Cook, dated October 14, 1980, concerning seismological input data acceptable to the Staff?

(f) If the answer to (e) is yes, please provide a copy of that re-analysis.

(g) If the answer to (e) is no, please state if you plan to make an analysis incorporating that data, which structures you plan to re-analysis, and when you plan to do so.
ze

(h) If you believe re-analysis is not required for any such Category I structure, please state for each structure ~~why~~ such re-analysis is not required.
the reason

(i) Was the floor response spectra for the diesel generator building generated on the assumption that the shear wave velocity would not be lower than 500 feet per second?

(j) If the answer to Question (i) is negative, please state the assumption used with respect to shear wave velocity.

(k) How have you assured yourself that the soil shear wave velocity will not be less than 500 feet per second for the life of the plant?

Interrogatory 2

The fill material under the northern wing of the service water pump structure has been found to provide inadequate support. While the portion of the structure over the fill material is being supported by the main structure founded on natural material, through cantilever action, it is stated in Management Corrective Action Report No. 24, Interim Report 6, issued September 7, 1978, that the total design loads cannot be supported by the main structure. Your proposed remedial action will utilize corbels attached to the side of the structural wall by bolts. The corbels are to be supported by pilings placed underneath them.

(a) What alternative corrective actions did you consider for supporting the cantilevered portion of the Service Water Pump Structure?

(b) Was one of the alternatives considered to provide a stable solid foundation support of the cantilever portion of the structure down to the glacial till rather than the concentrated support design eventually chosen?

(c) What structural analyses for each of these alternatives did you perform?

(d) Please provide a copy of any analysis described in 2(c) above.

(e) Did you factor into any analysis identified in 2(c) above the information contained in a letter from Robert Tedesco to Vice President J. Cook, dated October 14, 1980, concerning seismological input data acceptable to the Staff?

(f) Explain why each of the alternatives identified in 2(a) above was rejected or accepted.

(g) For those alternatives that were rejected, but for which no analysis was identified in 2(c) above, give the reasons for not considering those alternatives.

(h) What analyses have you done to assure yourselves that the long longitudinal bolts which will be used in the remedial action will withstand the force produced in the bending mode?

(i) Please provide a copy of any analysis identified in 2(h).

(j) If no such analysis has been performed do you plan to perform do an analysis and if so when?

(k) Do you have a plan for pre-service and in-service inspection of the integrity of the bolts during the life of the plant?

(l) If the answer to 2(k) is yes, provide a copy or description of that plan.

(m) If the answer to 2(k) is no, state the reasons that such a plan is not necessary.

(n) What type of bracing (if any) will be provided to assure that the vertical piling will resist horizontal forces?

(o) What analysis have you done to assure the adequacy of any horizontal braces identified in 2(n).

(p) Please provide a copy of any analysis identified in 2(o).

(q) What analyses have you done to assure yourselves that the piling under the service water pump structure will provide adequate vertical support after the occurrence of a postulated earthquake ([illegible])?

(r) Please provide a copy of any analysis identified in 2(q).

(s) Did you factor into any analysis identified in 2(q) above the information contained in a letter from Robert Tedesco to Vice President J. Cook, dated October 14, 1980, conterning seismological input data acceptable to the Staff?

Interrogatory 3

The following questions refer to the remedial actions at the service water pump structure.

(a) Is the corbel design such that it depends upon a friction-fit with the service water pump structure's north wall resulting from the pre-tensioning of the long longitudinal bolts.

(b) How have you assured yourselves that this friction-fit will be maintained under all the desing loads for the building?

(c) If the answer to 3(b) is based on tests or other analysis please identify and provide copies of the analysis or test results.

(d) How have you assured yourself that the concrete at the interface between the corbel and the Service Water Pump Structure can adequately resist bearing pressures developed as a result of pre-tensioning of the bolts.

(e) If the answer to 3(d) is based on tests or other analysis please identify and provide copies of the analysis or test results.

Interrogatory 4

In the response to Question 15 of the NRC request, regarding plant fill, it is stated that, "differential settlement primarily induces additional strain, which is a self-limiting effect and does not affect the ultimate strength of the structural members." Additional clarification of this statement is needed.

(a) Why do you classify the resulting strains as self-limiting in nature?

(b) How do you reconcile your statement quoted above with your statement concerning the Service Water Pump Structure in the Management Corrective Action Report No. 24, Interim Report 6, issued September 7, 1978 that the total design loads cannot be supported by the main structure.

Interrogatory 5

The applicant responses to Questions 14, 28, and 29 of the NRC request regarding the causes of cracks due to settlement, the significance of the extent of cracks, and the consequences of cracking, provided insight only into the existing condition of the Category I structures.

(a) Have you performed analyses which provide tension field data under the design load combinations at all crack locations for each Category I structure.

(b) Provide copies of any such data or analysis described in Part (a).

(c) If the answer to (a) is no, state why it is not necessary to perform that analysis.

(d) Have you performed any analyses to show the limiting tension field conditions in which a crack will not propagate.

(e) Provide copies of any such data or analysis described in Part (a).

(f) If the answer to (d) is no, state why you do not believe it is necessary to perform that analysis.

(g) What analyses have you performed prior to loading or surcharging of any structures or tanks will not further propagate existing cracks?

Interrogatory 6

Since the fill was replaced by other material, such as lean concrete, in the vicinity of the auxiliary building and of the feedwater valve pits, the soil properties of the foundation material have been changed.

(a) Have you performed new seismic/structural analyses that utilizes the new soil properties, (e.g. damping valves and shear modules).

(b) If the answer to (a) is yes, please provide a copy of any such seismic/structural analysis.

(c) If the answer to (a) is no, please state the reasons for not performing such new seismic/structural analysis.

(d) If the answer to (a) is no, please state your basis for concluded that these structures will comply with current NRC criteria.

(e) If the answer to (a) is yes, have you performed a new soilsstructural interaction analysis for the auxiliary building and the feedwater valve pits.

(f) If the answer to (e) is yes, please provide a copy of that analysis.

Interrogatory 7

The applicant has not established the effectiveness of the ground water well system. These wells are needed to control the ground water level and prevent soil-liquifaction.

(a) Is the permanent dewatering system designed to withstand the safe shutdown earthquake. (SSE)?

(b) If the answer to (a) is no, have you evaluated the impact of soil liquification on any soil supported Category I structure.

(c) If the answer to (b) is yes, what ground vibratory motion has been considered?

Interrogatory 8

In connection with your seismic analysis of the service water pump structure and the diesel generator building have you developed: (1) Lump mass models (2) Stiffness value for each member (3) Mass at each nodes point (4) Spring constants used in the analysis (K_o, C_o, K_x, C_x, K_y, C_y) and (5) Seismic inputs of the modified Taft N21E 1952 record used in this analysis. As to any affirmative answer, please provide copies.

Interrogatory 9

With respect to the seismic Category I valve pits located in the fill adjacent of the east and west side of the diesel generator building:

(a) What changes, if any, occurred to these pits during the diesel generator surcharge program?

(b) Do any cracks exist in these pits?

(c) What changes, if any, occurred in the rattle space for the piping during the diesel generator building surcharge program?

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

OCT 29 1980

Docket Nos. 50-329/330

MEMORANDUM FOR: Robert L. Tedesco, Assistant Director
for Licensing
Division of Licensing

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

SUBJECT: MIDLAND NPP - DISCOVERY QUESTIONS
REQUEST FOR INFORMATION, FSAR REVIEW

Plant Name: Midland NPP Units 1 and 2

Licensing Stage: Discovery - FSAR Review

Docket Number: 50-329/330

Responsible Branch and Project Manager: LWR # Darl Hood

Requested Completion Date: October 6, 1980

Review Status: Completed

The discovery round review of the FSAR has been completed by Pao Huang and John Matra of the NSWC and Frank Rinaldi of the Structural Engineering Branch. We find that additional information is required before we can complete our review. The additional information requested, which concerns structural aspects, is contained in the enclosure. The material reviewed to date consisted of information provided through Amendment No. 81, dated September 16, 1980.

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

CONTACT: F. Rinaldi x29467

Enclosure: Discovery Questions

cc: W. Pike, MPA
D. Eisenhut, DL
R. Vollmer, DE
F. Schauer, SEB
W. Paton, OELD
F. Miraglia, DL
D. Hood, DL
P. Huang, NSWC ✓
J. Matra, NSWC ✓
F. Rinaldi, SEB

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ENCLOSURE
MIDLAND NPP UNITS 1 AND 2
DISCOVERY QUESTIONS
REQUEST FOR INFORMATION FSAR REVIEW

1. As a result of settlement and inadequate compaction in the fill area, the applicant has agreed to re-run the seismic analyses of the Category I structures located in this area. We require that the applicant verify and evaluate any changes in the design safety margins available for all applicable Category I structures, by performing a structural re-analysis using the resulting seismic forces.

2. As a result of the strengthening measures planned for the auxiliary building and the service water intake structure, through the use of caissons and piles, respectively, the foundation of these structures will be different from the original design. Such a change will require a new seismic/structural analysis. In addition, since the floor response spectra for the diesel generator building were generated on the assumption that the shear wave velocity would not be lower than 500 FPS, we require that monitoring of the soil properties be undertaken throughout the period of consolidation in order to verify the validity of this assumption. Also, the applicant is required to report and evaluate any variations from the minimum assumed value of 500 FPS.

3. The fill material under the nothern part of the service water pump structure remains an open item. While the portion of the structure over the fill material is being supported by the rest of the structure founded on natural material, through cantilever action, it is stated in the Management Corrective Action Report, Interim Report 6, issued September 7, 1978, that the total design loads cannot be supported by the main structure. The proposed corrective action recommends the placing of pilings along the north wall of the structure. The following concerns regarding this proposed corrective action, need to be addressed:

    a. The corrective action does not provide the type of foundation support that was considered in the original design, which provided stable solid soil support along the foundation of the structure. The corrective action only provides concentrated supports along the wall through the use of piles, corbels, and bolts.

    b. The method of attaching corbels by using long longitudinal bolts through the walls requires the bolts to resist bending forces. This is not an effective way of utilizing bolts, since bolts provide low strength in the bending mode. Other corrective design methods, that more closely comply with the design intent, should be considered and compared.

c. In the proposed re-analysis of the service water pump structure for seismic loading, the manner in which piling will be modeled is not clear. It appears that the vertical piling may not resist horizontal forces unless proper bracing is provided. In addition, the aplicant should evaluate as to whether or not the piling will still be an effective way of providing vertical support after the occurrence of a postulated earthquake (SSE).

4. In the response to Question 15 of the NRC request, regarding plant fill, it is stated that, "differential settlement primarily induces additional strain, which is a self-limiting effect and does not affect the ultimate strength of the structural members." Additional clarification of this statement is needed. Due to differential settlement the foundations of Category I structures, in the plant fill areas, have become drastically different from the original design. Consequently, the new structural systems should be evaluated to determine that all of the design loads, load combinations and stress/strain limits identified in current NRC criteria are satisfied.

5. The applicant responses to Questions 14, 28, and 29 of the NRC request regarding the causes of cracks due to settlement, the significance of the extent of cracks, and the consequences of cracking, provide insight into the existing condition of the Category I structures. However additional information is needed for the evaluation of the Category I structures, as follows:

    a. Provide the tension field data, if any, under the design load combinations at all crack locations for each Category I structure.

    b. Provide an analysis that will show the limiting tension field condition in which a crack will not propagate.

    c. Demonstrate that the existing cracks will not propagate further as result of any postulated additional settlement.

    d. Demonstrate that adequate corrective plans, in regard to the adverse effects of corrosion of the reinforcing bars in the cracked areas, have been formulated and that quality assurance/control procedures have been carefully identified and evaluated.

6. Since the fill was replaced by other material, such as lean concrete, in the vicinity of the auxiliary building and of the feedwater valve pits, the soil properties of the foundation material have been changed. It is recommended that new soil properties (e.g. damping values and shear modulus) be used in the revised seismic analysis to determine the structural adequacy of all of the pertinent Category I structures. A new soil-structure interaction analysis should be conducted by the applicant and a summary of the assumptions, models, and results should be provided for our review.

Also, all structural/seismic analyses should be conducted using the revised seismic loading and current NRC criteria so that margins of safety can be determind against currently acceptable loads and standards. In addition, all analyses should include the effects of soil settlement, as identified in the revised load combination equations, and include an evaluation of significant local cracked areas, as per Question 5 criteria.

7. The applicant has not established the effectiveness of the groundwater well system. These wells are needed to control the ground water level and prevent soil-liquefaction. The proposed dewatering system should be categorized in its entirety or in part, as per the determination of the system and geoscience technical personnel, as Category I systems and should be designed and constructed to resist the loads of OBE/SSE and other pertinent loads.

8. The reactor vessel support system remains as an open item since it is undergoing a re-evaluation by the applicant. Provide the final design and analysis for our review.

9. Since the design of other Category I and internal concrete structures were completed before 1973 the load combinations presented in the FSAR are not in accordance with all of the current NRC criteria. Specifically, the staff has adopted as the acceptable criteria ACI-349 modified by the exceptions identified in Regulatory Guide (RG) 1.142. The applicant has not yet compared the degree of conservatism of the Midland NPP design for the two criteria, with respect to the load combination and with respect to related acceptable allowable stress/strain criteria. Demonstrate that the criteria (load combinations and acceptance limits) are equivalent in safety scope.

10. The Tornado Missile Spectra does not fully comply with the current NRC criteria. Specifically, the applicant has not considered the three steel pipe missiles (3" dia., 6" dia., 12" dia.). From a structural point of view the 12" diameter steel pipe controls the design of the concrete barriers. Therefore, further evaluation of the tornado missile barriers is required. In addition, the applicant should demonstrate that the vents used to reduce the differential pressure in other Category I structures are adequate to resist any postulated missile impact.

11. Confirmatory independent seismic analyses of the containment structure, service water pump structure and the diesel generator building are underway. Additional data to those presented in the FSAR are required. It is requested that the following data be forwarded to NRC for the structures mentioned above:

    1. Lump mass models
    2. Stiffenss value for each member
    3. Mass at each nodes point
    4. Spring constants used in the analysis (K_o, C_o, K_x, C_x, K_y, C_y)
    5. Seismic inputs of the modified Taft N21E 1952 record used in this analysis.

RESPONSES TO NRC REQUESTS REGARDING PLANT FILL

QUESTION 1. - QUALITY ASSURANCE - 13 DEFICIENCIES
2 - CONSIDERATION GIVEN TO & ESTIMATE COST OF [illegible]
3 - SETTLEMENT OF DIESEL GENERATOR BUILDING
EXCEEDED ANTICIPATED VALUES - CLARIFY
4 - ACCEPTANCE CRITERIA - FILL
5 - EXTENT OF ADDITIONAL BORING & MEASUREMENTS
ARE TAKEN
6 - BORATED WATER STORAGE TANKS - FILL & MEASURE SETTLEMENT
7 - ADEQUACY OF ELECTRIC DUCT BANK - CONTACT WITH
DIESEL GENERATOR BUILDING.
8 - ALIGNMENT & DIFFERENTIAL SETTLEMENT EFFECTS
ON DIESEL GENERATOR & PEDESTALS.
9 - SOIL PROPERTIES DO NOT MEET ORIGINAL COMPACTION
CRITERIA SET FORTH IN PSAR
10 - FILL SETTLING PROBLEM
11 - ASSURANCE THAT THE VERTICAL BORINGS TAKEN ADJACENT TO
STRUCTURE ARE REPRESENTATIVE OF FILL CONDITIONS UNDER [illegible]
12 - DOCUMENT CONDITION OF SOIL UNDER SAFETY - RELATED
STRUCTURES
13 - HOW DOES LACK OF COMPACTION AFFECT SOIL - STRUCTURE
INTERACTION DURING SEISMIC LOADINGS
14 - CATEGORY I STRUCTURES - ABILITY TO WITHSTAND INCREASED
DIFFERENTIAL SETTLEMENT & EVALUATE EFFECTS OF SEISMIC
15 - CATEGORY I STRUCTURES - ABILITY TO WITHSTAND
DIFFERENTIAL SETTLEMENT.
16 - SETTLE LOCALLY UNDER PIPING IN FILL
17 - IDENTIFY ALL SEISMIC CATEGORY I PIPING
18 - SEISMIC CATEGORY I PIPING - WITHSTAND INCREASED
DIFFERENTIAL SETTLEMENT
19 - STATUS OF PIPING DIESEL GENERATOR BUILD - DURING
PRELOAD PROGRAM
20 - COMPONENTS ASSOCIATED WITH SEISMIC CATEGORY I [illegible]
EXPOSED TO INCREASED SETTLEMENT WITHIN ALLOWABLE STR[illegible]
21 - PROVIDE INFO ON THE BASIS OF SELECTION OF THE AVAILABLE
OPTIONS ON SOLVING DIESEL GENERATOR PLANT FILL PR[illegible]
BY PRELOAD - RATHER THAN THE OTHER SELECTIONS

Rinaldi Depo Exh 8
1-6-81 WPB

RESPONSE TO NRC REQUEST REGARDING
PLANT FILL

QUESTION 22 - INFO REQUIRED - USING WORK STOPPAGE ASSUMPTION
SCHEDULE IMPACTS, COST, ETC
23 - INFO GIVEN IN THE RESPONSE FOR QUESTION (1)
IS NOT SUFFICIENT - ROOT CAUSE OF ALL 13 DEFIC
24 - INFO ON PERMANENT DEWATERING SYSTEM
25 - SOIL ACTUAL PROPERTIES IN AREA CONTAINING SEISMIC CATEGORY I
STRUCTURES - NEW SEISMIC LOADS INCORPORATED INTO
A REVISED STRUCTURAL ANALYSIS
26 - RESPONSE TO QUESTION IS NOT ACCEPTABLE - STRUCTURAL
RE-ANALYSIS MUST BE BASED ON SRP SEC 3.8.4 AND 3.8.5,
OR ACI 349 AS SUPPLEMENTED BY RG 1.142
STRUCTURES FOUNDED PARTIALLY OR TOTALLY ON FILL
27 - QUESTION ON QUESTION 4 RESPONSE - WHAT DOES
SETTLEMENT ESTIMATE INCLUDE - & ACCURACY OF
RESIDUAL SETTLEMENT ESTIMATE
28 - RESPONSE TO QUESTION 14 PROVIDES INSUFFICIENT INFO
REGARDING CAUSES OF CRACKS - WANT MORE INFO
29 - RESPONSE TO QUESTION 14 - TEMPORARILY OR
PERMANENTLY INACCESSIBLE - HOW DO YOU PLAN
TO INVESTIGATE CRACKS
30 - CLARIFICATION OF QUESTION 7 - ELECTRIC DUCT BANKS
31 - RESPONCE TO QUESTION 6A DOES NOT PROVIDE
INFO REQUESTED
32 - DESCRIBE TEMPORARY INTER-CONNECTION BETWEEN
BORATED WATER STORAGE TANKS -
33 - QUESTION TEST DURATION MENTIONED IN QUESTION 1
34 - SUPPLEMENT QUESTION 16 RESPONSE - EXCESSIVE STRESS
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35 - QUESTION RESPONCE TO QUESTION 5 - THAT ADDITIONAL
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OF PRELOADING PROGRAM

RESPONSES TO NRC QUESTIONS

SECTION 3.3

QUESTION 372.11 (3.3.2) – CRITERIA FOR DESIGN BASIS TORNADO IN R.G. 1.76 BASED ON PRESSURE DROP FOLLOWED BY INSTANTANEOUSLY PRESSURE RISE – HURRICANE (1 CT) 2 SEC TIME LAG – BETWEEN PRESSURE DROP AND PRESSURE RISE – DISCUSS BASIS FOR DEVIATION (SECTION 3.3.2.1 ADDRESSES THIS QUESTION)

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– QUESTION

RESPONSES TO NRC QUESTIONS

SECTION 3.4

QUESTION 010.1 (3.4.1) - DISCUSS MEANS OF SEALING EACH TYPE OF OPENINGS BELOW FLOOD LEVEL TO PREVENT FLOOD DAMAGE - (SECTION 3.4.1.2 - REVISED)

010.2 (3.4.2) - REANALYZE FLOODING PROTECTION IN TURBINE BUILDING BASED ON EXPANSION JOINT RUPTURE RESPONSE (SECTION 3.4.2.5.1)

130.2 (3.4.2) = FSAR DOES NOT FOLLOW RG 1.70 REV 2 FOR PROTECTION AGAINST FLOODING - WHAT IS "HARDEN" FLOOD PROTECTION - RESPONSE HARDEN FLOOD DEFINED IN RG-159 - & SECTION 3.4.1.2 DISCUSSED TYPES OF FLOOD TYPES PROTECTION.

[illegible] TO NRC QUESTIONS

SECTION 3.5

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312.8	(3.5.1)	- DESCRIBE TURBINE VALVE TESTING PROGRAM & HOW USED FOR ESTIMATING PROBABILITY FOR DESTRUCTIVE OVERSPEED. RESPONSE - SUMMARIZED IN G.E. REPORT SEC 3.5.1.2.6.2 & 10.2.6
312.29	(3.5.1)	RESPONSE TO QUESTION 312.8 INADEQUATE. RESPONSE - MORE INFO GIVEN IN RESPONSE TO QUESTION 040.62
312.30	(3.5.1)	TURBINE MISSILE ANALYSIS IN TOTAL PROBABILITY WANT INDIVIDUAL PROBABILITIES. RESPONSE TABLE 3.5-1, SUBSECTIONS 3.5.1.3.6.3 & 4 & TABLE 3.5-17
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130.6	(3.5.3)	PROVIDE TABLE SUMMARIZING WALL & ROOF THICKNESSES & STRENGTHS ETC. RESPONSE SEC 3.5.
211.16	(3.5.1.1)	PROVIDE JUSTIFICATION TO SHOW THAT MISSILES WITH LOWER ENERGY LEVELS WOULD NOT FAIL ANY SAFETY-RELATED EQUIPMENT. RESPONSE SEC 3.5.1.1

RESPONSES TO NRC QUESTIONS

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211.86 - (3.5.1.1) -	VERIFY TESTING REQUIRED BY RG 1.68 BEING ACCOMPLISHED - RESPONSE - SECT 14.2.7 & APPEND. 1
010.39 (3.5)	RESPONSE 10.3 STATES PORTION OF AUXILIARY BUILD NOT PROTECTED FROM TORNADO GEN MISSILES DEMONSTRATE EQUIPMENT LOCATED IN UNPROTECTED PORTION OF AUXILIARY BUILDING, WILL NOT BE SUBJECT TO TORNADO MISSILES - RESPONSE SEC 3.5.2, & 15.7.4, TABLE 3.5-10 & FIG 3.5-6 & 7
010.40 (3.5)	REQUEST 10.3 SHOW THAT AUXILIARY BUILDING HVAC EXHAUST STACKS NOT PROTECTED FROM TORNADO MISSILE DEMO THAT FAILURE WILL NOT RESULT IN DAMAGE TO SAFETY RELATED EQUIPMENT RESPONSE TABLE 3.5-11 & SEC 9.4.2.2.3
211.95 (3.5)	PROVIDE A TABLE WHICH LIST EACH STRUCTURE SYSTEM & COMPONENTS INSIDE CONTAINMENT ARE PROTECTED ETC RESPONSE TABLE 3.5-13
211.96 (3.5)	THE LIST OF MISSILES IN TABLE 3.5-1 DOES NOT INCLUDE CHECK VALVES, BONNETS & PIVOTS, CFT ISOLATION VALVES BONNET STUDS, PRESS. HEATER ETC - PROVIDE JUSTIFICATION TO RULE OUT SUCH MISSILES RESPONSE - 3.5.1.1.1
211.98 (3.5, 6.3)	BIOLOGICAL SHIELDING SAND BAGS - RUPTURE IN LOCA - CONCERN - RESPONSE DO NOT HAVE BIOLOGICAL SHIELDING SAND BAGS.
211.99 (3.5)	VESSEL SEAL RING COULD BECOME MISSILE DURING LOCA. ADDRESS CONCERN. RESPONSE SEAL WILL NOT BECOME A MISSILE DURING

RESPONSE TO NRC QUESTIONS

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MOTOR MOUNTING FLANGES & STRESS SUMMARY
FOR STUDS COMPARING CALCULATED & ALLOW STRESS
RESPONSE - SEE PAGE Q&R - 20, 20a & 20b

211.97 (3.[illegible]1.1, [illegible]) - QUESTION 211.86 DOES NOT ADEQUATELY
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RESPONSE. R.G 1.68 REV. 1, 1977 ISSUES FOR COMMENT
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APPLICABLE TO MIDLAND - HENCE R.G. 1.68 - 1973
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OF PROCEDURES REGARDING SUBSYSTEM DECOUPLING -
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CLARIFY - RESPONSE - LETTER TO R. BOYD FROM S.H. HOWELL
JULY 19, 1977

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130.8 (3.7.2.8) DESCRIBE METHOD OF ANALYSIS LOAD COMBINATIONS
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IS NOT FATIGUE CONTROLLED (3.7.3.2.1)
RESPONSE SECTION 3.7.3.2.1 REVISED

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JUNE 8, 1976 - ACCEPTING CHANGES AS NOTED

361.3 (3.7) INCREASED THE DESIGN RESPONSE SPECTRA BY [illegible]
TO ACCOUNT FOR DIFFERENCES BETWEEN THE
HOUSNER - DEVELOPED AND NEWMARK DEVELOPED.
STILL FALLS BELOW R.G. 1.60 PREPARE COMPARISON
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AND DAMPING VALUES MORE CONSERVATIVE THAN R.G. 1.61
COMBINED EFFECT COMPARABLE. AND ACCEPTED
BY STAFF .

RESPONSE TO NRC QUESTIONS

SECTION 3.7

QUESTION

130.18 (3.7)	FOR THE DESIGN RESPONSE SPECTRA COMPARE DIFFERENCES BETWEEN RESPONSES ARIVED AT BY YOUR METHODOLOGY AND THOSE ARRIVED AT BY THE USE OF YOUR METHODOLOGY AND R.G'S 1.60, 1.61, & 1.92. (ALL CATEGORY I STRUCTURES). RESPONSE - NRC LETTER JUNE 8, 1976 - RESPONSE SPECTRA LESS CONSERVATIVE THAN R.G 1.60 AND DAMPING VALUES MORE CONSERVATIVE THAN R.G 1.61. COMBINED EFFECT COMPARABLE AND ACCEPTED BY STAFF.
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130.15 (3.7.4)	EXCEPTION TO R.G 1.12 & ANSI N 18.5 ARE NOT CONSISTANT WITH STAFF POSITION. RESPONSE - QUESTION 130.10 FOLLOWED BY DISCUSSION
130.24 (3.7)	ANSWER TO REQUEST 130.15 NOT ACCEPTABLE PROVIDE FOR ALL CATEGORY I STRUCTURES SHEAR & MOMENT CURVES & COMPARE FLOOR RESPONSE SPECTRA COMPUTED AT CRITICAL LOCATIONS & THOSE OUTLINED IN R.G 1.60, 1.61, & 1.92. RESPONSE SEE PRE Q&R 3.7-13 & 14 - ALSO SEE FIG. 1 TO 124
361.6 (3.7)	FSAR FIGURES 3-7-66 & 67 SHOW THAT THE DESIGN CAPACITY SHEAR FORCE & BENDING MOMENT ARE GREATER THAN THOSE THAT WOULD RESULT FROM R.G. 1.60. DOES THIS MEAN THAT ALL CATEGORY I STRUCTURES DESIGN TO WITHSTAND GROUND MOTION ASSOCIATED WITH R.G SPECTRUM ANCHORED @ .12g EXPLANE RESPONSE - THIS CAN NOT BE CONCLUDED THE BEHAVIOR OF THE CATEGORY I STRUCTURES CANNOT BE EXTRAPOLATED.

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130.25 - APPROVED VERSION BECHTEL TOPICAL REPORT FOR SEISMIC ANALYSIS OF PIPING SYSTEMS IS BP-TOP-1 REVISION 3, FSAR REFERENCES REVISION 0, [illegible]-RESPONSE - FSAR SECTION 1.6 & 3.7 REVISED CORRECTING THIS

RESPONSES TO NRC QUESTIONS

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130.11 (3.8.1) - DESCRIBE METHOD USED IN THE DESIGN TO
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DOME & WALLS OF CONTAINMENT?
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130.13 (3.8.1) - LOAD COMBINATIONS DEVIATE FROM ACI 359
AND SECTION 3.8.1 OF SRP. DEMONSTRATE
DEGREE OF CONSERVATISM IN ANY & EXPLAIN
RESPONSE. - CONSTRUCTION COMPLETED BEFORE
CODE ACI 359 WAS RELEASED FOR PUBLICATION
& CONSISTENT WITH PREVIOUSLY LICENSED
POWER PLANTS.

130.14 (3.8.1) PROVIDE A LIST OF SPECIFICATION USED &
COMPARE WITH THOSE LISTED IN THE
ACI-359 CODE - RESPONSE 3.8.1.2.1

130.5 (3.8.1.6) 3.8.1.6 DOES NOT INDICATE VALUE FOR Fc'
RESPONSE - SECTION 3.8.1.6.1.2.1 REFERS
TO TABLE 3.5-4 WHIC SUMMARIZES
DESIGN VALUES USED.

130.12 (3.8.1.6) INDICATE IF VALUE OF Fc' STATED IN
TABLE 3.5-4 IS USED FOR ALL ANALYSIS
REQUIRED BY 3.8.1 IF SO GIVE AGE
AT WHICH F_c' IS SPECIFIED RESPONSE
TABLE 3.5-4 REVISED

130.15 (3.8.6) PROVIDE TERMINOLOGY CROSS REFERENCE
BETWEEN LOADS & LOAD COMBINATION
FOR STEEL & CONCRETE STRUCTURES AND
THOSES USED IN SRP 3.8.4. RESPONSE
TABLE 3.8-25 PRESENTS CROSS REFERENCE.

130.17 (3.8.1) ANSWER TO QUESTION 130.13 IS NOT
ACCEPTABLE - ASSESS THE EXTENT THE
MIDLAND DESIGN IS EQUIVALENT TO THAT
WHICH WOULD HAVE RESULTED IF ACI 359
AND SRP HAD BEEN USED RESPONSE
REQUEST NOT JUSTIFIED

RESPONSES TO NRC QUESTIONS

SECTION 3.8

QUESTION

130.16 (3.8.6) ANSWER TO QUESTION 130.15 NOT ACCEPTABLE. M.S REQUIRED BY LOAD COMBINATIONS OF SRP 3.8.3 & 3.8.4 ARE GREATER THAN THOSE REQUIRED BY YOUR CRITERIA. THEREFORE REQUEST ARE JUSTIFIED.

130.21 (3.8.2.5) EVALUATION OF CATEGORY I STRUCTURE LOCATED ON BACKFILL. DESCRIBE HOW STRESSES ASSOCIATED WITH DIFFERENTIAL SETTLEMENT AND ANY PRELOADING WILL BE FACTORED INTO THE EVALUATION AND COMPARE PREDICTED STRESSES DUE TO SETTLEMENT TO ALLOWABLE STRESSES PERMITTED BY THE ACI-3

RESPONSE - DIESEL GENERATOR BUILDING ONLY SEISMIC CATEGORY I BUILD LOCATED ON PLANT FILL. PRE LOAD PROGRAM IN PROGRESS - SETTLEMENT SURVEY PROGRAM EXPANDED. STRESSES DUE TO DIFFERENTIAL SETTLEMENT WILL BE SUBMITTED FOR STAFF REVIEW BY LETTER & THEN PLACED IN FSAR BY AMENDMENT

130.22 (3.8.1) ANSWER TO REQUEST 130.17 IS NOT ACCEPTABLE. EVALUATE STRUCTURES AT CRITICAL LOCATIONS. DETERMINE THAT USE OF ACI 359 CODE & SRP 3.8.1 WOULD RESULT IN ADEQUATE SAFETY MARGINS.

RESPONSE SEE TABLE 3.8-1, 3.8-2 THROUGH 11

130.23 (3.8.3) ANSWER TO REQUEST 130.16 NOT ACCEPTABLE. PROVIDE ASSESSMENT AS TO THE EXTENT ACI 318 & SRP 3.8.3, SRP 3.8.4 ADEQUATE M.S.

