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

APR 1 1983

MEMORANDUM FOR: R. C. DeYoung, Director, Office of Inspection and Enforcement

FROM: James G. Keppler, Regional Administrator, Region III

SUBJECT: SYSTEMATIC ASSESSMENT OF LICENSEE PERFORMANCE (SALP) FOR ZIMMER AND MIDLAND

The purpose of this memorandum is to request your approval to not perform SALP-3 assessments for the Midland and Zimmer projects.

As you know, on November 12, 1982, an Order to Show Cause and Order Immediately suspending Construction was issued to the Cincinnati Gas and Electric Company for the Zimmer facility. Also, as a result of a special inspection at Consumers Power Company's Midland facility and the Company's assessment of the project, the Company halted a significant amount of safety related work at the Midland facility.

NRC Region III involvement at both these facilities both prior to and since the suspension of safety related construction activities has resulted in widespread recognition of the management, quality assurance, and construction problems in connection with these facilities. It is also clear to the parties concerned what steps are necessary to resolve problems so that construction can resume in a quality manner.

Because of the unique status of these facilities and the actions in process by the NRC and the licensees, we do not believe SALP-3 assessments are useful. The actions already underway meet the Objectives given in paragraph 0516-02 of Manual Chapter 0516, Systematic Assessment of Licensee Performance. The Order requirements at Zimmer (independent management review, action based on this management review, development of a comprehensive plan to verify the quality of the Zimmer facility, and development of a comprehensive program for continuation of construction) will accomplish objectives which make SALP-3 redundant, unnecessary, and a questionable expenditure of resources. The Construction Completion program with the attendant third party overviews and the quality assurance program changes also make SALP-3 unnecessary at Midland.

Considering the above facts and the manpower being applied to these facilities to assure their quality recovery programs are successful, we request your concurrence that SALP-3 is not needed and your approval to not perform SALP-3 at these facilities.

APR 1 1983

If you have any question on this matter or desire to discuss it further, please call me or Bert Davis of my staff. We would appreciate your response by April 15, 1983.

James G. Keppler

James G. Keppler
Regional Administrator

REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:8303210446 DOC.DATE: 83/03/18 NOTARIZED: YES DOCKET #
FACIL:50-329 Midland Plant, Unit 1, Consumers Power Co. 05000329
50-330 Midland Plant, Unit 2, Consumers Power Co. 05000330
AUTH.NAME AUTHOR AFFILIATION
LEVIN,H.A. TERA Corp.
RECIP.NAME RECIPIENT AFFILIATION
KEPPLER,J.G. Region 3, Office of Director
EISENHUT,D.G. Division of Licensing

SUBJECT: Forwards affidavits attesting to corporate independence & prof qualifications of individuals who may participate in overview of const completion program.

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3/23/83

Please docket the attached letter from TERA and use the following internal NRC distribution:

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TERA

March 18, 1983

Mr. J. G. Keppler
Administrator, Region III
Office of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

Mr. D. G. Eisenhut
Director, Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: Docket Nos. 50-329 and 50-330
Midland Nuclear Plant - Units 1 and 2
Overview of the Midland Construction Completion Program

TERA Corporation has been informed by Mr. James W. Cook, Vice President, Consumers Power Company (CPC) that the Corporation is under consideration for management and implementation of a program to independently overview the Midland Construction Completion Program. We have been requested to submit the following information to the NRC for review:

- Affidavits attesting to TERA's corporate independence and the independence of individuals who may participate in the CCP Overview program;
- Professional qualifications of individuals who may participate in the CCP Overview program.

Mr. John W. Beck, Vice President of TERA Corporation and Principal-in-Charge of TERA's team which may conduct the Midland program has signed an affidavit on behalf of TERA Corporation and its subsidiaries which provides a statement of corporate independence (Attachment 1).

Signed affidavits for members of TERA's team are attached (Attachment 2). In the event that additional personnel are required to meet project objectives and are assigned to the team, TERA Corporation will obtain affidavits from these individuals as well.

~~8303210448~~

DAR
8303210448

TERA CORPORATION
7101 WISCONSIN AVENUE BETHESDA, MARYLAND 20814 301-654-8960

TERA proposes that a core of senior level personnel principally involved with the Midland Independent Design and Construction Verification (IDCV) program participate in the Midland CCP Overview for the purpose of maximizing the benefits gained to date within the IDCV relative to the understanding of the complex design and construction evolution and chains, project experience, and technical details of the design and construction efforts. Accordingly, it is proposed that the Midland IDCV project organization, management structure, and procedures be maintained and appropriately modified to meet the CPP Overview project objectives.

Mr. Martin Jones will be assigned responsibility for direction of site activities. Mr. Jones has previously served as Manager of Construction of the Summer Nuclear Plant for the South Carolina Electric and Gas Company. He is eminently qualified for this assignment with over 22 years of nuclear power plant experience.

The proposed CCP Overview staff has been selected based upon their unique technical, construction, and project management qualifications and experience. Key personnel are listed along with a short description of their areas of expertise, number of years of experience, and highlights of their previous employment (Attachment 3). Resumes have been provided previously to the NRC under separate cover in Appendix C of the Project Quality Assurance Plan, Revision 2, for the Midland IDCV program. (Reference: letters from Mr. Howard A. Levin to Mr. J. G. Keppler and Mr. D. G. Eisenhut dated February 9, 1983 and February 17, 1983.)

TERA Corporation is committed to providing an independent, comprehensive, and integrated assessment of the quality of the Midland plant through the activities currently in progress within the Midland IDCV Program. Consideration of the CCP Overview efforts within the Midland IDCV program will provide overall enhancement in meeting these objectives.

We are prepared to answer any questions that you may have relative to these matters. Please contact me at (301) 654-8960 or Mr. John Beck at (214) 871-1075.

Sincerely,

Howard A. Levin

Howard A. Levin
Project Manager

cc: J. Cook, CPC
G. Keeley, CPC
D. Hood, NRC

Enclosures

Sworn and Subscribed Before Me This 18th Day of March 1983

Linda Lee Robb

Notary Public

My Commission Expires My Commission Expires July 1, 1986

HAL/djb

ATTACHMENT I

CORPORATE AFFIDAVIT STATEMENT
OF INDEPENDENCE

STATEMENT OF CORPORATE INDEPENDENCE

AFFIDAVIT OF JOHN W. BECK
ON BEHALF OF TERA CORPORATION
AND ITS SUBSIDIARIES

My name is John W. Beck. I am a Vice President of TERA Corporation. This statement is made on behalf of TERA Corporation and its subsidiaries.

TERA Corporation is under consideration for conducting an Independent Overview of the Construction Completion Program (CCP) at the Midland Nuclear Plant site. I will serve in the capacity of Principal-in-Charge of the team which will conduct the CCP Overview.

The criteria for corporate independence and individual independence of personnel assigned to work on the CCP Overview program are set forth in a letter from Nunzio J. Palladino, Chairman, U.S. Nuclear Regulatory Commission (NRC), to the Honorable John D. Dingell, Chairman, Committee on Energy and Commerce, U.S. House of Representatives, dated February 1, 1982.

TERA Corporation has determined that the Corporation and individual members of the CCP Overview team satisfy the following criteria:

1. TERA Corporation and individuals assigned to the Midland CCP Overview program do not have any direct previous involvement with the Midland activities that they will be reviewing.

2. TERA Corporation and individuals assigned to the Midland CCP Overview program have not been previously hired by Consumers Power Company, Bechtel, or Babcock and Wilcox to perform design, construction or quality work relative to the Midland activities that they will be reviewing.

*3. TERA Corporation and individuals assigned to the Midland CCP Overview program have not been previously employed by Consumers Power Company.

4. The individuals assigned to work on the Midland CCP Overview program do not have present household members employed by Consumers Power Company.

5. The individuals assigned to work on the Midland CCP Overview program do not have any relatives employed by Consumers Power Company.

*With the exception of the Midland Independent Design and Construction

6. TERA Corporation and individuals assigned to work on the Midland CCP Overview program do not own or control significant amounts of Consumers Power Company stock.

TERA Corporation has obtained affidavits for each individual currently assigned to the Midland CCP Overview program team. In the event that additional personnel are assigned to the team, TERA Corporation will obtain affidavits from these individuals as well.

Signed

John W Beck
____

Sworn and Subscribed Before Me This 17th Day of March 1983

Terry Gamble
____
Notary Public

My Commission Expires _______________

TERRY GAMBLE, Notary Public
in and for the State of Texas
My Commission Expires 8-17-86

ATTACHMENT 2

INDIVIDUAL AFFIDAVIT STATEMENTS
OF INDEPENDENCE

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF John Beck

My name is John Beck. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project,* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

John W Beck

Sworn and Subscribed Before Me This 17th Day of March 1983

Terry Gamble
Notary Public

My Commission Expires ____________

TERRY GAMBLE, Notary Public
in and for the State of Texas
My Commission Expires 8-17-86

*With the exception of the Midland Independent Design and Construction Verification Project.

Murray Savings Money Market Fund

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF HOWARD A. LEVIN

My name is HOWARD A. LEVIN. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached.* I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

* MERRILL LYNCH CMA
PACE FUND

[signature]

Sworn and Subscribed Before Me This 17th Day of March 1983

[signature]
Notary Public

My Commission Expires My Commission Expires July 1, 1986

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* with the exception of the Midland Independent Design and Construction Verification Program

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Mark Polit

My name is Mark Polit. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project*, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

* with the exception of the Midland Independent Design and Construction Verification Program.

Signed

Mark W. Polit

Sworn and Subscribed Before Me This 17 Day of March 1983

JoAnn C. Walz
Notary Public

My Commission Expires 12/16/83

JoANN CAVE WALZ
NOTARY PUBLIC — CALIFORNIA
PRINCIPAL OFFICE IN
ALAMEDA COUNTY
My Commission Expires Dec. 16, 1983

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Curt Staley

My name is Curt Staley. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project,* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel,** or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Curt Staley

Sworn and Subscribed Before Me This 17th Day of March 1983

Terry Gamble
Notary, Public

My Commission Expires TERRY GAMBLE, Notary Public in and for the State of Texas My Commission Expires 3-17-86

** Except as follows:

1976-1977 Engineering Supervisor and Deputy Project Engineer, Bechtel Power Corporation, Gaithbrg, MD, for the Dickerson Steam Generation Plant, Potomic Electric Power Company.

1968-1974 Senior Engineer and Group Leader, Bechtel Power Corporation, San Francisco, CA, for the Limerick Generating Station, Philadelphia Electric Company.

*With the exception of the Midland Independent Design and Construction Verification Project.

Merrill Lynch Ready Assets Trust

Murray Savings Money Market Funds

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Frank Dougherty

My name is Frank Dougherty. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project*, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

* with the exception of the Midland Independent Design and Construction Verification Program.

Signed

Frank R. Dougherty

Sworn and Subscribed Before Me This 17 Day of March 1983

JoAnn C Walz

Notary Public

My Commission Expires 12/16/83

JoANN CAVE WALZ
NOTARY PUBLIC — CALIFORNIA
PRINCIPAL OFFICE IN
ALAMEDA COUNTY
My Commission Expires Dec. 16, 1983

Mutual Funds

Merrill Lynch CMA Money Trust
Kemper Money Market
Daily Interest Fund

Mathers Fund
Energy Fund
20th Century Growth Fund

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF RICHARD P. SNAIDER

My name is RICHARD P. SNAIDER. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Richard P. Snaider

Sworn and Subscribed Before Me This 17th Day of March 1983

Linda Lee Roth
Notary Public

My Commission Expires My Commission Expires July 1, 1986

* with the exception of the Midland Independent Design and Construction Verification Program

SNAIDER

MUTUAL FUNDS

ENERGY FUND
MERRILL-LYNCH HIGH INCOME BOND FUND
AMERICAN GENERAL PACE FUND

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Lionel D. Bates

My name is Lionel D. Bates. I am employed by TERA Corporation as Lead Technical Reviewer

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project,* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Lionel D. Bates

Sworn and Subscribed Before Me This 17th Day of March 1983

Vickey M. Gonthier
Notary Public

OFFICIAL SEAL
VICKEY M. GONTHIER
NOTARY PUBLIC - CALIFORNIA
SANTA CLARA COUNTY
My commission expires August 13, 1984

My Commission Expires 8-13-84

*With the exception of the Midland Independent Design Construction Verification Program.

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF MARTIN B. JONES, JR.

My name is Martin B. Jones, Jr. I am employed by TERA Corporation as Associate, Lead Site Activities

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel,* or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Martin B. Jones Jr.

Sworn and Subscribed Before Me This 17th Day of March 1983

Betty J. Mertz
Notary Public

My Commission Expires 10/10/84

* I have served as a consultant to Becon Construction Co., a subsidiary of Bechtel, during 1982. None of this work was related to the Midlands project, or any other nuclear work.

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Donald Davis

My name is Donald Davis. I am employed by TERA Corporation as Member Senior Review Team

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Don K Davis

Sworn and Subscribed Before Me This 16th Day of March 1983

Jo Ann C. Walz

Notary Public

My Commission Expires 12/16/83

* with the exception of the Midland Independent Design and Construction Verification Program

JoANN CAVE WALZ
NOTARY PUBLIC
PRINCIPAL OFFICE IN
ALAMEDA COUNTY
My Commission Expires Dec. 16, 1983

Funds in which D.K. Davis has an interest

1. Franklin Tax-Free - California
2. InterCapital Liquid Asset
3. TERA Deferred Compensation (Retirement)

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF WILLIAM J. HALL

My name is William J. Hall. I am employed by TERA Corporation as Consultant.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project,* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel,** or Babcock and Wilcox.

* with the exception of the Midland Independent Design and Construction Program.