RESPONSE SEE TABLE 3.8-12 THRU 15

TECHNICAL REVIEWERS FOR MIDLAND

H. Daniels
R. Stephens
M. Bolotsky
M. Boyle
→ A. Hafiz
W. Brooks
M. Tokar
G. Mazetis
O. Chopra
H. Balakuian
M. McCoy
S. Salah
W. LeFave
R. Kirkwood
D. Pickett
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J. Boegli
C. Hinson
W. Ross
R. Priebe
T. Cardone
L. Reiter
L. Heller
D. Gillen
R. Gonzales
J. Fairobent
D. Brinkman
B. Campbell
W. Belke
F. Alenspach
B. McDermott
S. Newberry
D. Hood

Rinaldi Depo Ex 9
1-6-81 CRB

NUCLEAR REGULATORY COMMISSION
[illegible]

February 15, 1979

NOTE:

SUBJECT: GUIDELINES FOR PREPARING SAFETY EVALUATION REPORTS

The attached guidance has been developed in connection with our experience over the last several years in preparing SER's. While the enclosed guidance has not been formalized, it has been used by DPM in editing SERs, with the goal of producing more consistent and easily understood documents.

We believe that if these guidelines are followed, particularly by the originators of SER inputs, the amount of editing and rewriting required will be greatly reduced, thereby, hopefully improving the efficiency of the process.

We welcome any suggestions on improving these guidelines.

DBVassallo
D. B. Vassallo, Assistant Director
for Light Water Reactors
Division of Project Management

Enclosure:
As stated

GUIDES [illegible]

A. CONTENT

1. Remember who your audience is. SER's are read by a diverse group of people. While your input must be able to withstand critical scrutiny by technical experts, it must also be intelligible to the informed layman. Remember that your words will be read carefully by the lawyers involved in the case, by the intervenors, the applicant, and by the public. If you can write your input so as to be more understandable to those who are not experts in your specialty, please do so.

2. At the beginning of each major section, give an introduction paragraph to explain what the section must conclude in order to make a favorable finding. Tell why we review the subject of the section.

3. State all the guides, codes, standards, GDC that were used in the review and whether the plant meets each.

4. Remember, regulatory guides recommend, they don't require.

5. Give special attention to hearing contentions. Since testimony on them will have to be prepared sooner or later, the issue they raise should be addressed in the SER to the extent practical. However, don't explicitly refer to the issues as contentions in the SER.

6. Do not say that the facility "meets the intent" of a regulation, guide, code, etc. It either meets it or it doesn't. If challenged, you can further explain or qualify this. Also an alternate approach in most cases is acceptable, if fully explained and justified.

7. Give a conclusion at the end of each major subheading. Don't go on for many pages without reaching at least an intermediate conclusion. Summarize the intermediate conclusions at the end of each major section.

8. Use the conclusions and findings in the SRP if applicable. However, don't use them blindly since, some situations may require modification to the standard conclusions.

9. When you have finished a section, ask yourself (1) Are there any other conclusions that can or should be reached? If so, put them down; (2) Is each conclusion adequately supported with bases? Avoid pages of system description followed by one sentence saying we reviewed it and it is acceptable. Why is it acceptable? What proves it is safe?

1. Keep sentences short and direct. [illegible] Minimize special technical jargon.

2. Minimize long strings of adjectives.

3. In most instances, use the personal pronouns we, us, our, rather than referring the NRC staff or the Commission.

4. For CP SER's describe the plant [illegible] plant [illegible] using future tense, e.g., the plant will be seismic Category I, etc. For OL SER's use the present or past tense [illegible] e.g. [illegible] constructed [illegible] seismic Category I, etc, and all [illegible] seismic Category I structures [illegible] designed to withstand the effects of ..... Avoid subjunctive conditional woulds and coulds in conclusions.

5. But, our requirements are present tense. Don't say we will require, say we require. Completed analyses and tests should be referred to in past tense, as should our review. The applicant performed a calculation, we reviewed it.

6. Do not use abbreviations. Spell out units such as degrees Farenheit, centimeters per second, Hertz, British thermal units per hour per square foot, percent, etc. Acceleration in g is acceptable (0.67g).

7. A limited number of commonly recognizable acronyms is acceptable e.g., NRC, PSAR, FSAR, ASME, IEE. Spell out construction permit, loss-of-coolant accident, emergency core cooling system, engineered safety feature. Call the plant by its name, or "the facility".

8. Minimize unnecessary capitalizations. Only titles and place names are capitalized. Loss-of-coolant accident, probable maximum hurricane, safe shutdown earthquake, and emergency core cooling system are all lower case, as are volt, meter, kilogram, applicant, staff, construction permit and technical specification. Do not capitalize names of systems.

9. Avoid use of foot notes.

10. Do not underline for emphasis.

11. The words "Category I" are always preceeded by the word "seismic".

12. When mentioning regulatory guides, include the title: Regulatory Guide 1.234, "The Design Basis Meteor Strike for Light Water Reactors," (Revision 3). Be sure the title is correct and unabbreviated. Include the Revision No.

13. Use hyphens consistently. Long-term, safety-related, loss-of-coolant, balance-of-plant are hyphenated when used as adjectival phrases such as the balance-of-plant design.

14. Do not hesitate to include drawings to clarify, particularly unique structures.

15. Spell out the first ten integral numbers, one, two...ten. Use numerals for decimals or numbers greater than ten, such as 2.5, 115, 12, etc.

16. Refer to the applicant as "it", not "he" or "they". The applicant's program is its program, not his or their program.

17. Don't use subheadings with more than three numbers, 2.3.5 is OK, 2.3.5.1 is not. Use (1), (2), (3) if you must further subdivide, and (a), (b), (c) if still more subdivision is warranted.

18. Refer to the PSAR and SER subheadings as Sections, rather than Chapters. Section 12.0, or Section 2.3.4, not Chapter 12.0 or Chapter 2.3.4.

19. Have your typist double space your SER input.

20. Section headings should be all caps, underlined and centered on the page: 12.0 RADIATION PROTECTION

21. Subsection headings should be underlined and have only the initial letter of each word capitalized: 8.2 Offsite Power System, 9.5.1 Fire Protection System.

22. Until a better approach is developed, references should not be superscripted. Use the author's name and the report date in parentheses in the text, give the full reference in the Bibliography. For example, "...based on the historical record (Jones, 1955)," or "Based on tests by Smith (1902), we conclude....."

23. References should be listed in alphabetical order, as follows: Author, "Title in quotes," Publishing organization, date.

Enclosure 1

Interim

SAFETY EVALUATION REPORT

Evaluation of Response to 10CFR 50.54(f) Request

Regarding Plant Fill

Dated March 21, 1973

MIDLAND PLANT

Units 1 & 2

Final to [illegible] 10
1-6-81 [illegible]

TABLE OF CONTENTS

I. INTRODUCTION

On August 22, 1978, Consumer Power Company (CPC) notified the NRC Resident Inspector that there was larger than expected settlement of the diesel generator building foundation. During subsequent investigations by NRC and CPC personnel, it was determined that the settlement was reportable. On March 21, 1979, a 50.54(f) request was issued by H.R. Denton, to the Director of the Office of Nuclear Reactor Regulation, which CPC responded on April 24, 1979. Revisions to the CPC response were submitted on May 31 (Rev. 1); July 9 (Rev. 2), and September 13, 1979 (Rev. 3). In addition, a series of meetings between the applicant and NRC personnel took place. The following report describes the observed settlement, the structural aspects of the issue, the applicant's proposed remedial action, the evaluation thereof by the NRC technical reviewer, and the staff's recommendations.

II. Results of Investigation

As a result of the investigations conducted by NRC personnel of the Office of Inspection and Enforcement, the following deficiencies were established:

a. The quality assurance program for obtaining proper soil compaction of the Midland site was deficient in a number of areas. This is especially evident in the area of diesel generator building.

b. Soil of the type used in the foundation of the diesel generator building is also located, to varying degrees, under other Class I structures and plant area piping.

c. Several inaccurate statements are contained in the FSAR with respect to soil foundations.

d. Although it has been stated that inadequate soil compaction contributed to the settlement of the D/G building, it had not been determined what other factors may have contributed to the settlement.

e. Extensive cracking has been observed in various Category I structures which are in excess of the limits specified by the applicable building codes (i.e., ACI-318, ACI-349) or acceptable engineering practice.

III. STATEMENT OF THE DEFICIENCIES

It appears that the deficiencies are caused mainly because of:

1. Insufficient compaction in the areas where backfill material was used.
2. Insufficient technical direction in the field during back filling operations.
3. The backfill material used was not in accordance with the criteria contained in the FSAR Section 2.5.4.5.3.

The structures affected by the backfill material are:

1. Diesel generator building.
2. Service water pump structure (partial).
3. Tank farm.
4. Diesel oil storage tank.
5. Feedwater isolation valve pit and the auxiliary building.

The affected structures are shown in Figure 1.

A description of settlement, structural cracking, and potential problems of the affected structures are as follows:

1. Settlement and Foundation Material Description

a.) Diesel Generator Building

The settlement monitoring problem of this structure began in July, 1978. It was observed that there was excessive settlement of the diesel generator building. The contours of the settlement monitoring are illustrated in Figure 2. It can be seen that the differential settlement approximates 4 inches.

The building and the generator pedestals are founded on approximately 20 feet of fill which consists of soft to stiff clay with pockets and layers of very loose to dense sand.

b.) Service Water Pump Structures

The major portion of the structure is founded on natural soil material except for the northern part which is founded on the fill. The extent of the backfill is shown on Figure 3 and 4. In view of the unusual settlement observed at the diesel generator building, an investigation was performed by NRC Region III to obtain information relating to design and construction activities affecting the Diesel Generator Building foundation and plant area fill. As a follow-up to the investigation of all Category I structures on fill, several borings were taken in this area. The borings indicated that the backfill consists of soft to very stiff clay and loose to very dense sand. The conclusion was that some areas of the fill material under the northern part of the structure were not sufficiently compacted. However, no significant settlement of the structure has been noted. The reason for this appears to be that the existing dead loads from this portion of the structure are partially supported by the rest of the structure through cantilever action.

c.) Tank Farm

Figure 5 shows the tank farm in plan. There are two borated water storage tanks (BWST), a utility tank and a primary storage tank. Of these, only the BWTSs are safety-related.

Adjoining the ring girder for each tank is a small box-shaped structure called a valve pit. This houses valves and other controls. As a follow-up to the investigation of all Category I structures founded on fill, several borings and test pit examinations were completed in the tank farm area. The results of the investigation indicated that the tanks are supported on medium to very stiff clay backfill with occasional medium to very dense sand layers. Selected points on the piping between the BWSTs and the auxiliary building will be monitored for settlement during the construction phase. Any differential settlement measured will be analyzed in accordance with established procedures.

d.) <u>Diesel Oil Storage Tanks</u>

There are four diesel oil storage tanks, each 12 feet in diameter and 44 feet in length (See Figure 6).

There is six feet of earth covering each tank. The tanks are supported at three points anchored to concrete pedestals. The tanks are founded on backfill and results of the boring program indicated that the tanks are supported on medium to stiff sandy clay backfill. The soil condition is adequate to support the tanks. Moreover, the weight of the tanks is approximately equal to the fill that it replaced. In order to verify that the fill is satisfactory, these tanks have been filled with water and settlements are being monitored. In the three months since the tanks have been filled with water, no appreciable settlements have been noted.

e.) Auxiliary Building and Feedwater Valve Pits

Since some of the fill extends under the auxiliary building and feedwater valve pits and its bearing capacity was found to be questionable, it was decided to replace it with structural elements which extended from the existing concrete foundations to underlying undisturbed glacial till. The proposed method will be described later.

2. Cracking of Structures

Extensive cracking of several Category I structures has been observed. These cracks vary in width from building to building. From the available data as reported by the applicant, it appears that at least some of the observed cracks are increasing in width. The maximum width of cracks for various structures are tabulated below:

Structure	Date/Crack Width in Mils	
Diesel Generator ~~Bui~~ ~~Welding~~ Building	8/30 (30)	9/79 (30)
Service Water Pump Structure	8/79 (20)	No data
Auxiliary Bldg	8/79 (20)	9/79 (30)
Borated Water Storage Tank and Valve Pit	No data	9/79 (20)

The applicant stated that the majority of these cracks are shrinkage and temperature cracks and that they do not affect the structural integrity of the buildings.

3. Inconsistencies Between Information Contained In the FSAR And The Design

In response to the 10CFR 50.54(f) request on plant fill, the following inconsistencies have been reported by the applicant:

a). A uniform load of 3000 psf was used in settlement calculations for the diesel generator building rather than 4000 psf indicated in Figure 2.5-47 of the FSAR.

b.) The calculations of settlement of the diesel generator building assumed a mat foundation rather than spread footings. Additionally, the sketches of the diesel generator building contained in the response to the 10CFR 50.54(f) Request show that the foundations of the diesel generator building consist of a continuous grade beam (Figure 2). This is not consistent with the assumption for the foundation used in the calculations.

c.) The response states that the FSAR contains the results of erroneous calculations for the mat foundation rather than the actual, i.e., the continuous grade beam.

4. Deflection of the Electric Duct Bank

During investigation of settlement of the diesel generator building, it was discovered that due to lack of clearance between the vertical portion of the electric duct bank projecting above floor level foundations, the duct was supporting practically the entire structure (See Fig. 7). As a result, the load transferred from the building to the duct bank produced bending, which could have caused the reinforcing steel (at Point A See Fig. 7) to exceed the yield strain. The duct bank might have been deformed beyond the allowable limits.

IV. Discussion of the Remedial Actions Proposed by the Applicant

1. Settlement and Inadequate Compaction

The remedial action roposed by the applicant is primarily directed towards stopping the excessive settlement and replacing the questionable material used as a fill. The specific actions for various structures are described below:

a.) Diesel Generator Building

On the basis of the recommendation of the soil consultant professors, R. Peck and A. J. Hendron, the remedial measure chosen was to preload the existing backfill by layers of sand surcharge. The surcharge was applied in steps up to 20 feet total. Fig. 8 shows a cross-section of the building and the surcharge. It is expected that the surcharge will produce stresses in the fill greater than those for which the fill would be exposed to during the life-span of the structure. The surcharge will remain until excess pore pressures are dissipated and the rate of settlement becomes small and the residual settlement can be predicted by extrapolation. In order to remove a potential of liquefaction, dewatering of site is planned which will be described later.

The applicant claims that the differential settlement of the diesel generator pedestals will have no effect on alignment of the engine and the generator because they are both mounted on the same foundation. Furthermore, during the operation of the plant, if further differential settlement causes the allowable tolerance to be exceeded, the manufacturer states that the generators can be shimmed to a leveled position.

b). Service Water Pump Structure

As mentioned before, the major portion of the structure is founded on natural soil material except for the northern portion which is founded on fill. During the investigation of all Category I structures on fill and as a result of examination of the borings taken in this area, it was concluded that the structure does not show any significant settlement, although it is partially situated on the fill. The reason for this is that the existing dead loads from this portion are being partially supported by the rest of the structures through cantilever action. The remedial measure chosen is to support the north wall on piles driven to hard glacial till.

Figures 9, 10 and 11 show the plan and details of the piles. A total of 16 piles is planned at this time. The piles will have a capaciy of 100 tons and are designed as bearing piles to carry only vertical load. The piles will be pipe piles filled with concrete. They will be predrilled through the fill and driven into the glacial till. The length is expected to be approximately 50 feet.

As shown in Figures 10 and 11, the concrete corbels will be anchored to the wall by a system of anchor bolts. The pipe piles in turn will be jacked against the corbels to effect the transfer of load.

A test pile will be load tested to determine its capacity.

c.) Tank Farm

No remedial measures are proposed by the applicant for these structures.

d.) Underground Facilities

The applicant stated that all safety related piping is sufficiently ductile, so that there are no adverse effects of differential settlement. Electrical duct banks are reinforced concrete elements enclosing PVC and rigid steel conduits providing voids for the cables.

The integrity of the duct bank is established by passing a rabbit through during the construction phase and the duct bank by itself is ductile and can absorbe a considerable amount of differential settlement without significant stresses. No remedial measures are planned by the applicant for duct banks or underground piping.

e.) Auxiliary Building and FW Valve Pits

The design of the remedial measure has the objective of replacing the soil of suspected bearing capacity with structural elements which extend from the existing concrete foundations to underlying undistributed glacial till. In order to accomplish this, it is planned to utilize the structural capacity of the electrical penetration rooms to bridge over some of the questionable underlying materials by providing caissons at the extremities of the electrical penetration rooms. These caissons shall have sufficient capacity to support approximately one-half of the dead and live loads of the electrical penetration rooms with the remaining one-half being supported by the control tower. The proposed method for supporting the isolation valve pits is to temporarily support them in place, totally undermine them by removing all materials to a depth at which undisturbed glacial till is encountered and filling the excavation with lean concrete.

The plan of attack for performing the work is as follows: (See Figures 12 through 14)

1. Locally dewater the soil above the glacial till in the affected areas. The dewatering system shall be installed and the water drawn down in advance of any excavation. The dewatering system is a curtain cut-off type.

2. Temporarily support the isolation valve pit by the use of I beams spanning between the buttress access shaft and turbine building foundation all at the ground surface.

3. Excavate an access shaft adjacent to the isolation valve pits to a depth of approximately 7 feet below the bottom of these pits. The excavation would then proceed laterally as a drift until the excavation reaches the extreme edge of the electrical penetration area.

4. Install jacked caissons at this location utilizing the electrical penetration rooms foundation as the reaction.

5. Concrete the caisson and load test same.

6. Install support of excavation system along the turbine building foundation wall and connect it to the access shaft and the jacked caissons. The jacked caissons which were previously installed under the electrical penetration rooms will temporarily act as support of excavation for the excavation under the isolation valve pit. The containment structure and the buttress access shaft form the remainder of the excavation enclosure under the isolation valve pit.

7. Excavate all material from underneath the isolation valve pits to a depth at which undisturbed glacial till is encountered.

8. Fill the excavation under the isolation valve pits with lean concrete backfill to within 7 feet of the existing foundation.

9. Place structural concrete in the drift under the isolation valve pits and the access area for installation of caissons underneath the electrical penetration rooms.

10. Dry pack and transfer isolation valve pit load to the lean concrete backfill.

f.) Dewatering

Figure 15 is a plan view of area dewatering system.

The present concept is to enclose the Q listed area with a permanent exterior dewatering system. The dewatering system would consist of submersible deepwells that would extend to the original clay till. Approximately 200 to 300 deepwells would be installed. The number required to maintain the ground water at the desired level would be operated and the remainder would be redundant. There would be sufficient redundancy to provide for interruption of parts of the system.

V. Results to Date

1. Settlement of Diesel Generator Building

The removal of surcharge was started on August 15, 1979, and completed on August 30, 1979. The applicant claims that the observed pore pressures are smaller than actually anticipated and are now dissipated. The curve of settlement as a function of logarithm of time became linear shortly after the completion of the fill and, therefore, it is possible to predict the settlement that would occur at any future time by extrapolation, assuming that the surcharge will remain in place. The applicant claims that the residual settlement for the diesel generator building due to secondary compression of clay in the 40-year plant life will be of the order of 1 inch. The applicant did not specify if this figure is based on the assumption that the surcharge is permanently left in the building or in the absence of it or whether it considers the effects of a seismic event.

2. Cracking

Lack of information regarding monitoring of cracking does not allow the staff to evaluate the present day situation regarding this issue. We have requested that the applicant continue to map the cracks in the affected areas. From the sketchy information received, it can be observed that at least in one area, the auxiliary building, the cracks are progressing and according to the data contained in Revision 3 of the Response to 10CFR 50.54(f), dated 9/13/79, they are up to 30 mils (Fig. 14-9, Auxiliary Building, Control Tower Walls). The cracks in the borated water storage tanks (BWST) foundations have also been recently observed. It is interesting to note that these cracks are not due to extensive loads because some of the structures have not been loaded at the present time, e.g., BWST foundation. The pattern of the cracks, which is predominantly vertical and in a random fashion, does not shed any light on the possible cause of cracking. The sketches submitted by the applicant contain large areas marked as "temporarily inaccessible" or "permanent inaccessibility", thus ruling out possibility of obtaining any information regarding cracking in these parts of structures.

VI. EVALUATION OF RESPONSE TO 10CFR 50.54(f) REQUEST REGARDING PLANT FILL DATED MARCH 21, 1979

1. In response to Question 15, the applicant presented an argument that the ACI-318 Code requires that the effects of settlement should be included in the dead load. Furthermore, the proposed load factors to be used in an

evaluation of the affected structures are such that they will effectively increase the allowable stresses (or reduce capacity of the designed section by 33 percent). The basic assumption on the part of the applicant is that the stresses due to settlement are similar to those due to temperature effects and, therefore, should be treated in a similar fashion. The applicant proposes to use two additional equations to be used to evaluate the effects of settlement (See Fig. 16 and 17). One of them, includes dead and live loads, temperature load and wind load. The other includes dead and live loads, temperature load and the OBE load. Both of these equations have the load factor of unity assigned to the loads which would correspond to the extreme environmental loading conditions of the requirements of the ACI-349 Code and that of the Standard Review Plan (SRP) Section 3.8.4.

We find that this method of evaluating effects of the settlement is not acceptable. The effects of settlement should be analyzed in accordance with the load combination requirements of the ACI-349 Code, supplemented by the Regulatory Guide 1.142 (April 1978).

2. In response to Question 7, the applicant provided criteria for structural integrity of electrical duct banks. These criteria consist of checking for continuity and obstructions by means of hard fiber composition rabbit and when no obstructions are observed, the conduit is considered to be adequate.

Electrical duct banks for the diesel generator building is a part of the plant which is necessary for a safe shutdown. For this reason, they are classified as a Category I structures and the design criteria applicable to other Category I structures such as containment and auxiliary building apply equally well to design of the ducts. Their failure in case of an emergency may be as important and catastrophic in consequences as that of any other Category I structure. In order to assure their functionality, appropriate Category I structural criteria must be applied to their design.

It appears that the applicant is applying somewhat different criteria for the design of the ducts. The exact criteria used are not stated, but it appears that the reinforcing provided is minimal, so that the ducts can achieve a considerable amount of ductility in bending. We consider that this approach for designing of electric duct banks is not acceptable to the design of Category I structures. The applicant applied a "test" by passing a rabbit through the voids to see if there is an obstruction to the electrical conduits. This is hardly an acceptable criterion for qualifying a Category I structure and in an event of an earthquake, the damage to the ducts may be unpredictable and the consequences may be catastrophic, if the ducts were not designed to criteria applicable to Cateogry I structures.

3. In reference to the Response to Question 14, we do not agree with the applicant's evaluation of effects of diffrential settlements and his approach to the evaluation of cracking. The following will provide the reasons for the above:

1. One of the fundamental assumptions in structural design of nuclear plants is that the structural members are designed for elastic behavior. This means that the yield stresses are not exceeded and that cracking in the concrete are limited to those due to temperature and shrinkage. The cracks in the auxiliary building, the feedwater isolataion valve

pits and the borated water storage tank ring are in excess of those which could originate from these causes. The maximum crack width is as large as 0.03 inches. This is far beyond the limit set in the ACI-318 Code, which are 0.016 and 0.013 inches for interior and exterior exposure, respectively. It is noted that in some cases, cracks develop even before the structure has been loaded, e.g., foundation for borated water storage tanks. Such cracks may be caused by a number of reasons, such as, volumetric changes, chemical incompatibility of concrete components, etc. These cracks may become larger when the load is applied on the foundation and may adversely affect the reinforcing steel by exposing it to the environment.

The foregoing discussion tends to indicate that the construction of the Category I structures of the Midland plant may have proceeded in a direction which violates the basic criteria of commercial standards, such as ACI-318. The criteria adopted for a nuclear plant should be more restrictive. The extensive cracking of various Category I structures indicates that it is not so. The applicant discusses the matter of cracks by a generalized type of response. In response to Question 14 (p.14.3), the applicant makes the vague statement that "Wherever cracks are caused by loads not included in the original design (such as cantilever action of a part of a structure), their width may be reduced when the loads are released during the corrective action. Therefore, it is concluded that the structural integrity of the buildings has not been affected by cracking". This kind of statement does not answer questions of the cause of the cracks, the corrective action planned for all of the structures, where the cracks appeared, and what is the prognosticated impact of the cracks on structural integrity and performance throughout the life-span of the structures.

We maintain a position that it is the responsibility of the applicant to demonstrate that the plant does not present danger to the safety of the public and to enable the regulatory staff to reach a conclusion that it is adequately designed and constructed according to pertinent design criteria. We have concluded, based on our review of the information submitted to date by the applicant, that he has not demonstrated the above noted design adequacy.

VII. RECOMMENDATIONS

On the basis of the discussion contained in the Evaluation (Section VI), the following recommendations regarding future actions pertinent to the safety related structures can be made.

1. Settlement and Inadequate Compaction of the Foundations Material

a.) Because of replacement of the fill by other material (such as lean concrete in case of auxiliary buildng and FW valve pits) the soil properties of the foundation material will be changed. We recommend that the new properties of this new foundation material be thoroughly investigated. The new soil properties (e.g., damping values and shear modulus) should be used in the revised seismic analysis for determination of the structural adequacy of the affected structures. Pertinent soil-structure interaction method should be used in the revised analysis. Our present position on soil-structure interaction is attached (Encl. 3).

b.) The structural analysis should be conducted using the current NRC criteria so that the margins of safety can be determined against the current standards. This involves inclusion of the effects of settlement and of revised load combination equations that are appropriate for the structures.

c.) We consider the electrical duct banks to be a vital link between the diesel generator and other parts of the plant. The acceptance of the ducts should be based on the structural criteria for Category I structures as provided in the appropriate sections of the Standard Review Plan (SRP) and Regulatory Guides. Passing of a rabbit though the duct banks cannot be substituted for such a criteria. We recommend, therefore, that the applicant be requested to perform an analysis of the affected duct banks using the criteria applicable to other Category I structures.

2. Cracking of Category I Structures

We believe that the applicant did not answer the basic questions regarding the causes of the cracks, significance of the extent of the crack and their consequences. In view of the above, we recommend that the applicant be requested to conduct a detailed and comprehensive study which would answer these questions.

3. Inconsistencies of Information

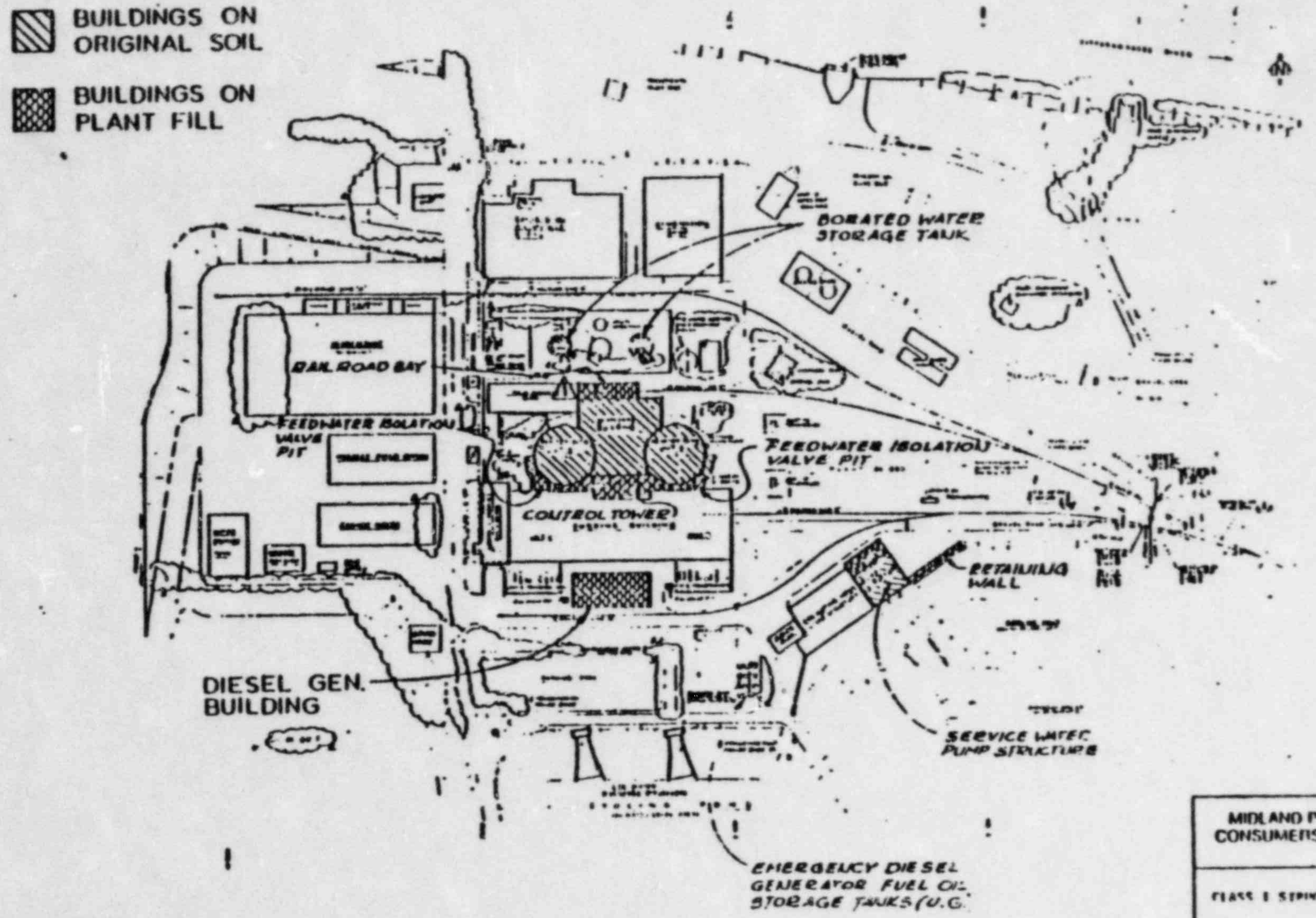
The Response to the 50.54(f) Request reported the following inconsistencies between data used for structural design of the diesel generator building and the data contained in the FSAR.

1. A uniform load of 3,000 psf was used rather than the 4,000 psf shown in Figure 2.4-47 in the FSAR.
2. The calculations assumed a mat foundation rather than a spread footing foundation, which is the actual design condition.
3. The results of these erroneous calculations were included in the FSAR.

We recommend that the applicant be requsted to clarify these apparent inconsistencies.

4. Floor Response Spectra

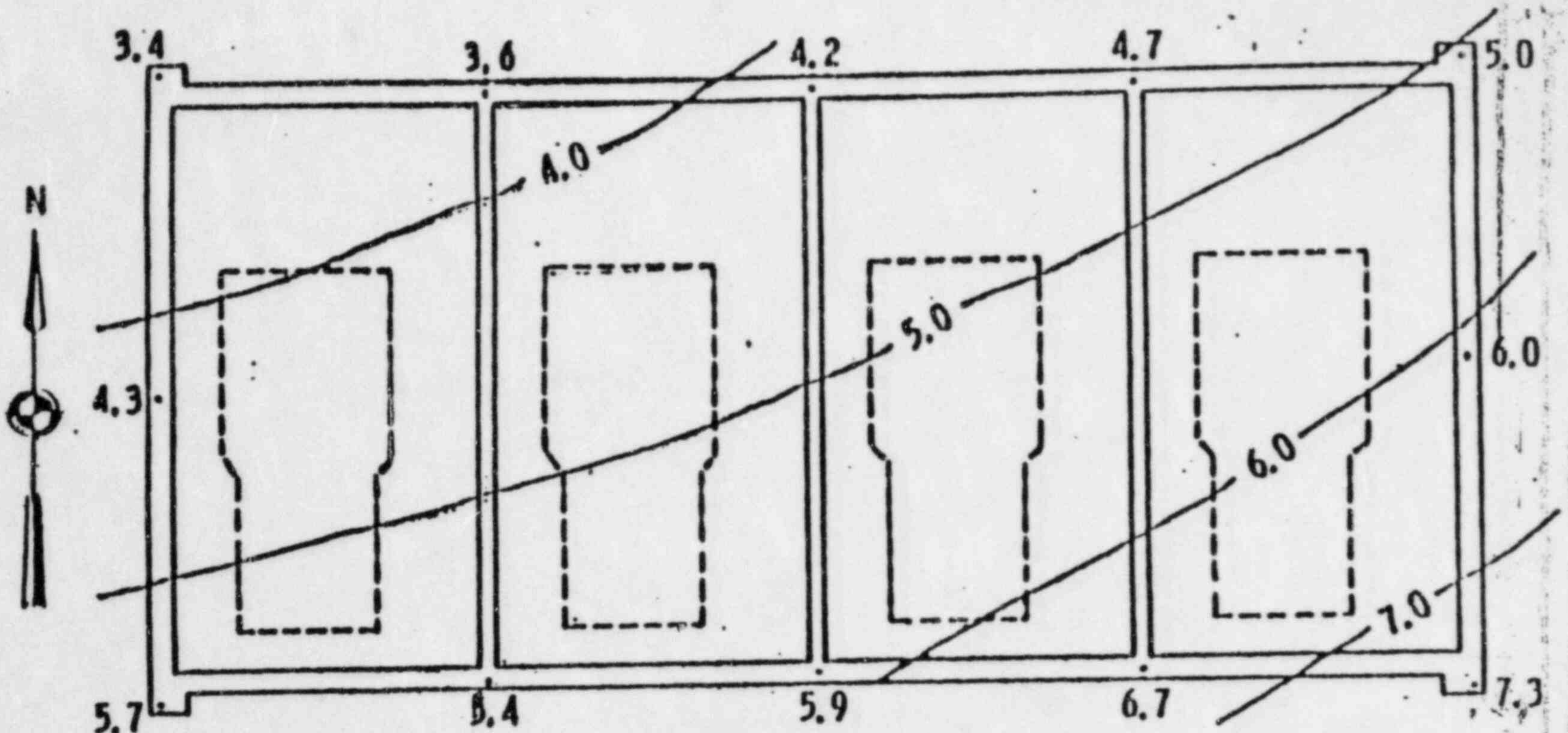
- The floor response spectra for diesel generator building were generated on the assumption that the shear wave velocity will not be lower than 500 fps. We recommend that the surveillance of the soil properties be conducted throughout the entire period of consolidation of the building to verify the validity of this assumption.



MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

CLASS I STRUCTURES

FIGURE 1 DATE [illegible]

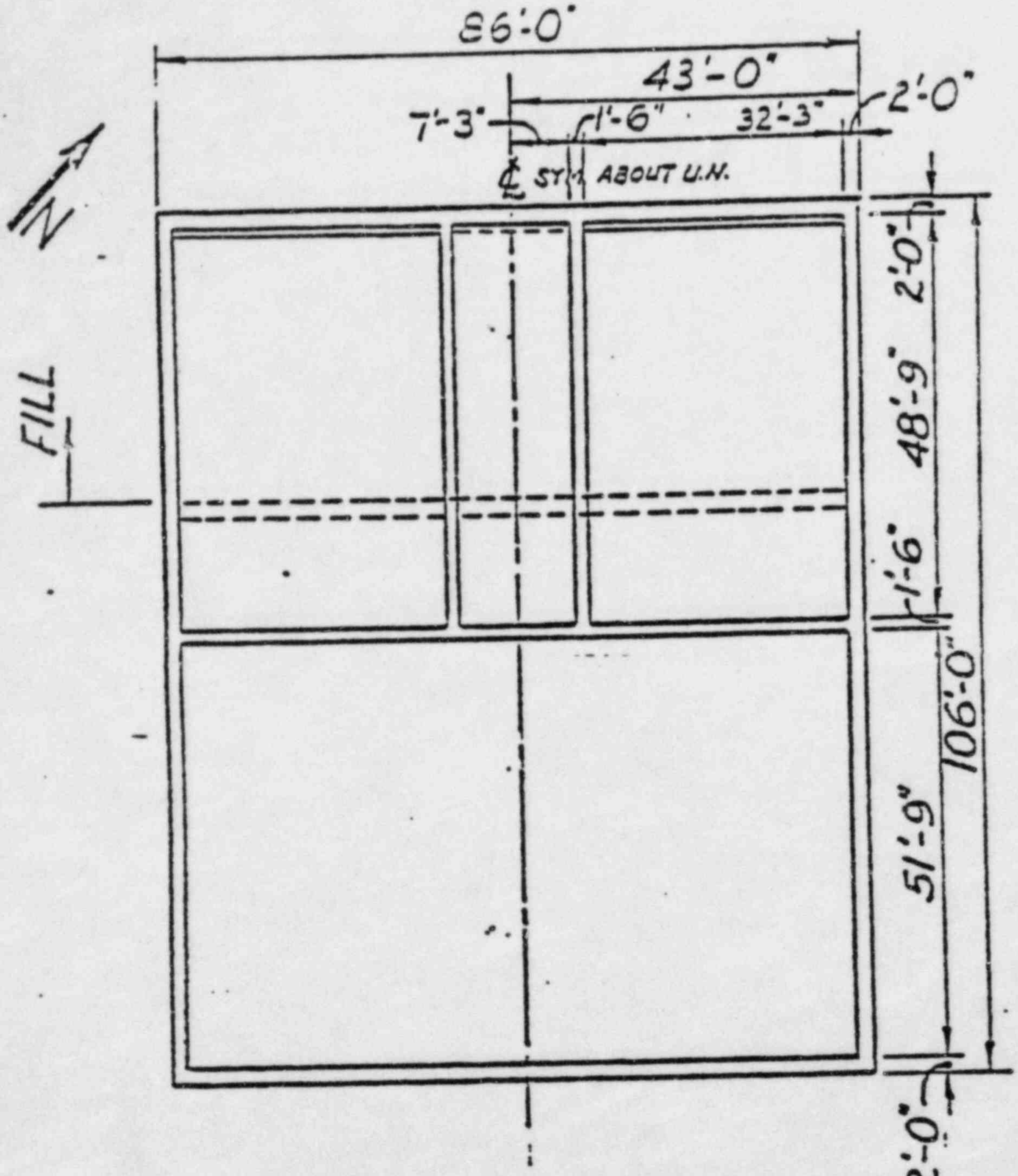


DIESEL GENERATOR BUILDING

TOTAL SETTLEMENT OF WALLS FROM 7-14-76 TO 6-29-79 IN INCHES

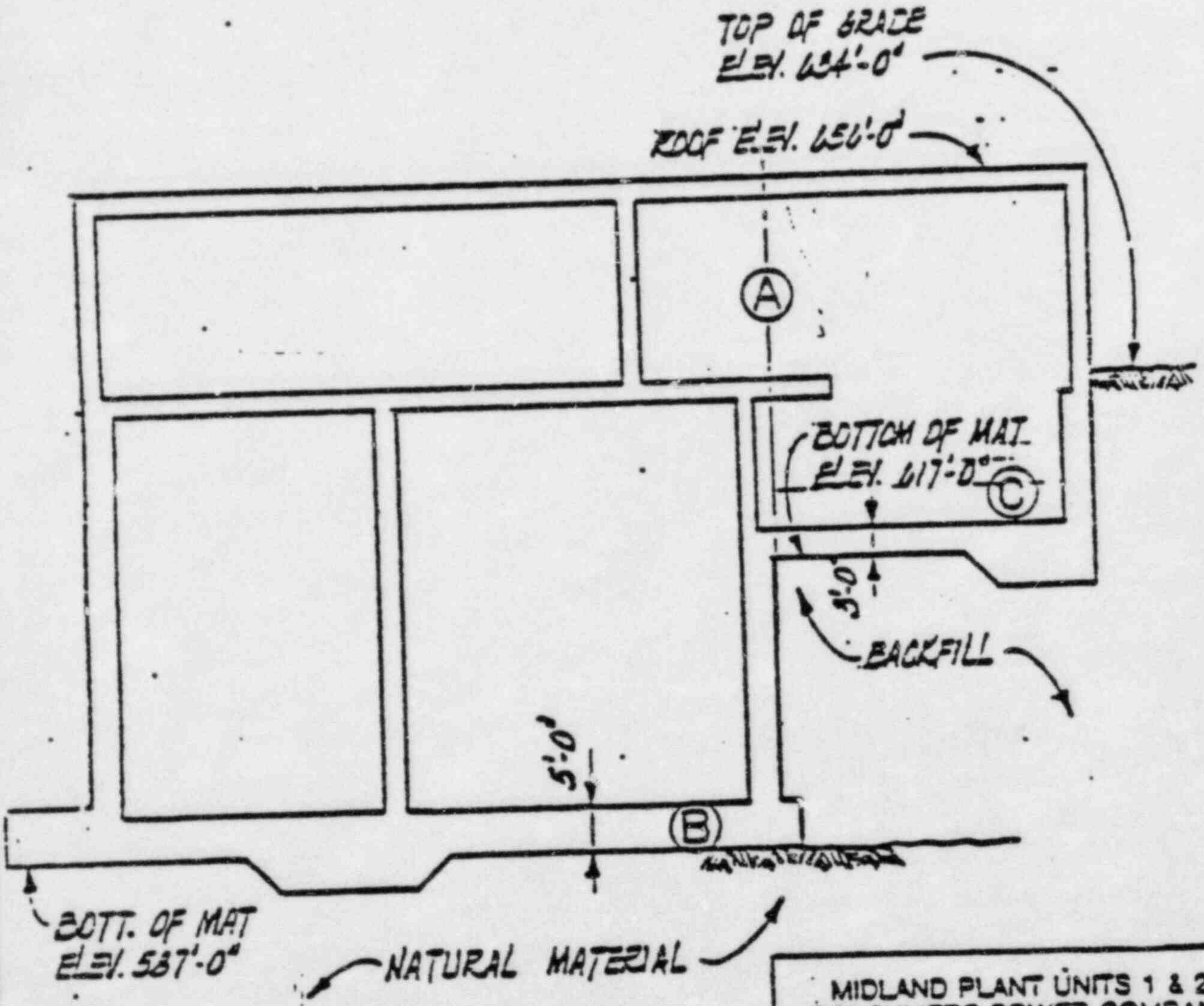
(20 FEET OF SURCHARGE)

FIGURE 2



SERVICE WATER STRUCTURE
PLAN AT EL. 634'-6"

FIG. 3



TYPICAL SECTION
(LOOKING WEST)
SERVICE WATER
STRUCTURE

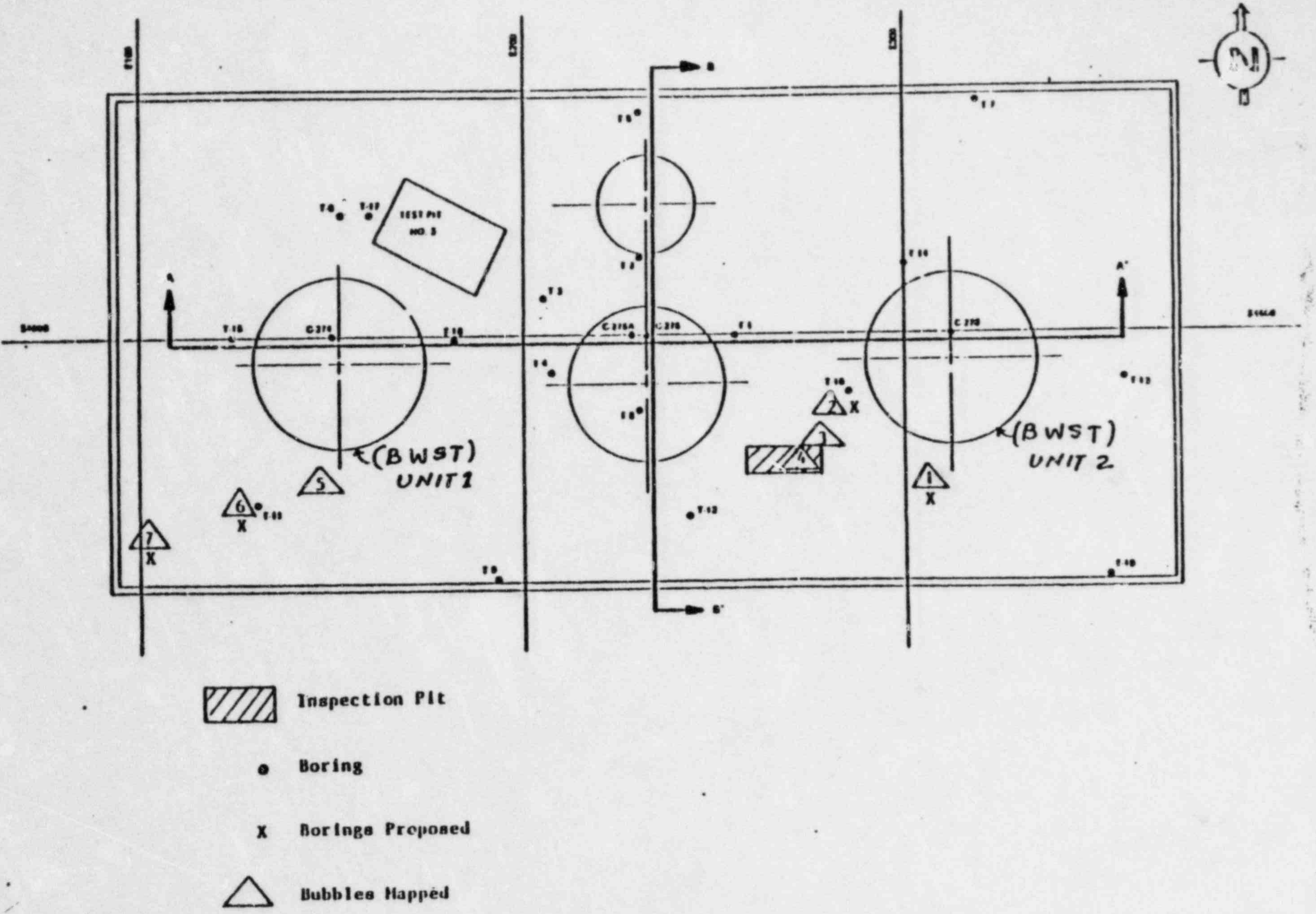
MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

SERVICE WATER STRUCTURE
TYPICAL SECTION

FIG. 4

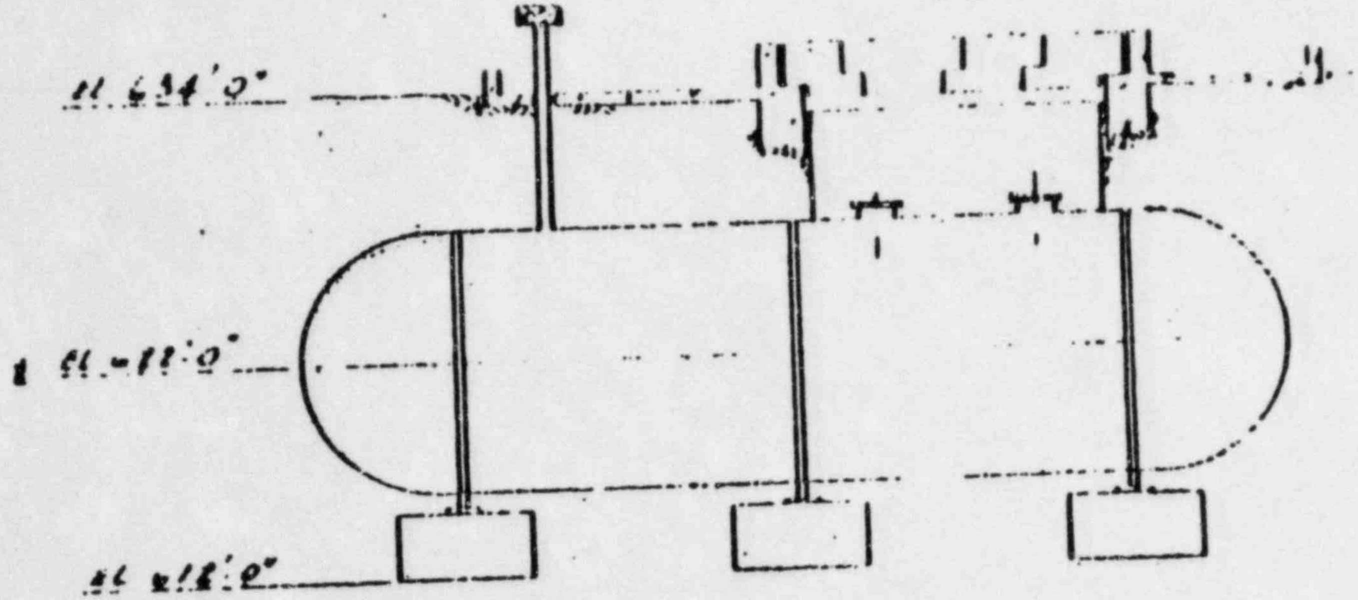
DATE: 4/24/79

7/13/79



TANK FARM BORING PLAN

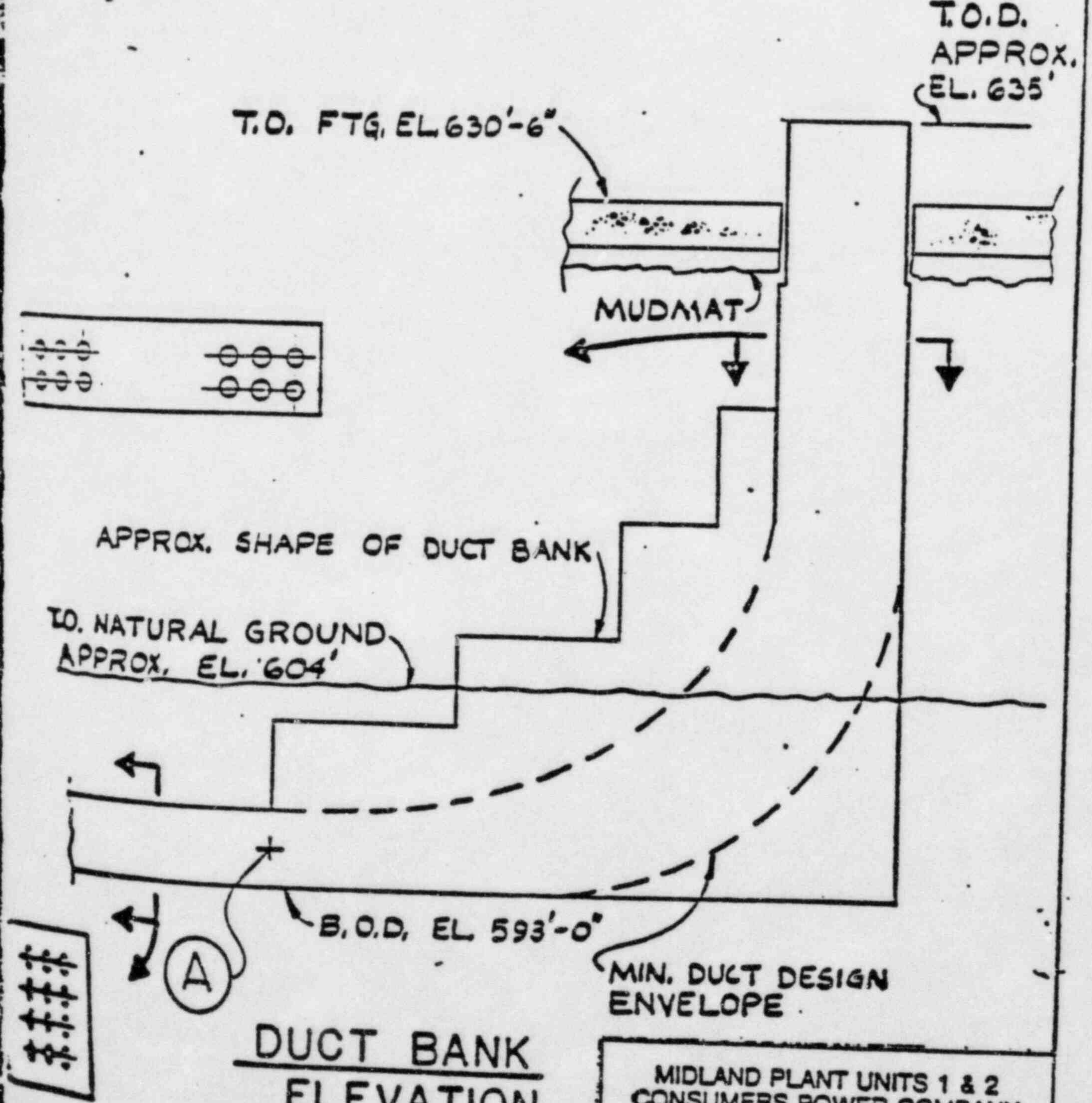
FIG. 5



ELEVATION

EMERGENCY DIESEL FUEL OIL
STORAGE TANKS (Q)

FIG. 6



DUCT BANK
ELEVATION
(LOOKING EAST)

MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

ELECTRICAL
DUCT BANK ELEVATION
FIGURE 7

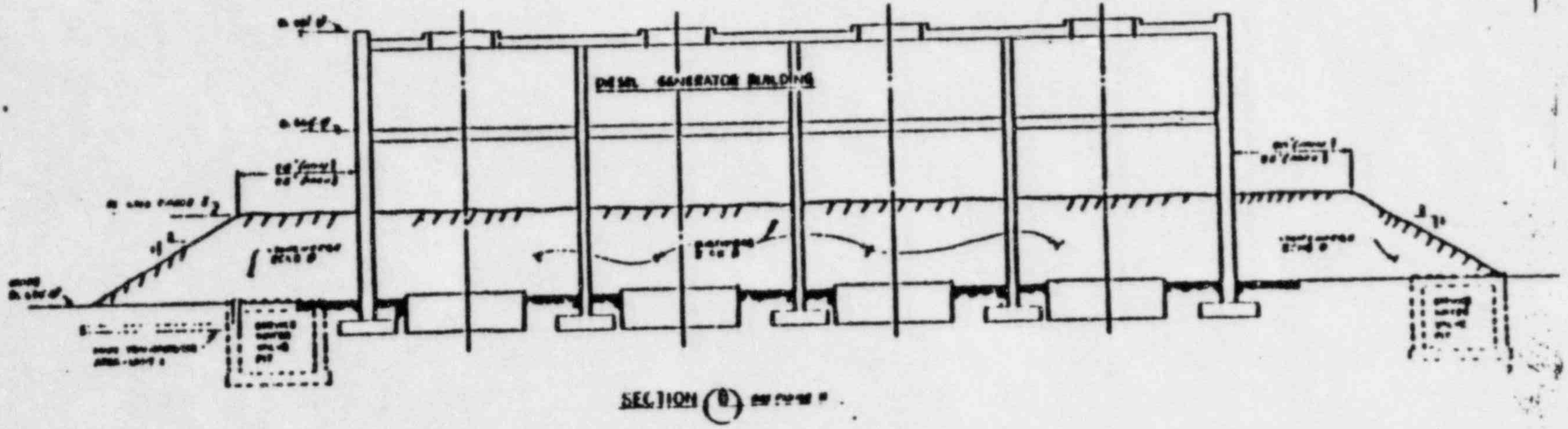
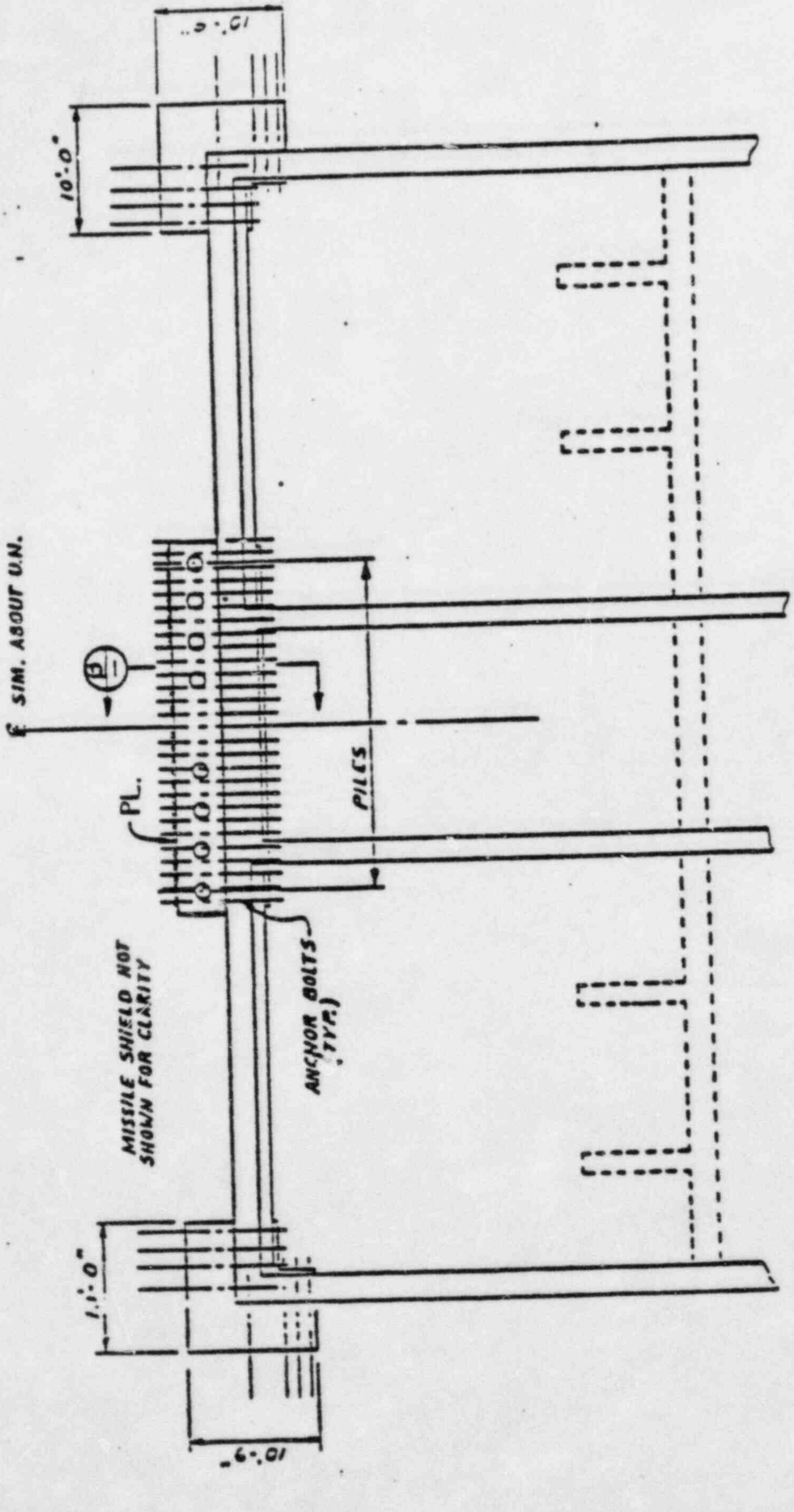


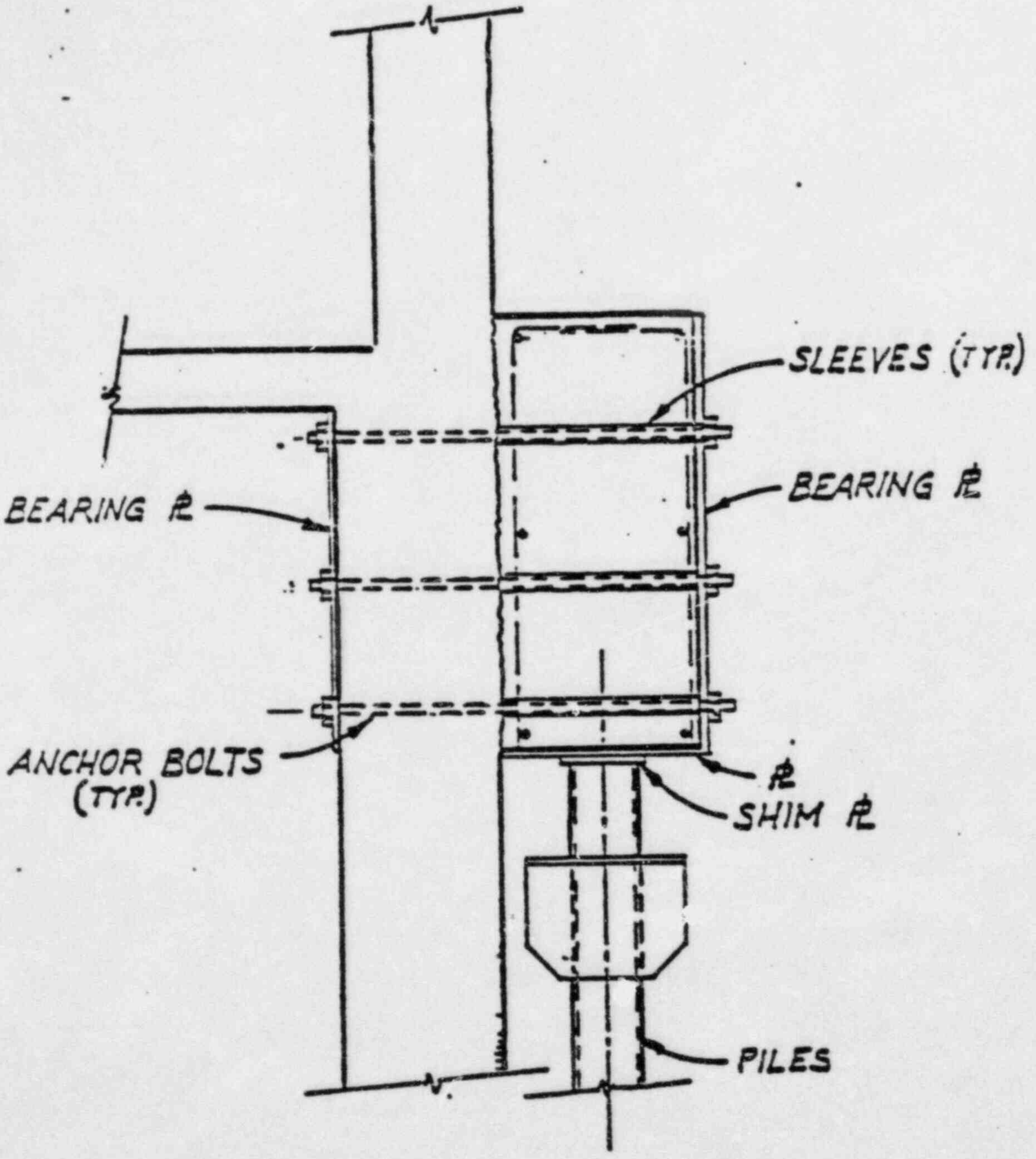
FIG. 8



PLAN AT EL. 634'-6"

FIG. 9

REDUCE CAPACITY OF A-540 BOLTS (T.S. = [illegible]
BY 25% TO ACCOUNT FOR STEEL RELAXING,
CONCRETE CREEP AND ELASTIC SHORTENING.