** a son-in-law employed by Bechtel, Gaithersburg, MD

Signed

William J Hall

William J. Hall

Sworn and Subscribed Before Me This 17th Day of March 1983

Lois A. Dallas

Notary Public

My Commission Expires 2/6/85

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Robert Wilson

My name is Robert Wilson. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project*, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

* with the exception of the Midland Independent Design and Construction Verification Program.

Signed

Robert L. Wilson

Sworn and Subscribed Before Me This 17th Day of March 1983

J. C. Walz
Notary Public

My Commission Expires 12/19/83

JoANN CAVE WALZ
NOTARY PUBLIC — CALIFORNIA
PRINCIPAL OFFICE IN
ALAMEDA COUNTY
My Commission Expires Dec. 19, 1983

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Robert Cudlin

My name is Robert Cudlin. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project*, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached.* I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.**

* with the exception of the Midland Independent Design and Construction Verification Program.

Signed

Robert J. Cudlin

Sworn and Subscribed Before Me This 17 Day of March 1983

JoAnn Cave Walz
Notary Public

My Commission Expires 12/16/83

JoANN CAVE WALZ
NOTARY PUBLIC — CALIFORNIA
PRINCIPAL OFFICE IN
ALAMEDA COUNTY
My Commission Expires Dec. 16, 1983

* First Jersey Securities
** Brother, Joseph Cudlin, is currently employed by B&W as Manager, Analysis Technology

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Henry I. George

My name is Henry George. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Henry J. George

Sworn and Subscribed Before Me This 17th Day of March 1983

Linda Lee Pott
Notary Public

My Commission Expires My Commission Expires July 1, 1986

---

* with the exception of the Midland Independent Design and Construction Verification Program

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Joseph Martore

My name is J. MARTORE. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Joseph Martore

Sworn and Subscribed Before Me This 18th Day of March 1983

Notary Public

My Commission Expires My Commission Expires July 1, 1988

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* with the exception of the Midland Independent Design and Construction Verification Program

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Robert C. Snyder

My name is Robert C. Snyder. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Robert C Snyder

Sworn and Subscribed Before Me This 17th Day of March 1983

Linda Lee Robb
Notary Public

My Commission Expires My Commission Expires July 1, 1988

* with the exception of the Midland Independent Design and Construction Verification Program

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Michael B. Aycock

My name is Michael B. Aycock. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

MB Aycock

Sworn and Subscribed Before Me This 17th Day of March 1983

Linda Lee Robb
Notary Public

My Commission Expires My Commission Expires July 1, 1985

---

* with the exception of the Midland Independent Design and Construction Verification Program

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Christian Mortgat

My name is Christian Mortgat. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project*, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

* with the exception of the Midland Independent Design and Construction Verification Program.

Signed

C Mortgat

Sworn and Subscribed Before Me This 17 Day of March 1983

Jo C. Walz
Notary Public

My Commission Expires 12/16/83

JO[illegible] CA[illegible]E WALZ
NOTARY PUBLIC — CALIFORNIA
[illegible] OFFICE IN
[illegible] COUNTY
My Commission Expires Dec. 13, 1983

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Jorma Arros

My name is Jorma Arros. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project*, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

* with the exception of the Midland Independent Design and Construction Verification Program.

Signed

Jorma Arros

Sworn and Subscribed Before Me This 17 Day of March 1983

Jo Ann C. Walz

Notary Public

My Commission Expires 12/16/83

JoANN CAVE WALZ
NOTARY PUBLIC — CALIFORNIA
PRINCIPAL OFFICE IN
ALAMEDA COUNTY
My Commission Expires Dec. 16, 1983

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Kenneth W. Campbell

My name is Kenneth W. Campbell. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Kenneth W. Campbell

Sworn and Subscribed Before Me This 18th Day of March 1983

Linda Lee Abbott
Notary Public

My Commission Expires My Commission Expires July 1, 1986

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* with the exception of the Midland Independent Design and Construction Verification Program

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Normand A. Berube

My name is Normand A. Berube. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Normand A. Berube

Sworn and Subscribed Before Me This 18th Day of March 1983

Linda Lee Robb
Notary Public

My Commission Expires My Commission Expires July 1, 1986

* with the exception of the Midland Independent Design and Construction Verification Program

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Frederick Berthrong

My name is Frederick Berthrong. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project*, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company.* I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

* with the exception of the Midland Independent Design and Construction Verification Program.

Signed

Frederick Berthrong

*I was employed by Bechtel Power Corporation (Jan. 1972 - Sept 1977) but performed no services on the Midland Project.

Sworn and Subscribed Before Me This 17 Day of March 1983

Jo Ann C. Walz
Notary Public

My Commission Expires 12/16/83

JoANN CAVE WALZ
NOTARY PUBLIC — CALIFORNIA
PRINCIPAL OFFICE IN
ALAMEDA COUNTY
My Commission Expires Dec. 16, 1983

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Richard MacDonald

My name is Richard MacDonald. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project*, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox. *

* with the exception of the Midland Independent Design and Construction Verification Program.

Signed

Richard R. MacDonald

Sworn and Subscribed Before Me This 17th Day of March 1983

Jo Ann C. Walz

Notary Public

My Commission Expires 12/16/83

JoANN CAVE WALZ
NOTARY PUBLIC — CALIFORNIA
PRINCIPAL OFFICE IN
A... COUNTY
My Commission Expires Dec. 16, 1983

* I was employed by Bechtel Power Corporation (1971-79) for 8½ years as Mechanical Engineering Supervisor, Assistant to the Manager of Engineering, and Project Engineer on small projects. I was never directly involved on the Midland Project ... Power or Babcock and

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Donald B. Tulodieski

My name is Donald B. Tulodieski. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company.** I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Donald B. Tulodieski

Sworn and Subscribed Before Me This 17th Day of March 1983

Linda Lee Roff
Notary Public

My Commission Expires My Commission Expires July 1, 1986

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* with the exception of the Midland Independent Design and Construction Verification Program

** Employed by Babcock & Wilcox Co. from 1973 to 1978. Final Position was Project Manager for Toledo Edison, Davis Besse Units.

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Gary Smith

My name is Gary Smith. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project,* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Gary Smith

Sworn and Subscribed Before Me This 17th Day of March 1983

Sandra Vinson
Notary Public

My Commission Expires 2-17-85

SANDRA [illegible]
In and for [illegible] of Texas
My Commission Expires 2-17-85

*With the exception of the Midland Independent Design and Construction Verification Project.

A. G. Edwards, Daily Cash Accumulation Fund

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Douglas Witt

My name is Douglas Witt. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project*, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

* with the exception of the Midland Independent Design and Construction Verification Program.

Signed

Douglas Witt

Sworn and Subscribed Before Me This 18 Day of March 1983

JoAnn Cave Walz

Notary Public

My Commission Expires 12/16/83

JoANN CAVE WALZ
NOTARY PUBLIC — CALIFORNIA
PRINCIPAL OFFICE IN
ALAMEDA COUNTY
My Commission Expires Dec. 16, 1983

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Randy Cleland

My name is Randy Cleland. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project,* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Randy Cleland

Sworn and Subscribed Before Me This 17th Day of March 1983

Terry Gamble
Notary Public

My Commission Expires ____________

TERRY GAMBLE, Notary Public
in and for the State of Texas
My Commission Expires 8-17-86

*With the exception of the Midland Independent Design and Construction Verification Project.

University Savings Association Money Master Fund

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF George J. Trigilio, Jr.

My name is George J. Trigilio, Jr. . I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

George J Trigilio Jr

Sworn and Subscribed Before Me This 18th Day of March 1983

Linda Lee Robb
Notary Public

My Commission Expires My Commission Expires July 1, 1986

---

* with the exception of the Midland Independent Design and Construction Verification Program

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Stephen Schreurs

My name is Stephen Schreurs. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Stephen E Schreurs

Sworn and Subscribed Before Me This 17th Day of March 1983

Linda Lee Robb

Notary Public

My Commission Expires My Commission Expires July 1, 1986

---

* with the exception of the Midland Independent Design and Construction Verification Program

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Farzin Ramezanbeigi

My name is Farzin Ramezanbeigi . I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project*, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

* with the exception of the Midland Independent Design and Construction Verification Program.

Signed

Farzin Ramezanbeigi

Sworn and Subscribed Before Me This 17 Day of March 1983

Jo Ann Cave Walz

Notary Public

My Commission Expires 12/16/83

JOANN CAVE WALZ
NOTARY PUBLIC — CALIFORNIA
PRINCIPAL OFFICE IN
ALAMEDA COUNTY
My Commission Expires Dec. 16, 1983

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Christian Nelson

My name is Christian Nelson. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Christian Nelson

Sworn and Subscribed Before Me This 17th Day of March 1983

Linda Lee Robb
Notary Public

My Commission Expires My Commission Expires July 1, 1986

* with the exception of the Midland Independent Design and Construction Verification Program

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Mehmet Celebi

My name is Mehmet Celebi. I am employed by TERA Corporation as Associate Technical Reviewer

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project*, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company.** I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

*except for the Midland Independent Design and Construction Verification Program at TERA.

Signed

M Celebi

Sworn and Subscribed Before Me This 17 Day of March 1983

J. R. C. Daly
Notary Public

My Commission Expires 12/16/83

NOTARY PUBLIC - CALIFORNIA
My Comm. Expires Dec. 16, 1983

**I was employed by Bechtel Power Corporation, San Franciso between January 1978 to May 1979 as an Engineering Specialist and between August 1982-December 1982 on a Casual Project Engineer status.

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF ALBERT MARTORE

My name is ALBERT MARTORE. I am employed by TERA Corporation as ASSOC. TECHNICAL REVIEWER.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Albert V. Martore

Sworn and Subscribed Before Me This 17 Day of March 1983

[illegible]
Notary Public

My Commission Expires MY COMMISSION EXPIRES OCTOBER 15, [illegible]

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Lou Fusco

My name is Lou Fusco. I am employed by TERA Corporation as Assoc. Tech Reviewer

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Louis Fusco

Sworn and Subscribed Before Me This 17 Day of March 1983

Marjorie Hand
Notary Public

My Commission Expires March 19, 1985

OFFICIAL SEAL
MARJORIE HAND
NOTARY PUBLIC CALIFORNIA
PRINCIPAL OFFICE IN
SANTA CLARA COUNTY
My Commission Expires Mar. 19, 1985

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF James I Owens

My name is James I Owens. I am employed by TERA Corporation as Associate Technical Reviewer

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project,* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

James I Owens

Sworn and Subscribed Before Me This 17th Day of March 1983

Margaret R. Cameron
Notary Public

My Commission Expires My Commission expires December 23, 1984

* WITH THE EXCEPTION of the MIDLAND INDEPENDENT DESIGN And Construction VERIFICATION PROGRAM.

3/17/83

A LIST OF MUTUAL FUNDS IN WHICH I HAVE AN intrest BUT OVER WHICH I HAVE NO CONTROL IS

1) 44 WALL STREET FUND INC

2) MUTUAL SHARES CORP

[signature]

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Edward M. Beck

My name is Edward M. Beck. I am employed by TERA Corporation as Associate Technical Reviewer.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project,* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Sworn and Subscribed Before Me This 17 Day of March 1983

Elizabeth T. Wentz
Notary Public

My Commission Expires 11-1-1985

*with the exception of the Midland Independent Design and Construction Verification Program

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Robert Reneau

My name is Robert Reneau. I am employed by TERA Corporation as Associate Technical Reviewer.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment,* I have never worked on any job or task associated with the Midland Project, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Robert A. Reneau

Sworn and Subscribed Before Me This 17 Day of March 1983

Elizabeth T. Wentz
Notary Public

My Commission Expires 11-1-1985

*with the exception of the Midland Independent Design and Construction Verification Program

Daily Cash Accumulation Fund Inc.
3600 S. Yosemite Street
Denver, Colorado 80237

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Joseph Penzien

My name is Joseph Penzien. I am employed by TERA Corporation as Associate Technical Reviewer

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

* with the exception of the Midland Independent Design and Construction Verification Program.

Signed

Joseph Penzien

Sworn and Subscribed Before Me This 17 Day of March 1983

Michele J. Gubbay
Notary Public

My Commission Expires April 14, 1985

GUBBAY
CALIFORNIA
COUNTY
1985

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Daniele Veneziano

My name is Daniele Veneziano. I am employed by TERA Corporation as Associate Technical Reviewer

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Daniele Veneziano

Sworn and Subscribed Before Me This 17 Day of March 1983

Gloria M. McAvenia
Notary Public

My Commission Expires August 10, 1984

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF S. N. BRISCOMBE

My name is Stephen N. Briscombe. I am employed by TERA Corporation as Associate Technical Reviewer.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project, or any job or task for or on behalf of Consumers Power Company, *Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company,*Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

S. N. Briscombe

Sworn and Subscribed Before Me This 17TH Day of March 1983

Marjorie Hand
Notary Public

My Commission Expires March 19, 1985

OFFICIAL SEAL
MARJORIE HAND
NOTARY PUBLIC-CALIFORNIA
PRINCIPAL OFFICE IN
SANTA CLARA COUNTY
My Commission Expires Mar. 19, 1985

* Employed by Bechtel Power Corporation, Construction Staff, 1977-79. Performed Review Activity on site for three days in 1979. Work consisted of reviewing electrical design, notes and details, for constructability.