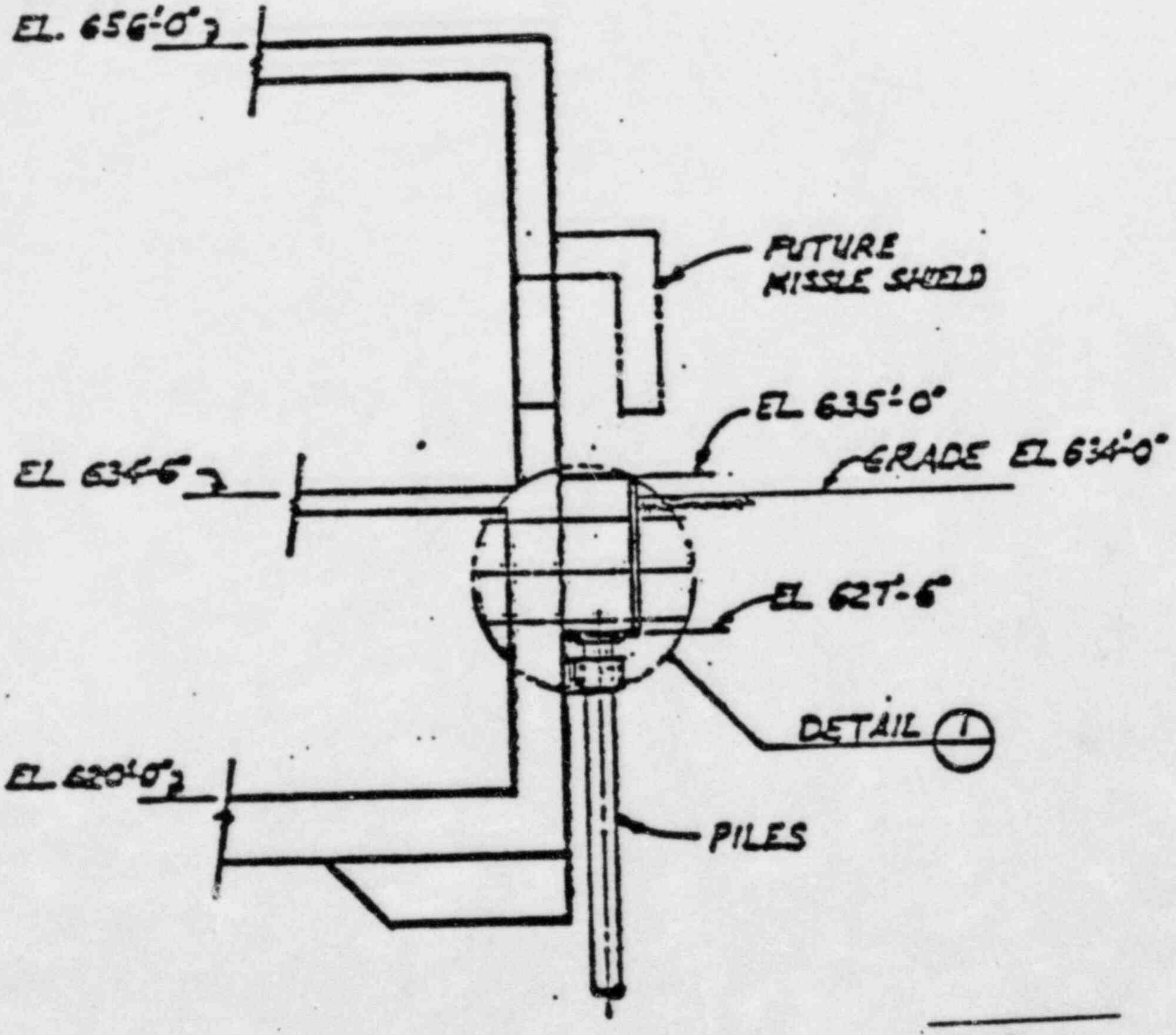


DETAIL ①

FIG. 10

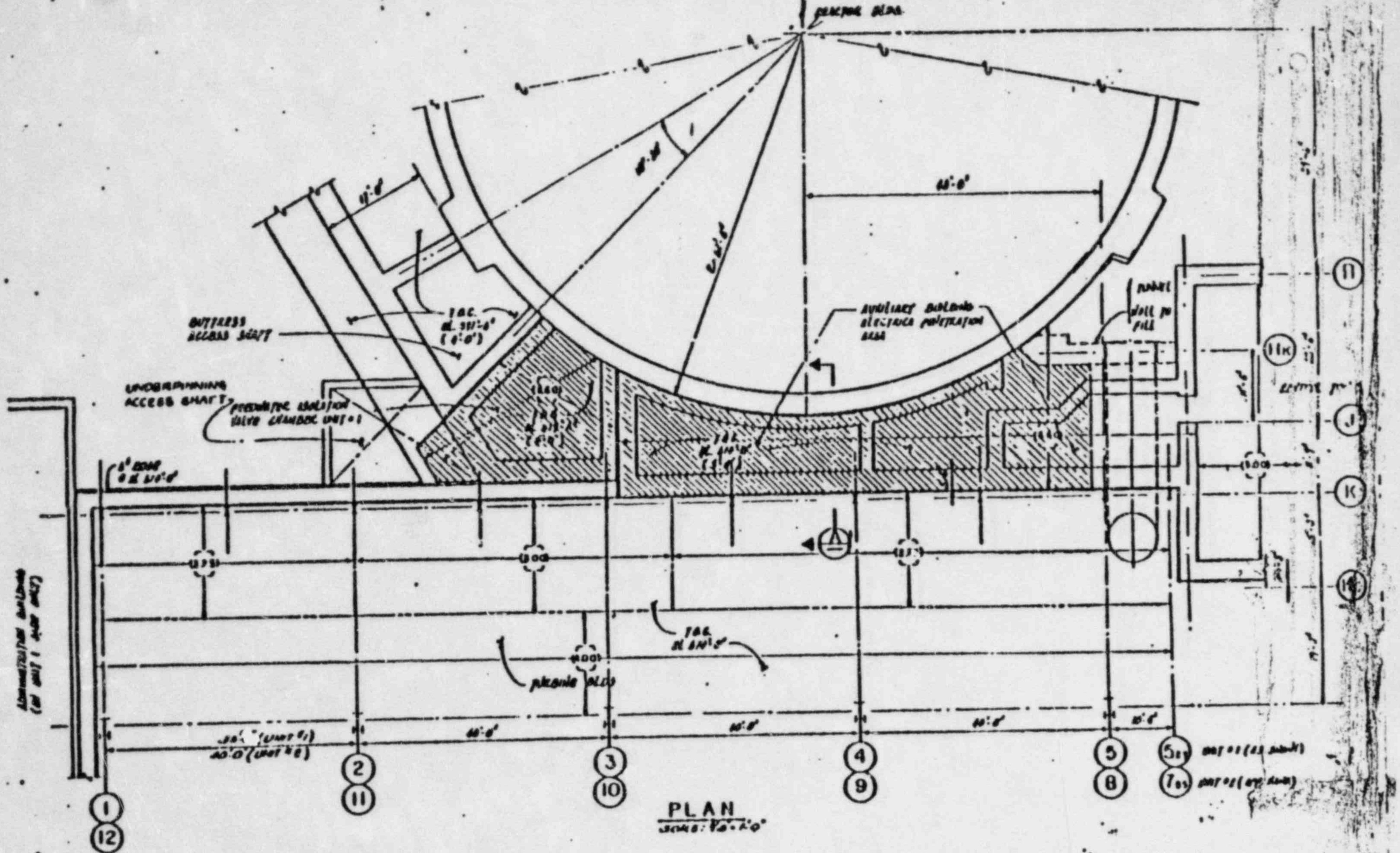
$DL + LL + EQ = 2790^{K}$

$16\ PILES\ @\ 100^{TON}/PILE = 3200^{K}$



SECTION B

FIG. 11



PLAN
SCALE: 1/8" = 1'-0"

FIG. 12

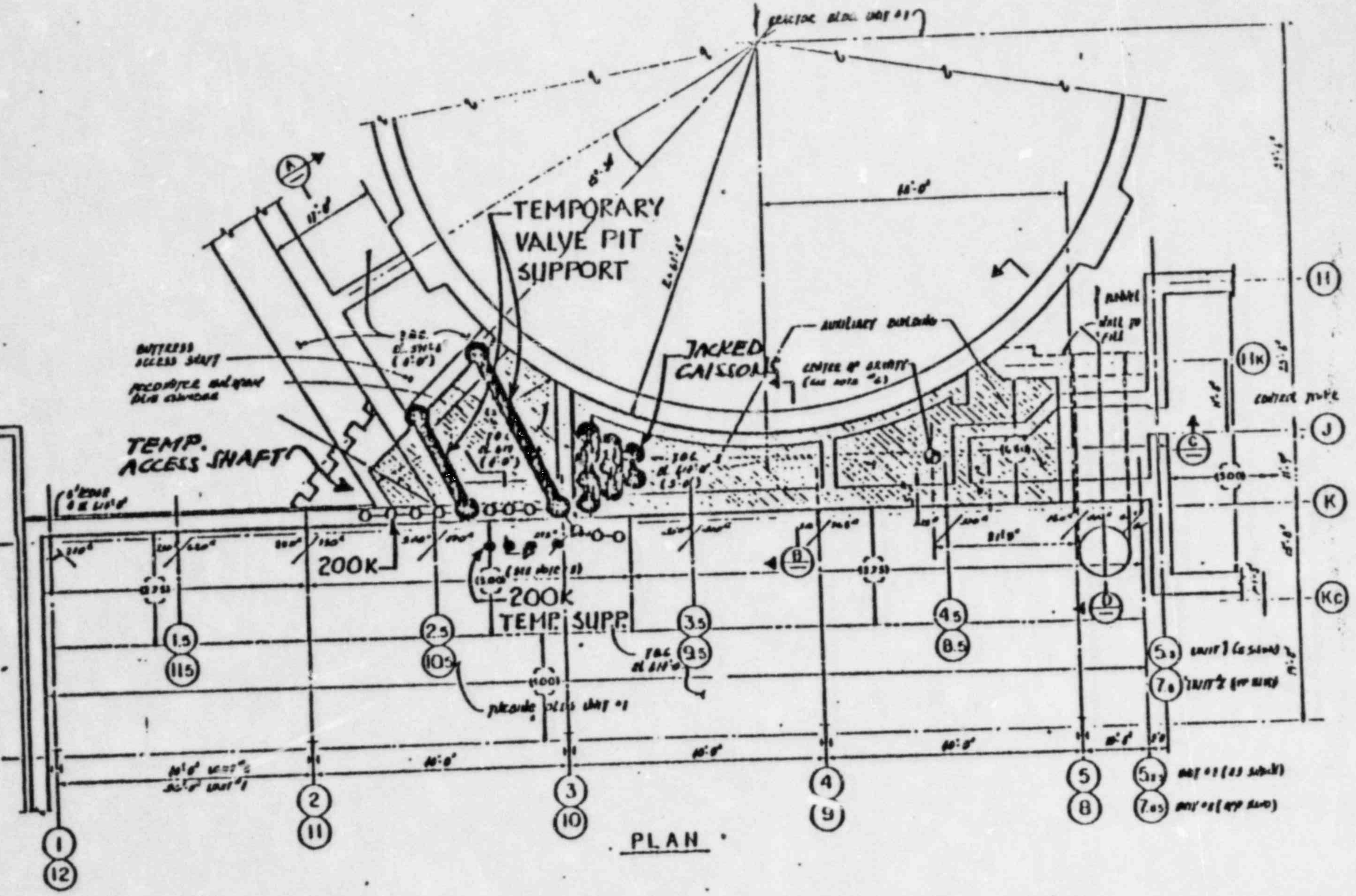
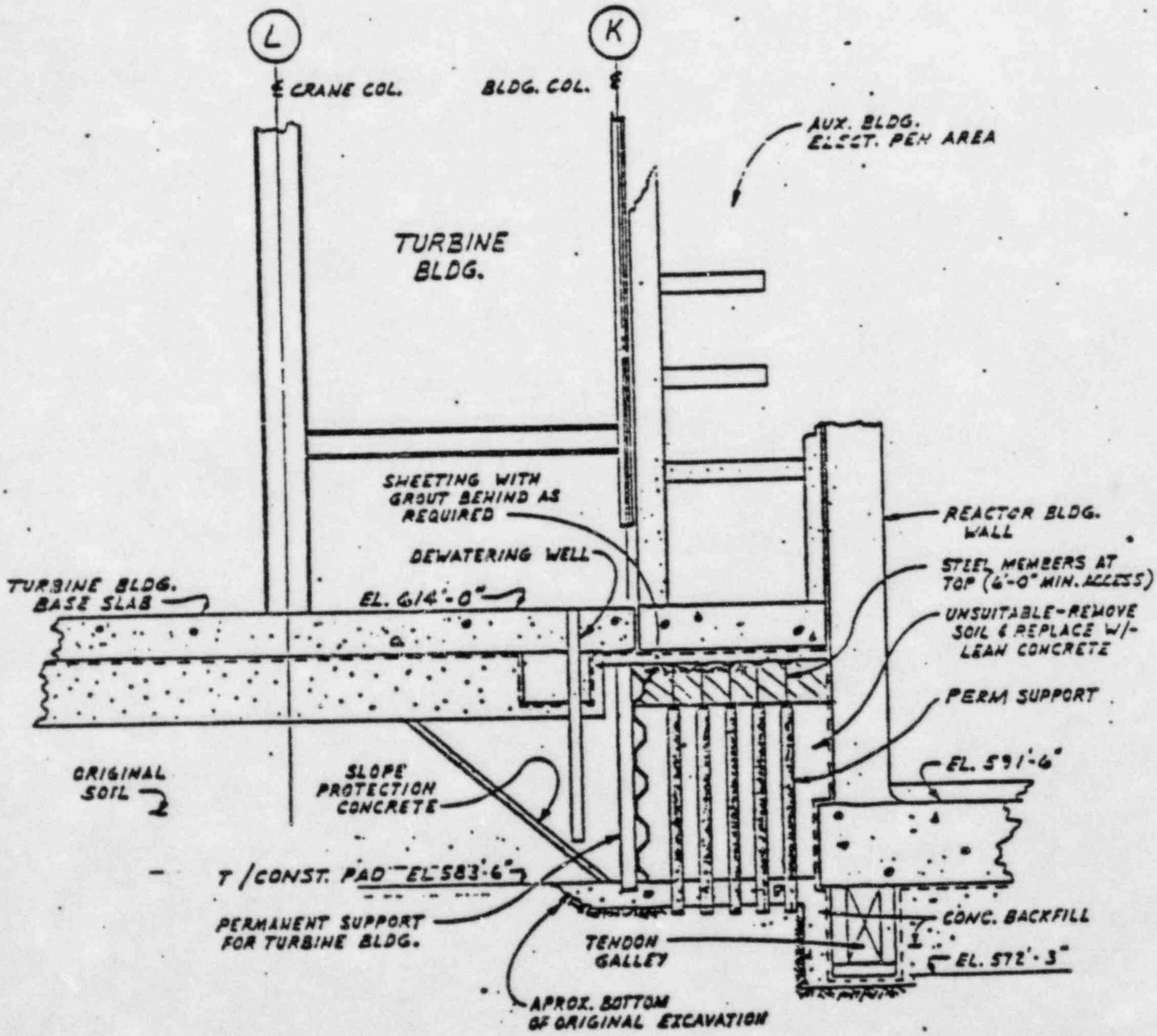

TEMPORARY VALVE PIT SUPPORT
JACKED CAISSONS
TEMP. ACCESS SHAFT
200K
200K
TEMP. SUPP.
BUTTRESS ACCESS SHAFT
AUXILIARY BUILDING
CENTER OF GRAVITY
CONTROL TOWER
A
B
C
D
11
11K
J
K
KC
1
12
1.5
11.5
2
11
2.5
10.5
3
10
3.5
9.5
4
9
4.5
8.5
5
8
5.5
7.5
5.25
7.05
PLAN

FIG 13



TYPICAL SECT.

FIG 14

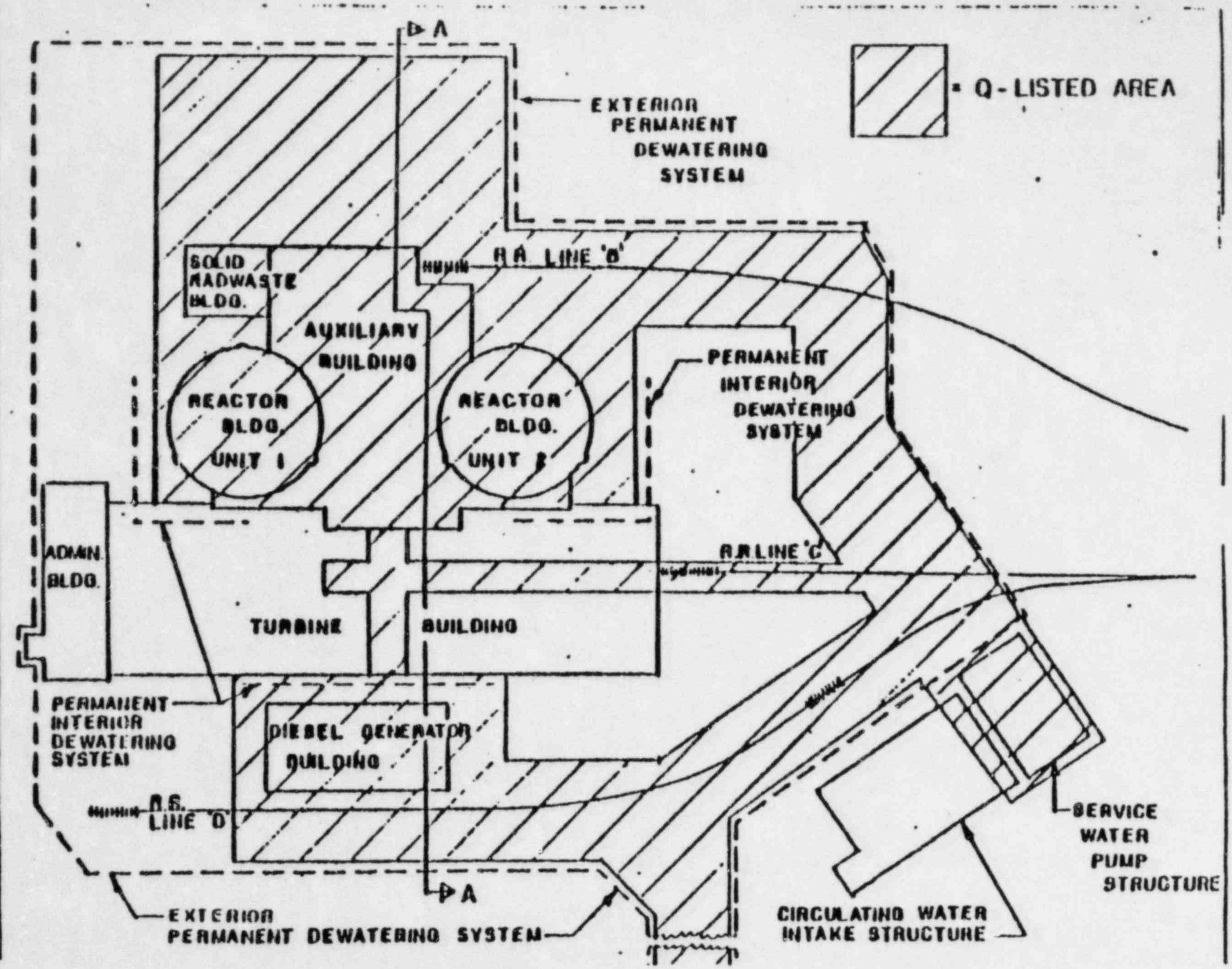

▨ = Q-LISTED AREA
EXTERIOR PERMANENT DEWATERING SYSTEM
SOLID RADWASTE BLDG.
AUXILIARY BUILDING
R.R. LINE 'B'
REACTOR BLDG. UNIT 1
REACTOR BLDG. UNIT 2
PERMANENT INTERIOR DEWATERING SYSTEM
ADMN. BLDG.
R.R. LINE 'C'
TURBINE
BUILDING
PERMANENT INTERIOR DEWATERING SYSTEM
DIESEL GENERATOR BUILDING
R.R. LINE 'D'
A
A
SERVICE WATER PUMP STRUCTURE
CIRCULATING WATER INTAKE STRUCTURE
EXTERIOR PERMANENT DEWATERING SYSTEM

FIGURE 15

TYPES OF LOADS

PRIMARY

1. MECHANICAL (DEADLOAD, PRESSURE, WIND, ETC.)
2. SEISMIC INERTIA (BUT SHORT DURATION)
3. MISSILE IMPACT & PIPE RUPTURE (LIMITED ENERGY)

SECONDARY

1. INTERNAL SELF CONTRAINT
   - (A) SEISMIC DISPLACEMENT (CYCLIC)
   - (B) THERMAL (CYCLIC)
2. SETTLEMENT (1/2 CYCLE)
3. FORMING (1/2 CYCLE)

FIG. 16

MIDLAND DESIGN CRITERIA

FSAR

(A) $1.4D + 1.7L$

(B) $1.4\ (D + L + E_o) + \ldots$

(C) $1.25\ (D + L + W) + \ldots$

(D) $1.0D + 1.0L + 1.0E_{ss} + \ldots$

(E) $1.0D + 1.0L + 1.0W_T + \ldots$

ADDITIONAL CRITERIA

(A) $1.05D + 1.28L + 1.05$ SET

(B) $1.4D + 1.4$ SET

(C) $1.0D + 1.0L + 1.0W + 1.0$ SET

(D) $1.0D + 1.0L + 1.0E_o + 1.0$ SET

D: DEAD LOAD
L: LIVE LOAD
E_o: (OBE) EARTHQUAKE
W: DESIGN WIND
E_{ss}: (SSE) EARTHQUAKE
W_T: TORNADO
SET: SETTLEMENT

FIG. 17

Enclosure 2

MIDLAND NUCLEAR PLANT

Docket No. 50-329 and 50-330
(TAC #5063)
Structural Engineering Branch
Review of Response to 50.54(f) Request

1. Investigate the soil properties of all of the areas where the fill material will or has been changed. On the basis of the soil properties thus determined conduct a new seismic analysis to account for the revised soil-structure interaction effect and the new structural response. The structural response spectra should be used to determine the new seismic loads to be incorporated into a revised structural analysis of Category I structures.

2. Your proposed method of re-evaluation of Category I structures which are founded partially or totally on fill, as outlined in the resopnse to Question 15, is not acceptable. The structural analysis should be conducted using the current NRC criteria, i.e., the Standard Review Plan (Sections 3.8.4 and 3.8.5) or ACI-349 supplemented by the appropriate Regulatory Guides, (R.G., 1.142), so the margins of safety can be assessed.

3. With reference to your response to Question #4, it was stated that the preliminary estimate for the residual settlement for the diesel generator building for the 40-year plant life is of the order of 1 inch. In this connection, specify the following:

   a) Is this estimate based on static condition only or does it include soil shakedown due to an earthquake event and if the answer is negative, what would be the total predicted settlement. In your response describe your method of analysis of settlement.

   b) What is the accuracy of the results of your analysis. State the possible upper bound of the settlement.

4. With reference to Question #14, you did not answer the basic questions regarding the causes of the cracks, significance of the extent of the crack

and their consequences. In view of the above, you are requested to conduct a detailed and comprehensive study which would answer these questons. It is noted that large areas of the auxiliary building are marked as temporarily or permanently inaccessible. Indicate how you plan to investigate the extent of the cracks in those areas.

5. Review of your response to Question #7 indicates that the electrical duct banks have not been designed in accordance with the same criteria as those applicable to other Category I structures.

   The electrical duct banks are considered to be a vital link between diesel generators and other parts of the plant. The acceptance of these ducts should be based on the use of the structural criteria for Category I structures as provided in the appropriate sections of the Standard Review Plan (SRP) and Regulatory Guides. Passing of a rabbit through the duct banks cannot be substituted for review using such criteria. You are requested, therefore, to perform an analysis of the affected duct banks using the criteria applicable to other Category I structures.

6. The Response to 50.54(f) Request reported the following inconsistencies between data used for structural design of the diesel generator building and the data contained in the FSAR.

   a) A uniform load of 3,000 psf was used rather than the 4,000 psf shown in Figure 2.5-47 in the FSAR.

   b) The calculations assumed a mat foundation rather than a spread footing foundation, which is the actual design condition.

   c) The results of these erroneous calculations were included in the FSAR.

   Please clarify these apparent inconsistencies.

7. In response to Question #13, it was indicated that the floor response spectra for the diesel generator building were generated on the assumption that the shear wave velocity will not be lower than 500 fps. Describe the basis for this assumption. Describe the surveillance plan during the life span of the plant by which you will be able to monitor the soil conditions to ascertain in the future that the assumption is valid.

SUMMARY OF SEB INTERIM LICENSING POSITIONS AND STATUS OF SRP REVISION MARCH 1979

SRP SECTION	INTERIM LICENSING POSITION IN ADDITION TO OR DIFF. FROM THOSE LISTED IN CORRESPONDING SRP SECTIONS
3.7.1 Seismic Input	1. Use of site dependent input design spectra is acceptable if the input spectra are reviewed and accepted by GSB (Ref. SRP Section 2.5) 2. For western United States (West of Rockies), the response spectrum for vertical motion can be taken as 2/3 the response spectrum for horizontal motion over the entire range of frequencies. (Encl. 4) 3. Methods for implementing the soil-structure interaction analysis should include both the half space lumped spring and mass representation and the finite element approaches. Category I structures, systems and components should be designed to responses obtained by any one of the following methods: a) Envelope of results of the two methods, b) Results of one method with conservative design consideration of impact from use of the other method, c) Combination of (a) and (b) with provision of adequate conservatism in design. 4. Consideration of the effects due to accidental torsional forces in design (as a minimum, the 5% times base dimension off-setting criteria should apply).

Sh. 1 of 2

SUMMARY OF SED INTERIM LICENSING POSITIONS AND STATUS OF SRP REVISION MARCH 1979

SRP SECTION	INTERIM LICENSING POSITION IN ADDITION TO OR DIFF. FROM THOSE LISTED IN CORRESPONDING SRP SECTIONS
3.7.1. (continued)	5. Case by case review for special situations (e.g, Diablo Canyon) to consider the effects due to torsional inputs. Horizontally propagating waves and " τ" effects for large foundation structures and the attendant torsional and tilting effects, should also be considered in the case by case review (Refer to Diablo Canyon SER's). 6. Staff onsite seismic design audit on a case by case basis.
3.7.2	1. Deletion of Table 3.7.2-1, "Acceptable Methods for Soil-Structure Interaction Analysis" and adopt acceptance criteria of 3(a), 3(b) and 3(c) stated in Section 3.7.1 2. Use of R.G. 1.92 and 1.122 3. Staff onsite seismic design audit on a case by case basis.
3.7.3	1. Staff onsite seismic design audit on a case by case basis 2. Consideration of component torsional response due to accidental torsion.
3.7.4	1. Case by case acceptance of the use of a single seismic instrumentation system for sites with multiple plants (more than 2 plants)

ENCLOSURE 5
SH 2 OF 2

CONSUMERS POWER COMPANY (C.P. CO.)
MIDLAND PLANT UNITS 1 & 2
STRUCTURAL ENGINEERING BRANCH

DOCKET NOS. 50-329 & 50-330

SAFETY EVALUATION REPORT

DRAFT

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Docket Nos. 50-329 & 50-330

SAFETY EVALUATION REPORT

3.3.1 Wind Design Criteria

All Category I structures exposed to wind forces are designed to withstand the effects of the design wind. The design wind specified has a velocity of 85 mph based on a recurrence interval of 100 years.

The procedures that are used to transform the wind velocity into pressure loadings on structures and the associated vertical distribution of wind pressures and dust factors are in accordance with ASCE Paper No. 3269. This document is acceptable to the staff.

The procedures that are utilized to determine the loadings on seismic Category I structures induced by the design wind specified for the plant are acceptable since these procedures provide a conservative basis for engineering design to assure that the structure will withstand such environmental forces.

The use of these procedures provides reasonable assurance that, in the event of design basis winds, the structural integrity of the plant seismic Category I structures will not be impaired and, in consequence, seismic Category I systems and components located within these structures are adequately protected and will perform their intended safety functions, if needed. Conformance with these procedures is an acceptable basis for satisfying, in part, the requirements of General design Criterion 2.

3.3.2 Tornado Design Criteria

All Category I structures exposed to tornado forces and needed for the safe shutdown of the plant are designed to resist a tornado of 290 mph tangential wind velocity and a 70 mph translational wind velocity. A simultaneous atmospheric pressure drop was assumed to be 3 psi in 1.5 seconds. Tornado missiles are also considered in the design as discussed in Section 3.5 of this report.

The procedures that are used to transform the tornado wind velocity into pressure designs are similar to those used for the design wind loadings as discussed in Section 3.3.1 of this report. The tornado missiles effects will be determined using procedures to be discussed in Section 3.5 of this report. The total effect of the design tornado on Category I structures is determined by appropriate combinations of the individual effects of the tornado wind pressure, pressure drop and tornado associated missiles. Bechtel Corp. Topical Report BC-TOP-3A was the major reference used as design criteria.

Structures will be arranged on the plant site and protected in such a manner that collapse of structures not designed for tornadoes will not effect other safety-related structures.

The tornado missile spectra does not fully comply with the current NRC tornado missile criteria. Specifically, the applicant has not considered the three steel pipe missiles (3" dia., 6" dia., 12" dia.). From the structural point of view, the 12" dia. steel pipe controls the design of the concrete barriers. Therefore, further evaluation for this tornado missile is required. In addition, the applicant should demonstrate that the vents used to reduce the differential pressure in other Category I structures are adequate to resist the missile impact.

The procedures utilized to determine the loadings on structures induced by the design basis tornado specified for the plant are acceptable, with the exception of the two open items stated in the previous paragraph; since these procedures provide a conservative basis for engineering design to assure that the facilities structures withstand such environmental forces.

The use of these procedures provides reasonable assurance that in the event of a design basis tornado, the structural integrity of the plant structures that have to be designed for tornadoes will not be impaired and, in consequence, safety-related systems and components located within these structures will be adequately protected and may be expected to perform necessary safety functions as required. Conformance with these procedures and the resolution of the two open items is an acceptable basis for satisfying, in part, the requirements of General Design Criterion 2.

3.4.2 Water Level (Flood) Design Procedures

The design flood level resulting from the most unfavorable condition or combination of conditions that produce the maximum water level at the site is discussed in Section 2.4, Hydrology. The hydrostatic effect of the flood will be considered in the design of all Category I structures exposed to the water head.

The procedures utilized to determine the loadings on seismic Category I structures induced by the design flood or highest groundwater level specified for the plant are acceptable since these procedures provide a conservative basis for engineering design to assure that the structures will withstand such environmental forces.

The use of these procedures provides reasonable assurance that in the event of floods or high groundwater, the structural integrity of the plant seismic Category I structures will not be impared and, in consequence, seismic Category I systems and components located within these structures will be adequately protected and may be expected to perform necessary safety functions, as required. Conformance with these design procedures is an acceptable basis for satisfying, in part, the requirements of General Design Criterion 2.

However, the applicant has not established the effectiveness of the groundwater well-system. These wells are needed to control the groundwater level and prevent soil-liquefaction. The above conclusions are subject to the final approval of the major concern related to the groundwater level and considerations for soil-liquefaction and any effects on the structures.

3.5.3 Barrier Design Procedures

The plant Category I structures, systems and components are shielded from, or designed for, various postulated missiles. Missiles considered in the design of structures include tornado generated missiles and various containment internal missiles, such as those associated with a loss-of-coolant accident.

Information has been provided indicating that the procedures that are used in the design of the structures, shields and barriers to resist the effect of missiles are adequate. The analysis of structures, shiled and barriers to determine the effects of missile impact will be accomplished in two steps. In the first step, the potential damage that could be done by the missile in the immediate vicinity of impact is investigated. This is accomplished by estimating the depth of penetration of the missile into the impacted structure. Furthermore, secondary missiles will be prevented by fixing the target thickness well above that determined for penetration. In the second step of the analysis, the overall structural response of the target when impacted by a missile is determined using established methods of impactive analysis. The equivalent loads of missile impact, whether the missile is environmentally generated or accidentally generated within the plant, are combined with other applicable loads as is discussed in Section 3.8 of this report.

The procedures that will be utilized to determine the effects and loadings on seismic Category I structures and missile shields and barriers induced by design basis missiles selected for the plant are acceptable since these procedures provide a conservative basis for engineering design to assure that the structures or barriers are adequately resistant to and will withstand the effect of such forces. Bechtel Corp. Topical Report BC-TOP-3A was the major reference used as design criteria.

The use of these procedures provides reasonable assurance that in the event of design basis missiles striking seismic Category I structures or other missiles shields and barriers, the structural integrity of the structures, shields, and barriers will not be impaired or degraded to an extent that will result in a loss of required protection. Seismic Category I systems and components protected by these structures are, therefore, adequately protected against the effects of missiles and will perform their intended safety function if needed. However, the current evaluation does not consider the effect of the 12" dia. pipe missile on the integrity of the vent structures. Conformance with these procedures, with the exception noted above, is an acceptable basis for satisfying, in part, the requirements of General Design Criteria 2 and 4.

3.7.1 Seismic Input

The input seismic design response spectra (OBE and SSE) applied in the design of seismic Category I structures, systems and components was developed by a site-dependent analysis. This site-dependent analysis developed the seismic design response spectra from site-related information including site time histories, in lieu of the response spectra specified in Regulatory Guide 1.60, "Design Response Spectra For Nuclear Power Plants." This is acceptable since the free field response spectra at the finished grade level or at the structural foundation level include consideration of appropriate amplification factors based upon an acceptable set of site earthquake records, and the analysis has taken into account actual soil properties at the site, and includes consideration of appropriate damping values corresponding to the calculated soil stress levels.

The specific percentage of critical damping values used in the seismic analysis of category I structures, system, and components differ with Regulatory Guide 1.61, "Damping Valves For Seismic Analysis Of Nuclear Power Plants." Since these values are lower than those in Regulatory Guide 1.61, an analysis performed using them is conservative and therefore acceptable.

The synthetic time history used for the seismic design of Category I structures, systems and components is adjusted in amplitude and frequency content to obtain response spectra that envelope the response spectra specified for the site.

The use of the site-dependent analysis and the critical damping values provide reasonable assurance that, for an earthquake whose intensity is .06 for operating base earthquake (OBE), and .12 for safe shutdown earthquake (SSE), the seismic inputs to seismic Category I structures, systems, and components are adequately defined to assure an acceptance basis for the design of such structures, systems and components to withstand the consequent seismic loadings.

3.7.2 & 3.7.3 Seismic System and Subsystem Analysis

The scope of review of the Seismic System and Subsystem Analysis for the plant included the seismic analysis methods for all Category I structures, systems and components. It included review of procedures for modeling, seismic soil-structure interaction, development of floor response spectra, inclusion of torsional effects, evaluation of Category I structure overturning, and determination of composite damping. The review has included design criteria and procedures for evaluation of interaction of non-Category I structures and piping with Category I structures and piping and effects of parameter variations on floor response spectra. The review has also included criteria and seismic analysis procedures for reactor internals and Category I buried piping outside the containment.

The system and subsystem analyses was performed by the applicant on an elastic basis. Modal response spectrum multidegree of freedom and time history methods form the basis for the analyses of all major Category I structures, systems and components. When the modal response spectrum method was used, governing response parameters will be combined by the square root of the sum of the squares rule. However, the absolute sum of the modal responses was used for modes with closely spaced frequencies. The square root of the sum of the squares of the maximum codirectional responses was used in accounting for three components of the earthquake motion for both the time history and response spectrum methods. Floor spectra inputs used for design and test verifications of structures, systems, and components was generated from the time history method, taking into account variation of parameters by peak widening. A vertical seismic system dynamic analysis was employed for all structures, systems and components where analysis show significant structural application in the vertical direction. Torsional effects and stability against overturning are considered.

The (finite element, lumped soil spring) approach is used to evaluate soil-structure interaction and structure to structure interaction effects upon seismic responses. For the finite element analysis, appropriate nonlinear stress-strain and damping relationships for the soil are considered in this analysis.

We conclude that the seismic system and subsystem analysis procedures and criteria proposed by the applicant provide an acceptable basis for the seismic design. However, a confirmatory, independent structural analysis of major Category I structures will be performed in the near future and the conclusion report in an addendum to this report. This independent work will consider the containment building and at least one other Category I structure.

3.7.4 Seismic Instrumentation Program

The type, number, location and utilization of strong motion accelerographs to record seismic events and to provide data on the frequency, amplitude and phase relationship of the seismic response of the containment structure comply with Regulatory Guide 1.12. Supporting instrumentation is being installed on Category I structures, systems and components in order to provide data for the verification of the seismic responses determined analytically for such Category I items.

The installation of the specified seismic instrumentation in the reactor containment structure and at other Category I structures, systems, and components constitutes an acceptable program to record data on seismic ground motion as well as data on the frequency and amplitude relationship of the sesponse of major structures and systems. A prompt readout of pertinent data at the control room can be expected to yield sufficient information to guide the operator on a timely basis for the purpose of evaluating the seismic response in the event of an earthquake. Data obtained from such installed seismic instrumentation will be sufficient to determine that the seismic analysis assumptions and the analytical model used for the design of the plant are adequate and that allowable stresses are not exceeded under conditions where continuity of operation is intended. Provision of such seismic instrumentation complies with Regulatory Guide 1.12.

3.8.1 Concrete Containment

The reactor coolant system will be enclosed in a concrete containment (reinforced base and prestressed cylindrical wall) as described in Section 3.8.1 of the FSAR. The containment structure was designed in accordance with applicable codes, standards and specifications in use before April 1973. Designs and analysis performed after this date were designed in accordance with applicable subsections of the ASME Boiler and Pressure Vessel Code, Section III Div. 2, and the American Concrete Institute (ACI 318). Various combinations of dead loads, live loads, environmental loads including those due to wind, tornadoes, OBE, SSE, and loads generated by the design base accident including pressure, temperature and associated pipe rupture effects were considered. Since a majority of the containment design was completed by 1973, the load combinations used and presented in the FSAR do not agree with those in the U. S. Atomic Energy Commission Standard Review Plan (SRP) 3.8.1. Also, the applicant has not demonstrated the degree of conservatism used in the Midland design, with respect to the load combinations and the related acceptance criteria. Is it equivalent to that which would have resulted if the NRC Standard Review Plan Acceptance Criteria had been used? This remains an open item.

Static analysis for the containment shell and base are based on methods previously applied. Likewise, the liner design for the containment employs methods similar to those previously accepted.

The choice of the materials, the arrangement of the anchors, the design criteria and design methods are similar to those evaluated for previously licensed plants. Materials, construction methods, quality assurance and quality control measures are covered in the SAP and, in general, are similar to those used for previously accepted facilities.

Prior to operation, the containment will be subjected to an accepted test in accordance with the Regulatory Guide 1.13 during which the internal pressure will be 1.15 times the containment design pressure.

The criteria used in the analysis, design, and construction of the concrete containment structure to accound for anticipated loadings and postulated conditions that may be imposed upon the structure during its service lifetime are not fully in conformance with established criteria, codes, standards, guides, and specifications acceptable to the Regulatory staff. Resolution of the open items will bring the design and analysis of the containment structure in full conformance with NRL established criteria.

The use of these criteria as defined by applicable codes, standards, guides, and specifications; the loads and loading combinations; the design and analysis procedures; the structural acceptance criteria; the materials, quality control programs and special construction techniques; and the testing and in-service surveillance requirements provide reasonable assurance that, in the event of winds, tornadoes, earthquakes and various postulated accidents occurring within the containment, the structure will withstand the specified design conditions without impairment of structural integrity of safety function. Conformance with these criteria pending the resolution of the open items constitutes an acceptable basis for satisfying, in part, the requirements of General Design Criteria 2, 4, 16, and 50.

3.8.3 Concrete And Structural Steel Internal Structures

The containment interior structures consist of support systems (reactor, steam generator, coolant pump), reactor coolant pipe restraints, primary and secondary shield walls, pressurizer supports, refueling canal walls, operating and intermediate floors, missile shields, polar crane supporting elements, in core instrumentation tunnel and let down cooler enclosure. The containment concrete and steel internal structures will be designed to resist various combinations of dead and live loads, accident induced loads, including pressure, jet loads, and seismic loads. Since the design of Category I internal concrete structures were completed before 1973, the load combinations presented in the FSAR are not in accordance with current NRC requirements. Specifically, the staff uses as the acceptable reference ACI-349, modified as per Regulatory Guide RG 1.42. This deviation is considered an open item. The load combinations for steel structures in SRP 3.83 are in accordance with the AISC specification. The applicant fully follows these requirements in their design of the Category I internal steel structures. Via our April 21, 1980 memorandum and the IE Bulletin No. 80-11, the applicant was requested to submit information on the use of masonry walls in Category I structures, their location, design and analyses methods, piping/equipment supports, etc. Our final evaluation of this matter will be completed following the requested submittal by the applicant. This phase of the evaluation remains an open item.

As of this writing, the reactor vessel support system is under review because the previous design was determined ineffective due to the failure of the anchor bolts prior to any application of loads (other than pre-tension loads). A new reactor vessel support system was proposed by the applicant. The review for the proposed support system will be performed at a later date. Therefore, the design and analysis for the reactor vessel support and any other internal structure affected by this modification remains an open item.

The criteria that is used in the design, analysis, and construction of the containment internal structures to accound for anticipated loadings and postulated conditions that may be imposed upon the structures during their service lifetime are not fully in conformance with established criteria, and with codes, standards, and specifications acceptable to the Regulatory staff. Resolution of the open items will bring the design and analysis of the internal structure in full compliance with NRC established criteria.

The use of these criteria as defined by applicable codes, standards, and specifications; the loads and loading combinations; the design and analysis procedures; the structural acceptance criteria; the materials, quality control programs, and special construction techniques; and the testing and in-service surveillance requirements provide reasonable assurance that, in the event of earthquakes and various postulated accidents occurring within the containment, the interior structures will withstand the specified design conditions without impairment of structural integrity or the performance of required safety functions. Conformance with these criteria pending resolution of the open items constitutes an acceptable basis for satisfying in part the requirements of General Design Criteria 2 and 4.

3.8.4 Other Category I Structures

Category I structures other than the containment and its interior structure are all of structural steel, reinforced concrete and reinforced concrete block. The structural components consist of slabs, walls, beams and columns. The major codes used in the design of the ACI 318-63, ACI 318-71, "Building Code Requirements For Reinforced Concrete." For steel Category I structures, the AISC, "Specification for the Design, Fabrication and Erection of Structures", steel for buildings is used.

These Category I structures was designed resist various combinations of dead loads; live loads; environmental loads including winds, tornadoes, OBE and SSE, and loads generated by postulated ruptures of high energy pipes such as reaction and jet impingement forces, compartment pressures, and impact effects of whipping pipes. Since the design of a majority of Category I structures were completed before 1973, the load combinations presented in the FSAR are in accordance with applicable codes and standards in use before this date. The load combinations for the concrete structures do not agree with the current NRC acceptance criteria. Specifically the staff uses as the acceptance reference ACI 349 modified as per RG 1.142. This deviation is considered an open item. For steel structures the AISC specification is found acceptable to the staff.

The materials of construction, their fabrication, construction and installation are in accordance with the ACI 318-63, ACI 318-71 codes and the AISC specifications for concrete and steel structures respectively. However, the applicant is required to evaluate any deviation from ACI-349 as modified by R. G. 1.142 and determine the effect on the safety of these concrete structures.

The extensive soil settlement and related concrete wall cracking which have been observed in various Category I structures are discussed in Section 3.8.5 of this report. However, the review of this problem area remains an open item until the applicant addresses all of the staffs questions and they are found acceptable.

The criteria that will be used in the analysis, design, and construction of all the plant Category I structures to accound for anticipated loadings and postulated conditions that may be imposed upon each structure during its service lifetime are not fully in conformance with established criteria, codes, standards, and specifications acceptable to the Regulatory staff. Resolution of the open items will bring the design and analysis of other Category I structure in full compliance with NEC established criteria.

The use of these criteria as defined by applicable codes, standards, and specifications; the loads and loading combinations; the design and analysis procedures; the structural acceptance criteria; the materials, quality control, and special construction techniques; and the testing and in-service surveillance requirements provide reasonable assurance that, in the event of winds, tornadoes, earthquakes and various postulated accidents occurring within the structures, the structures will withstand the specified design conditions without impairement of structural integrity or the performance of required safety functions. Conformance with these criteria, codes, specifications, and standards pending resolution of the open items constitutes an acceptable basis for satisfying, in part, the requirements of General Design Criteria 2 and 4.

3.8.5 Foundations

Foundations of Category I structures are described in Section 3.8.5 of the FSAR. Primarily, these are reinforced concrete MAT foundations. The diesel generator building is one of the major structures which utilizes footers instead of MAT foundations. The major code used in the design of these concrete foundations is ACI 318-63 prior to 1973 and ACI 318-71 after 1973. These concrete foundations are designed to resist various combinations of dead loads; live loads; environmental loads including winds, tornadoes, OBE and SSE, and loads generated by postulated ruptures of high energy pipes.

The design and analysis procedures used for Category I foundations are the same as those approved on previously licensed applications and, in general, are in accordance with procedures delineated in ACI 318-63 and ACI 318-71 codes. The material of construction, their fabrication, construction and installation are in aqcordance with ACI 318-63 and ACI 318-71 codes.

Extensive soil settlement and cracking in concrete walls have been observed in various category I structures. The structures affected include the diesel generator building, the diesel oil storage tank, the service water pump structure (partial), the tank farm, the feedwater isolation pit and the auxiliary building. On the basis of the structural problems which have occurred due to the extensive soil settlement, (cracking of concrete walls of various Category I structures) it is recommended that the following action items be addressed by the applicant and reviewed by the staff in order to insure the adequate safety of the related structures prior to the final acceptance of the FSAR.

1. Settlement and Inadequate Compaction of the Foundations Material

a. Because the fill will be replaced by other material such as lean concrete in case of auxiliary building and feedwater valve pits), the soil properties of the foundation material will be changed. We recommend that the new properties of this new foundation material be thoroughly investigated. The new soil properties (e.g., damping values and shear modulus) should be used in the revised seismic analysis to determine the structural adequacy of the affected structures. Pertinent soil-structure interaction methods should be used in the revised analysis.

b. The structural analysis should be conducted using the current NRC criteria so that the margins of safety can be determined against the current standards. This analysis should include the effects of settlement and revised load combination equations that are appropriate for the structures.

c. We consider the electrical duct banks to be a vital link between the diesel generator building and other parts of the plant. The acceptance of the ducts should be based on the structural criteria for Category I structures as provided in the appropriate sections of the Standard Review Plan and Regulatory Guides. The method of passing a rabbit through the duct banks cannot be substituted for such criteria. We, therefore, recommend that the applicant be requested to perform an analysis of the affected duct banks using the criteria applicable to other Category I structures.

[illegible]

2. Cracking of Category I Structures

We believe that the applicant did not answer the basic questions regarding the causes of the cracks, the significance of the extent of the crack, and the consequences of the cracking. In view of the above, we recommend that the applicant be requested to conduct a detailed and comprehensive study to answer these questions.

3. Inconsistencies of Information

The response to the 10 CFR 50.54(f) request reported the following inconsistencies between data used for structural design of the diesel generator building and the data contained in the FSAR.

a. A uniform load of 3,000 psf was used rather than the 4,000 psf shown in Figure 2.4-47 in the FSAR.

b. The calculations assumed a mat foundation rather than a spread footing foundation, which is the actual design condition.

c. The results of these erroneous calculations were included in the FSAR.

We recommend that the applicant be requested to clarify these apparent inconsistencies.

4. Floor Response Spectra

Because of replacement of the backfill with caissons or piles, the properties of the foundation material supporting the structures will be changed. Such a change may alter the response of structures to seismic forces.

The floor response spectra for the diesel generator building were generated on the assumption that the shear wave velocity would not be lower than 500 fps. We recommend that the surveillance of the soil properties be conducted throughout the entire period of consolidation of the building to verify the validity of this assumption.

5. Corrective Actions Under Consideration

The corrective actions undertaken and/or proposed by the applicant for the structures in question do not recommend the most conservative and permanent remedial action.

In order to increase the rigidity of the diesel generator building, it is recommended that a solid, continuous mat be placed under the existing structure. This mat should be connected to the present foundation by dowels or other positive means.

The electrical duct system should be designed as other Category I structures. Therefore, they should remain elastic under all load combinations, including settlement load in combination with other loads identified for other Category I structures.

The proposed repair for the service water building consisting of the vertical piles and corbels is not considered as dependent as the placing of a foundation resting on the stable soil. The erection of abutments under this part of the structure is the only remedial action that provides soil support resembling that of the original design.

The Borated Water Storage tanks should be loaded to monitor any effects on their supporting foundations and soil media.

The proposed dewatering systems should be categorized in its entirety or in part, as per determination of the system evaluation and geoscience personnel, as Category I systems and should be designed and constructed to resist the loads of OBE/SSE and other pertinent soil loads.

The above action items 1 through 5 are considered open items.

The criteria that will be used in the analysis, design, and construction of all the plant Category I foundations to accound for anticipated loadings and postulated conditions that may be imposed upon each foundation during its service lifetime not fully are in conformance with established criteria, codes, standards, and specifications acceptable to the MPC staff. Resolution of the open items will bring the design and analysis of Category I structures in full compliance with NRC established criteria.

The use of these criteria as defined by applicable codes, standards, and specifications; the loads and loading combinations; the design and analysis procedures; the structural acceptance criteria; the materials, quality control, and special construction techniques; and the testing and in-service surveillance requirements provide quakes, and various postulated events, Category I foundations will withstand the specified design conditions without impairment to structural integrity and stability or the performance of required safety functions. Conformance with these criteria, codes, specifications, and standards pending resolution of the open items constitutes an acceptable basis for satisfying in part the requirements of General Design Criteria 2 and 4.

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BC-TOP-7	"Full Scale Buttress Test For Prestressed Nuclear Containment Structures".
BC-TOP-8	"Tendon And Anchor Reinforcement Test".
BC-TOP-9A	"Design Of Structures For Missile Impact".

CONSUMERS POWER COMPANY (C.P. CO.)
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3.3.1 Wind Design Criteria

All Category I structures exposed to wind forces are designed to withstand the effects of the design wind. The design wind specified has a velocity of 85 mph based on a recurrence interval of 100 years.

The procedures that are used to transform the wind velocity into pressure loadings on structures and the associated vertical distribution of wind pressures and gust factors are in accordance with ASCE Paper No. 3269. This document is acceptable to the staff.

The procedures that are utilized to determine the loadings on seismic Category I structures induced by the design wind specified for the plant are acceptable since these procedures provide a conservative basis for engineering design to assure that the structure will withstand such environmental forces.

The use of these procedures provides reasonable assurance that, in the event of design basis winds, the structural integrity of the plant seismic Category I structures will not be impaired and, in consequence, seismic Category I systems and components located within these structures are adequately protected and will perform their intended safety functions, if needed. Conformance with these procedures is an acceptable basis for satisfying, in part, the requirements of General design Criterion 2.

3.3.2 Tornado Design Criteria

All Category I structures exposed to tornado forces and needed for the safe shutdown of the plant are designed to resist a tornado of 290 mph tangential wind velocity and a 70 mph translational wind velocity. A simultaneous atmospheric pressure drop was assumed to be 3 psi in 1.5 seconds. Tornado missiles are also considered in the design as discussed in Section 3.5 of this report.

The procedures that are used to transform the tornado wind velocity into pressure loadings are similar to those used for the design wind loadings as discussed in Section 3.3.1 of this report. The tornado missiles effects will be determined using procedures to be discussed in Section 3.5 of this report. The total effect of the design tornado on Category I structures is determined by appropriate combinations of the individual effects of the tornado wind pressure, pressure drop and tornado associated missiles. Bechtel Corp. Topical Report BC-TOP-3A was the major reference used as design criteria.

Structures will be arranged on the plant site and protected in such a manner that collapse of structures not designed for tornadoes will not effect other safety-related structures.

The tornado missile spectra does not fully comply with the current NRC tornado missile criteria. Specifically, the applicant has not considered the three steel pipe missiles (3" dia., 6" dia., 12" dia.). From the structural point of view, the 12" dia. steel pipe controls the design of the concrete barriers. Therefore, further evaluation for this tornado missile is required. In addition, the applicant should demonstrate that the vents used to reduce the differential pressure in other Category I structures are adequate to resist the missile impact.

The procedures utilized to determine the loadings on structures induced by the design basis tornado specified for the plant are acceptable, with the exception of the two open items stated in the previous paragraph; since these procedures provide a conservative basis for engineering design to assure that the facilities structures withstand such environmental forces.

The use of these procedures provides reasonable assurance that in the event of a design basis tornado, the structural integrity of the plant structures that have to be designed for tornadoes will not be impaired and, in consequence, safety-related systems and components located within these structures will be adequately protected and may be expected to perform necessary safety functions as required. Conformance with these procedures and the resolution of the two open items is an acceptable basis for satisfying, in part, the requirements of General Design Criterion 2.

3.4.2 Water Level (Flood) Design Procedures

The design flood level resulting from the most unfavorable condition or combination of conditions that produce the maximum water level at the site is discussed in Section 2.4, Hydrology. The hydrostatic effect of the flood will be considered in the design of all Category I structures exposed to the water head.

The procedures utilized to determine the loadings on seismic Category I structures induced by the design flood or highest groundwater level specified for the plant are acceptable since these procedures provide a conservative basis for engineering design to assure that the structures will withstand such environmental forces.

The use of these procedures provides reasonable assurance that in the event of floods or high groundwater, the structural integrity of the plant seismic Category I structures will not be impared and, in consequence, seismic Category I systems and components located within these structures will be adequately protected and may be expected to perform necessary safety functions, as required. Conformance with these design procedures is an acceptable basis for satisfying, in part, the requirements of General Design Criterion 2.

However, the applicant has not established the effectiveness of the groundwater well-system. These wells are needed to control the groundwater level and prevent soil-liquefaction. The above conclusions are subject to the final approval of the major concern related to the groundwater level and considerations for soil-liquefaction and any effects on the structures.

3.5.3 Barrier Design Procedures

The plant Category I structures, systems and components are shielded from, or designed for, various postulated missiles. Missiles considered in the design of structures include tornado generated missiles and various containment internal missiles, such as those associated with a loss-of-coolant accident.

Information has been provided indicating that the procedures that are used in the design of the structures, shields and barriers to resist the effect of missiles are adequate. The analysis of structures, shiled and barriers to determine the effects of missile impact will be accomplished in two steps. In the first step, the potential damage that could be done by the missile in the immediate vicinity of impact is investigated. This is accomplished by estimating the depth of penetration of the missile into the impacted structure. Furthermore, secondary missiles will be prevented by fixing the target thickness well above that determined for penetration. In the second step of the analysis, the overall structural response of the target when impacted by a missile is determined using established methods of impactive analysis. The equivalent loads of missile impact, whether the missile is environmentally generated or accidentally generated within the plant, are combined with other applicable loads as is discussed in Section 3.8 of this report.

The procedures that will be utilized to determine the effects and loadings on seismic Category I structures and missile shields and barriers induced by design basis missiles selected for the plant are acceptable since these procedures provide a conservative basis for engineering design to assure that the structures or barriers are adequately resistant to and will withstand the effect of such forces. Bechtel Corp. Topical Report BC-TOP-9A was the major reference used as design criteria.

The use of these procedures provides reasonable assurance that in the event of design basis missiles striking seismic Category I structures or other missiles shields and barriers, the structural integrity of the structures, shields, and barriers will not be impaired or degraded to an extent that will result in a loss of required protection. Seismic Category I systems and components protected by these structures are, therefore, adequately protected against the effects of missiles and will perform their intended safety function if needed. However, the current evaluation does not consider the effect of the 12" dia. pipe missile on the integrity of the vent structures. Conformance with these procedures, with the exception noted above, is an acceptable basis for satisfying, in part, the requirements of General Design Criteria 2 and 4.

3.7.1 Seismic Input

The input seismic design response spectra (operating base earthquake (OBE) and safe shutdown earthquake (SSE)) applied in the design of seismic Category I structures and components was developed by a site design response spectra (Housner-developed) analysis. The seismic responses used for the design in the period range from .2 to .6 seconds and are increased by 50% to compensate for the differences between the site design response spectra (Housner-developed) and the Newmark-developed response spectra. The vertical design response spectra are defined by multiplying the horizontal site design response spectra by two-thirds. The site design response spectra are applied at the various foundations of seismic Category I structures.

The Midland design response spectra for the bulk of the plant differs from regulatory guide 1.60, "Design Response Spectra for Nuclear Power Plants". These spectra (OBE and SSE) correspond to maximum horizontal ground acceleration of .06 g for OBE and .12 g for SSE. Vertical response spectra are linearly scaled in proportion to the maximum vertical ground acceleration which equals 2/3 of the maximum horizontal ground acceleration. The response spectra for the Midland site are the average response spectra developed by normalizing and averaging both components of the strong motion ground accelerations for four earthquakes (El Centro, Calif., December 3, 1934; El Centro, Calf., May 18, 1940; Olympia, Wash., April 13, 1943; and Taft, Calif., July 21, 1952). This spectrum is intended to envelop large magnitude earthquakes at moderate distances from the epicenter. This is acceptable since the free field response spectra at the finished grade level or at the structural foundation level include consideration of appropriate amplification factors based upon an acceptable set of site earthquake records, and the analysis has taken into account actual soil properties at the site, and includes consideration of appropriate damping values corresponding to the calculated soil stress levels.

The specific percentage of critical damping values used in the seismic analysis of Category I structures, system, and components differ with Regulatory Guide 1.61, "Damping Values For Seismic Analysis Of Nuclear Power Plants." Since these values are lower than those in Regulatory Guide 1.61, an analysis performed using them is conservative and therefore acceptable.

The synthetic time history used for the seismic design of Category I structures, systems and components is adjusted in amplitude and frequency content to obtain response spectra that envelope the response spectra specified for the site.

The use of the site-dependent analysis and the critical damping values provide reasonable assurance that, for an earthquake whose intensity is .06 for OBE, and .12 for SSE, the seismic inputs to seismic Category I structures, systems, and components are adequately defined to assure an acceptable basis for the design of such structures, systems and components to withstand the consequent seismic loadings.

3.7.2
&
3.7.3

Seismic System and Subsystem Analysis

The scope of review of the Seismic System and Subsystem Analysis for the plant included the seismic analysis methods for all Category I structures, systems and components. It included review of procedures for modeling, seismic soil-structure interaction, development of floor response spectra, inclusion of torsional effects, evaluation of Category I structure overturning, and determination of composite damping. The review has included design criteria and procedures for evaluation of interaction of non-Category I structures and piping with Category I structures and piping and effects of parameter variations on floor response spectra. The review has also included criteria and seismic analysis procedures for reactor internals and Category I buried piping outside the containment.

The system and subsystem analyses were performed by the applicant on an elastic basis. Modal response spectrum multidegree of freedom and time history methods form the basis for the analyses of all major Category I structures, systems and components. When the modal response spectrum method was used, governing response parameters will be combined by the square root of the sum of the squares rule. However, the absolute sum of the modal responses was used for modes with closely spaced frequencies. The square root of the sum of the squares of the maximum codirectional responses was used in accounting for three components of the earthquake motion for both the time history and response spectrum methods. Floor spectra inputs used for design and test verifications of structures, systems, and components were generated from the time history method, taking into account variation of parameters by peak widening. A vertical seismic system dynamic analysis was employed for all structures, systems and components where analysis show significant structural application in the vertical direction. Torsional effects and stability against overturning are considered.

The (finite element, lumped soil spring) approach is used to evaluate soil-structure interaction and structure to structure interaction effects upon seismic responses. For the finite element analysis, appropriate nonlinear stress-strain and damping relationships for the soil are considered in this analysis.

Due to the settlement and inadequate compaction problem, the applicant has agreed to perform seismic re-analysis of all Category I structures in the plant fill area of the Midland Plant. In addition, we require as necessary a structural re-analysis of the Category I structures.

We conclude that the seismic system and subsystem analysis procedures and criteria proposed by the applicant with the exception of the open item stated in the previous paragraphs; provide an acceptable basis for the seismic design. However, a confirmatory, independent structural analysis of major Category I structures will be performed in the near future and the conclusion reported in an addendum to this report. This independent work will consider the container building and at least one other Category I structure.

3.7.4 Seismic Instrumentation Program

The type, number, location and utilization of strong motion accelerographs to record seismic events and to provide data on the frequency, amplitude and phase relationship of the seismic response of the containment structure comply with Regulatory Guide 1.12. Supporting instrumentation is being installed on Category I structures, systems and components in order to provide data for the verification of the seismic responses determined analytically for such Category I items.

The installation of the specified seismic instrumentation in the reator containment structure and at other Category I structures, systems, and components constitutes an acceptable program to record data on seismic ground motion as well as data on the frequency and amplitude relationship of the response of major structures and systems. A prompt readout of pertinent data at the control room can be expected to yield sufficient information to guide the operator on a timely basis for the purpose of evaluating the seismic response in the event of an earthquake. Data obtained from such installed seismic instrumentation will be sufficient to determine that the seismic analysis assumptions and the analytical model used for the design of the plant are adequate and that allowable stresses are not exceeded under conditions where continuity of operation is intended. Provision of such seismic instrumentation complies with Regulatory Guide 1.12.

3.8.1 Concrete Containment

The reactor coolant system will be enclosed in a concrete containment (reinforced base and prestressed cylindrical wall) as described in Section 3.8.1 of the FSAR. The containment structure was designed in accordance with applicable codes, standards and specifications in use before April 1973. Designs and analysis performed after this date were designed in accordance with applicable subsections of the ASME Boiler and Pressure Vessel Code, Section III Div. 2, and the American Concrete Institute (ACI 318). Various combinations of dead loads, live loads, environmental loads including those due to wind, tornadoes, OBE, SSE, and loads generated by the design base accident including pressure, temperature and associated pipe rupture effects were considered. Since a majority of the containment design was completed by 1973, the load combinations used and presented in the FSAR do not agree with those in the U.S. Atomic Energy Commission Standard Review Plan (SRP) 3.8.1. Also, the applicant has not demonstrated the degree of conservatism used in the Midland design, with respect to the load combinations and the related acceptance criteria. Is it equivalent to that which would have resulted if the NRC Standard Review Plan Acceptance Criteria had been used? This remains an open item.

Static analysis for the containment shell and base are based on methods previously applied. Likewise, the liner design for the containment employs methods similar to those previously accepted.

The choice of the materials, the arrangement of the anchors, the design criteria and design methods are similar to those evaluated for previously licensed plants. Materials, construction methods, quality assurance and quality control measures are covered in the SAR and, in general, are similar to those used for previously accepted facilities.

Prior to operation, the containment will be subjected to an accepted test in accordance with the Regulatory Guide 1.18 during which the internal pressure will be 1.15 times the containment design pressure.

The criteria used in the analysis, design, and construction of the concrete containment structure to account for anticipation loadings and postulated conditions that may be imposed upon the structure during its service lifetime are not fully in conformance with established criteria, codes, standards, guides, and specifications acceptable to the Regulatory staff. Resolution of the open items will bring the design and analysis of the containment structure in full conformance with NRC established criteria.

The use of these criteria as defined by applicable codes, standards, guides, and specifications; the loads and loading combinations; the design and analysis procedures; the structural acceptance criteria; the materials, quality control programs and special construction techniques; and the testing and in-service surveillance requirements provide reasonable assurance that, in the event of winds, tornadoes, earthquakes and various postulated accidents occuring within the containment, the structure will withstand the specified design conditions without impairment of structural integrity of safety function. Conformance with these criteria, pending the resolution of the open items, constitutes an acceptable basis for satisfying, in part, the requirements fo General Design Criteria 2,4,16, and 50.

3.8.3 Concrete And Structural Steel Internal Structures

The containment interior structures consist of support systems (reactor, steam generator, coolant pump), reactor coolant pipe restraints, primary and secondary shield walls, pressurizer supports, refueling canal walls, operating and intermediate floors, missile shields, polar crane supporting elements, in core instrumentation tunnel and let down cooler enclosure. The containment concrete and steel internal structures will be designed to resist various combinations of dead and live loads, accident induced loads, including pressure, jet loads, and seismic loads. Since the design of Category I internal concrete structures were completed before 1973, the load combinations presented in the FSAR are not in accordance with current NRC requirements. Specifically, the staff uses as the acceptable reference ACI-349, modified as per Regulatory Guide RG 1.142. This deviation is considered an open item. The load combinations for steel structures in SRP 3.8.3 are in accordance with the AISC specification. The applicant fully follows these requirements in their design of Category I internal steel structures. Via our April 21, 1980 memorandum and the IE Bulletin No. 80-11, the applicant was requested to submit information on the use of masonry walls in Category I structures, their location, design and analyses methods, piping/equipment supports, etc. Our final evaluation of this matter will be completed following the requested submittal by the applicant. This phase of the evaluation remains an open item.

As of this writing, the reactor vessel support system is under review because the previous design was determined ineffective due to the failure of the anchor bolts prior to any application of loads (other than pre-tension loads). A new reactor vessel support system was proposed by the applicant. The review for the proposed support system will be performed at a later date. Therefore, the design and analysis for the reactor vessel support and any other internal structure affected by this modification remains an open item.

The criteria that is used in the design, analysis, and construction of the containment internal structures to account for anticipated loadings and postulated conditions that may be imposed upon the structures during their service lifetime are not fully in conformance with established criteria, and with codes, standards, and specification acceptable to the Regulatory staff. Resolution of the open items will bring the design and analysis of the internal structure in full compliance with NRC established criteria.

The use of these criteria as defined by applicable codes, standards, and specification; the loads and loading combinations; the design and analysis procedures; the structural acceptance criteria, the materials, quality control programs, and special construction techniques; and the testing and in-service surveillance requirements provide reasonable assurance that, in the event of earthquakes and various postulated accidents occurring within the containment, the interior structures will withstand the specified design conditions without impairment of structural integrity or the performance of required safety functions. Conformance with these criteria, pending resolution of the open items, constitutes an acceptable basis for satisfying in part the requirements of General Design Criteria 2 and 4.

3.8.4 Other Category I Structures

Category I structures other than the containment and its interior structure are all of structural steel, reinforced concrete and reinforced concrete block. The structural components consist of slabs, walls, beams, and columns. The major codes used in the design of concrete Category I structures are the ACI 318-63 , ACI 318-71, "Building Code Requirements for Reinforced Concrete." For steel Category I structures, the AISC, "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" is used.

These Category I structures were designed to resist various combinations of dead loads, live loads; environmental loads including winds, tornadoes, OBE and SSE, and loads generated by postulated ruptures of high energy pipes such as reaction and jet impingement forces, compartment pressures, and impact effects of whipping pipes. Since the design of a majority of Category I structures were completed before 1973, the load combinations presented in the FSAR are in accordance with applicable codes and standards in use before this date. The load combinations for the concrete structures do not agree with the current NRC acceptance criteria. Specifically the staff uses as the acceptance reference ACI 349 modified as per RG 1.142. This deviation is considered an open item. For steel structures the AISC specification is found acceptable to the staff.