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Richard W. Keller

My name is Richard W. Keller. I am employed by TERA Corporation as Assistant Technical Reviewer.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project,* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

* with the exception of the Midland independent design and construction verification program,

Signed

Richard W. Keller

Sworn and Subscribed Before Me This 17th Day of March 1983

Charles S. Fagaralley
Notary Public

My Commission Expires at death

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF LOREN STANLEY

My name is Loren Stanley. I am employed by TERA Corporation as ASSOC. TECH. REVIEWER.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Loren Stanley

Sworn and Subscribed Before Me This 17th Day of March 1983

Marjorie Hand
Notary Public

My Commission Expires March 19, 1985

OFFICIAL SEAL
MARJORIE HAND
NOTARY PUBLIC - CALIFORNIA
PRINCIPAL OFFICE IN
SANTA CLARA COUNTY
My Commission Expires Mar. 19, 1985

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF LOREN STANLEY

My name is Loren Stanley. I am employed by TERA Corporation as Assoc. Tech. Reviewer.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Loren Stanley

Sworn and Subscribed Before Me This 17th Day of March 1983

Marjorie Hand
Notary Public

My Commission Expires March 19 1985

OFFICIAL SEAL
MARJORIE HAND
NOTARY PUBLIC - CALIFORNIA
PRINCIPAL OFFICE IN
SANTA CLARA COUNTY
My Commission Expires Mar. 19, 1985

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF EDWARD D. SCHRULL

My name is EDWARD D SCHRULL. I am employed by TERA Corporation as ASSOCIATE TECHNICAL REVIEWER.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project,* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Edward D Schrull

Sworn and Subscribed Before Me This 17th Day of March 1983

Vickey M. Gonthier
Notary Public

OFFICIAL SEAL
VICKEY M. GONTHIER
NOTARY PUBLIC - CALIFORNIA
SANTA CLARA COUNTY
My commission expires August 13, 1984

My Commission Expires 8-13-84

*With the exception of the Midland Independent Design Construction Verification Program.

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Luis E. Flores

My name is Luis E. Flores. I am employed by TERA Corporation as Associate Technical Reviewer.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project,* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Sworn and Subscribed Before Me This 17th Day of March 1983

Notary Public

OFFICIAL SEAL
VICKEY M. GONTHIER
NOTARY PUBLIC - CALIFORNIA
SANTA CLARA COUNTY
My commission expires August 13, 1984

My Commission Expires 8-13-84

*With the exception of the Midland Independent Design Construction Verification Program.

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF DAVID B. HAMEL

My name is DAVID B. HAMEL. I am employed by TERA Corporation as ASSOCIATE TECHNICAL REVIEWER,

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project,* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

David B. Hamel

Sworn and Subscribed Before Me This 17th Day of March 1983

Vickey M. Gonthier
Notary Public

OFFICIAL SEAL
VICKEY M. GONTHIER
NOTARY PUBLIC - CALIFORNIA
SANTA CLARA COUNTY
My commission expires August 13, 1984

My Commission Expires 8-13-84

*With the exception of the Midland Independent Design Construction Verification Program.

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF HARRY L. BROXSON

My name is HARRY L. BROXSON. I am employed by TERA Corporation as ASSOCIATE TECHNICAL REVIEWER

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project,* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

Harry L Broxson

Sworn and Subscribed Before Me This 17th Day of March 1983

Vickey M. Gonthier
Notary Public

OFFICIAL SEAL
VICKEY M. GONTHIER
NOTARY PUBLIC - CALIFORNIA
SANTA CLARA COUNTY
My commission expires August 13, 1984

My Commission Expires 8-13-84

*With the exception of the Midland Independent Design Construction Verification Program.

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF Lawrence Wight

My name is Lawrence Wight . I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project*, or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

* with the exception of the Midland Independent Design and Construction Verification Program.

Sworn and Subscribed Before Me This 18 Day of March 1983

Notary Public

My Commission Expires 12/16/83

JoANN CAVE WALZ
NOTARY PUBLIC – CALIFORNIA
PRINCIPAL OFFICE IN
ALAMEDA COUNTY
My Commission Expires Dec. 16, 19..

STATEMENT OF INDEPENDENCE

AFFIDAVIT OF JAMES A. LONG, III

My name is James A. Long, III. I am employed by TERA Corporation.

I am under consideration for assignment to the team which will conduct an independent overview of the Construction Completion Program at the Midland Nuclear Plant site. Prior to being given this assignment, I have never worked on any job or task associated with the Midland Project* or any job or task for or on behalf of Consumers Power Company, Bechtel, or the Babcock and Wilcox Company relating to issues that I am reviewing. I have never been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox Company. I do not own any shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock. Mutual fund or other funds in which I may have a beneficial interest, but over which I have no control, may own shares of Consumers Power Company, Bechtel, or Babcock and Wilcox stock, of which I am unaware. A list of such funds in which I have an interest are attached. I have no relatives which are or have been employed by Consumers Power Company, Bechtel, or Babcock and Wilcox.

Signed

James A. Long III

Sworn and Subscribed Before Me This 18th Day of March 1983

Linda Lee Robb
Notary Public

My Commission Expires My Commission Expires July 1, 1986

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* with the exception of the Midland Independent Design and Construction Verification Program

EXPLANATORY NOTE FOR ATTACHMENT 2:

Several individual affidavits are not presently included as part of attachment 2 due to logistics. These affidavits will be submitted under separate cover.

Attachment 3

KEY PERSONNEL

CONSTRUCTION COMPLETION PROGRAM OVERVIEW

- PROJECT DIRECTION

JOHN BECK, M.S., PRINCIPAL-IN-CHARGE

NUCLEAR POWER PLANT OPERATIONS AND CORPORATE MANAGEMENT, LICENSING, ENGINEERING AND PROJECT MANAGEMENT

- VICE PRESIDENT, TERA CORPORATION
- 18 YEARS NUCLEAR EXPERIENCE
- FORMERLY EXECUTIVE VICE PRESIDENT, VERMONT YANKEE NUCLEAR POWER CORPORATION; SERVED AS CHIEF OPERATING OFFICER
- FORMERLY DIRECTOR OF ENGINEERING, YANKEE ATOMIC ELECTRIC COMPANY

HOWARD LEVIN, M.S., PROJECT MANAGER

NUCLEAR POWER PLANT STRUCTURAL, MECHANICAL DESIGN AND CONSTRUCTION, EQUIPMENT QUALIFICATION, OPERATING REACTOR SAFETY, LICENSING, PROJECT MANAGEMENT

- 9 YEARS NUCLEAR EXPERIENCE/11 YEARS ENGINEERING EXPERIENCE
- FORMERLY WITH NRC AND STONE & WEBSTER

KEY PERSONNEL
(continued)

- SENIOR REVIEW TEAM

WILLIAM J. HALL, PH.D., UNIVERSITY OF ILLINOIS

ENGINEERING ANALYSIS AND DESIGN, STRUCTURAL ENGINEERING, STRUCTURAL MECHANICS AND DYNAMICS, SOIL MECHANICS, FRACTURE MECHANICS, ENGINEERING CRITERIA DEVELOPMENT FOR MAJOR PROJECTS

- 39 YEARS EXPERIENCE IN NUCLEAR, MILITARY, AND COMMERCIAL FIELDS
- CONSULTANT TO NRC, NATIONAL LABS, TERA CORPORATION, AND OTHERS ON NUCLEAR SAFETY ISSUES
- LONG ASSOCIATE OF LATE NATHAN M. NEWMARK

DONALD DAVIS, TERA

NUCLEAR SAFETY AND LICENSING, PLANT AND REACTOR SYSTEMS, THERMAL-HYDRAULIC ANALYSIS, ACCIDENT ANALYSIS

- 15 YEARS NUCLEAR EXPERIENCE/18 YEARS ENGINEERING EXPERIENCE
- FORMERLY WITH NRC AND HITTMAN ASSOCIATES

ROBERT WILSON, M.S.

NUCLEAR POWER PLANT OPERATIONS, ENGINEERING AND DESIGN, LICENSING, CONTRACT ADMINISTRATION, PROJECT MANAGEMENT, PUBLIC RELATIONS

- SENIOR VICE PRESIDENT, TERA CORPORATION
- 16 YEARS NUCLEAR EXPERIENCE
- FORMERLY SUPERVISOR OF NUCLEAR ENGINEERING, SMUD

KEYPERSONNEL

(continued)

- LEAD TECHNICAL REVIEWERS

CURT STALEY, M.S., LEAD STRUCTURAL REVIEWER AND CONSTRUCTION VERIFICATION PROGRAM MANAGER

NUCLEAR POWER PLANT STRUCTURAL, MECHANICAL DESIGN, CONSTRUCTION PROJECT MANAGEMENT AND CONTROL

- 14 YEARS NUCLEAR EXPERIENCE
- FORMERLY WITH BECHTEL, GENERAL DYNAMICS, CHEMICO

FRANK DOUGHERTY, M.S., M.B.A., LEAD MECHANICAL REVIEWER

NUCLEAR POWER PLANT MECHANICAL DESIGN, QUALITY ASSURANCE, SAFETY AND RELIABILITY ANALYSIS, SYSTEM DESIGN/CRITERIA DEVELOPMENT

- 14 YEARS NUCLEAR EXPERIENCE
- FORMERLY WITH EDS AND SARGENT & LUNDY

RICHARD SNAIDER, M.B.A., LEAD SYSTEMS REVIEWER

NUCLEAR POWER PLANT OPERATIONS, MAINTENANCE AND DESIGN, SYSTEMS ENGINEERING, LICENSING PROJECT MANAGEMENT, MECHANICAL ENGINEERING

- 15 YEARS NUCLEAR EXPERIENCE
- FORMERLY WITH JERSEY CENTRAL POWER & LIGHT AND NRC

LIONEL BATES, M.S., LEAD ELECTRICAL REVIEWER

NUCLEAR POWER PLANT ELECTRICAL, INSTRUMENTATION AND CONTROL SYSTEMS DESIGN, EQUIPMENT QUALIFICATION, PLANT OPERATIONS AND MAINTENANCE

- 10 YEARS NUCLEAR EXPERIENCE
- FORMERLY WITH NUTECH, WESTINGHOUSE, SAN DIEGO GAS AND ELECTRIC COMPANY, AND OMTEC

KEY PERSONNEL
(continued)

- LEAD SITE ACTIVITIES

  MARTIN JONES

  NUCLEAR POWER PLANT CONSTRUCTION MANAGEMENT, QUALITY CONTROL, TRAINING, START-UP, ELECTRICAL ENGINEERING

  - 22 YEARS NUCLEAR EXPERIENCE
  - FORMERLY MANAGER OF CONSTRUCTION AND QUALITY CONTROL, SOUTH CAROLINA ELECTRIC AND GAS COMPANY

- PROJECT QUALITY ASSURANCE

  CHARLES LEMON

  NUCLEAR POWER PLANT ENGINEERING, QUALITY ASSURANCE, LICENSING, COMPUTER SYSTEMS APPLICATION

  - 12 YEARS NUCLEAR EXPERIENCE
  - FORMERLY WITH BECHTEL

  MARK POLIT

  NUCLEAR POWER PLANT LICENSING, EQUIPMENT QUALIFICATION, INSTRUMENTATION AND CONTROL, SYSTEMS ENGINEERING

  - 3 YEARS NUCLEAR EXPERIENCE
  - FORMERLY WITH OMTEC AND NUTECH

- DESIGN REVIEW TEAM PERSONNEL

  ROBERT CUDLIN, M.S., J.D.

  NUCLEAR SAFETY AND LICENSING, REACTOR SAFEGUARDS, PLANT AND CONTAINMENT SYSTEMS, EQUIPMENT QUALIFICATION

  - 9 YEARS NUCLEAR EXPERIENCE
  - FORMERLY WITH NRC, SENATE SUBCOMMITTEE ON NUCLEAR REGULATION

KEY PERSONNEL
(continued)

- DESIGN REVIEW TEAM PERSONNEL

HENRY GEORGE, M.S.

QUALITY ASSURANCE, TRAINING, NUCLEAR PLANT SYSTEMS, PROCEDURES, PROJECT MANAGEMENT, MECHANICAL ENGINEERING

- 8 YEARS NUCLEAR EXPERIENCE
- FORMERLY WITH NRC AND ARMY

CHRISTIAN MORTGAT, PH.D.

ENGINEERING MECHANICS, EARTHQUAKE ENGINEERING

- 5 YEARS NUCLEAR EXPERIENCE/9 YEARS ENGINEERING EXPERIENCE
- FORMERLY WITH WOODWARD-CLYDE

LOREN STANLEY

NUCLEAR POWER PLANT LICENSING, DESIGN REVIEW, SAFETY-RELATED COMPONENT DETERMINATIONS, PROBABILISTIC RISK ASSESSMENT, INSTRUMENTATION, SYSTEM DESIGN AND ANALYSIS

- 26 YEARS NUCLEAR EXPERIENCE
- FORMERLY WITH GENERAL ELECTRIC COMPANY, OMTEC AND QUADREX CORPORATION

RICHARD KELLER, M.S.

ELECTRICAL, INSTRUMENTATION, AND CONTROL SYSTEMS DESIGN, NUCLEAR POWER PLANT OPERATIONAL ANALYSIS, PLANT PROTECTION SYSTEMS/ENGINEERED SAFETY FEATURES EVALUATION, PROBABILISTIC RISK ASSESSMENT

- 15 YEARS NUCLEAR EXPERIENCE
- FORMERLY WITH AEROJET NUCLEAR, STOLLER AND SYSTEM DEVELOPMENT CORPORATION

KEY PERSONNEL
(continued)

- DESIGN REVIEW TEAM PERSONNEL

MEHMET CELEBI, PH.D.

NUCLEAR POWER PLANT STRUCTURAL, MECHANICAL DESIGN AND CONSTRUCTION, QUALITY ASSURANCE

- 16 YEARS NUCLEAR EXPERIENCE
- FORMERLY WITH BECHTEL, EDAC

JORMA ARROS, PH.D. (CANDIDATE)

ENGINEERING MECHANICS

- 5 YEARS NUCLEAR EXPERIENCE/8 YEARS ENGINEERING EXPERIENCE

KENNETH CAMPBELL, PH.D.