The materials of construction, their fabrication, construction and installation are in accordance with the ACI 318-63, ACI 318-71 codes and the AISC specifications for concrete and steel structures respectively. However, the applicnat is required to evaluate any deviation from ACI-349 as modified by R. G. 1.142 and determine the effect on the safety of these concrete structures.

The extensive soil settlement and related concrete wall cracking which have been observed in various Category I structures are discussed in Section 3.8.5 of this report. However, the review of this problem area remains an open item until the applicant addresses all of the staffs questions and they are found acceptable.

The criteria that will be used in the analysis, design, and construction of all the plant Category I structures to account for anticipated loadings and postulated conditions that may be imposed upon each structure during its service lifetime are not fully in conformance with established criteria, codes, standards, and specifications acceptable to the Regulatory staff. Resolution of the open items will bring the design and analysis of other Category I structure in full compliance with NRC established criteria.

The use of these criteria as defined by applicable codes, standards, and specifications; the loads and loading combinations; the design and analysis procedures; the structural acceptance criteria; the material, quality control, and special construction techniques; and the testing and in-service surveillance requirements provide reasonable assurance that, in the event of winds, tornadoes, earthquakes and various postulated accidents occurring within the structures, the structures will withstand the specified design conditions without impairment of structural integrity or the performance of required safety functions. Conformance with these criteria, codes, specifications, and standards pending resolution of the open items constitutes an acceptable basis for satisfying, in part, the requirements of General Design Criteria 2 and 4.

3.8.5 Foundations

Foundations of Category I structures are described in Section 3.8.5 of the FSAR. Primarily, these are reinforced concrete mat foundations. The diesel generator building is one of the major structures which utilizes footers instead of mat foundations. The major code used in the design of these concrete foundations is ACI 318-63 prior to 1973 and ACI 318-71 after 1973. These concrete foundations are designed to resist various combinations of dead loads; live loads; environmental loads including winds, tornadoes, OBE and SSE, and loads generated by postulated ruptures of high energy pipes.

The design and analysis procedures used for Category I foundations are the same as those approved on previously licensed applications and, in general, are in accordance with procedures delineated in ACI 318-63 and ACI 318-71 codes. The material of construction, their fabrication, construction and installation are in accordance with ACI 318-63 and ACI 318-71 codes.

Extensive soil settlement and cracking in concrete walls have been observed in various Category I structures. The structures affected include the diesel generator building, the diesel oil storage tank, the service water pump structure (partial), the tank farm, the feedwater isolation pit and the auxilliary building. On the basis of the structural problems which have occurred due to the extensive soil settlement, (cracking of concrete walls of various Category I structures) it is recommended that the following action items be addressed by the applicant and reviewed by the staff in order to insure the adequate safety of the related structures prior to the final acceptance of the FASR.

1. Settlement and Inadequate Compaction fo the Foundations Material

a. Because the fill will be replaced by other material such as lean concrete in case of auxilliary building and feedwater valve pits, the soil properties of the foundation material will be changed. We recommend that the new properties of this new foundation material be thoroughly investigated. The new soil properties (e.g., damping values and shear modulus) should be used in the revised seismic analysis to determine the structural adequacy of the affected structures. Pertinent soil-structure interaction methods should be used in the revised analysis.

b. The structural analysis should be conducted using the revised seismic loading and current NRC criteria so that the margins of safety can be determined against the current standards. This analysis should include the effects of settlement and revised load combination equations that are appropriate for the structures.

c. We consider the electrical duct banks to be a vital link between the diesel generator building and other parts of the plant. The applicant has stated that, "The function of the duct banks is to provide a space in the ground through which cables may be pulled. They also provide a casing around the cables to protect them during future construction activities in the area. The duct banks are not required to provide a watertight boundary around the cables. Therefore, cracking of the duct banks due to differential settlement does not affect their design functions. In the event that any significant obstruction or discontinuities are encountered, several alternatives will be considered to correct this condition. If the obstructions are small, a router may be pulled through the conduit to remove the obstruction and provide a smooth transition through the conduit. Replacement and rerouting of the duct bank will be studied as alternatives in the event of large discontinuities of the duct bank." With the foregoing information, we agree with the applicant that as long as the pressure and watertight conditions around the cables are not included in the design requirements minor cracking of duct banks are not objectionable.

2. Cracking of Category I Structures

The applicant responses to question 14,28 and 29 of NRC request regarding plant fill regarding the causes of cracks, the significance of the extent of cracks and the consequences of cracking gives us a better insight of just what the existing condition of the Category I structures are. We further recommend that the applicant be requested to:

a. Provide tension field data, if any, under the design load combinations at all the crack locations for each of the Category I structures.

b. Provide analysis to show the limiting tension field conditions in which a crack will not enlarge or propagate.

c. Show that the existing cracks shall not propagate further due to settlement and inadequate compaction problem.

d. Show the corrective plans in regards to the adverse effects of corrosion of the reinforcing bars in the crack areas.

3. Floor Response Spectra

Because of replacement of the backfill with caissons or piles, the properties of the foundation material supporting the structures will be changed. Such a change may alter the response of structures to seismic forces.

The floor response spectra for the diesel generator building were generated on the assumption that the shear wave velocity would not be lower than 500 fps. We recommend that the surveillance of the soil properties be conducted throughout the entire period of consolidation of the building to verify the validity of this assumption.

4. Corrective Actions Under Consideration

The corrective actions undertaken and/or proposed by the applicant for the structures in question do not recommend the most conservative and permanent remedial action.

The proposed repair for the service water building consisting of the vertical piles and corbels is not considered as dependent as the placing of a foundation resting on the stable soil. The erection of abutments under this part of the structure is the only remedial action that provides soil support resembling that of the original design.

The Borated Water Storage tanks should be loaded to monitor any effects on their supporting foundations and soil media.

The proposed dewatering systems should be categorized in its entirety or in part, as per determination of the system evaluation and geoscience personnel, as Category I systems and should be designed and constructed to resist the loads of OBE/SSE and other pertinent soil loads.

The above action items 1 through 4 are considered open items.

The criteria that will be used in the analysis, design, and construction of all the plant Category I foundations to account for anticipated loadings and postulated conditions that may be imposed upon each foundation during its service lifetime are not fully in conformance with established criteria, codes, standards, and specifications acceptable to the NRC staff. Resolution of the open items will bring the design and analysis of Category I structures in full compliance with NRC established criteria.

The use of these criteria as defined by applicable codes, standards, and specifications; the loads and loading combinations; the design and analysis procedure; the structural acceptance criteria; the materials, quality control, and special construction techniques; and the testing and in-service surveillance requirements provide quakes, and various postulated events, Category I foundations will withstand the specified design conditions without impairment to structural integrity and stability or the performance of required safety functions. Conformance with these criteria, codes, specifications, and standards, pending resolution of the open items, constitutes an acceptable basis for satisfying in part the requirements of General Design Criteria 2 and 4.

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BC-TOP-8 "Tendon And Anchor Reinforcement Test".

BC-TOP-9A "Design Of Structures For Missile Impact".

QUESTIONS & OPEN ITEMS

①

THE TORNADO MISSILE SPECTRUM DOES NOT FULLY COMPLY WITH THE CURRENT NRC TORNADO MISSILE CRITERIA. SPECIFICALLY, THE APPLICANT HAS NOT CONSIDERED THE THREE STEEL PIPE MISSILES (3" DIA., 6" DIA., 12" DIA.). FROM A STRUCTURAL POINT OF VIEW, THE 12" DIA. STEEL PIPE CONTROLS THE DESIGN OF THE CONCRETE BARRIERS. THEREFORE, FURTHER EVALUATION FOR THIS TORNADO MISSILE IS REQUIRED. IN ADDITION, THE APPLICANT SHOULD DEMONSTRATE THAT THE VENTS USED TO REDUCE THE DIFFERENTIAL PRESSURE IN OTHER CATEGORY I STRUCTURES ARE ADEQUATE TO RESIST THE MISSILE IMPACT.

② THE APPLICANT HAS NOT ESTABLISHED THE EFFECTIVENESS OF THE GROUNDWATER WELL-SYSTE THESE WELLS ARE NEEDED TO CONTROL THE GROUNDWATER LEVEL AND PREVENT SOIL-LIQUEFACTION. THE PROPOSED DEWATERING SYSTEM SHOULD BE CATEGORIZED IN ITS ENTIRETY OR IN PART, AS PER DETERMINATION OF THE SYSTEM EVALUATION AND GEO-SCIENCE PERSONNEL, AS CATEGORY I SYSTEMS AND SHOULD BE DESIGNED AND CONSTRUCTED TO RESIST THE LOADS OF OBE/SSE AND OTHER PERTINENT SOIL LOADS.

③ DUE TO SETTLEMENT AND INADEQUATE COMPACTION PROBLEM, THE APPLICANT HAS AGREED TO PERFORM SEISMIC RE-ANALYSIS OF ALL CATEGORY I STRUCTURES IN THE PLANT FILL AREA OF THE MIDLAND PLANT. IN ADDITION, WE REQUIRE AS NECESSARY A STRUCTURAL RE-ANALYSIS OF THE CATEGORY I STRUCTURES.

④. BECAUSE OF REPLACEMENT OF THE BACKFILL WITH CAISSONS OR PILES, THE PROPERTIES OF THE FOUNDATION MATERIAL SUPPORTING THE STRUCTURES WILL BE CHANGED. SUCH A CHANGE MAY ALTER THE RESPONSE OF THE STRUCTURE TO SEISMIC FORCES.

THE FLOOR RESPONSE SPECTRA FOR THE DIESEL GENERATOR BUILDING WERE GENERATED ON THE ASSUMPTION THAT THE SHEAR WAVE VELOCITY WOULD NOT BE LOWER THAN 500 FPS. WE RECOMMEND THAT THE SURVEILLANCE OF THE SOIL PROPETIES BE CONDUCTED THROUGHOUT THE ENTIRE PERIOD OF CONSOLIDATION OF THE BUILDING TO VERIFY THE VALIDITY OF THIS ASSUMPTION.

⑤. SOME AREAS OF THE FILL MATERIAL UNDER THE NORTHERN PART OF THE SURVICE WATER PUMP STRUCTURE HAVE NOT BEEN SUFFICIENTLY COMPACTED. THE PORTION OF THE STRUCTURE OVER THE FILL MATERIAL IS BEING SUPPORTED-BY THE REST OF THE STRUCTURE FOUNDED ON NATURAL MATERIAL THROUGH CANTILEVER ACTION. A STATIC ANALYSIS OF THE STRUCTURE BY THE APPLICANT INDICATED THAT THE TOTAL DESIGN LOADS CAN NOT BE SUPPORTED BY THE MAIN STRUCTURE THROUGH CANTILEVER ACTION. THE CORRECTIVE ACTION STATED IN MCAR 24 (ISSUED 9/7 INTERM REPORT 6. CONSIST OF PLACING PILINGS UNDER THE NORTH WALL OF THE STRUCTURE.

TWO QUESTIONS REGARDING THIS CORRECTIVE ACTION OF CONCERN TO NRC SHOULD BE ADDRESSED BY THE APPLICANT. THE ARE LISTED BELOW.

1) THE METHOD OF ATTACHING THE CORBELS BY USING LONG LONGITUDINAL BOLTS THROUGH THE WALLS WOULD REQUIRE THE BOLTS TO RESIST BENDING. THIS IS NOT AN EFFECTIVE WAY OF UTILIZING BOLTS. OTHER METHODS SHOULD BE CONSIDERED AND COMPARED.

2) IN THE SEISMIC RE-ANALYSIS OF THE SURVICE WATER PUMP STRUCTURE IT IS NOT CLEAR HOW THE PILING WILL BE TREATED. THE VERTICAL PILING CANNOT RESIST HORIZONTAL FORCES UNLESS PROPER BRACING IS PROVIDED. WILL THE PILING STILL BE EFFECTIVE TO SUPPORT VERTICAL LOAD AFTER AN EARTHQUAKE ?.

⑥ THE REACTOR VESSEL SUPPORT SYSTEM IS UNDER REVIEW BECAUSE THE PREVIOUS DESIGN WAS DETERMINED INEFFECTIVE DUE TO FAILURE OF THE ANCHOR BOLTS PRIOR TO ANY APPLICATION OF LOADS (OTHER THAN PRE-TENSION LOADS). A NEW REACTOR VESSEL SUPPORT SYSTEM WAS PROPOSED BY THE APPLICANT. THEREFORE, THE DESIGN AND ANALYSIS FOR THE REACTOR VESSEL SUPPORT AND ANY OTHER INTERNAL STRUCTURE AFFECTED BY THIS MODIFICATION SHOULD BE RE-ANALYZED.

⑰ IN THE RESPONSE TO QUESTION 15 OF NRC REQUESTS REGARDING PLANT FILL, THE APPLICANT HAS STATED THAT "DIFFERENTIAL SETTLEMENT PRIMARILY INDUCES ADDITIONAL STRAIN, WHICH IS A SELF-LIMITING EFFECT AND DOES NOT AFFECT THE ULTIMATE STRENGTH OF THE STRUCTURAL MEMBERS". EXPLAIN THIS STATEMENT AND TELL US HOW IT APPLIES TO THE SEISMIC CATEGORY I STRUCTURES?

B) THE APPLICANT RESPONSES TO QUESTIONS 14, 28, AND 29 OF NRC REQUEST REGARDING PLANT FILL REGARDING THE CAUSES OF CRACKS, THE SIGNIFICANCE OF THE EXTENT OF CRACKS AND THE CONSEQUENCES OF CRACKING GIVES US A BETTER INSIGHT OF JUST WHAT THE EXISTING CONDITION OF THE CATEGORY I STRUCTURES ARE. WE FURTHER RECOMMEND THAT THE APPLICANT BE REQUESTED TO:

a) PROVIDE TENSION FIELD DATA, IF ANY UNDER THE DESIGN LOAD COMBINATIONS AT ALL CRACK LOCATIONS FOR EACH CATEGORY I STRUCTURE.

b) PROVIDE ANALYSIS TO SHOW THE LIMITING TENSION FIELD CONDITIONS IN WHICH A CRACK WILL NOT ENLARGE OR PROPAGATE.

c) SHOW THAT THE EXISTING CRACKS SHALL NOT PROPAGATE FURTHER DUE TO SETTLEMENT AND INADEQUATE COMPACTION PROBLEM.

d) SHOW THE CORRECTIVE PLANS IN REGARDS TO THE ADVERSE EFFECTS OF CORROSION OF THE REINFORCING BARS IN THE CRACK AREAS.

⑨ BECAUSE THE FILL WAS REPLACED BY OTHER MATERIAL SUCH AS LEAN CONCRETE IN CASE OF THE AUXILLIARY BUILDING AND THE FEEDWATER VALVE PITS, THE SOIL PROPERTIES OF THE FOUNDATION MATERIAL WILL BE CHANGED. WE RECOMMEND THAT THE NEW PROPERTIES OF THIS NEW FOUNDATION MATERIAL BE THOROUGHLY INVESTIGATED. THE NEW SOIL PROPERTIES (e.g. DAMPING VALUES AND SHEAR MODULUS) SHOULD BE USED IN THE REVISED SEISMIC ANALYSIS TO DETERMINE THE STRUCTURAL ADEQUACY OF THE AFFECTED STRUCTURES. PERTINENT SOIL-STRUCTURE INTERACTION METHODS SHOULD BE USED IN THE REVISED ANALYSIS. STRUCTURAL ANALYSIS SHOULD BE CONDUCTED USING THE REVISED SEISMIC LOADING AND CURRENT NRC CRITERIA SO THAT MARGINS OF SAFETY CAN BE DETERMINED AGAINST CURRENT STANDARDS. THIS ANALYSIS SHOULD INCLUDE THE EFFECTS OF SETTLEMENT AND REVISED LOAD COMBINATION EQUATIONS THAT ARE APPROPRIATE FOR THE STRUCTURE.

⑩ SINCE A MAJORITY OF THE CONTAINMENT DESIGN WAS COMPLETED BY 1973, THE LOAD COMBINATIONS USED AND PRESENTED IN THE FSAR DO NOT AGREE WITH THOSE IN THE U.S. ATOMIC ENERGY COMMISSION STANDARD REVIEW PLAN (SRP) 3.8.1. ALSO, THE APPLICANT HAS NOT DEMONSTRATED THE DEGREE OF CONSERVATISM USED IN THE MIDLAND DESIGN, WITH RESPECT TO THE LOAD COMBINATIONS AND THE RELATED ACCEPTANCE CRITERIA. IS IT EQUIVALENT TO THAT WHICH WOULD HAVE RESULTED IF THE NRC STANDARD REVIEW PLAN ACCEPTANCE CRITERIA HAD BEEN USED?

(31) SINCE THE DESIGN OF CATEGORY I AND INTERNAL CONCRETE STRUCTURES WERE COMPLETED BEFORE 1973, THE LOAD COMBINATION PRESENTED IN THE FSAR ARE NOT IN ACCORDANCE WITH THE CURRENT NRC REQUIRE. SPECIFFICALLY, THE STAFF USES AS THE ACCEPTABLE REFERANCE ACI-349, MODIFIED AS PER REGULATORY GUIDE RG 1.142. THE APPLICANT HAS NOT DEMONSTRATED THE DEGREE OF CONSERVATISM USED IN THE MIDLAND DESIGN, WITH RESPECT TO THE LOAD COMBINATIONS AND THE RELATED ACCEPTANCE CRITERIA. IS IT EQUIVALENT TO THAT WHICH WOULD HAVE RESULTED IF THE CURRENT NRC ACCEPTANCE CRITERIA HAD BEEN USED?

[illegible]

File 562-1

DEC 17 1979

REQUEST FOR [illegible]
RFPA NO. NRR-80-109

MEMORANDUM TO: Dennis J. Dougherty, Chief
Technical Assistance Contracts Branch
Division of Contracts

FROM: Roger J. Mattson, Director
Division of Systems Safety

(This form is designed to accommodate varying kinds of procurement requests, including small purchases, sole source actions and competitive solicitations. Inapplicable items or those for which you have not developed information should be left blank. In such cases, project officer should contact Division of Contracts personnel for appropriate guidance.)

Part 1 - Project Data

1. It is requested that the Division of Contracts take the following action: Enter into an Interagency Agreement and

☒ Issue a Request for Proposal with the Naval Surface Weapons Center

☐ Award a contract on the basis of our acceptance of a proposal received from ____________ in response to an RFP or under a BOA.

☐ Award a Sole Source Contract to ____________ (Name of Person or Firm)

☐ Execute a Modification to Contract No. ____________ with ____________ (Name of Person or Firm)

☐ Award a contract on basis of our acceptance of an Unsolicited Proposal

2. The project is entitled, "Structural Engineering Case Reviews (II)".

3. The level of effort required to perform this work is estimated at 4.0 man-year(s) and ____________ month(s) over a 2.0 year ____________ month period from the effective date of the contract.

. Rinaldi depo Ex. 13
1·6·81 [illegible]

4. The expiration date for receipt of proposals is ________ working days after issuance of RFP.

5. A preproposal conference is ☐ is not ☒ contemplated.

6. ☒ No classified information is anticipated.

   ☐ Classified information is anticipated. See NRC Form 187, attached.

7. The Technical Monitor for this requirement is F. Rinaldi, telephone number 4927807; the COAR is F. Schauer, telephone number 492 -7483.

Part II - Funds

1. Estimated Cost: $300,000. Current FY $90,000*

   Second FY $150,000 Third FY $60,000

   Funds Availability: This certifies that funds in the amount of $ 60,000* are available for obligation in the current budget for the subject work and/or that funds in the amount of $150,000 have been included in next year's budget request for the work (if work is contemplated beyond this Fiscal Year).

   B&R Symbol 20-19-05-15 FIN No. B6878

   Appropriation Symbol 31X0200.200

Signature of Certifying Officer

12/12/77

Part III - Duplication of Effort

1. I certify that, based on inquiries made with other NRC offices, no unnecessary duplication of effort will result from the conduct of the subject work.

2. Attached are the certifications executed by each of the members of the Contract Review Board in accordance with the instructions contained in the memorandum of L. V. Gossick dated October 15, 1976.

*To be incrementally funded this fiscal year.

Part IV - Attachments

☒ Statement of Work (Attachment No. 1)

☐ Evaluation criteria and their numerical weights (Attachment No. ___)

☐ List of firms to be invited to submit proposals in addition to general public notification (Attachment No. ____)

☐ Copy of letter designating Source Evaluation Panel members (Attachment No. ______)

☐ Sole Source Justification, if applicable. (Attachment No. ___)

☐ Unsolicited Proposal Justification, if applicable. Approval and execution of a contract with ______________________________ on
Name of Proposer
the basis of an unsolicited proposal is recommended. (Attachment No. ___)

☐ Contract Review Board Certifications (Attachment No. ____)

☐ Special Requirements* (Attachment No. _____)

Roger J. Mattson, Director
Division of Systems Safety

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*This pertains to instructions concerning schedules, reports, data, Government-furnished equipment, or other special requirements.

STATEMENT OF WORK

TITLE: Structural Engineering Case Reviews (V)

FIN: B6578

B&R NUMBER: 20-19-05-15

TECHNICAL MONITOR: F. Rinaldi

COGNIZANT BRANCH CHIEF: F. P. Schauer (FTS 492-7807)

BACKGROUND INFORMATION

Applicants seeking to construct and operate nuclear power plants must submit to NRC for review and evaluation documentation consisting of a Preliminary Safety Analysis Report (PSAR) and a Final Safety Analysis Report (FSAR).

The safety review and evaluation process is conducted in two phases: (1) At the PSAR stage the applicant describes and discusses the general layout of Category I structures and systems, basic design codes and criteria to be used, analysis and design procedures to be adopted, and technical information needed for showing compliance to applicable NRC regulations and design criteria. On completion of the PSAR review, evaluation, and approval, the applicant receives a Construction Permit (CP) which enables him to start plant construction; (2) At the FSAR stage the applicant describes in detail and with more specific engineering data the design calculations and details of all Category I structures, systems and components. Demonstration of compliance to applicable NRC regulations and requirements in all aspects of design, analysis, fabrication, and erection of Category I structures and systems is a prerequisite for NRC staff approval of the FSAR. On completion of the FSAR review, evaluation, and approval, the applicant receives an Operating License (OL) for commercial plant operation.

In addition to the above, safety reviews are also conducted on various standard plant designs in accordance with the Commission's standardization policy. The two types most commonly reviewed are: (1) a standard nuclear steam supply system plant design submitted by a Nuclear Steam Supply System (NSSS) vendor, and (2) a standard Balance of Plant (BOP) design submitted by an utility applicant or an architect-engineer firm. The reviews of these applications are carried out in the same manner as previously described except for the identification of system interface requirements which require staff review to assure consistency between the NSSS and the BOP.

PURPOSE OF PROGRAM

The objective of this agreement is to obtain expert technical personnel of the contractor to assist the Structural Engineering Branch, DSS, in its licensing review of Operating License (OL) applications.

GENERAL REQUIREMENTS

The reviews are to be conducted using the guidance contained in regulatory guides, applicable codes and standards, and the guidance and acceptance criteria found in the Standard Review Plans (SRPs) in the areas of SEB responsibility. The contractor will generally follow the approach outlined below in conducting reviews and evaluations.

-- Recommend requests for additional information or clarification based upon initial review and evaluation of the information provided by the applicants.

-- Evaluate the responses provided by the applicants.

-- Attend meetings with the staff, applicants, and their architect-engineer to discuss and resolve outstanding issues.

-- Perform independent structural and seismic analysis of key Category I structures and compare the analytical results obtained with those of the PSAR/FSAR's.

-- Participate with the NRC staff coordinator(s) in implementing a Structural Design, Analysis and Construction Audit at the applicants' engineering offices.

-- Propose specific solutions/acceptance criteria for outstanding issues identified in the reviews. The solutions proposed can be different from the acceptance criteria of the SRP's as long as design adequacy of Category I structures and systems can be assured or demonstrated by the solution.

-- Prepare Safety Evaluation Reports (SERs) which describe the evaluation of the design and analysis of the applicants' Category I structures and systems.

-- Attend meetings with the Advisory Committee on Reactor Safeguards (ACRS) and public hearings, on an as-needed basis, to assist the staff in explaining bases for conclusions and positions reached in the SER.

-- Prepare input to SER Supplements which further clarify and document Category I structural evaluations in the SER based upon review by the ACRS.

-- Perform plant inspection trips with NRC staff coordinator(s) on an as-needed basis.

TASK 1: Midland

Estimated Level of Effort
FY 80: 4 man-months
FY 81: 9 man-months

The contractor shall perform a license review and evaluation of Category I Structures covered by SRP Sections 3.3, 3.4, 3.5.3, 3.7 and 3.8.

SUBTASKS	Estimated Man-Days	Estimated Completion Date
Review and evaluate material covered in the above sections of the SAR in accordance with acceptance criteria contained in the related SRPs. Prepare input for a draft SER and identify open issues and sections of the SAR where additional information is needed from the applicant.	60	1/8/80
Discuss the draft SER with the SEB staff, participate in meetings with the applicant and the SEB staff to resolve open issues and assess additional information submitted by the applicant, and prepare input for a final SER.	10	2 /11/80
Prepare input to SER supplement. Attend ACRS meetings and licensing board hearings as needed to assist the staff in explaining the bases for conclusions and positions reached in the SER. Attendance at these meetings may take place at a time beyond the estimated completion date for this subtask.	20	4 /7/80
Conduct a design audit, at the A&E's office, of the Category I structures, and make one site visit. The purpose of the site visit is to familiarize the contractor with the structures. The audit shall be based on the existing Audit Guidelines used by the staff on previous occasions and modified for this task by the contractor as needed. During the audit structural design calculations of key structures selected by the contractor and approved by the staff shall be reviewed in detail. It is estimated that the audit will last one week.	30	5/18/8~~1~~0

SUBTASKS	Estimated Man-Days	Estimated Completion Date
Perform a confirmatory, independent structural analysis of the facility containment structure and one other Category I structure selected by the NRC staff. The analytical procedure shall be performed on the basis of the A&E's up-to-date design drawings, the loading information and the current staff criteria. The appropriate seismic input shall be obtained from the applicant applied at the base of the foundation in the form of time history from which the contractor will develop floor response spectra at different elevations using the criteria contained in section 3.7 of the Standard Review Plan (SRP). The structural analysis for all applicable loads including seismic shall be performed using the criteria contained in Section 3.8.1 (containment structure), 3.8.4 (structures other than containment) and 3.8.5 (foundations) of the SRP, and the current branch positions. As noted in Regulatory Guide 1.142, ACI-349 code supplemented by the Regulatory Guide 1.142 may be used in lieu of section 3.8.4 of the SRP. On the basis of the analysis the contractor is expected to assess the safety of the structures and specify the available margins of safety.	160	1/31/81

TASK 2: Waterford 3

Estimated Level of Effort
FY 80: 6 1/2 man-months
FY 81: 6 1/2 man-months

The contractor shall perform a license review and evaluation of Category I Structures covered by SRP Sections 3.3, 3.4, 3.5.3, 3.7 and 3.8.

SUBTASKS	Estimated Man-Days	Estimated Completion Date
Review and evaluate material covered in the above sections of the SAR in accordance with acceptance criteria contained in the related SRPs. Prepare input for a draft SER and identify open issues and sections of the SAR where additional information is needed from the applicant.	60	10/27/80
Discuss the draft SER with the SEB staff, participate in meetings with the applicant and the SEB staff to resolve open issues and assess additional information submitted by the applicant, and prepare input for a final SER.	10	11/1/80
Prepare input to SER supplement. Attend ACRS meetings and licensing board hearings as needed to assist the staff in explaining the bases for conclusions and positions reached in the SER. Attendance at these meetings may take place at a time beyond the estimated completion date for this subtask.	20	1/7/80
Conduct a design audit, at the A&E's office, of the Category I structures, and make one site visit. The purpose of the site visit is to familiarize the contractor with the structures. The audit shall be based on the existing Audit Guidelines used by the staff on previous occasions and modified for this task by the contractor as needed. During the audit structural design calculations of key structures selected by the contractor and approved by the staff shall be reviewed in detail. It is estimated that the audit will last one week.	30	3 /18/80

SUBTASKS	Estimated Man-Days	Estimated Completion Date
Perform a confirmatory, independent structural analysis of the facility containment structure and one other Category I structure selected by the NRC staff. The analytical procedure shall be performed on the basis of the A&E's up-to-date design drawings, the loading information and the current staff criteria. The appropriate seismic input shall be obtained from the applicant applied at the base of the foundation in the form of time history from which the contractor will develop floor response spectra at different elevations using the criteria contained in section 3.7 of the Standard Review Plan (SRP). The structural analysis for all applicable loads including seismic shall be performed using the criteria contained in Section 3.8.1 (containment structure), 3.8.4 (structures other than containment) and 3.8.5 (foundations) of the SRP, and the current branch positions. As noted in Regulatory Guide 1.142, ACI-349 code supplemented by the Regulatory Guide 1.142 may be used in lieu of section 3.8.4 of the SRP. On the basis of the analysis the contractor is expected to assess the safety of the structures and specify the available margins of safety.	160	11/31/81

TASK 3: Comanche Peak

Estimated Level of Effort
FY 80: 9 man-months
FY 81: 4 man-months

The contractor shall perform a license review and evaluation of Category I Structures covered by SRP Sections 3.3, 3.4, 3.5.3, 3.7 and 3.8.

SUBTASKS	Estimated Man-Days	Estimated Completion Date
Review and evaluate material covered in the above sections of the SAR in accordance with acceptance criteria contained in the related SRPs. Prepare input for a draft SER and identify open issues and sections of the SAR where additional information is needed from the applicant.	60	6/1/80
Discuss the draft SER with the SEB staff, participate in meetings with the applicant and the SEB staff to resolve open issues and assess additional information submitted by the applicant, and prepare input for a final SER.	10	6/15/80
Prepare input to SER supplement. Attend ACRS meetings and licensing board hearings as needed to assist the staff in explaining the bases for conclusions and positions reached in the SER. Attendance at these meetings may take place at a time beyond the estimated completion date for this subtask.	20	10/4/80
Conduct a design audit, at the A&E's office, of the Category I structures, and make one site visit. The purpose of the site visit is to familiarize the contractor with the structures. The audit shall be based on the existing Audit Guidelines used by the staff on previous occasions and modified for this task by the contractor as needed. During the audit structural design calculations of key structures selected by the contractor and approved by the staff shall be reviewed in detail. It is estimated that the audit will last one week.	30	9/16/80

SUBTASKS	Estimated Man-Days	Estimated Completion Date
Perform a confirmatory, independent structural analysis of the facility containment structure and one other Category I structure selected by the NRC staff. The analytical procedure shall be performed on the basis of the A&E's up-to-date design drawings, the loading information and the current staff criteria. The appropriate seismic input shall be obtained from the applicant applied at the base of the foundation in the form of time history from which the contractor will develop floor response spectra at different elevations using the criteria contained in section 3.7 of the Standard Review Plan (SRP). The structural analysis for all applicable loads including seismic shall be performed using the criteria contained in Section 3.8.1 (containment structure), 3.8.4 (structures other than containment) and 3.8.5 (foundations) of the SRP, and the current branch positions. As noted in Regulatory Guide 1.142, ACI-349 code supplemented by the Regulatory Guide 1.142 may be used in lieu of section 3.8.4 of the SRP. On the basis of the analysis the contractor is expected to assess the safety of the structures and specify the available margins of safety.	160	6/1/81

LEVEL OF EFFORT AND PERIOD OF PERFORMANCE

The estimated level of effort is 4 man years over a two year period from acceptance of this work order.

REPORTING REQUIREMENTS

Upon the completion of each subtask of each task the contractor will provide the cognizant NRC Branch Chief with a letter report which includes (as appropriate) recommended requests for additional information, safety evaluation report input, supplemental safety report input, independent analysis results, and other related technical documents.

A monthly business report is to be submitted by the 20th of the month to cognizant Branch Chief with a copy to the Director, Division of Systems Safety (Attn: B. L. Grenier). These reports will contain:

-- A listing of efforts completed during the period, milestones reached or, if missed, an explanation.

-- The amount of funds expended during the period and cumulated to date, by engineer, and totaled.

-- Any problems or delays encountered or anticipated.

-- A summary of the progress to date and plans for the next reporting period.

-- The first monthly report, after acceptance of NRC Form 173, should contain the planned monthly rate of expenditure based upon the funds authorized.

A suggested form for the report is available in the branch.

MEETINGS AND TRAVEL

The contractor may be required to attend guidance sessions at the NRC Headquarters in Bethesda, Maryland, for approximately seven (7) days during the first month of the contract. In addition, one two-day meeting each month should be planned between the NRC staff and the contractor staff to discuss work progress and to meet with applicants. One site visit and a two-week period design audit for each (OL) case review task is anticipated.

NRC FURNISHED MATERIALS

The NRC will provide one copy of the Safety Analysis Report (or selected portions thereof), SAR amendments, and other related documentation for each of the applications identified herein.

BILLING REQUIREMENTS

Vouchers submitted for payment should list expenditures for manpower and any other major items of expenditures for each task. This information on expenditures by task must be gathered by the NRC as a legal requirement to properly assess licensing fees to utilities.

Director, Division of Contracts

DISTRIBUTION:
Central File F. Schauer
NRR Rdg. File F. Rinaldi
R. Mattson Rdg. File R. Lipinski
DSS CON File (Grenier)
J. Knight
P. Triplett (w/o attmt)
~~D. Dandois, GCN (w/o attmt)~~
T. Murley, RES
G. Arlotto, SD
D. Eisenhut, DOR

Part IV - Attachments

☐ Statement of Work (Attachment No. ____)

☐ Evaluation criteria and their numerical weights (Attachment No. ____)

☐ List of firms to be invited to submit proposals in addition to general public notification (Attachment No. ____)

☐ Copy of letter designating Source Evaluation Panel members (Attachment No. ______)

☐ Sole Source Justification, if applicable. (Attachment No. ____)

☐ Unsolicited Proposal Justification, if applicable. Approval and execution of a contract with ________________________ on
Name of Proposer
the basis of an unsolicited proposal is recommended. (Attachment No. ___)

☐ Contract Review Board Certifications (Attachment No. ____)

☐ Special Requirements* (Attachment No. _____)

Original signed by
F. Schroeder

Roger J. Mattson, Director
Division of Systems Safety

DSS:SEB
FRinaldi
12/5/79

DSS:SEB
DJeng
12/6/79

OFFICE ▶	DSS:SEB	DSS:AD/E	DSS	NRR 12/14	DSS	DSS
SURNAME ▶	FSchauer	JPKnight	BLGrenier	HBarkow ~~PTriplett~~	FSchroeder	RJMattson
DATE ▶	12/9/79	12/10/79	12/17/79	12/ /79	12/17/79	12/17/79

NRC FORM 318 (9-76) NRCM 0240

☆U.S. GOVERNMENT PRINTING OFFICE: 1979-289-369

NRC FORM 255
(10-76)

CONTRACT NUMBER Frank Rinaldi

NRC-03-80-109

MODIFICATION NUMBER

N/A

☒ NEW ☐ MODIFICATION

OTHER (Specify)

DIVISION OF CONTRACTS
U.S. NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

NOTIFICATION OF CONTRACT EXECUTION

TO: Roger J. Mattson, Director
(Title)

Division of Systems Safety
(Organization)

CONTRACT BASED ON:
AUTHORIZATION NUMBER

RFPA No. NRR-109

DATE

12/17/79

FROM: William B. Menczer William B. Menczer FEB 28 1980
(Contract Specialist) (Date)

Technical Assistance Contracts Branch

DIVISION OF CONTRACTS, ADM

CONTRACT CHANGES PER THIS ACTION:

CONTRACTOR (Name & Location)
U.S. Naval Surface Weapons Center
Silver Spring, MD

EXECUTION DATE
2/19/80

TYPE OF CONTRACT
Cost

PROJECT TITLE
"Structural Engineering Case Reviews II"

PERIOD OF PERFORMANCE
2/19/80 - 2/18/82

PRINCIPAL INVESTIGATOR

NRC AUTHORIZED REPRESENTATIVE
Franz Schauer

FUNDING	B&R NUMBER 20-19-05-15	FIN NUMBER B-6878	AMOUNT
	NEW NRC FUNDS		$ 60,000.00
	TOTAL FY ~~XX~~ 80 FUNDING		$ 60,000.00
	TOTAL NRC OBLIGATIONS		$ 60,000.00

GOVERNMENT PROPERTY

ATTACHMENT(S):
CONTRACT DOCUMENT NRC-03-80-109

NRC FORM 255
(10-76)

Rinaldi depo Ex 14
1-6-81 CAB

ARTICLE XII

BILLING INSTRUCTIONS FOR NRC COST-TYPE CONTRACTS

General. The contractor shall submit vouchers for cost-reimbursement in the manner and format described herein and as illustrated in the sample voucher.

Form. Claims shall be submitted on the payee's letterhead, invoice or on the Government Standard Form 1034, "Public Voucher for Purchases and Services Other Than Personal," and "Standard Form 1035, Public Voucher for Purchases Other Than Personal - Continuation Sheet." These forms are available from the Government Printing Office, 710 North Capitol Street, Washington, DC 20801.

Number of Copies. An original and six copies should be mailed to the NRC offices identified below.

Frequency. The contractor shall submit claims for reimbursement once each month unless otherwise authorized by the Contracting Officer.

Billing of Costs After Expiration of Contract. If cost-reimbursements are incurred during the contract period and claimed after the contract has expired, the period during which these costs were incurred must be cited.

Currency. Billings may be expressed in the currency normally used by the contractor in maintaining his accounting records; payments will be made in that currency. However, the U.S. dollar equivalent for all invoices paid under the contract may not exceed the total U.S. dollars authorized in the contract.

Supersession. These instructions supersede all previous billing instructions.

Preparation and Itemization of the Voucher. The contractor shall furnish the information set forth in the explanatory notes below. These notes are keyed to the entries on the sample voucher.

(a) Payor's Name and Address. (i) Address the original voucher (with copies) to: U.S. Nuclear Regulatory Commission, Division of Accounting, Office of the Controller, ATTN: GOV/COM Accounts Section, Washington, DC 20555.

(b) Voucher Number. Insert the appropriate serial number of the voucher. This is to be in sequential order beginning with 001 as the number to be used for the first voucher submitted under this contract.

(c) Date of Voucher. Insert the date the voucher is prepared.

(d) Contract Number and Date. Insert the contract number and the date of the contract.

(e) Payee's Name and Address. Show the name of the contractor as it appears in the contract and its correct address; except when an approved assignment has been made by the contractor, or a different payee has been designated, then insert the name and address of the payee.

(f) Contract Amount. Insert the total estimated cost of the contract, exclusive of fixed-fee. For incrementally funded contracts enter the amount currently obligated and available for payment.

(g) Fixed Fee. Insert total fixed-fee (where applicable).

(h) Billing Period. Insert the beginning and ending dates (day, month, and year) of the period in which costs were incurred and for which reimbursement is claimed.

(i) Direct Costs. Insert the major cost elements

(i)(1) Direct Labor. This consists of salaries and wages paid (or accrued) for direct performance of the contract.
(i)(2) Fringe Benefits. This represents fringe benefits applicable to direct labor and billed as a direct cost. Fringe benefits included in direct costs should not be identified here.
(i)(3) Capitalized Nonexpendable Equipment. For educational institutions list each item costing $1,000. or more; for contractors other than educational institutions list each item costing $200. or more and having a life expectancy of more than one year. List only those items of equipment for which reimbursement is requested. A reference shall be made to the following (as applicable): (1) the item number for the specific piece of equipment listed in the Property Schedule; (2) the Contracting Officer's Approval Letter, if the equipment covered by the Property Schedule; or (3) be preceded by an asterisk (*) if the equipment is below the approval level. Further itemization of vouchers shall only be required for items having specific limitations set forth in the contract.
(i)(4) Materials, Supplies, and Noncapitalized Equipment. This is consumable materials and supplies and equipment other than that described in (i)(3) above.
(i)(5) Premium Pay. This is remuneration in excess of the basic hourly rate.
(i)(6) Consultants' Fee. These are fees paid to consultants.
(i)(7) Travel. Domestic travel is travel within the United States, its territories, possessions, and Canada; it should be billed

separately from foreign travel.
(i)(8) Other. List all other direct costs in total unless significant in amount. If significant, list cost elements and dollar amount separately, e.g., subcontracts.

(j) Indirect Costs--Overhead. Cite the formula (rate and base) in effect during the time the cost was incurred and for which reimbursement is claimed.

(k) Fixed-Fee. If the contract provides for a fixed-fee, it must be claimed as provided for by the contract. Cite the formula or method of computation.

(l) Amount Billed for Current Period. Insert the amount billed for the major cost elements, adjustment, and adjusted amounts for the period.

(m) Cumulative amount from Inception to Date of this Billing. Insert the cumulative amounts billed for the major cost elements and adjusted amounts claimed during this contract.

(n) Total Amounts Claimed. Insert the total amounts claimed for the current and cumulative periods.

(o) Adjustments. This includes amounts conceded by the contractor, outstanding suspensions, and disapprovals subject to appeal.

(p) Grand Totals.

SAMPLE VOUCHER

(a) Payor's Name and Address The U. S. Nuclear Regulatory Commission Division of Accounting, CON Attention: Gov/Com Accts Section Washington, DC 20555	(b) Voucher No. (c) Date Voucher Prepared (d) Contract No. and Date
(e) Payee's Name and Address ABC CORPORATION 100 Main Street Anywhere, U.S.A. "or" The National Bank, Anywhere, U.S.A. Assignee for ABC Corporation Anywhere, U.S.A. (When Payments are Assigned)	(f) Total Estimated Cost of Contract (g) Total Fixed-Fee

(h) This voucher represents reimburseable costs from July 1, 1977 through July 31, 1978

	(l) Amount Billed for Current Period	(m) Cumulative Amount From Inception to Date of this Billing
(i) Direct Costs		
(i)(1) Direct Labor	$ 3,400	$ 6,800
(i)(2) Fringe Benefits	600	1,200
(i)(3) Capitalized Nonexpendable Equipment	5,000	8,000
(i)(4) Materials, Supplies and Noncapitalized Equipment	2,000	4,000
(i)(5) Premium Pay	100	150
(i)(6) Consultant's Fee	100	100
(i)(7) Travel — Domestic	200	200
Foreign	200	200
(i)(8) Other	-0-	-0-
Total Direct Costs	$11,600	$20,650
(j) INDIRECT COSTS		
________% of Direct Labor or Other Base (Formula)	4,000	6,000
(k) FIXED-FEE EARNED (Formula)	700	1,400
(n) Total Amounts Claimed	$16,300	$28,050
(o) Adjustments		
Outstanding Suspensions		(1,700)
(p) Grand Totals	$16,300	$26,350

Consumers
Power
Company

James W Cook
Vice President – Projects, Engineering
and Construction

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

November 26, 1980

Robert L Tedesco
Assistant Director for Licensing
Division of Licensing
US Nuclear Regulatoy Commission
Washington, DC 20555

MIDLAND PROJECT
NRC REVIEW OF SEISMIC AND
STRUCTURAL DESIGN CALCULATIONS
FILE: 0460.2 UFI: 73*60 SERIAL: 10109

We have reviewed the NRC questions and guidelines preparatory to an NRC staff audit of major Midland safety-related structures which were provided to us with the NRC's correspondence of July 7, 1980.

We note that this "audit" has been structured as a very comprehensive review of the Midland safety grade structures which will require considerable preparation and resources by both the NRC and applicant. We recommend, therefore, that this effort be considered an integral part of the FSAR review and safety evaluation report preparations. We believe this approach will meet NRC staff management concerns on the efficient utilization of resources and assist in the timely completion of the licensing review process. We request the NRC staff to work with us to make this activity serve this dual purpose.

We suggest as a starting point that the following NRC open items could be integrated into this NRC review and resolved:

o CSB 4 External Containment Pressure Analysis
(NRC Questions 022.29, 022.46/FSAR Section 6.2)

o MEB (M) 1 Containment Liner and Penetration Structural Integrity
(FSAR Table 3.8-36)

o SEB 2 Adequacy of Containment Using ACI 359 Loads
(NRC Questions 130.22, 130.17)

o SEB 3 Adequacy of Category I Structures to ACI 318 Code
(NRC Questions 130.23, 130.16)

o SEB 4 Floor Response Spectra
(NRC Questions 130.24, 130.18/FSAR Section 3.7)

We invite the staff to add or delete open issues to the above list which could be targeted for resolution as part of the structural review.

As requested by the NRC's correspondence, we plan to prepare a comprehensive written response to all questions and to have backup data available for the NRC team's review. Backup data will include such items as appropriate sections of the FSAR, portions of the civil/structural design criteria, drawings, and typical calculations.

Guideline questions were reviewed and categorized, and a preliminary estimate was made of the engineering manhours required to prepare for and undergo the audit envisioned in the the NRC letter. Based on present estimates it is anticipated that approximately 12,000 engineering manhours will be required to prepare for and undergo the audit. We find that this amount of preparatory work is consistent with that of other licensees which the NRC has reviwed. Our schedule of this effort indicates that we will be ready after April 1, 1980. We recommend, therefore, that the audit should be scheduled for the week of April 6 through April 10, 1981, beginning at 9:00 am on April 6.

We can accommodate the need for access to available design information and the need for an open meeting by holding this meeting in the first floor conference room in Bechtel Power Corporation's Ann Arbor engineering offices. As requested we will work through the NRC Licensing Project Manager to complete the details of these arrangements.

James W. Cook

JWC/RLT/cr

CC LHCurtis
RJCook, Midland Resident Inspector
DFJudd

FED 4 [illegible]

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

JAN 2 5 1980

Commander
ATTN: CR-15
U.S. Naval Surface Weapons Center
White Oak Laboratory
Silver Spring, MD 20910

Gentlemen:

Subject: Interagency Agreement No. NRC-03-80-109

Pursuant to the authority contained in the Economy Act of 1932, as amended, 31 USC 686, the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Naval Surface Weapons Center (NSWC) desire to enter into a cooperative agreement whereby NSWC will provide technical assistance in the conduct of licensing review of operating license applications.

Accordingly, the Parties hereto mutually agree to the following terms of this agreement:

I <u>Period of Performance</u>

The period of performance shall be from the effective date of the agreement through twenty-four (24) months thereafter.

II <u>Statement of Work</u>

Work performed under this agreement shall be in accordance with Attachment I which is attached and made a part hereof.

III <u>Estimate of Cost</u>

The estimated cost of the effort described in paragraph II above is $300,000. The NSWC shall provide within thirty (30) days of the date of this agreement a detailed cost estimate for the work described in Article II, above, which may result in a reduction in the total estimated cost of the agreement.

IV <u>Obligation of Funds</u>

The amount presently obligated hereunder for the effort described is $60,000, chargeable to the following B&R and FIN:

<u>B&R</u>: 20-19-05-15 <u>FIN</u>: B-6878

Additional obligations to cover the remainder of costs will be provided through unilateral modifications to this agreement, subject to the availability of funds, until such obligations equal the estimated cost in III above.

V Billing Instructions

NSWC, to receive reimbursement for costs incurred, shall submit invoices in accordance with Attachment II, Billing Instructions for NRC Cost-Type Contracts, which is attached and made a part hereof.

VI Advance Notification

Whenever NSWC has reason to believe that the total cost of the work under this agreement will be substantially greater or less than the presently estimated cost of the work or whenever NSWC expects to incur costs in excess of the funds presently obligated, NSWC shall promptly notify NRC in writing. When the costs incurred equal 100% of such estimated total costs, NSWC shall not incur costs in excess of the estimated cost.

VII NRC Contacts

Technical Contact: The NRC technical contact for the work hereunder is Mr. Frank Rinaldi, Division of Systems Safety, telephone number (301) 492-7807.

Contracts Contact: The NRC contact is Mr. William B. Menczer, telephone number (301) 427-4480.

If this agreement is acceptable to NSWC, please so indicate by signing in the space below and returning two (2) signed copies to me. The third signed copy is for your records.

Sincerely,

D J Dougherty

D. J. Dougherty, Chief
Technical Assistance Contracts Branch
Division of Contracts
Office of Administration

ACCEPTED:

BY: ______________________
M. BROWN
TITLE: By direction
DATE: 19 FEB 1980

Acceptance on a Reimbursable Basis

STATEMENT OF WORK

TITLE: Structural Engineering Case Reviews (V)

FIN: B6579

B&R NUMBER: 20-19-05-15

TECHNICAL MONITOR: F. Rinaldi

COGNIZANT BRANCH CHIEF: F. P. Schauer (FTS 492-7807)

BACKGROUND INFORMATION.

Applicants seeking to construct and operate nuclear power plants must submit to NRC for review and evaluation documentation consisting of a Preliminary Safety Analysis Report (PSAR) and a Final Safety Analysis Report (FSAR).

The safety review and evaluation process is conducted in two phases: (1) At the PSAR stage the applicant describes and discusses the general layout of Category I structures and systems, basic design codes and criteria to be used, analysis and design procedures to be adopted, and technical information needed for showing compliance to applicable NRC regulations and design criteria. On completion of the PSAR review, evaluation, and approval, the applicant receives a Construction Permit (CP) which enables him to start plant construction; (2) At the FSAR stage the applicant describes in detail and with more specific engineering data the design calculations and details of all Category I structures, systems and components. Demonstration of compliance to appliable NRC regulations and requirements in all aspects of design, analysis, fabrication, and erection of Category I structures and systems is a prerequisite for NRC staff approval of the FSAR. On completion of the FSAR review, evaluation, and approval, the applicant receives an Operating License (OL) for commercial plant operation.

In addition to the above, safety reviews are also conducted on various standard plant designs in accordance with the Commission's standardization policy. The two types most commonly reviewed are: (1) a standard nuclear steam supply system plant design submitted by a Nuclear Steam Supply System (NSSS) vendor, and (2) a standard Balance of Plant (BOP) design submitted by an utility applicant or an architect-engineer firm. The reviews of these applications are carried out in the same manner as previously described except for the identification of system interface requirements which require staff review to assure consistency between the NSSS and the BOP.

PURPOSE OF PROGRAM

The objective of this agreement is to obtain expert technical personnel of the contractor to assist the Structural Engineering Branch, DSS, in its licensing review of Operating License (OL) applications.

GENERAL REQUIREMENTS

The reviews are to be conducted using the guidance contained in regulatory guides, applicable codes and standards, and the guidance and acceptance criteria found in the Standard Review Plans (SRPs).in the areas of SEB responsibility. The contractor will generally follow the approach outlined below in conducting reviews and evaluations.

-- Recommend requests for additional information or clarification based upon initial review and evaluation of the information provided by the applicants.

-- Evaluate the responses provided by the applicants.

-- Attend meetings with the staff, applicants, and their architect-engineer to discuss and resolve outstanding issues.

-- Perform independent structural and seismic analysis of key Category I structures and compare the analytical results obtained with those of the PSAR/FSAR's.

-- Participate with the NRC staff coordinator(s) in implementing a Structural Design, Analysis and Construction Audit at the applicants' engineering offices.

-- Propose specific solutions/acceptance criteria for outstanding issues identified in the reviews. The solutions proposed can be different from the acceptance criteria of the SRP's as long as design adequacy of Category I structures and systems can be assured or demonstrated by the solution.

-- Prepare Safety Evaluation Reports (SERs) which describe the evaluation of the design and analysis of the applicants' Category I structures and systems.

-- Attend meetings with the Advisory Committee on Reactor Safeguards (ACRS) and public hearings, on an as-needed basis, to assist the staff in explaining bases for conclusions and positions reached in the SER.

-- Prepare input to SER Supplements which further clarify and document Category I structural evaluations in the SER based upon review by the ACRS.

-- Perform plant inspection trips with NRC staff coordinator(s) on an as-needed basis.

TASK 1: Midland

Estimated Level of Effort
FY 80: 4 man-months
FY 81: 9 man-months

The contractor shall perform a license review and evaluation of Category I Structures covered by SRP Sections 3.3, 3.4, 3.5.3, 3.7 and 3.8.

	Estimated Man-Days	Estimated Completion Date
SUBTASKS		
Review and evaluate material covered in the above sections of the SAR in accordance with acceptance criteria contained in the related SRPs. Prepare input for a draft SER and identify open issues and sections of the SAR where additional information is needed from the applicant.	60	3/8/80
Discuss the draft SER with the SEB staff, participate in meetings with the applicant and the SEB staff to resolve open issues and assess additional information submitted by the applicant, and prepare input for a final SER.	10	4/1/80
Prepare input to SER supplement. Attend ACRS meetings and licensing board hearings as needed to assist the staff in explaining the bases for conclusions and positions reached in the SER. Attendance at these meetings may take place at a time beyond the estimated completion date for this subtask.	20	6/15/80
Conduct a design audit, at the A&E's office, of the Category I structures, and make one site visit. The purpose of the site visit is to familiarize the contractor with the structures. The audit shall be based on the existing Audit Guidelines used by the staff on previous occasions and modified for this task by the contractor as needed. During the audit structural design calculations of key structures selected by the contractor and approved by the staff shall be reviewed in detail. It is estimated that the audit will last one week.	30	5/18/81

SUBTASKS	Estimated Man-Days	Estimated Completion Date
Perform a confirmatory, independent structural analysis of the facility containment structure and one other Category I structure selected by the NRC staff. The analytical procedure shall be performed on the basis of the A&E's up-to-date design drawings, the loading information and the current staff criteria. The appropriate seismic input shall be obtained from the applicant applied at the base of the foundation in the form of time history from which the contractor will develop floor response spectra at different elevations using the criteria contained in section 3.7 of the Standard Review Plan (SRP). The structural analysis for all applicable loads including seismic shall be performed using the criteria contained in Section 3.8.1 (containment structure), 3.8.4 (structures other than containment) and 3.8.5 (foundations) of the SRP, and the current branch positions. As noted in Regulatory Guide 1.142, ACI-349 code supplemented by the Regulatory Guide 1.142 may be used in lieu of section 3.8.4 of the SRP. On the basis of the analysis the contractor is expected to assess the safety of the structures and specify the available margins of safety.	160	1/31/81

TASK 2: Waterford 3

Estimated Level of Effort
FY 80: 6 1/2 man-months
FY 81: 6 1/2 man-months

The contractor shall perform a license review and evaluation of Category I Structures covered by SRP Sections 3.3, 3.4, 3.5.3, 3.7 and 3.8.

SUBTASKS	Estimated Man-Days	Estimated Completion Date
Review and evaluate material covered in the above sections of the SAR in accordance with acceptance criteria contained in the related SRPs. Prepare input for a draft SER and identify open issues and sections of the SAR where additional information is needed from the applicant.	60	10/27/80
Discuss the draft SER with the SEB staff, participate in meetings with the applicant and the SEB staff to resolve open issues and assess additional information submitted by the applicant, and prepare input for a final SER.	10	11/1/80
Prepare input to SER supplement. Attend ACRS meetings and licensing board hearings as needed to assist the staff in explaining the bases for conclusions and positions reached in the SER. Attendance at these meetings may take place at a time beyond the estimated completion date for this subtask.	20	4/7/80
Conduct a design audit, at the A&E's office, of the Category I structures, and make one site visit. The purpose of the site visit is to familiarize the contractor with the structures. The audit shall be based on the existing Audit Guidelines used by the staff on previous occasions and modified for this task by the contractor as needed. During the audit structural design calculations of key structures selected by the contractor and approved by the staff shall be reviewed in detail. It is estimated that the audit will last one week.	30	7/18/80

SUBTASKS	Estimated Man-Days	Estimated Completion Date
Perform a confirmatory, independent structural analysis of the facility containment structure and one other Category I structure selected by the NRC staff. The analytical procedure shall be performed on the basis of the A&E's up-to-date design drawings, the loading information and the current staff criteria. The appropriate seismic input shall be obtained from the applicant applied at the base of the foundation in the form of time history from which the contractor will develop floor response spectra at different elevations using the criteria contained in section 3.7 of the Standard Review Plan (SRP). The structural analysis for all applicable loads including seismic shall be performed using the criteria contained in Section 3.8.1 (containment structure), 3.8.4 (structures other than containment) and 3.8.5 (foundations) of the SRP, and the current branch positions. As noted in Regulatory Guide 1.142, ACI-349 code supplemented by the Regulatory Guide 1.142 may be used in lieu of section 3.8.4 of the SRP. On the basis of the analysis the contractor is expected to assess the safety of the structures and specify the available margins of safety.	160	11/31/81

TASK 3: Comanche Peak

Estimated Level of Effort
FY 80: 9 man-months
FY 81: 4 man-months

The contractor shall perform a license review and evaluation of Category I Structures covered by SRP Sections 3.3, 3.4, 3.5.3, 3.7 and 3.8.

SUBTASKS	Estimated Man-Days	Estimated Completion Date
Review and evaluate material covered in the above sections of the SAR in accordance with acceptance criteria contained in the related SRPs. Prepare input for a draft SER and identify open issues and sections of the SAR where additional information is needed from the applicant.	60	6/1/80
Discuss the draft SER with the SEB staff, participate in meetings with the applicant and the SEB staff to resolve open issues and assess additional information submitted by the applicant, and prepare input for a final SER.	10	6/15/80
Prepare input to SER supplement. Attend ACRS meetings and licensing board hearings as needed to assist the staff in explaining the bases for conclusions and positions reached in the SER. Attendance at these meetings may take place at a time beyond the estimated completion date for this subtask.	20	10/4/80
Conduct a design audit, at the A&E's office, of the Category I structures, and make one site visit. The purpose of the site visit is to familiarize the contractor with the structures. The audit shall be based on the existing Audit Guidelines used by the staff on previous occasions and modified for this task by the contractor as needed. During the audit structural design calculations of key structures selected by the contractor and approved by the staff shall be reviewed in detail. It is estimated that the audit will last one week.	30	9/16/80

SUBTASKS	Estimated Man-Days	Estimated Completion Date
Perform a confirmatory, independent structural analysis of the facility containment structure and one other Category I structure selected by the NRC staff. The analytical procedure shall be performed on the basis of the A&E's up-to-date design drawings, the loading information and the current staff criteria. The appropriate seismic input shall be obtained from the applicant applied at the base of the foundation in the form of time history from which the contractor will develop floor response spectra at different elevations using the criteria contained in section 3.7 of the Standard Review Plan (SRP). The structural analysis for all applicable loads including seismic shall be performed using the criteria contained in Section 3.8.1 (containment structure), 3.8.4 (structures other than containment) and 3.8.5 (foundations) of the SRP, and the current branch positions. As noted in Regulatory Guide 1.142, ACI-349 code supplemented by the Regulatory Guide 1.142 may be used in lieu of section 3.8.4 of the SRP. On the basis of the analysis the contractor is expected to assess the safety of the structures and specify the available margins of safety.	160	6/1/81

LEVEL OF EFFORT AND PERIOD OF PERFORMANCE

The estimated level of effort is 4 man years over a two year period from acceptance of this work order.

REPORTING REQUIREMENTS

Upon the completion of each subtask of each task the contractor will provide the cognizant NRC Branch Chief with a letter report which includes (as appropriate) recommended requests for additional information, safety evaluation report input, supplemental safety report input, independent analysis results, and other related technical documents.

A monthly business report is to be submitted by the 20th of the month to cognizant Branch Chief with a copy to the Director, Division of Systems Safety (Attn: B. L. Grenier). These reports will contain:

-- A listing of efforts completed during the period, milestones reached or, if missed, an explanation.

-- The amount of funds expended during the period and cumulated to date, by engineer, and totaled.

-- Any problems or delays encountered or anticipated.

-- A summary of the progress to date and plans for the next reporting period.

-- The first monthly report, after acceptance of NRC Form 173, should contain the planned monthly rate of expenditure based upon the funds authorized.

A suggested form for the report is available in the branch.

MEETINGS AND TRAVEL

The contractor may be required to attend guidance sessions at the NRC Headquarters in Bethesda, Maryland, for approximately seven (7) days during the first month of the contract. In addition, one two-day meeting each month should be planned between the NRC staff and the contractor staff to discuss work progress and to meet with applicants. One site visit and a two-week period design audit for each (OL) case review task is anticipated.

NRC FURNISHED MATERIALS

The NRC will provide one copy of the Safety Analysis Report (or selected portions thereof), SAR amendments, and other related documentation for each of the applications identified herein.

BILLING REQUIREMENTS

Vouchers submitted for payment should list expenditures for manpower and any other major items of expenditures for each task. This information on expenditures by task must be gathered by the NRC as a legal requirement to properly assess licensing fees to utilities.

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

DEC 19 1980

MEMORANDUM FOR: Frank Rinaldi, Structural Engineering Branch, DE

FROM: Darl Hood, Licensing Branch #3, DL

SUBJECT: CONSIDERATION OF RELATED OPEN AND NEW ITEMS FOR THE MIDLAND STRUCTURAL DESIGN AUDIT

The attached letter of November 26, 1980 requests, in essence, that all appropriate outstanding staff requests and open items related to structural integrity be determined and included for resolution as part of the pending structural design audit. There are several such items by technical review branches other than SEB which no doubt could productively be addressed during the structural design audit and resolved. In addition, new structural requirements, such as Emergency Response Facilities, could be included during the audit.

Please advise me whether you agree with this request by Consumer Power Company, and if so what other items should be added to the audit. I shall be happy to assist you in polling other review branches for related inputs should you desire.

My own view is that we should make maximum advantage of this opportunity to resolve all possible structural and structural-related outstanding and new items while this rare collection of personnel and information will be available to us. Of course, structural matters related to soil settlement will have to be segregated out for the modifications hearing which will probably be starting also around April, 1981. I also believe that parallel meetings during the audit can be arranged so that time restraint and excessive manpower problems during the audit can be avoided.

I would appreciate your reply by January 9, 1981 in order that I may reply to Consumer Power Company's suggestion.

Darl Hood

Darl Hood, Project Manager
Licensing Branch #3
Division of Licensing

Enclosure:
11/26/80 letter

cc: See next page.

Rinaldi depo Ex 15
1-6-81

DEC 1 9 1980

cc: F. Schauer
J. Knight
R. Tedesco
W. Paton
G. Lear
W. Haass
S. Pawlicki
W. Butler
R. Bosnak
E. Gallagher
R. Shoemaker
B. Grimes

J. Kane

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

AUG 5 1980

MEMORANDUM FOR: A. Schwencer, Acting Chief
Licensing Branch No. 3
Division of Licensing

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

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

SUBJECT: TRANSMITTAL OF U. S. ARMY CORPS OF ENGINEERS LETTER REPORT - GEOTECHNICAL ENGINEERING REVIEW (TAC NO. 5077)

PLANT NAME: Midland Plants, Units 1 and 2
LICENSING STAGE: Post CP
DOCKET NUMBERS: 50-329/330
RESPONSIBLE BRANCH: Lic. Br. No. 3; D. Hood, LPM
REQUESTED COMPLETION DATE: N/A
REVIEW STATUS: Continuing

The NRC Geotechnical Consultant, Corps of Engineers, Detroit District, has submitted a letter report which summarizes their review efforts to date for the Midland project, identifies unresolved issues and makes recommendations for resolving these matters. The July 7, 1980 letter report was submitted as an enclosure to the July 10, 1980 transmittal letter from Z. Goodwin, Chief, Engr. Div., NCD, COE, to R. Jackson, NRC.

We have reviewed the Corps report and have found it to be a thorough effort in identifying the problem areas including specific requests for the information needed to resolve the identified matters. The Corps report should assist NRC in preparation for upcoming safety hearings.

Rinaldi depo Ex 16
1-6-81 CRB

We request that the contents of the July 7, 1980 letter report (enclosure 1) from the Corps be submitted to Consumers Power Company (CPCo) for their response. In addition, we request that enclosure 2 also be provided to CPCo as a supplement to the letter report. Enclosure 2 clarifies certain issues identified in the Corps report and is based on the comments by various reviewers in NRC Branches (MEB, SEB, GSB and HGEB) who are involved in areas of interface review responsibility.

Coordination of the internal NRC comments and Enclosure 2 was completed by J. Kane, GES, HGEB.

Lyman W. Heller
for George Lear, Chief
Hydrologic and Geotechnical
Engineering Branch
Division of Engineering

Enclosures:
1. July 7, 1980 Ltr Report from COE
2. Suppl. to COE July 7, 1980 Ltr Report

cc w/o encl:
R. Vollmer
L. Reiter
R. McMullen

w/encl 2:
R. Jackson
R. Gonzales
F. Rinaldi
A. Cappucci
W. Lawhead, COE

w/encls 1 & 2:
J. Knight
G. Lear
L. Heller
W. Bivins
D. Hood
E. Gallagher, IE, Region III
J. Kane
NRC PDR
Local PDR

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

REPLY TO ATTENTION OF

7 JUL 1980

NCEED-T

SUBJECT: Interagency Agreement No. NRC-03-79-167, Task No. 1 - Midland Plant Units 1 and 2, Subtask No. 1 - Letter Report

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

TO: U.S. Nuclear Regulatory Commission
ATTN: Dr. Robert E. Jackson
Division of Systems Safety
Mail Stop P-314
Washington, D. C. 20555

1. The Detroit District hereby submits this letter report with regard to completion of subtask No. 1 of the subject Interagency Agreement concerning the Midland Nuclear Plant, Units 1 and 2. The purpose of this report is to identify unresolved issues and make recommendations on a course of action and/or cite additional information necessary to settle these matters prior to preparation of the Safety Evaluation Report.