SOIL MECHANICS, EARTHQUAKE ENGINEERING

- 10 YEARS ENGINEERING EXPERIENCE

EDWARD SCHRULL

REACTOR SAFETY SYSTEMS, NUCLEAR LICENSING, RELIABILITY AND RISK ASSESSMENT, INSTRUMENTATION AND CONTROL, COMPUTER ANALYSES

- 9 YEARS NUCLEAR EXPERIENCE
- CURRENTLY WITH EIGEN ENGINEERING
- FORMERLY WITH OMTEC, QUADREX AND NUTECH

STAN FABIC, PH.D.

THERMAL-HYDRAULIC AND HYDRO-ELASTIC ANALYSIS, COMPUTER METHODS DEVELOPMENT (AUTHORED BLODWN-2, WHAM, GASRAD, MULTIFLEX), PIPE RUPTURE ANALYSIS, CONTAINMENT ANALYSIS

- 24 YEARS NUCLEAR EXPERIENCE
- FORMERLY WITH NRC, WESTINGHOUSE, AND KAISER ENGINEERS

KEY PERSONNEL
(continued)

- DESIGN REVIEW TEAM PERSONNEL

NORMAND BERUBE, M.S.

DESIGN AND ANALYSIS OF MECHANICAL SYSTEMS, THERMAL-HYDRAULICS, HEAT TRANSFER, ENGINEERING, ANALYSIS

- 11 YEARS ENGINEERING EXPERIENCE

JOSEPH MARTORE, M.S., M.B.A.

NUCLEAR POWER PLANT STRUCTURAL, MECHANICAL DESIGN AND CONSTRUCTION, EQUIPMENT QUALIFICATION, OPERATING REACTOR SAFETY, LICENSING, PROJECT MANAGEMENT

- 8 YEARS NUCLEAR EXPERIENCE/10 YEARS ENGINEERING EXPERIENCE
- FORMERLY WITH NRC AND STONE & WEBSTER

JOHN ANGELO, M.S.

DESIGN, OPERATION, MAINTENANCE, INSTALLATION, TESTING AND INSPECTION OF POWER PLANT SYSTEMS AND COMPONENTS, NUCLEAR SAFETY AND LICENSING

- 20 YEARS NUCLEAR EXPERIENCE/33 YEARS ENGINEERING EXPERIENCE
- FORMERLY WITH GENERAL ELECTRIC, ARMY REACTORS, NRC

FARZIN RAMEZANBEIGI

STRUCTURAL AND MECHANICAL ENGINEERING, USAGE AND INTERPRETATION OF STRUCTURAL/MECHANICAL COMPUTER CODES

SUSAN SLY

CIVIL/MECHANICAL DESIGN AND CONSTRUCTION, INSTALLATION AND INSPECTION

- 4 YEARS NUCLEAR EXPERIENCE
- FORMERLY WITH BECHTEL

KEY PERSONNEL
(continued)

- DESIGN REVIEW TEAM PERSONNEL

JAMES LONG

ENGINEERING MANAGEMENT, NUCLEAR SAFETY AND LICENSING

- 16 YEARS NUCLEAR EXPERIENCE
- FORMERLY WITH NRC, NAVY

RICHARD MACDONALD, M.B.A.

ENGINEERING, CONSTRUCTION, OPERATION, MAINTENANCE AND PROJECT MANAGEMENT SYSTEMS, NUCLEAR PLANT START-UP AND OPERATIONS

- 11 YEARS NUCLEAR EXPERIENCE
- FORMERLY WITH BECHTEL

CHRISTIAN NELSON

NUCLEAR POWER PLANT SAFETY AND LICENSING, SEISMIC DESIGN, OPERATIONAL ANALYSIS, PLANT INSPECTION PROGRAM DEVELOPMENT

- 12 YEARS NUCLEAR EXPERIENCE
- FORMERLY WITH NRC

JOSEPH PENZIEN, PH.D., UNIVERSITY OF CALIFORNIA (BERKELEY)

STRUCTURAL ENGINEERING, EARTHQUAKE ENGINEERING, REINFORCED CONCRETE RESPONSE

- 37 YEARS ENGINEERING EXPERIENCE
- CURRENTLY DIRECTOR OF EARTHQUAKE ENGINEERING RESEARCH CENTER AT UNIVERSITY OF CALIFORNIA, BERKELEY

KEY PERSONNEL

(continued)

- DESIGN REVIEW TEAM PERSONNEL

DANIELE VENEZIANO, PH.D., MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ENGINEERING STATISTICAL ANALYSIS, PROBABILISTIC ANALYSIS, CIVIL ENGINEERING

- PROFESSOR OF CIVIL ENGINEERING

MICHAEL AYCOCK

NUCLEAR POWER PLANT SYSTEMS, OPERATING PROCEDURES, LICENSING AND PROJECT MANAGEMENT

- 8 YEARS NUCLEAR EXPERIENCE
- FORMERLY WITH NRC

GEORGE TRIGILIO

NUCLEAR RADWASTE SYSTEM DESIGN AND ANALYSIS, PROJECT MANAGEMENT

- FORMERLY WITH BROWN & ROOT, STONE & WEBSTER AND HITTMAN NUCLEAR DEVELOPMENT CORPORATION

LENNY LAAKSO, M.S.

STRUCTURAL/MECHANICAL ANALYSIS AND DESIGN OF NUCLEAR POWER PLANT BUILDINGS AND EQUIPMENT, SPECIFICATIONS, PLANNING AND SCHEDULING

- 8 YEARS NUCLEAR EXPERIENCE
- FORMERLY WITH STONE AND WEBSTER, CHAS. T. MAIN

KEY PERSONNEL
(continued)

- DESIGN REVIEW TEAM PERSONNEL

  LOUIS FUSCO, JR.

  NUCLEAR SYSTEMS ENGINEERING AND LICENSING, EQUIPMENT QUALIFICATION, ENGINEERING AND PROJECT MANAGEMEMENT, NUCLEAR POWER PLANT OPERATIONS AND MANAGEMENT
  - 8 YEARS NUCLEAR EXPERIENCE
  - FORMERLY WITH NUS, EDS, NAVY

  STEPHEN SCHREURS

  DESIGN AND ANALYSIS OF RADWASTE PROCESSING SYSTEMS, COMPUTER SYSTEMS APPLICATION, PROJECT MANAGEMENT
  - 9 YEARS NUCLEAR EXPERIENCE

  DOUGLAS M. WITT, M.S.

  NUCLEAR POWER PLANT SYSTEMS AND MECHANICAL DESIGN, SAFETY ANALYSIS, EQUIPMENT DESIGN, LICENSING, HELBA, THERMAL-HYDRAULICS
  - 12 YEARS NUCLEAR EXPERIENCE
  - FORMERLY WITH SARGENT AND LUNDY, EDS NUCLEAR

- CONSTRUCTION REVIEW TEAM PERSONNEL

  JAMES OWENS

  NUCLEAR AND FOSSIL POWER PLANT DESIGN AND CONSTRUCTION NUCLEAR STEAM SUPPLY SYSTEMS DESIGN AND CONSTRUCTION, PROJECT MANAGEMENT, CONTROL SYSTEMS, SAFEGUARDS, LICENSING
  - 32 YEARS NUCLEAR EXPERIENCE
  - FORMERLY GENERAL MANAGER - PRODUCTION ENGINEERING AND CONSTRUCTION AND PROJECT MANAGER SUMMIT NUCLEAR POWER STATION, DELMARVA POWER AND LIGHT COMPANY

KEY PERSONNEL
(continued)

- CONSTRUCTION REVIEW TEAM PERSONNEL

LUIS FLORES

NUCLEAR POWER PLANT LICENSING, OPERATIONS, SYSTEMS ENGINEERING, INSTRUMENTATION AND CONTROL SYSTEMS, FAILURE ANALYSIS

- 9 YEARS NUCLEAR EXPERIENCE
- CURRENT WITH EIGEN ENGINEERING
- FORMERLY WITH OMTEC AND GENERAL ELECTRIC COMPANY

MONTE WISE

ENGINEERING AND PROJECT MANAGEMENT, PRESERVICE/INSERVICE INSPECTION, NDE, NUCLEAR POWER PLANT OPERATIONS AND MANAGEMENT, QUALITY ASSURANCE, EQUIPMENT QUALIFICATION

- 25 YEARS NUCLEAR EXPERIENCE
- FORMERLY SUPERINTENDENT OF LACROSSE BWR
- FORMERLY WITH SW RESEARCH AND GENERAL ELECTRIC

PATRICK LONGSTRETH, B.S., M.B.A.

PROJECT AND CONSTRUCTION MANAGEMENT, ADMINISTRATION, CONTROL AND PLANNING, CONTRACTING

- 15 YEARS PROJECT AND CONSTRUCTION MANAGEMENT EXPERIENCE
- FORMERLY WITH BECHTEL

KEY PERSONNEL
(continued)

- CONSTRUCTION REVIEW TEAM PERSONNEL

STEPHEN BRISCOMBE

CONSTRUCTION MANAGEMENT, SITE CONSTRUCTION SERVICES, CONSTRUCTION SUPERVISION, ELECTRICAL CONSTRUCTION TECHNIQUES, PROCEDURES AND SPECIFICATION DEVELOPMENT, DESIGN REVIEW, QUALITY CONTROL

- 17 YEARS NUCLEAR EXPERIENCE/25 YEARS ENGINEERING EXPERIENCE
- FORMERLY WITH GE AND BECHTEL

SIDNEY BROWN

ENGINEERING AND CONSTRUCTION MANAGEMENT, COST AND SCHEDULING, QUALITY CONTROL, FIELD ENGINEERING

- 17 YEARS NUCLEAR EXPERIENCE/30 YEARS ENGINEERING EXPERIENCE
- FORMERLY WITH BECHTEL

LEONARD STOUT

DESIGN, CONSTRUCTION, START-UP AND OPERATIONS, PROJECT CONTROL, SCHEDULE AND COST CONTROL SYSTEMS

- 14 YEARS EXPERIENCE
- FORMERLY WITH BECHTEL

DAVID HAMEL

NUCLEAR POWER PLANT LICENSING, EQUIPMENT ENVIRONMENTAL QUALIFICATION, REACTOR DESIGN, SAFETY EVALUATION, INSTRUMENTATION AND CONTROL DESIGN, FACILITIES OPERATION, HEALTH PHYSICS, QUALITY ASSURANCE

- 16 YEARS NUCLEAR EXPERIENCE
- CURRENTLY WITH EIGEN ENGINEERING
- FORMERLY WITH NUTECH AND GENERAL ELECTRIC COMPANY

KEY PERSONNEL
(continued)

- CONSTRUCTION REVIEW TEAM PERSONNEL

FREDERICK BERTHRONG, M.S.

ENGINEERING PROJECT MANAGEMENT, PLANNING, SCHEDULING AND FIELD ENGINEERING

- 18 YEARS NUCLEAR EXPERIENCE
- FORMERLY WITH BECHTEL

DONALD TULODIESKI

PROJECT MANAGEMENT/CONTROL, START-UP TESTING, ENGINEERING

- 17 YEARS NUCLEAR EXPERIENCE
- FORMERLY WITH B&W AND PUBLIC SERVICE ELECTRIC AND GAS COMPANY

ALBERT MARTORE

ENGINEERING, SPECIFICATION, CONSTRUCTION FABRICATION, CONSTRUCTION MANAGEMENT AND CONTROL, SCHEDULING, SUPERVISION, INSPECTION

- 10 YEARS NUCLEAR EXPERIENCE/30 YEARS ENGINEERING EXPERIENCE
- FORMERLY WITH PRESCON CORPORATION

ROBERT SNYDER

NUCLEAR POWER PLANT DESIGN AND CONSTRUCTION, PROJECT MANAGEMENT, START-UP AND OPERATIONS

- 5 YEARS NUCLEAR EXPERIENCE/OVER 30 YEARS ENGINEERING EXPERIENCE
- FORMERLY WITH HITTMAN ASSOCIATES AND KAISER

GARY SMITH

CIVIL ENGINEERING DESIGN AND CONSTRUCTION, PROJECT MANAGEMENT

- 15 YEARS EXPERIENCE

KEY PERSONNEL
(continued)

- CONSTRUCTION REVIEW TEAM PERSONNEL

STANLEY KAUT

DESIGN, REVIEW, CONSTRUCTION, TESTING, OPERATION, AND LICENSING OF ELECTRICAL POWER, INSTRUMENTATION AND CONTROL SYSTEMS AND EQUIPMENT; PROJECT MANAGEMENT, DESIGN REVIEW, PLANT PROCEDURES, QUALITY ASSURANCE

- 17 YEARS NUCLEAR EXPERIENCE/20 YEARS ENGINEERING EXPERIENCE
- FORMERLY WITH NUTECH, NUCLEAR SERVICES CORPORATION, AND GE

RANDY CLELAND, M.B.A.