2. The Detroit District's team providing geotechnical engineering support to the NRC to date has made a review of furnished documents concerning foundations for structures, has jointly participated in briefing meetings with the NRC staff, Consumers Power Company (the applicant) and personnel from North Central Division of the Corps of Engineers and has made detailed site inspections. The data reviewed includes all documents received through Amendment 78 to the operating license request, Revision 28 of the FSAR, Revision 7 to the 10 CFR 50.54(f) requests and MCAR No. 24 through Interim Report No. 8. Generally, each structure within the complex was studied as a separate entity.

3. A listing of specific problems in review of Midland Units 1 and 2 follows for Category I structures. The issues are unresolved in many instances, because of inadequate or missing information. The structures to be addressed follow the description of the problem.

a. Inadequate presentation of subsurface information from completed borings on meaningful profiles and sectional views. All structures.

Enclosure 1

b. Discrepancies between soil descriptions and classifications on boring logs with submitted laboratory test results summaries. Examples of such discrepancies are found in boring T-14 (Borated water tank) which shows stiff to very stiff clay where laboratory tests indicate soft clay with shear strength of only 500 p.s.f. The log of boring T-15 shows stiff, silty clay, while the lab tests show soft, clayey sand with shear strength of 120 p.s.f. All structures.

c. Lack of discussion about the criteria used to select soil samples for lab testing. Also, identification of the basis for selecting specific values for the various parameters used in foundation design from the lab test results. All structures.

d. The inability to completely identify the soil behavior from lab testing (prior to design and construction) of individual samples, because in general, only final test values in summary form have been provided. All structures.

(1) Lack of site specific information in estimating allowable bearing pressures. Only textbook type information has been provided. If necessary, bearing capacity should be revised based on latest soils data. All structures on, or partially on, fill.

(2) Additional information is needed to indicate the design methods used, design assumptions and computations in estimating settlement for safety related structures and systems. All structures except Diesel Generator Building where surcharging was performed.

e. A complete detailed presentation of foundation design regarding remedial measures for structures undergoing distress is required. Areas of remedial measures except Diesel Generator Building.

f. There are inconsistencies in presentation of seismic design information as affected by changes due to poor compaction of plant fill. Response to NRC question 35 (10 CFR 50.54f) indicates that the lower bound of shear wave velocity is 500 feet per second. We understand that the same velocity will be used to analyze the dynamic response of structures built on fill. However, from information provided by the applicant at the site meeting on 27 and 28 February 1980, it was stated that, except for the Diesel Generator Building, higher shear wave velocities are being used to re-evaluate the dynamic response of the structures on fill material. Structures on fill or partially on fill except Diesel Generator Building.

4. A listing of specific issues and information necessary to resolve them.

a. Reactor Building Foundation

(1) Settlement/Consolidation. Basis for settlement/consolidation of the reactor foundation as discussed in the FSAR assumes the plant site would

not be dewatered. Discuss and furnish computation for settlement of the Reactor Buildings in respect to the changed water table level as the result of site dewatering. Include the effects of bouyancy, which were used in previous calculations, and fluctuations in water table which could happen if the dewatering system became inoperable.

(2) Bearing Capacity. Bearing capacity computations should be provided and should include method used, foundation design, design assumptions, adopted soil properties, and basis for selecting ultimate bearing capacity and resulting factor of safety.

b. Diesel Generator Building.

(1) Settlement/Consolidation. In the response to NRC Question 4 and 27, (10 CFR 50.54f), the applicant has furnished the results of his computed settlements due to various kinds of loading conditions. From his explanation of the results, it appears that compressibility parameters obtained by the preload tests have been used to compute the static settlements. Information pertaining to dynamic response including the amplitude of vibration of generator pedestals have also been furnished. The observed settlement pattern of the Diesel Generator Building indicates a direct correlation with soil types and properties within the backfill material. To verify the preload test settlement predictions, compute settlements based on test results on samples from new borings which we have requested in a separate memo and present the results. Reduced ground water levels resulting from dewatering and diesel plus seismic vibration should be considered in settlement and seismic analysis. Furnish the computation details for evaluating amplitude of vibration for diesel generator pedestals including magnitude of exciting forces, whether they are constant or frequency dependent.

(2) Bearing Capacity. Applicant's response to NRC Question 35 (10 CFR 50.54f) relative to bearing capacity of soil is not satisfactory. Figure 35-3, which has been the basis of selection of shear strength for computing bearing capacity does not reflect the characteristics of the soils under the Diesel Generator Building. A bearing capacity computation should be submitted based on the test results of samples from new borings which we have requested in a separate memo. This information should include method used, foundation design assumptions, adopted soil properties and basis for selection, ultimate bearing capacity and resulting factor of safety.

(3) Preload Effectiveness The effectiveness of the preload should be studied with regard to the moisture content of the fill at the time of preloading. The height of the water table, its time duration at this level, and whether the plant fill was placed wet or dry of optimum would be all important considerations.

(a) Granular Soils.

When sufficient load is applied to granular soils it usually causes a reorientation of grains and movement of particles into more stable positions plus (at high stresses) fracturing of particles at their points of contact. Reorientation and breakage creates a chain reaction among these and adjacent particles resulting in settlement. Reorientation is resisted by friction between particles. Capillary tension would tend to increase this friction. A moisture increase causing saturation, such as a rise in the water table as occurred here, would decrease capillary tension resulting in more compaction. Present a discussion on the water table and capillary water effect on the granular portion of the plant fill both above and below the water table during and after the preload.

(b) Impervious and/or Clay Soils.

Clay fill placed dry of optimum would not compact and voids could exist between particles and/or chunks. In this situation SPT blow counts would give misleading information as to strength. Discuss the raising of the water table and determine if the time of saturation was long enough to saturate possible clay lumps so that the consolidation could take place that would preclude further settlement.

Discuss the preload effect on clay soils lying above the water table (7 feet ±) that were possibly compacted dry of optimum. It would appear only limited consolidation from the preload could take place in this situation and the potential for further settlement would exist.

Discuss the effect of the preload on clays placed wet of optimum. It would appear consolidation along with a gain in strength would take place. Determine if the new soil strength is adequate for bearing capacity.

Conclusion: Since the reliability of existing fill and compaction information is uncertain, additional borings and tests to determine void ratio (granular soils) relative density, moisture content, density, consolidation properties and strength (triaxial tests) would appear to be desirable in order to satisfactorily answer the above questions. Borings should be continuous push with undisturbed cohesive soil samples taken.

(4) Miscellaneous. A contour map, showing the settlement configuration of the Diesel Generator Building, furnished by the applicant at the meeting of 27 and 28 February 1980 indicates that the base of the building has warped due to differential settlements. Additional stresses will be induced in the various components of the structure. The applicant should evaluate these stresses due to the differential settlement and furnish the computations and results for review.

c. Service Water Building Foundation.

(1) Bearing Capacity. A detailed pile design based upon pertinent soil data should be developed in order to more effectively evaluate the proposed pile support system prior to load testing of test piles. Provide adopted soil properties, reference to test data on which they are based, and method and assumptions used to estimate pile design capacity including computations. Provide estimated maximum static and dynamic loads to be imposed and individual contribution (DL, LL, OBE, SSE) on the maximum loaded pile. Provide factor of safety against soil failure due to maximum pile load.

(2) Settlements.

(a) Discuss and provide analysis evaluating possible differential settlement that could occur between the pile supported end and the portion placed on fill.

(b) Present discussion why the retaining wall adjacent to the intake structure is not required to be Seismic Category I structure. Evaluate the observed settlement of both the service water pumphouse retaining walls and the intake structure retaining wall and the significance of the settlement including future settlement prediction on the safe operation of the Midland Nuclear Plant.

(3) Seismic Analysis. Provided the proposed 100 ton ultimate pile load capacities are achieved and reasonable margin of safety is available, the vertical pile support proposed for the overhang section of the Service Water Pump Structure will provide the support necessary for the structure under combined static and seismic inertial loadings even if the soil under the overhang portion of the structure should liquefy. There is no reason to think this won't be achieved at this time, and the applicant has committed to a load test to demonstrate the pile capacity. The dynamic response of the structure, including the inertial loads for which the structure itself is designed and the mechanical equipment contained therein, would change as a result of the introduction of the piles. Therefore:

(a) Please summarize or provide copies of reports on the dynamic analysis of the structure in its old and proposed configuration. For the latter, provide detailed information on the stiffness assigned to the piles and the way in which the stiffnesses were obtained and show the largest change in interior floor vertical response spectra resulting from the proposed modification. If the proposed configuration has not yet been analyzed, describe the analyses that are to be performed giving particular attention to the basis for calculation or selection, of and the range of numerical stiffness values assigned to the vertical piles.

(b) Provide after completion of the new pile foundation, in accordance with commitment No. 6, item 125, Consumers Power Company memorandum dated 13 March 1980, the results of measurements of vertical applied load and absolute pile head vertical deformation which will be made when the structural load is jacked on the piles so that the pile stiffness can be determined and compared to that used in the dynamic analysis.

d. Auxiliary Building Electrical Penetration Areas and Feedwater Isolation Valve Pits.

(1) Settlement. Provide the assumptions, method, computation and estimate of expected allowable lateral and vertical deflections under static and seismic loadings.

(2) Provide the construction plans, and specifications for underpinning operations beneath the Electrical Penetration Area and Feedwater Valve Pit. The requested information to be submitted should cover the following in sufficient details for evaluation:

(a) Details of dewatering system (locations, depth, size and capacity of wells) including the monitoring program to be required, (for example, measuring drawdown, flow, frequency of observations, etc.) to evaluate the performance and adequacy of the installed system.

(b) Location, sectional views and dimensions of access shaft and drift to and below auxiliary building wings.

(c) Details of temporary surface support system for the valve pits.

(d) Dewatering before underpinning is recommended in order to preclude differential settlement between pile and soil supported elements and negative drag forces.

(e) Provide adopted soil properties, method and assumptions used to estimate caisson and/or pile design capacities, and computational results. Provide estimated maximum static and dynamic load (compression, uplift and lateral) to be imposed and the individual contribution (DL, LL, OBE, SSE) on maximum loaded caisson and/or pile. Provide factor of safety against soil failure due to maximum pile load.

(f) Discuss and furnish computations for settlement of the portion of the Auxiliary Building (valve pits, and electrical penetration area) in respect to changed water level as a result of the site dewatering. Include the effect of bouyancy, which was used in previous calculations, and fluctuations in water table which could happen, if dewatering system becomes inoperable.

(g) Discuss protection measures to be required against corrosion, if piling is selected.

(h) Identify specific information, data and method of presentation to be submitted for regulatory review at completion of underpinning operation. This report should summarize construction activities, field inspection records, results of field load tests on caissons and piles and an evaluation of the completed fix for assuring the stable foundation.

e. Borated Water Tanks.

(1) Settlement. The settlement estimate for the Borated Water Storage Tanks furnished by the applicant in response to NRC Question 31 (10 CFR 50.54f) is based upon the results of two plate load tests conducted at the foundation elevation (EL 627.00±) of the tanks. Since a plate load test is not effective in providing information regarding the soil beyond a depth more than twice the diameter of the bearing plate used in the test, the estimate of the settlement furnished by the applicant does not include the contribution of the soft clay layers located at depth more than 5' below the bottom of the tanks (see Boring No. T-14 and T-15, and T-22 thru T-26).

(a) Compute settlements which include contribution of all the soil layers influenced by the total load on the tanks. Discuss and provide for review the analysis evaluating differential settlement that could occur between the ring (foundations) and the center of the tanks.

(b) The bottom of the borated tanks being flexible could warp under differential settlement. Evaluate what additional stresses could be induced in the ring beams, tank walls, and tank bottoms, because of the settlement, and compare with allowable stresses. Furnish the computations on stresses including method, assumptions and adopted soil properties in the analysis.

(2) Bearing Capacity. Laboratory test results on samples from boring T-15 show a soft stratum of soil below the tank bottom. Consideration has not been given to using these test results to evaluate bearing capacity information furnished by the applicant in response to NRC Question 35 (10 CFR 50.54f). Provide bearing capacity computations based on the test results of the samples from relevant borings. This information should include method used, foundation design assumptions, adopted soil properties, ultimate bearing capacity and resulting factor of safety for the static and the seismic loads.

f. Underground Diesel Fuel Tank Foundation Design

(1) Bearing capacity. Provide bearing capacity computation based on the test results of samples from relevent borings, including method used, foundation design assumptions, adopted soil properties, ultimate bearing capacity and the resulting factor of safety.

(2) Provide tank settlement analysis due to static and dynamic loads including methods, assumptions made, etc.

(3) What will be effects of uplift pressure on the stability of the tanks and the associated piping system if the dewatering system becomes inoperable?

g. Underground Utilities:

(1) Settlement

(a) Inspect the interior of water circulation piping with video cameras and sensing devices to show pipe cross section, possible areas of crackings and openings, and slopes of piping following consolidation of the plant fill beneath the imposed surcharge loading.

(b) The applicant has stated in his response to NRC Question 7 (10 CFR 50.54f) that if the duct banks remain intact after the preload program has been completed, they will be able to withstand all future operating loads. Provide the results of the observations made, during the preload test, to determine the stability of the duct banks, with your discussion regarding their reliability to perform their design functions.

(c) The response to Question 17 of "Responses to NRC Requests Regarding Plant Fill" states that "there is no reason to believe that the stresses in Seismic Category I piping systems will ever approach the Code allowable." We question the above statement based on the following:

Profile 26" - OHBC-54 on Fig. 19-1 shows a sudden drop of approx. 0.2 feet within a distance of only 20 feet. Using the procedure on p. 17-2,

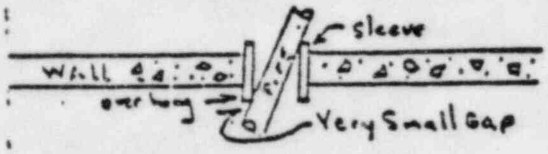
$$\sigma_b = E(e) = E\left(\frac{D}{2R}\right) = E\left(\frac{D}{2}\right)\left(\frac{8\delta}{L^2}\right)$$

$$\sigma_b = 30000\ \left(\frac{26}{2}\right)\left[\frac{8(0.2)(12)}{(20x12)^2}\right] = 130.0 \text{ KSI}$$

Furthermore, the Eq. 10(a) of Article NC-3652.3, Sec. III, Division 1, of the ASME code requires that some Stress Intensification Factor "i" be assigned to all computed settlement stresses. Yet, Table 17-2 lists only 52.5 KSI stress for this pipe. This matter requires further review. Please respond to apparent discrepancy and also specify the location of each computed settlement stress at the pipeline stationing shown on the profiles. More than one critical stress location is possible along the same pipeline.

(d) During the site visit on 19 February 1980, we observed three instances of what appeared to be degradation of rattlespace at penetrations of Category I piping through concrete walls as follows:

West Borated Water Tank - in the valve pit attached to the base of the structure, a large diameter steel pipe extended through a steel sleeve placed in the wall. Because the sleeve was not cut flush with the wall, clearance between the sleeve and the pipe was very small.



Service Water Structure - Two of the service water pipes penetrating the northwest wall of the service water structure had settled differentially with respect to the structure and were resting on slightly squashed short pieces of 2 x 4 placed in the bottom of the penetration. From the inclination of the pipe, there is a suggestion that the portions of the pipe further back in the wall opening (which was not visible) were actually bearing on the invert of the opening. The bottom surface of one of the steel pipes had small surface irregularities around the edges of the area in contact with the 2 x 4. Whether these irregularities are normal manufacturing irregularities or the result of concentration of load on this temporary support caused by the settlement of the fill, was not known.

These instances are sufficient to warrant an examination of those penetrations where Category I pipe derives support from plant fill on one or both sides of a penetration. In view of the above facts, the following information is required.

(1) What is the minimum seismic rattlespace required between a Category I pipe and the sleeve through which it penetrates a wall?

(2) Identify all those locations where a Category I pipe deriving support from plant fill penetrates an exterior concrete wall. Determine and report the vertical and horizontal rattlespace presently available and the minimum required at each location and describe remedial actions planned as a result of conditions uncovered in the inspection. It is anticipated that the answer to Question (1) can be obtained without any significant additional excavation. If this is not the case, the decision regarding the necessity to obtain information at those locations requiring major excavation should be deferred until the data from the other locations have been examined.

(e) Provide details (thickness, type of material etc.) of bedding or cradle placed beneath safety related piping, conduits, and supporting structures. Provide profiles along piping, and conduits alignments showing the properties of all supporting materials to be adopted in the analysis of pipe stresses caused by settlement.

(f) The two reinforced concrete return pipes which exit the Service Water Pump Structure, run along either side of the emergency cooling water reservoir, and ultimately enter into the reservoir, are necessary for safe shutdown. These pipes are buried within or near the crest of Category I slopes that form the sides of the emergency cooling water reservoir. There is no report on, or analysis of, the seismic stability of post earthquake residual displacement for these slopes. While the limited data from this area do not raise the specter of any problem, for an important element of the plant such as this, the earthquake stability should be examined by state-of-the-art methods. Therefore, provide results of the seismic analysis of the slopes leading to an estimate of the permanent deformation of the pipes. Please provide the following: (1) a plan showing the pipe location with respect to other nearby structures, slopes of the reservoir and the coordinate system; (2) cross-sections showing the pipes, normal pool levels, slopes, subsurface conditions as interpreted from borings and/or logs of excavations at (a) a location parallel to and about 50 ft from the southeast outside wall of the service water pipe structure and (b) a location where the cross section will include both discharge structures. Actual boring logs should be shown on the profiles; their offset from the profile noted, and soils should be described using the Unified Soil Classification System; (3) discussion of available shear strength data and choice of strengths used in stability analysis; (4) determination of static factor or safety, critical earthquake acceleration, and location of critical circle; (5) calculation of residual movement by the method presented by Newmark (1965) or Makdisi and Seed (1978); and (6) a determination of whether or not the pipes can function properly after such movements.

h. Cooling Pond.

(1) Emergency Cooling Pond. In recognition that the type of embankment fill and the compaction control used to construct the retention dikes for the cooling pond were the same as for the problem plant fill, we request reasonable assurance that the slopes of the Category I Emergency Cooling Pond (baffle dike and main dike) are stable under both static and dynamic loadings. We request a revised stability analysis for review, which will include identification of locations analyzed, adopted foundation and embankment conditions (stratification, seepage, etc.) and basis for selection, adopted soil properties, method of stability analysis used and resulting factor of safety with identification of sliding surfaces analyzed. Please address any potential impact on Category I pipes near the slopes, based on the results of this stability study. Recommendations for location of new exploration and testing have been provided in a separate letter.

(2) Operating Cooling Pond. A high level of safety should be required for the remaining slopes of the Operating Cooling Pond unless it can be assured that a failure will not: (a) endanger public health and properties, (b) result in an assault on environment, (c) impair needed emergency access. Recommendations for locations of new borings and laboratory tests have been submitted in a separate letter. These recommendations were made on the assumptions that the stability of the operating cooling pond dikes should be demonstrated.

i. Site Dewatering Adequacy.

(1) In order to provide the necessary assurance of safety against liquefaction, it is necessary to demonstrate that the water will not rise above elevation 610 during normal operations or during a shutdown process. The applicant has decided to accomplish this by pumping from wells at the site. In the event of a failure, partial failure, or degradation of the dewatering system (and its backup system) caused by the earthquake or any other event such as equipment breakdown, the water levels will begin to rise. Depending on the answer to Question (a) below concerning the normal operating water levels in the immediate vicinity of Category I structures and pipelines founded on plant fill, different amounts of time are available to accomplish repair or shutdown. In response to Question 24 (10 CFR 50.54f) the applicant states "the operating groundwater level will be approximately el 595 ft" (page 24-1). On page 24-1 the applicant also states "Therefore el 610' is to be used in the designs of the dewatering system as the maximum permissible groundwater level elevation under SSE conditions." On page 24-15 it is stated that "The wells will fully penetrate the backfill sands and underlying natural sands in this area." The bottom of the natural sands is indicated to vary from elevation 605 to 580 within the plant fill area according to Figure 24-12. The applicant should discuss and furnish response to the following questions:

(a) Is the normal operating dewatering plan to (1) pump such that the water level in the wells being pumped is held at or below elevation 595 or (2) to pump as necessary to hold the water levels in all observation wells near Category I Structures and Category I Pipelines supported on plant fill at or below elevation 595, (3) to pump as necessary to hold water levels in the wells mentioned in (2) above at or below elevation 610, or (4) something else? If it is something else, what is it?

(b) In the event the water levels in observation wells near Category I Structures or Pipelines supported on plant fill exceed those for normal operating conditions as defined by your answeer to Question (a) what action will be taken? In the event that the water level in any of these observation wells exceeds elevation 610, what action will be taken?

(c) Where will the observation wells in the plant fill area be located that will be monitored during the plant lifetime? At what depths will the screened intervals be? Will the combination of (1) screened interval in cohesionless soil and (2) demonstration of timely response to changes in cooling pond level prior to drawdown be made a condition for selecting the observation wells? Under what conditions will the alarm mentioned on page 24-20 be triggered? What will be the response to the alarm? A worst case test of the completed permanent dewatering and groundwater level monitoring systems could be conducted to determine whether or not the time required to accomplish shutdown and cooling is available. This could be done by shutting off the entire dewatering system when the cooling pond is at elevation 627 and determining the water level versus time curve for each observation well. The test should be continued until the water level under Category I structure, whose foundations are potentially liquefiable, reaches elevation 610 (the normal water level) or the sum of the time intervals allotted for repair and the time interval needed to accomplish shutdown (should the repair prove unsuccessful) has been exceeded, whichever occurs first. In view of the heterogeneity of the fill, the likely variation of its permeability and the necessity of making several assumptions in the analysis which was presented in the applicant's response to Question 24a, a full-scale test should give more reliable information on the available time. In view of the above the applicant should furnish his response to the following:

If a dewatering system failure or degradation occurs, in order to assure that the plant is shutdown by the time water level reaches elevation 610, it is necessary to initiate shutdown earlier. In the event of a failure of the dewatering system, what is the water level or condition at which shutdown will be initiated? How is that condition determined? An acceptable method would be a full-scale worst-case test performed by shutting off the entire dewatering system with the cooling pond at elevation 627 to determine, at each Category I Structure deriving support from plant fill, the water level at which a sufficient time window still remains to accomplish shutdown before the water rises to elevation 610. In establishing the groundwater level or condition that will trigger shutdown, it is necessary to account for normal surface water inflow as well as groundwater recharge and to assume that any additional action taken to repair the dewatering system, beyond the point in time when the trigger condition is first reached, is unsuccessful.

(2) As per applicant response to NRC Question 24 (10 CFR 50.54f) the design of the permanent dewatering system is based upon two major findings: (1) the granular backfill materials are in hydraulic connection with an underlying discontinuous body of natural sand, and (2) seepage from the cooling pond is restricted to the intake and pump structure area, since the plant fill south of Diesel Generator Building is an effective barrier to the inflow of the cooling pond water. However, soil profiles (Figure 24-2 in the "Response to NRC Requests Regarding Plant Fill"), pumping test time-drawdown graphs (Figure 24-14), and plotted cones of influence (Figure 24-15) indicate that south of Diesel Generator Building, the plant fill material adjacent to

the cooling pond is not an effective barrier to inflow of cooling pond water. The estimated permeability for the fill material as reported by the applicant is 8 feet/day and the transmissivities range from 29 to 102 square feet/day. Evaluate and furnish for review the recharge rate of seepage through the fill materials from the south side of the Diesel Generator Building on the permanent dewatering system. This evaluation should especially consider the recovery data from PD-3 and complete data from PD-5.

(3) The interceptor wells have been positioned along the northern side of the Water Intake Structure and service water pump structures. The calculations estimating the total groundwater inflow indicate the structures serve as a positive cutoff. However, the isopachs of the sand (Figures 24-9 and 24-10) indicate 5 to 10 feet of remaining natural sands below these structures. The soil profile (Figure 24-2) neither agrees nor disagrees with the isopachs. The calculations for total flow, which assumed positive cutoff, reduced the length of the line source of inflow by 2/3. The calculations for the spacing and positioning of wells assumed this reduced total flow is applied along the entire length of the structures. Clarify the existence of seepage below the structures, present supporting data and calculations, and reposition wells accordingly. Include the supporting data such as drawdown at the interceptor wells, at midway location between any two consecutive wells, and the increase in the water elevations downstream of the interceptor wells. The presence of structures near the cooling pond appears to have created a situation of artesian flow through the sand layer. Discuss why artesian flow was not considered in the design of the dewatering system.

(4) Provide construction plans and specification of permanent dewatering system (location, depths, size and capacity of wells, filterpack design) including required monitoring program. The information furnished in response of NRC Question 24 (10 CFR 50.54f) is not adequate to evaluate the adequacy of the system.

(5) Discuss the ramifications of plugging or leaving open the weep holes in the retaining wall at the Service Water Building.

(6) Discuss in detail the maintenance plan for the dewatering system.

(7) What are your plans for monitoring water table in the control tower area of the Auxiliary Building?

(8) What measures will be required to prevent incrustation of the pipings of the dewatering system. Identify the controls to be required during plant operation (measure of dissolved solids, chemical controls). Provide basis for established criteria in view of the results shown on Table 1, page 23 of tab 147.

(9) Upon reaching a steady state in dewatering, a groundwater survey should be made to confirm the position of the water table and to insure that no perched water tables exist.

Dewatering of the site should be scheduled with a sufficient lead time before plant start up so that the additional settlement and its effects (especially on piping) can be studied. Settlement should be closely monitored during this period.

j. Liquefaction Potential.

An independent Seed-Idriss Simplified Analysis was performed for the fill area under the assumption that the groundwater table was at or below elevation 610. For 0.19 g peak ground surface accceleration, it was found that blow counts as follows were required for a factor of safety of 1.5:

Elevation ft	Minimum SPT Blow Count*[1] For F.S. = 1.5
610	14
605	16
600	17
595	19

The analysis was considered conservative for the following reasons (a) no account was taken of the weight of any structure, (b) liquefaction criteria for a magnitude 6 earthquake were used whereas an NRC memorandum of 17 Mar 80 considered nothing larger than 5.5 for an earthquake with the peak acceleration level of 0.19 g's, (c) unit weights were varied over a range broad enough to cover any uncertainty and the tabulation above is based on the most conservative set of assumptions. Out of over 250 standard penetration tests on cohesionless plant fill or natural foundation material below elevation 610, the criteria given above are not satisfied in four tests in natural materials located below the plant fill and in 23 tests located in the plant fill. These tests involve the following borings:

SW3, SW2, DG-18, AX 13, AX 4, AX 15, AX 7, AX 5, AX 11,
DG 19, DG 13, DG 7, DG 5, D 21, GT 1, 2.

Some of the tests on natural material were conducted at depths of at less than 10 ft before approximately 35 ft of fill was placed over the location. Prior to comparison with the criteria these tests should be multiplied by a factor of about 2.3 to account for the increase in effective overburden pressure that results from the placement and future dewatering of the fill.

[1] *For M = 7.5, blow counts would increase by 30%.

Of the 23 tests on plant fill which fail to satisfy the criteria, most are near or under structures where remedial measures alleviating necessity for support from the fill are planned. Only 4 of the tests are under the Diesel Generator Building (which will still derive its support from the fill) and 3 others are near it. Because these locations where low blow counts were recorded are well separated from one another and are not one continuous stratum but are localized pockets of loose material, no failure mechanism is present.

In view of the large number of borings in the plant fill area and the conservatism adopted in analysis, these few isolated pockets are no threat to plant safety. The fill area is safe against liquefaction in a Magnitude 6.0 earthquake or smaller which produces a peak ground surface acceleration of 0.19 g or less provided the groundwater elevation in the fill is kept at or below elevation 610.

k. Seismic analysis of structures on plant fill material.

(1) Category I Structures. From Section 3.7.2.4 of the FSAR it can be calculated that an average V_s of about 1350 ft/sec was used in the original dynamic soil structure interaction analysis of the Category I structures. This is confirmed by one of the viewgraphs used in the 28 February Bechtel presentation. Plant fill V_s is clearly much lower than this value. It is understood from the response to Question 13 (10 CFR 50.54f) concerning plant fill that the analysis of several Category I structures are underway using a lower bound average V_s = 500 ft/sec for sections supported on plant fill and that floor response spectra and design forces will be taken as the most severe of those from the new and old analysis. The questions which follow are intended to make certain if this is the case and gain an understanding of the impact of this parametric variation in foundation conditions.

(a) Discuss which Category I structures have and/or will be reanalyzed for changes in seismic soil structure interaction due to the change in plant fill stiffness from that envisioned in the original design. Have any Category I structures deriving support from plant fill been excluded from reanalysis? On what basis?

(b) Tabulate for each old analysis and each reanalysis, the foundation parameters (v_s, ν and ρ) used and the equivalent spring and damping constants derived therefrom so the reviewer can gain an appreciation of the extent of parametric variation performed.

(c) Is it the intent to analyze the adequacy of the structures and their contents based upon the envelope of the results of the old and new analyses? For each structure analyzed, please show on the same plot the old, new, and revised enveloping floor response spectra so the effect of the changed backfill on interior response spectra predicted by the various models can be readily seen.

(2) Category I retaining wall near the southeast corner of the Service Water Structure. This wall is experiencing some differential settlement. Boring information in Figure 24-2 (Question 24, Volume 1 Responses to NRC Requests Regarding Plant Fill) suggests the wall is founded on natural soils and backfilled with plant fill on the land side. Please furnish details clarifying the following:

(a) Is there any plant fill underneath the wall? What additional data beyond that shown in Figure 24-2 support your answer?

(b) Have or should the design seismic loads (FSAR Figure 2.5-45) be changed as a result of the changed backfill conditions?

(c) Have or should dynamic water loadings in the reservoir be considered in the seismic design of this wall? Please explain the basis of your answer.

5. In your response for the comments and questions in paragraph 4 above, if you feel that sufficiently detailed information already exists on the Midland docket that may have been overlooked, please make reference to that information. Resolution of issues and concerns will depend on the expeditious receipt of data mentioned above. Contact Mr. Neal Gehring at FTS 226-6793 regarding questions.

FOR THE DISTRICT ENGINEER:

D. McCallister

P. McCALLISTER
Chief, Engineering Division

MIDLAND PLANT - UNITS 1 AND 2
CONSUMERS POWER COMPANY
DOCKET NO. 50-329/330
SUPPLEMENT TO COE JULY 7, 1980 LETTER REPORT
PREPARED BY: J. D. Kane, GES, HGEB

4.b.(3)(a) Page 4	The fifth paragraph beginning with "Conclusion:" should be deleted. The purpose of the comments in this paragraph has been covered in a separate letter from A. Schwencer to J. W. Cook, June 30, 1980, "Subject: Request for Additional Information Regarding Plant Fill."
4.c.(2)(a) Page 5	Add the words "and glacial till" following the words "on fill."
4.c.(2)(b) Page 5	The requested discussion on the safety categorization of the intake structure retaining wall should include any impact on safety related features (e.g., emergency diesel fuel oil storage tanks, conduits, etc.) behind the wall. Also the evaluation of observed and future settlements of the retaining walls should address actual stresses induced by the settlement against allowable stresses permitted by approved codes. The previous response to question 24 does not cover this concern.
4.d.(2)(a) Page 6	Add the word "temporary" following the words "Details of..." The paragraph (d) below beginning with "Dewatering before ..." should be added at the end of paragraph 4.d.(2)(a) and deleted from its present position.
4.g.(1)(c) Page 8	Delete the entire sentence beginning with "Furthermore the Eq. 10(a)..." Stress intensification factor is not a consideration for the computation on the straight length of pipe section in the above equation. To clarify the comparison being made in this paragraph add the words "as allowable" following the 52.5 KSI.
4.i.(9) Page 14	At the end of this paragraph add the sentence "Please provide your plans for conducting this groundwater survey."
4.j. Page 14	Paragraph j. does not require action on the part of CPCo but presents conclusions of the COE reviewer in his evaluation of the plant fill's resistance against liquefaction. These conclusions are tentative and subject to the final resolution of the seismic input for the Midland project.