POWER PLANT MECHANICAL DESIGN, PIPING/HANGER DESIGN AND CONSTRUCTION, REVIEW AND INSPECTION OF MECHANICAL SYSTEMS, CONSTRUCTION SUPERVISION AND MANAGEMENT, RESULTS ENGINEERINGS

- 10 YEARS POWER PLANT ENGINEERING EXPERIENCE, 2 YEARS NUCLEAR
- FORMERLY WITH CENTRAL ILLINOIS PUBLIC SERVICE COMPANY AND SARGENT AND LUNDY

EDWARD BECK

NONDESTRUCTIVE TESTING, LEVEL III IN RADIOGRAPHY, ULTRASONICS, MAGNETIC PARTICLE, LIQUID PENETRANT

- 14 YEARS NUCLEAR EXPERIENCE
- CURRENTLY WITH LAW ENGINEERING

ROBERT RENEAU

NONDESTRUCTIVE TESTING, LEVEL II IN RADIOGRAPHY, ULTRASONICS, MAGNETIC PARTICLE, LIQUID PENETRANT

- 10 YEARS NUCLEAR EXPERIENCE
- PREVIOUSLY WITH WESTINGHOUSE, CURRENTLY WITH LAW ENGINEERING

NEL

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, CONSTRUCTION, STARTUP AND

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ASGC, ANSI N45.2.6 LEVEL III

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MONITORING, SUPERVISION, AND

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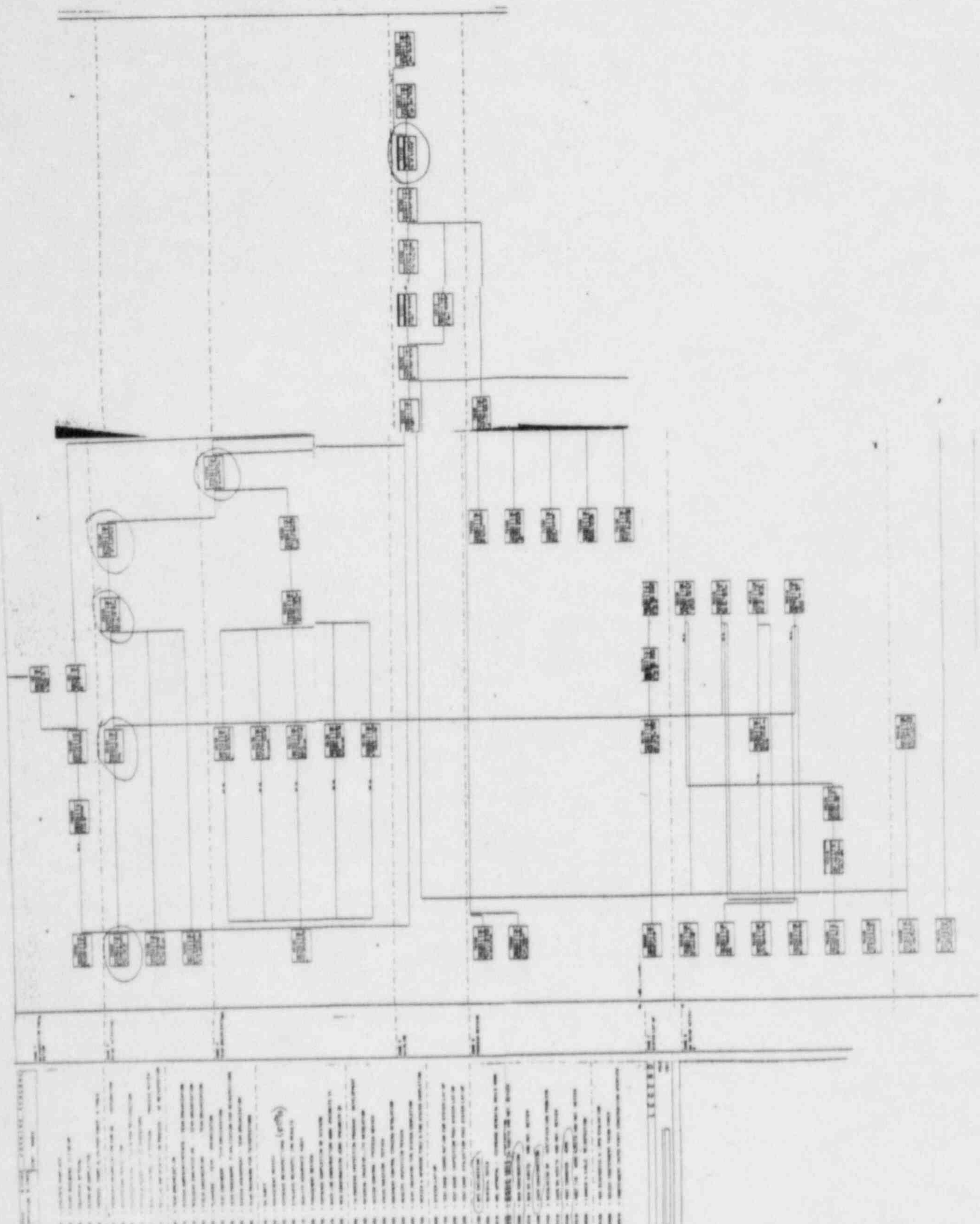
EAR CONTRACTORS SUCH AS
ASSOCIATES, STONE & WEBSTER,
INDUSTRIES



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

MEMORANDUM FOR: T. Novak, Assistant Director for Licensing, Division of Licensing

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

SUBJECT: NRR ASSISTANCE IN RESOLVING MIDLAND SOILS ISSUE

Region III has assumed all responsibility for reviewing the remedial soils work at the Midland site. However, we expect the licensee to periodically request relief from commitments made in the SSER. NRR's assistance will be requested when this occurs.

The expertise of NRR will also be required from time to time for consultation with Mr. Ross Landsman during his review of the remedial soils activities. A schedule cannot be defined at this time. NRR's assistance will be requested on a case by case basis as the need arises.

We also recommend that periodic site visits be made in order for your personnel to maintain their awareness of the underpinning effort. These visits could be limited to observations of critical work activities such as the pier 11 load tests and the drift work to the control tower. The schedule for these activities can be obtained from Ross Landsman.

Should you have any questions please contact Wayne Shafer (FTS 384-2656).

RF Warnick

R. F. Warnick, Director
Office of Special Cases

cc: A. B. Davis
J. H. Sniezek, IE
J. C. Stone, IE
D. Hood, NRR

Records maintained by NRC: Office of Executive Legal Director related to a 1983 discovery by the Government Accountability Project.

Dupes - 18

Records requested from boxes 1 thru 28 Joseph Kove's records.

1 thread

Rd. 7

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

APR 9 - 1979

Docket No. 50-329
Docket No. 50-330

Consumers Power Company
ATTN: Mr. Stephen H. Howell
Vice President
1945 West Parnall Road
Jackson, MI 49201

Gentlemen:

This refers to the inspection conducted by Mr. E. J. Gallagher of this office on March 28-29, 1979, of activities at the Midland Nuclear Plant, Units 1 and 2, authorized by NRC Construction Permits No. CPPR-81 and No. CPPR-82 and to the discussion of our findings with Messrs. D. Miller and R. Wollney and others of your staff at the conclusion of the inspection.

The enclosed copy of our inspection report identifies areas examined during the inspection. The inspection consisted of an examination of the continuing exploratory soil borings program and settlement monitoring of plant area fill.

No items of noncompliance with NRC requirements were identified during the course of this inspection.

In accordance with Section 2.790 of the NRC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations, a copy of this letter and the enclosed inspection report will be placed in the NRC's Public Document Room, except as follows. If this report contains information that you or your contractors believe to be proprietary, you must apply in writing to this office, within twenty days of your receipt of this letter, to withhold such information from public disclosure. The application must include a full statement of the reasons for which the information is considered proprietary, and should be prepared so that proprietary information identified in the application is contained in an enclosure to the application.

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2pp.

We will gladly discuss any questions you have concerning this inspection.

Sincerely,

Gaston Fiorelli, Chief
Reactor Construction and
Engineering Support Branch

Enclosure: IE Inspection
Reports No. 50-329/79-06
and No. 50-330/79-06

cc w/encl:
Central Files
Reproduction Unit NRC 20b
PDR
Local PDR
NSIC
TIC
Ronald Callen, Michigan Public
Service Commission
Dr. Wayne E. North
Myron M. Cherry

OFFICE	RIII	RIII	RIII	RIII	RIII	
SURNAME	Gallagher/blk	Hayes	Fiorelli	Cook	Hansen	
DATE	4/3/79					

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

REGION III

Report No. 50-329/79-06; 50-330/79-06

Docket No. 50-329; 50-330 License No. CPPR-81; CPPR-82

Licensee: Consumers Power Company
1945 West Parnall Road
Jackson, MI 49201

Facility Name: Midland Nuclear Power Plant, Units 1 and 2

Inspection At: Midland Site, Midland, Michigan

Inspection Conducted: March 28-29, 1979

F. J. Jablonski for
Inspector: E. J. Gallagher 4/4/79

F. J. Jablonski for
Approved By: D. W. Hayes, Chief 4/4/79
Engineering Support Section 1

Inspection Summary

Inspection on March 28-29, 1979 (Report No. 50-329/79-06; 50-330/79-06)
Areas Inspected: Followup 10 CFR 50.55(e) report concerning settlement of diesel generator building and plant area fill; monitoring of settlement, piezometer, strain gage and pipe profile survey measurements; soil borings in plant area fill and beneath safety-related structures. The inspection involved a total of 15 inspection hours by one NRC inspector.
Results: No items of noncompliance or deviations were identified in the areas inspected.

~~7905240734~~ 7,10

DETAILS

1. Persons Contacted

Principal Licensee Employees (CPCo)

*D. Miller, Site Project Manager
*D. Horn, Quality Assurance Group Supervisor
*R. Wollney, Quality Assurance Engineer
*B. Peck, Construction Supervisor

U. S. Testing Laboratory

J. Speltz, Lab Manager

Bechtel Associates Professional Corporation

*A. Boos, Project Field Engineer
*A. Ozeroff, Quality Assurance Engineer
*W. L. Barclay, Project Field Quality Control Engineer
J. Wanzeck, Geotech Engineer, Ann Arbor Office
F. Wall, Geologist, Gaithesburg Office
W. Kinzer, Geotech, Ann Arbor Office
D. Jinnett, Quality Control, San Fransico Office
J. Hartman, Project Engineering, Ann Arbor Office

NRC Resident Inspector

*R. Cook

*Denotes those present at exit meeting

Functional or Program Areas Inspected

Followup of Reportable Occurrence (10 CFR 50.55(e)) - Settlement of Plant Area Fill and Structures

The purpose of this inspection was to observe the exploratory soil boring program which Consumers Power Company has undertaken in an effort to identify subsurface conditions of the plant area fill and soil condition beneath safety related structures founded on plant fill. In addition, a review of the current soil boring logs, settlement data compiled for structures and piping and monitoring of ground water levels was performed. Future planned activities were also discussed with licensee personnel.

1. Status of Diesel Generator Building Settlement

The program of applying a surcharge of sand material in and around the building has continued. As of March 28, 1979, approximately 15 feet of material has been placed and is proposed to be continued until a total of 20 feet of surcharge is in place. This surcharge is an attempt to accelerate any future settlement of DG Buidling by consolidating the foundation material. The following are the total settlement measurements as of March 22, 1979:

DG Building Settlement:

North Wall - RE:SK-628RC	(Westside) 2.6"	(Eastside) 4.1"
South Wall - RE:SK-629RC	(Westside) 4.25"	(Eastside) 5.7"
East Wall - RE:SK-629RC	(Southside) 5.7"	(Northside) 4.1"
West Wall - RE:SK-628RC	(Southside) 4.25"	(Northside) 2.6"

DG Pedestal No. 4

Northwest Corner - 4.8" SK-654RA
Northeast Corner - 5.5" SK-635RB
Southwest Corner - 4.35" SK-635RB
Southeast Corner - 4.8" SK-654RA

2. Soil Borings in Progress

Exploratory soil boring operations are in progress in order to identify and develop the quality of material in the plant area fill and beneath safety related structures. Soil borings are being taken in accordance with the following ASTM standard methods:

a. ASTM D-1586 Penetration Test and Split Barrel Sampling of Soils.

b. ASTM D-1452 Soil Investigation and Sampling by Auger Borings.

c. ASTM D-1587 Thin Wall Tube Sampling of Soils.

The following recent preliminary soil boring logs were reviewed:

Soil Boring ID	Building Location	Comments
RW-5	Radwaste	Soft Material Elev 629-624 2, 2, 3 Blows/ft.

DF-6	Diesel Fuel Oil Storage	Low Blow Counts Elev 620-613 3, 3, 8 Blows/ft.
AX-4	Auxiliary Building	Soft Material Elev 601 3 Blows/ft.
AX-5	Auxiliary Building	Soft Material Elev 601/597 3, 4 Blows/ft.
AX-7	Auxiliary Building	Loose Material Elev 607-603 7, 2 Blows/ft Soft Material Elev 603-595 5, 2, 4 Blows/ft.
AX-11	Auxiliary Building	Soft Material Elev 616-606 3, 4, 4, 6 Blows/ft.
SW-4	Service Water Intake	Soft Material Elev 611-605 3, 2 Blows/ft.
SW-5	Service Water Intake	Low Blow Counts Elev 624-620 6, 3, 6 Blows/ft.
SW-5A	Service Water Intake	Loose Material Elev 628-618 5, 3, 8 Blows/ft.
SW-6	Service Water Intake	Loose Material Elev 601-599
SW-8	Service Water Intake	Soft Material Elev 616-612 Drill Rod sunk under own weight
OL-4	Oily Waste	Low Blow Count Elev 619-614 9, 7, 6 Blows/ft. Observed drilling in progress and split spoon soil sampling

NOTE: (1) Blows per foot are determined by the weight of a 140 pound hammer dropping 30 inches in accordance with ASTM standards.
(2) The term "Loose" refers to sand material and "Soft" refers to clay material.

In addition to the above soil boring log's the following records of soil borings indicated relatively higher blow counts per foot: AX-1, AX-2, AX-6, AX-8, SW-3, SW-6, SW-7, SW-9. The quality of the soil in these areas are presumed to be adequate.

A number of additional soil borings are still in progress in order to develop a full profile of the quality of the foundation material.

3. Ground Water Levels in Plant Area Fill

The cooling pond water elevation is now at maximum elevation 627 feet. Piezometers have been installed throughout the plant area in order to measure ground water elevations and the effect on settlements. The piezometers indicated the following ground water elevations in the plant:

Location	Water Level (feet)
Service Water Building SW-1, SW-4 SW-6, SW-7, and SW-8	626
Auxiliary Building AX-1, AX-2	624
Diesel Fuel Oil Tanks DF-6	627
Chlorination Building CL-1	626
Administration Building A-1	624
Tank Farm Area T-19	615

Ground water elevations are continuing to be monitored in the plant fill.

4. Profiles of Underground Piping

Survey profiles of the service water lines in the plant fill have been developed. This information is under evaluation by Bechtel stress analysis group to determine the stress induced due to differential settlement of the pipe lines. The current plans of the licensee are to take soil boring along the service water and borated water lines in order to predict future settlements and perform an evaluation in order to determine whether the additional stress levels are within the permissible ASME Code requirements. No information regarding the evaluation was available at this time.

5. Crack Mapping and Strain Gage Measurements

Field survey's of existing cracks in the diesel generator building and service water intake structure have been performed. Strain gage measurement devices have been installed on the diesel generator building to monitor the displacements of these cracks due to the effects of the surcharge being applied to the building foundation and walls. No plans have been made to install strain gages on the service water structure, however, periodic visual observations are made to determine if any additional cracks occur and the width measurements of these cracks. Crack width measurements continue to be monitored as well on the DG Building using the strain gage instrumentation.

6. CPCo Investigation of Possible Causes of the Plant Area Fill Settlement

CPCo and Bechtel have developed the following preliminary list of possible causes which either individually or collectively contributed to the settlement failure of the diesel generator building and plant area fill material.

a. Placement method regarding lift thickness, moisture control, compaction equipment and type of materials.

b. Theoretical comparison between Bechtel Modified Proctor (BMP) Compaction test versus settlement.

c. Specification C-211 regarding the omission of frost protection and flooding of trenches.

d. Testing of plant area fill.

e. Test frequency and location for small areas.

f. Work performed by different contractors regarding personnel qualifications and inpsection methods.

g. Extensively re-excavated areas regarding procedures and control.

h. Filling of the cooling water pond in March 1978.

i. Moisture intrusion in ground compared with compaction.

j. Stockpiling material relative to moisture control (weathered, drying out).

k. Investigation of moisture control (dry year in 1977).

l. Inspection procedures after March, 1977.

m. Personnel Qualifications of Bechtel, U. S. Testing and Connoie contractors.

Details of the licensee's effort in this area will be reviewed when completed.

7. Planned Activities

The licensee is planning to perform the following activities to identify the quality of subsurface materials:

a. Perform lift thickness test to verify if the required density could be achieved using hand held compaction equipment with a maximum of 12 inch lifts.

b. Excavate test pits in order to visually observe the subsurface materials and perform in-place density tests to compare with quality control records.

c. Continue preload in DG Builidng by applying a surcharge of 20 feet of sand to accelerate consolidation of foundation materials.

d. Study alternatives for additional support of the service water intake structure and portions of Auxiliary Building.

e. Perform pipe stress analysis on piping in the plant fill such as service water lines and condensate lines.

f. Continue to perform soil borings as identified on drawing C-1145 R2 to identify subsurface conditions in the plant fill.

Exit Interview

The inspector met with site staff representatives (denoted in Persons Contacted) at the conclusion of the inspection on March 29, 1979. The inspector summarized the purpose and scope of the inspection. The licensee acknowledged the findings reported herein. The inspector requested that the licensee provide a weekly status report by telephone communications in order to keep the NRC RIII office apprised of the status of the site exploratory program. The licensee acknowledged this request would be accommodated.

RzL 24

SEP 27 1979

Docket No. 50-329/330

MEMORANDUM FOR: George C. Gower, Acting Executive Officer for Operations Support, IE

FROM: Harold D. Thornburg, Director, Division of Reactor Construction Inspection, IE

SUBJECT: COMMENTS ON NEEDED ACTION ON MIDLAND ENFORCEMENT PACKAGE

RIII transmitted an enforcement package to me dated April 3, 1979 and that package was sent to XOOS as directed by J. Davis's memorandum of March 21, 1979.

RCI provided comments on the enforcement package in a memorandum dated June 13, 1979 (see Enclosure 1) to XOOS for coordination. We have not seen any positions in writing from NRR on the package. Since that date there have been several meetings (8/1, 8/3 and 8/16) which addressed, at least in part, the questions centering around further action on the enforcement package. The meetings were attended by personnel from NRR, ELD and IE. The various elements necessary to make a finding on a material false statement were examined.

a. Is the statement false?

b. Is the statement material?

c. Under what circumstances or in what frame of mind was the statement made (willful, deceitful, careless disregard)?

As a result of these meetings and the subsequent discussions by telephone with NRR representatives, we are of the opinion that the enforcement action should be taken on Item 1 of the package as a material false statement in that the fill used ~~at~~ the site was not the type stated in the FSAR as having been used (random vs engineered structural fill). The NRR conclusions on the other four items were that the statements were not material and indicated "poor QA performance" on the part of the licensee.

CONTACT: R. E. Shewmaker, IE
49-27551

7912140299

Further, it is our opinion that the fact that there are four clear instances of conflicting statements in the FSAR vs what was actually done, is evidence of improper internal coordination and failure on the part of the licensee to assure that accurate information was being provided in the FSAR. These constitute sufficient facts to make a finding that the material false statement was made in careless disregard of the facts. This would make the material false statement subject to a civil penalty vs actions allowed under the Administrative Procedures Act for the "second chance."

We strongly recommend that XOOS advise RIII to prepare the enforcement package in this manner and that we proceed quickly on this matter. We understand that there is a reluctance by some in the NRC against finalizing an action on material false statements while the bigger questions of the QA program and work being done at the site as corrective actions which are not yet approved by the NRC are being considered for action. In our opinion, the two matters are distinct and IE should proceed with the initiation of enforcement action on the false statement.

If you have any questions, please contact us.

Harold D. Thornburg

Harold D. Thornburg
Director
Division of Reactor
Construction Inspection, IE

cc: G. W. Reinmuth, IE
J. G. Keppler, RIII
T. W. Brockett, IE
D. Hood, NRR
C. E. Norelius, RIII

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

AUG 9 1979

MEMORANDUM FOR: File

FROM: Darl Hood, Project Manager, Light Water Reactors Branch No. 4, DPM

SUBJECT: NRR COMMENTS REGARDING ENFORCEMENT ACTION ON MIDLAND SOIL DEFICIENCIES

An April 3, 1979 memorandum from J. Keppler to H. Thornburg identified five statements from the FSAR regarding the backfill deficiency at the Midland site which I&E considered to be false, and requested a determination as to the materiality of these statements. Following receipt of this memorandum by NRR on May 7, 1979, it was distributed to technical review branches for review and a meeting was held August 1 to provide NRR comments. Meeting attendees, listed by Enclosure 1, included both I&E and OELD. A summary of the NRR comments as to the materiality of the five same-numbered statements of the Keppler memo is given in Enclosure 2.

OELD defined "materiality" of FSAR statements. This definition served as the basis for judgments in the meeting. A statement was deemed to be "material" if, not withstanding the fact that it was detected by the I&E investigation, it would or could have an influence upon a safety conclusion of the NRR staff (i.e., if it could have resulted in an improper finding or less probing analysis by the staff). The technical significance and willfullness of any such false statement is relevant to selection of the specific enforcement action deemed to be appropriate.

It was noted that some of the technical reviewers had not yet completed review of some of the relevant background material, and therefore only preliminary comments could be given at the meeting. A subsequent meeting on or about August 3, 1979 was scheduled to confirm or modify these preliminary comments.

Darl S. Hood, Project Manager
Light Water Reactors Branch No. 4
Division of Project Management

Enclosures:
As stated

cc: See next page

8106090704

cc: All Attendees

G. Gower
L. Rubenstein
S. Varga
D. Vassallo
W. Olmstead
H. Thornburg
J. Keppler
W. Haass
D. Skovholt
J. Murray

ENCLOSURE 1

ATTENDEES
August 1, 1979

R. Shewmaker	(I&E HQ)
T. Brockett	(I&E HQ)
D. Gillen	(NRR GSB)
J. Lieberman	(OELD)
D. Bachman	(OELD)
D. Hood	(NRR DPM)
L. Heller	(NRR GSB)
J. Gilray	(NRR QAB)
J. Spraul	(NRR QAB)
J. Knight	(NRR AD:Eng)
P. Baci	(I&E HQ)
R. Lipinski	(NRR SEB)
F. Schauer	(NRR SEB) (part-time)
C. Moon	(NRR LWR#4:Acting BC)
R. Jackson	(NRR GSB:Chief)

ENCLOSURE 2

NRR COMMENTS ON APRIL 3, 1979 KEPPLER MEMORANDUM

1. This statement is considered by NRR to be material; the fact that the Midland fill is of the wrong type (random fill verses structural fill) and was not sufficiently compacted is viewed by NRR as the core of the settlement problem. Other findings in the report appear to be subparts of (contributers to) this central problem and NRR suggested consideration be given to combining all five findings.

2. NRR stated that the difference between use of 3.0 KSF and 4.0 KSF for the load density for the Diesel Generator Building calculation would not or did not influence a safety conclusion by the NRR staff, and therefore, was not considered to be "material". Rather, the finding is viewed as an indicator of poor QA performance.

3. NRR stated that the difference between use of 0.001 and 0.003 for the index of compressibility for the Diesel Generator Building calculation would not or did not infuence a safety conclusion by the NRR staff, and therefore, was not considered to be "material " Rather, the finding is viewed as an indicator of poor QA performance.

4. NRR recognizes the statements in FSAR sections 2.5.4.10.3.5 and 3.8.4.1.2 regarding the type of mat for the Diesel Generator Building to be inconsistent. However they are not false insofar as they reflect what was actually done. In its review, NRR interpretated the use of 41 points to represent a mat foundation, whereas FSAR section 3.8.4.1.2 accurately identified the buidling to have continuous footings. The improper calculation is viewed by NRR as an indicator of poor QA performance.

5. This statement is considered to be a subpart of statement 1. It also appears to be relevant to poor QA performance.

Ref. 31

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

April 3, 1979

MEMORANDUM FOR: Harold D. Thornburg, Director, Division of Reactor Construction Inspection, IE

FROM: James G. Keppler, Director

SUBJECT: ENFORCEMENT ACTION RE: MIDLAND DIESEL GENERATOR BUILDING AND PLANT FILL AREA

As you are aware, we have sent to Consumers Power Company a report on our two meetings held with them and a report of the investigation into the causes of the diesel generator building settlement. In my memorandum to you dated March 12, 1979, I summarized our findings and our concerns resulting from this investigation.

In view of NRR's involvement in the technical issues in this case, and the need for a determination as to the materiality of FSAR statements we consider to be false, we are not in a position at this time to recommend specific enforcement action which should be taken.

Attached to this memorandum are the specific FSAR statements and the basis for our conclusion that they are false. Also attached are copies of our letter dated March 22, 1979, which transmitted the Investigation report to the licensee and a draft Notice of Violation setting forth the items of noncompliance based on the investigation findings. The draft Notice of Violation includes all of the FSAR discrepancies described in Attachment 1 as examples of noncompliance with Criterion III of 10 CFR 50, Appendix B. If it is determined that any of these matters constitute material false statements, we assume they would then be treated separately, and removed as examples of noncompliance with this criteria.

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We request that the items of noncompliance be given technical and legal review and that a determination be made of the materiality of FSAR discrepancies so that upon resolution of the technical issues, we will be in a position to move more promptly toward taking enforcement action.

James G. Keppler
James G. Keppler
Director

Attachments:
1. FSAR False Statements
2. Draft Notice of Violation
3. Ltr dtd 3/22/79, with
   Investigation Report

cc w/attachments:
D. Thompson, IE

Midland FSAR Statements

1. Statement

Section 2.5.4.5.3, Fill, states: "All fill and backfill were placed according to Table 2.5-9."

Table 2.5-9, Minimum Compaction Criteria, contains the following:

			Compaction Criteria	
"Function	Zone(1) Designation	Soil Type	Degree	ASTM Designation
Support of structures		Clay	95%	ASTM D 1557-66T (modified)(2)

(1) For zone designation see Table 2.5-10.
(2) The method was modified to get 20,000 foot-pounds of compactive energy per cubic foot of soil."

Section 2.5.4.10.1, Bearing Capacity, states: "Table 2.5-14 shows the contact stress beneath footings subject to static and static plus dynamic loadings, the foundation elevation, and the type of supporting medium for various plant structures."

Table 2.5-14, Summary of Contact Stresses and Ultimate Bearing Capacity for Mat Foundations Supporting Seismic Category I and II Structures, contains, in part; the following:

"Unit	Supporting Soils
Diesel Generator Building	Controlled compacted cohesive fill.

Finding

Construction Drawing C-45, Class I fill material areas, specifies the foundation material for Class I structures to be Zone 2 material which is identified in FSAR Table 2.5-10, Gradation Ranges for Fill Material, as Random Fill and is described as "Any material free of humus, organic or other deleterious material." It was ascertained that materials other than "clay" or "controlled compacted cohesive fill" were used for support of structures.

2. Statement

Section 2.5.4.10.3.1, Plant Layout and Loads, states: "The building loads superimposed by the structures on undisturbed soil or compacted fill are given in the soil pressure plan, Figure 2.5-47."

Figure 2.5-47, Soil Pressure Diagram Category I and II Structures, shows the superimposed load density for the Diesel Generator Building to be 4.0 KSF (4000 lbs. per sq. ft.).

Finding

It was ascertained through a review of the settlement calculations and an interview of the individual who performed those calculations that 3.0 KSF was used.

3. Statement

Section 2.5.4.10.3.3, Soil Parameters, states: "The soil compressibility parameters used in the settlement calculation are presented together with soil profile in Table 2.5-16."

Table 2.5-16, Idealized Soil Profile and Parameters for Elastic Half-space Settlement and Heave Analysis, contains the following:

Layer	Idealized Soil Type	Elevation Interval (ft)	Thickness (ft)	Average $\frac{C_c \cdot r^{(1)}}{1+e_o}$
A	Fill (CL)	634-609	25	0.003
B	Fill (CL)	609-603	6	0.003

NOTE: Final groundwater table is taken at elevation 627.

(1) Values were estimated from the mathematical relationship between Young's Modulus and Compression and rebound indexes and averaged with those obtained from consolidation tests. Young's Modulus was estimated from empirical relationship with shear strength.

Finding

It was ascertained through a review of the statement calculations for the Diesel Generator Building and an interview with the individual who performed these calculations that an index of compressibility of 0.001 not 0.003, was used for the elevation interval 603-634.

4. Statement

Section 2.5.4.10.3.5, Analysis, states: "For settlement computations, a total of 41 settlement points are established on a grid and at selected structure locations as shown in Figure 2.5-48. . . . To account for possible time-dependent relationship, the estimated total settlements at each of the 41 points were obtained respectively by adding 25% of the calculated settlement values of loading Case A to the calculated ultimate settlement values of loading Case B. These values are presented in Figure 2.5-48."

Section 3.8.4.1.2, Diesel Generator Building, states: "The walls are supported by continuous footings with bases at elevation 628'-0". Each diesel generator rests on a 6'-6" thick reinforced concrete pedestal which is not structurally connected to the building foundation for purposes of vibration isolation."

Finding

It was ascertained through a review of the settlement calculations for the Diesel Generator Building and an interview with the individual who performed these calculations that the data in Figure 2.5-48 regarding the Diesel Generator Building are based on calculations performed on the erroneous assumption that the Diesel Generator Building was constructed on a mat foundation.

5. Statement

Section 3.8.5.5, Structural Acceptance Criteria, states: "Settlements of shallow spread footings founded on compacted fills are estimated to be on the order of 1/2 inch or less. These settlements are essentially elastic and occur as the loads are applied."

Finding

It was ascertained through an interview with the individual who wrote this section of the FSAR that the above statement was taken from the Dames and Moore report submitted as part of the PSAR. He assumed the statement was valid for inclusion in the FSAR. He said there was no other basis to support the statement.

(NOTE: In this regard the licensee has subsequently stated this statement ". . . is not applicable to the as-built configurations and conditions of the diesel generator building and has been eliminated from the FSAR in Revision 18.")

Appendix A

NOTICE OF VIOLATION

Consumers Power Company

Docket No. 50-329
Docket No. 50-330

Based on the results of an NRC investigation conducted on December 11-13, 18-20, 1978, and January 4-5, 9-11, 22-25, 1979, it appears that certain of your activities were not conducted in full compliance with NRC requirements as noted below. These items are infractions.

1. 10 CFR 50, Appendix B, Criterion III requires, in part, that measures shall be established and executed to assure that regulatory requirements and the design basis as specified in the license application for structures are correctly translated into specifications, drawings, procedures and instructions. Also, it provides that measures shall be established for the identification and control of design interfaces and for coordinates among participating design organizations.

   CPCo Topical Report CPC-1-A policy No. 3, Section 3.4 states, in part, "the assigned lead design group or organization (i.e., the NSSS supplier, A&E, supplier or CPCo) assure that designs and materials are suitable and that they comply with design criteria and regulatory requirements."

CPCo is committed to ANSI N45.2 (1971), Section 4.1, which states, in part, "measures shall be established and documented to assure that the applicable specified design requirements, such as a design basis, regulatory requirements . . . are correctly translated into specifications, drawings, procedures, or instructions."

Contrary to the above, measures did not assure that design basis were included in drawings and specifications nor did they provide for the identification and control of design interfaces. As a result, several inconsistencies were identified in the license application and in other design basis documents. Specific examples are set forth below:

a. Construction Drawing C-45 (Class I fill material areas) specifies the foundation material for Class I structures to be Zone 2 material, defined as any material free of humus, organic or other deleterious material with no restrictions or gradation while FSAR Tables 2.5-9 and 2.5-14 indicate the foundation material for support of Class I structures to be controlled compacted cohesive (clay) material.

b. The FSAR is internally inconsistent in that FSAR Figure 2.5-48 indicates settlement of the Diesel Generator Building to be on the order of 3" while FSAR Section 3.8.5.5 (structural acceptance criteria) indicates settlements on shallow spread footings founded on compacted fill to be on the order of 1/2" or less. The Diesel Generator Building is supported by a continuous shallow spread footing.

c. The design settlement calculations for the diesel generator and borated water storage tanks were performed on the assumption of uniform mat foundations while these foundations were designed and constructed as spread footing foundations.

d. The settlement calculations for the Diesel Generator Building indicate a load intensity of 3000 PSF while the FSAR, Figure 2.5-47, shows a load intensity of 4000 PSF, as actually constructed.

e. The settlement calculations for the diesel generator building were based on an index of compressibility of the plant fill between elevations 603 and 634 of 0.001. These settlement values were shown in FSAR Figure 2.5-48. However, FSAR, Table 2.5-16, indicates an index of compressibility of the same plant fill to be 0.003.

f. PSAR, Amendment 3, indicated that if filling and backfilling operations are discontinued during periods of cold weather, all frozen soil would be removed or recompacted prior to the resumption of operations. Bechtel specification C-210 does not specifically include instructions for removal of frozen/thawed compacted material upon resumption of work after winter periods.

g. PSAR Amendment 3 indicates that cohesionless soil (sand) would be compacted to 85% relative density according to ASTM D-2049. However, Bechtel specification C-210, Section 13.7.2 required cohesionless soil to be compacted to not less than 80% relative density.

2. 10 CFR 50, Appendix B, Criterion V requires, in part, that activities affecting quality shall be prescribed and accomplished in accordance with documented instructions, procedures or drawings.

CPCo Topical Report CPC-1-A Policy No. 5, Section 1.0 states, in part, that, "Instructions for controlling and performing activities affecting quality of equipment or operation during design, construction and operations phase of the nuclear power plant such as procurement, manufacturing, construction, installation, inspection, testing . . . are documented in instruction, procedures, sepcifications . . . these documents provide qualitative and quantitive acceptance criteria for determining important activities have been satisfactorily accomplished.

CPCo is committed to ANSI N45.2 (1971), Section 6 which states, in part, "activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures or drawings."

a. Contrary to the above, instructions provided to field construction for substituting lean concrete for Zone 2 material did not address the differing foundation properties which would result in differential settlement of the Diesel Generator Building.

b. Also, contrary to the above, certain activites were not accomplished according to instruction and procedures, in that:

   (1) The compaction criteria used for fill material was 20,000 ft-lbs (Bechtel modified proctor test) rather than a

compactive energy of 56,000 ft-lbs as specified in Bechtel Specification C-210, Section 13.7.

(2) Soils activites were not accomplished under the continuous supervision of a qualified soils engineer who would perform in-place density tests in the compacted fill to verify that all materials are placed and compacted in accordance with specification criteria. This is required by Bechtel Specification C-501 as well as PSAR, Ammendment 3 (Dames and Moore Report, page 16).

3. 10 CFR 50, Appendix B, Criterion X requires, in Part, that a program for inspection of activites affecting quality shall be established and executed to verify conformance with the documented instruction, procedures and drawings for accomplishing the activity.

CPCo Topical Report CPC-1-A Policy No. 10, Section 3.1, states, in part, that "work activities are accomplished according to approved procedures or instructions which include inspection hold points beyond which work does not proceed until the inspection is complete or written consent for bypassing the inspection has been received from the organization authorized to perform the inspections."

CPCo is committed to ANSI N45.2 (1971), which states, in part, "A program for inspection of activities affecting quality shall be established and executed by or for the organization performing the activity to verify conformance to the documented instructions, procedures, and drawings for accomplishing the activity."

Contrary to the above, Quality Control Instruction C-1.02 the program for inspection of compacted backfill issued on October 18, 1976, did not provide for inspection hold points to verify that soil work was satisfactorily accomplished according to documented instructions.

4. 10 CFR 50, Appendix B, Criterion XVI requires, in part, that measures shall be established to assure that conditions adverse to quality such as failures, deficiencies, defective material and nonconformances are promptly identified and corrected. In case of significant conditions adverse to quality, measures shall assure that corrective action is taken to preclude repetition.

CPCo Topical Report CPC-1-A Policy No. 16, Section 1.0 states, in part, "corrective action is that action taken to correct and preclude recurrence of significant conditions adverse to the quality of items or operations. Corrective action includes an evaluation of the conditions that led to a nonconformance, that disposition of the nonconformance and completions of the actions necessary to prevent or reduce the possibility of recurrence."

Contrary to the above, measures did not assure that soils conditions of adverse quality were promptly corrected to preclude repetition. For example:

a. As of January 25, 1979, moisture control in fill material had not been established nor adequate direction given to implement this specification requirement. The finding that the field was not performing moisture control tests as required by specification C-210 was identified in Quality Action Request SD-40, dated July 22, 1977.

b. Corrective action regarding nonconformance reports related to plant fill was insufficient or inadequate to preclude repetition as evidenced by repeated deviations from specification requirements. For example, nonconformance reports No. CPCo QF-29, QF-52, QF-68, QF-147, QF-174, QF-172 and QF-199 contain numerous examples of repeated nonconformances in the same areas of plant fill construction.

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

MAY 22 1979

Docket No. 50-329
Docket No. 50-330

Consumers Power Company
ATTN: Mr. Stephen H. Howell
Vice President
1945 West Parnall Road
Jackson, MI 49201

Gentlemen:

This refers to the investigation conducted by Messrs. G. A. Phillip, E. G. Gallagher and G. F. Maxwell of this office on December 11-13, 18-20, 1978, and January 4-5, 9-11 and 22-25, 1979, of activities at the Midland Nuclear Plant, Units 1 and 2, authorized by NRC Construction Permits No. CPPR-81 and No. CPPR-82. The investigation related to the settlement of the diesel generator building at Midland and the adequacy of the plant area fill. The preliminary results of this investigation were discussed with Consumers Power Company and Bechtel Corporation representatives in our office on February 23 and March 5, 1979. The report on the matters discussed during those meetings were included with my letter to you dated March 15, 1979. That letter also set forth the principal matters of our concern as a result of this investigation.

Enclosed is a copy of the report of this investigation. In accordance with Section 2.790 of the NRC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations, a copy of this letter and the enclosed investigation report will be placed in the NRC's Public Document Room, except as follows. If this report contains information that you or your contractors believe to be proprietary, you must apply in writing to this office within twenty days of your receipt of this notice, to withhold such information from public disclosure. The application must include a full statement of the reasons for which the information is considered proprietary, and should be prepared so that proprietary information identified in the application is contained in an enclosure to the application.

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The results of this investigation continue to be under review by the NRC staff. Upon completion of this review you will be advised of any enforcement action to be taken by the Commission.

Should you have any questions concerning this investigation, we would be pleased to discuss them with you.

Sincerely,

James G. Keppler
Director

Enclosure: IE Investigation
Reports No. 50-329/78-20
and No. 50-330/78-20

cc w/encl:
Central Files
Reproduction Unit NRC 20b
PDR
Local PDR
NSIC
TIC
Ronald Callen, Michigan Public
Service Commission
Dr. Wayne E. North
Myron M. Cherry, Chicago

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

REGION III

Report No. 050-329/78-20; 050-330/78-20

Subject: Consumers Power Company
Midland Nuclear Power Plant, Units 1 and 2
Midland, Michigan

Settlement of the Diesel Generator Building

Period of Investigation: December 11-13, 18-20, 1978 and January 4-5, 9-11, 22-25, February 23, March 5, 1979

Investigators:	G. A. Phillip	3-19-79
	E. J. Gallagher	3-19-79
	G. F. Maxwell	3-19-79
Reviewed By:	D. W. Hayes, Chief Engineering Support Section 1	3/19/79
	G. Fiorelli, Chief Reactor Construction and Engineering Support Branch	3/19/79
	C. E. Norelius Assistant to the Director	3/19/79

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REASON FOR INVESTIGATION

On September 7, 1978, the licensee notified Region III, by telephone, that the settlement of the Diesel Generator Building and foundations experienced constituted a matter reportable under the requirements of 10 CFR 50.55(e). Written interim reports were subsequently submitted by the licensee by letters dated September 29 and November 7, 1978. An investigation was initiated to obtain information concerning the circumstances of this occurrence to determine whether: a breakdown in the Quality Assurance program had occurred; the occurrence had been properly reported; and, whether the FSAR statements were consistent with the design and construction of the plant.

SCOPE

This investigation was performed to obtain information relating to design and construction activities affecting the Diesel Generator Building foundations and the activities involved in the identification and reporting of unusual settlement of the building. The investigation consisted of an examination of pertinent records and procedures and interviews with personnel at the Midland site, the Consumers Power Company offices in Jackson, Michigan, and the Bechtel Power Corporation offices in Ann Arbor, Michigan.

SUMMARY OF FACTS

By letter dated September 29, 1978, the licensee submitted a report as required by 10 CFR 50.55(e) concerning an unusal degree of settlement of the Diesel Generator Building (DGB). This report confirmed information provided during earlier telephone conversations on or about August 22, 1978, with the NRC Resident Inspector and on September 7, 1978, with the Region III office. This report was an interim report and was followed by periodic interim reports providing additional information concerning actions being taken to resolve the problem. Further testing and monitoring programs and an evaluation of the resulting data have been undertaken by the licensee to determine the cause of the settlement and the adequacy of the corrective action being taken. The results of these efforts will be submitted in a final report to the NRC.

Information obtained during this investigation indicates: (1) A lack of control and supervision of plant fill activities contributed to the inadequate compaction of foundation material; (2) corrective action regarding nonconformances related to plant fill was insufficient or inadequate as evidenced by the repeated deviations from specification requirements; (3) certain design bases and construction specifications related to foundation type, material properties and compaction requirements were not followed; (4) there was a lack of clear direction and support between the contractors engineering office and construction site as well as within the contractors engineering office; and, (5) the FSAR contains inconsistent, incorrect and unsupported statements with respect to foundation type, soil properties and settlement values.

DETAILS

Persons Contacted

During this investigation approximately 50 individuals were contacted. Twelve CPCo personnel which included corporate engineering and quality assurance personnel as well as site management, quality assurance and quality control personnel. Thirty-two Bechtel personnel were contacted. These largely consisted of site engineering, quality assurance, quality control, survey and labor supervisors and personnel in project engineering, quality assurance and Geotech at the Ann Arbor, Michigan office. Three individuals employed by U.S. Testing Company were also interviewed.

Introduction

On August 22, 1978, the licensee informed the NRC Resident Inspector at the Midland site that unusual settlement of the Diesel Generator Building (DGB) had been detected through the established Foundation Data Survey Program. While the licensee regarded the matter as serious it was not considered to be reportable under the provisions of 10 CFR 50.55(e) until further data was obtained.

Following the acquisition of additional data from further surveys and a core boring program which was initiated on August 25, 1978, the licensee concluded the matter was reportable and so telephonically notified Region III on September 7, 1978. The notification was followed up by a series of interim reports the first of which was submitted to Region III by letter dated September 29, 1978. Subsequent interim reports were transmitted by letters dated November 7, 1978 and January 5, 1979.

An inspection was conducted by Region III during the period October 24-27, 1978, to review the data then available; to observe the current condition of the structure; and, to review current activities. Information regarding the inspection is contained in NRC Inspection Report No. 50-329/78-12; 50-330/78-12.

On December 3-4, 1978, a meeting with NRR and Region III representatives was held at the Midland site to review the status of the problem, to discuss open items identified in the aforementioned inspection report and possible corrective actions.

Identification and Reporting of Diesel Generator Building Settlement

Surveys to establish a baseline elevation for the DGB were completed by Bechtel on May 9, 1978. As a result of these surveys, the Chief of Survey Parties noted what he considered to be unusual settlement. He indicated that from his experience he would have expected about 1/8" settlement. The July 22 data showed a differential settlement between various locations ranging from 1/4" to a maximum of 1 5/8". He promptly instructed his survey personnel to resurvey to determine whether the data was accurate The resurvey confirmed the accuracy of the survey data. The Chief of Survey Parties reported the survey results to the Bechtel lead civil field enginee

The lead civil field engineer said that in July 1978 the settlement of a pedestal in the DGB was noted from surveys and about a week later a 1" discrepancy was noted when scribes on the DGB were being moved up. He said that at that time he was uncertain as to whether actual settlement had occurred, the survey was in error or the apparent discrepancy was a construction error. He instructed the Chief of Survey Parties to check his survey results and to perform surveys more frequently than the 60-day intervals required by the survey program as a means of determining whether actual settlement had occurred and whether settlement continued.

The Field Project Engineer was also informed of the apparent settlement and concurred with the lead civil field engineer's actions. He said he had toured the building at that time and he saw no visible indications of stress which could be expected when unusual settlement occurs.

The lead civil field engineer said the DGB was monitored for about a month. He compared the amount of settlement being experienced with the settlement values reflected in Figure 2.5-48 of the FSAR and did not consider it reportable until those values were exceeded. When the settlement did exceed those values as indicated by survey data obtained on about August 18, 1978, he prepared a nonconformance report with the assistance of OC personnel.

The July 22 survey data was transmitted by the site to the Bechtel Project Engineering office in Ann Arbor by a routine transmittal memo dated July 26, 1978. The data was received at Ann Arbor, processed through document control on August 9, 1978, and was routinely routed to the Civil Engineering Group Supervisor. He stated he did not review the data but placed a route slip on it indicating those members of his group who should review it.

The engineer in the Civil Group, who had established the survey program and who was responsible for assuring it was being carried out, stated he reviewed the data and did not regard it as unusual. For that reason he did not bring the matter to anyone's attention but merely routed it to other personnel in the civil group. The engineer responsible for the DGB said he did not see the data before the settlement problem was identified by the field in a nonconformance report.

With the issuance of the noncomformance report, No. 1482, on August 18, 1978, CPCo was also informed of this condition. On or about August 21, 1978, the NRC Resident Inspector was orally informed of the matter by CPCo. It was indicated at that time that although CPCo regarded the matter as serious, they did not consider it to be reportable under 10 CFR 50.55(e).

Construction on the DGB was placed on hold on August 23, 1978 and a test boring program was initiated on August 25, 1978. After preliminary evaluation of soil boring data, a Management Corrective Action Report (MCAR), No. 24, was issued by Bechtel on September 7, 1978. The MCAR stated that based on a preliminary evaluation of the data, the matter was reportable under 10 CFR 50.55(e), 1, iii and Region III was so notified by telephone on that date.

The telephone notification was subsequently followed up by a letter dated September 29, 1978, from CPCo enclosing a copy of MCAR 24 and Interim Report 1 prepared by Bechtel.

On the basis of the above, it is concluded that in this instance the licensee complied with the reporting requirements of 10 CFR 50.55(e).

Review of PSAR/FSAR Commitments on Compacted Fill Material

In a previous NRC Inspection Report, No. 329/78-12; 330/78-12, an apparent inconsistency was identified between FSAR Table 2.5-14 (Summary of Foundations Supporting Seismic Category I and II Structures), Table 2.5-9 (Minimum Compaction Criteria) and the site construction drawing C-45 (Class I Fill Material Areas) regarding the type of foundation material to be used for plant area fill. Table 2.5-14 identifies the supporting soil materials for the Auxiliary Building D, E, F, and G, Radwaste Building, Diesel Generator Building and Borated Water Storage Tanks to be "controlled compacted cohesive fill." Table 2.5-9 also indicates the soil type for "support of structures" to be clay. Contrary to these FSAR commitments, drawing C-45 indicates Zone 2 (random fill) material, defined in Table 2.5-10 as "any material free of humus, organic or other deleterious material," is to be used with "no restrictions on gradation." Boring samples substantiated that Zone 2 (random fill) material was in fact used.

During this investigation a review of documentation showed that the commitment to use cohesive soils was also made in response to PSAR question 5.1.11 and submitted in PSAR Amendment 6, dated December 12, 1969, which states, "Soils above Elevation 605 will be cohesive soils in an engineered backfill." This response also indicated that certain class 1 components such as, emergency diesel generators, borated water storage tanks and associated piping and electrical conduit would be founded on this material.

CPCo quality assurance issued a nonconformance report QF-66, dated October 10, 1975, which stated that contrary to the PSAR statement (quoted above) Specification C-211 being implemented at the site required cohesionless (sand) material to be used within 3 feet of the walls of the plant area structures. The corrective action taken was for Bechtel to issue SAR Change Notice No. 0097 which stated, "The FSAR will clarify the use of cohesive and cohesionless soils for support of Class 1 structures." As noted above, the FSAR tables 2.5-14 and 2.5-9 once again stated that cohesive (clay) material was used for support of structures while the construction drawing continued to permit the use of random fill material.

This investigation included efforts to ascertain whether procedures were established and implemented for the preparation, control and review of the technical criteria set forth in the safety analysis report (SAR). This included the role of both Bechtel and CPCo in the review of the SAR. Bechtel had established control of the SAR in procedure MED 4.22 (Preparation and Control of Safety Analysis Report Revision 1, dated June 20, 1974). The SAR preparation and review flow chart requires the Engineering Group Supervisor (EGS) to review the originator's draft for technical accuracy and compliance with the standard format guide. Records indicated that Section 2.5.4 was originated by the Bechtel Geotech group on January 3, 1977. It was reviewed and approved for technical accuracy by an engineer in the civil project group on April 29, 1977. No technical inaccuracies were noted in the documentation. The Civil EGS advised that he did not personally review Section 2.5.4.

The designated engineer stated that in his review of the section he was primarily concerned with the Auxiliary Building not the Diesel Generator Building. He said the review of FSAR material was performed by members of a group set up for this purpose. Not all of the content was checked since they relied to some extent on the originator. The author of Section 2.5.4 said he was not aware that changes regarding fill material had occurred since the preparation of the PSAR. It was ascertained that Field Engineering did not review the FSAR prior to its submittal.

A partial review of the FSAR revealed that although Figure 2.5-48 indicates anticipated settlement of the Diesel Generator Building during the life of the plant to be on the order of 3 inches. Section 3.8.5.5 (Structural Acceptance Criteria) contains the following statement: "Settlements on shallow spread footings founded on compacted fills are estimated to be on the order of 1/2" or less."

Section 3.8 was prepared by Project Engineering. Geotech, who prepared Section 2.5, said they were unaware of the presence of the statement regarding 1/2" settlement in Section 3.8. The originator of Section 3.8

said that the above statement was taken from the Dames and Moore report submitted as part of the PSAR. Since the PSAR did not show any change in this regard, he assumed the statement was valid for inclusion in the FSAR. He said there was no other basis to support this statement.

CPCo also has an established procedure for the review and final approval of the SAR by procedure MPPM-13 dated June 23, 1976. Section 5.6 states that "CPCo shall approve all final draft sections of the FSAR prior to final printing." Discussion with the responsible licensee representatives for review of Section 2.5.4 indicated that a limited amount of cross-reference verification of technical content of the FSAR is performed by CPCo.

The CPCo Project Engineer in Jackson stated that the review of drawings and specifications was an owner's preference kind of thing. No attempt was made to review all drawings and specifications since they did not have the manpower or expertise for that type of review. The staff engineers of the various disciplines were asked to indicate the drawings and specifications they wanted to review.

Regarding the review of the FSAR, he said that he had prepared a memorandum to the staff engineers stating the procedure that would be followed in performing the review. An examination of this memo, dated July 28, 1976, showed that prime reviewers would perform a technical review, resolve comments made by other reviewers and perform the CPCo licensing review to assure compliance with required FSAR format and content.

As portions of the FSAR were received from Bechtel, CPCo sent comments to Bechtel. Following this review, meetings between Bechtel and CPCo were held to clearup any unresolved matters before each section was released for printing. A review of the files at CPCo relating to Section 2.5 and 3.8 showed that no comments were made concerning the above inconsistent and incorrect content. The apparent inconsistent and incorrect statements were not identified during the review of the FSAR prior to submittal and the review procedures did not provide any mechanism to identify apparent inconsistencies between sections of the FSAR.

Based on the above, measures did not assure that design basis included in design drawings and specifications were translated into the license application which resulted as an inconsistency between the design drawings and the FSAR. This is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion III as identified in Appendix A. (329/78-20-01; 330/78-20-01)

Effect of Ground Water in Plant Area Fill

Final plant grade will be established at elevation 634. The normal ground water was assumed to be at ground surface prior to construction approximately elevation 603. The surface of the water in the cooling water pond will be at a maximum of approximately elevation 627.

The Dames and Moore report on Foundation Investigation submitted with PSAR Amendment No. 1, dated February 3, 1969, stated that, "The effect of raising the water level to elevation 625 in the reservoirs will cause the normal ground water level in the general plant area to eventually rise to approximately elevation 625. However, a drainage system will be provided to maintain the ground water level in the plant fill at elevation 603."

A supplement to Dames and Moore report was submitted in PSAR Amendment No. 3, dated August 13, 1969, which changed the above planning of a drainage system to control the ground water. The supplement states, "The underdrainage system considered in the initial report has been eliminated; consequently it is assumed that the ground water level in the plant area will rise concurrently to approximately elevation 625."

A Bechtel soils consultant theorized in a December 4, 1978, site meeting that if soils beneath the diesel generator building had been compacted too dry of optimum, changes in moisture after placement could cause the soils to settle significantly. Therefore, the total effect of the ground water being permitted to saturate the plant fill material is undetermined at this time. An evaluation of this condition is under review by the licensee. This item is considered unresolved. (329/78-20-02; 330/78-20-02)

Review of Compaction Requirements for Plant Area Fill

During the investigation a review of the history of the compaction requirements was performed in order to determine whether the compaction of the plant fill was implemented in compliance with the commitments in the PSAR and in site construction specifications.

PSAR, Amendment 1, dated February 3, 1969, presented the Dames and Moore report "Foundation Investigation and Preliminary Exploration for Borrow Materials." The recommended minimum compaction criteria for support of critical structures is stated on page 15. It indicates 95% of maximum density for "cohesive soils" as determined by ASTM D-1557-66T and 100% for "granular soils."

PSAR, Amendment 3, dated August 13, 1969, included a supplement to the Dames and Moore report entitled, "Foundation Investigation and Preliminary

Exploration for Borrow Materials." Page 16 of this report lists the recommended minimum compaction criteria for sand soils and cohesive soils. For the fill material for supporting structures the minimum compaction is 85% relative density for sand and 100% of maximum density for clay as determined by ASTM D-698 modified to require 20,000 ft-lbs. of compactive energy (equivalent to 95% of ASTM D-1557, Method D which provides 56,000 ft-lbs of compactive energy). Subsequent to the filing of Amendment 3, no amendments were made to the PSAR to indicate that the recommendations contained in the Dames and Moore report would not be followed or would be further modified.

Bechtel Specification C-210, Section 13.0 (Plant Area Backfill and Berm Backfill) indicates the compaction requirements for cohesive soil (13.7.1) to be "not less than 95% of maximum density as determined by ASTM D-1557, Method D" and for cohesionless soils (sand) (13.7.2) to be compacted "to not less than 80% relative density as determined by ASTM D-2049."

A comparison of the PSAR commitments to the specification requirements shows that the compaction commitments for cohesive soil (clay) were translated into the construction specification i.e. 95% of maximum density using ASTM D-1557, Method D (compactive energy of 56,000 ft-lbs). However, the compaction commitment in the PSAR for cohesionless soil (sand) was not the same as in the construction specification, i.e. 85% relative density versus the 80% relative density, translated in the construction specification.

The compaction requirements actually implemented were as follows:

a. Cohesive soil (clay): 95% of maximum density as determined by the "Bechtel Modified Test," a compactive energy of 20,000 ft-lbs was used instead of 56,000 ft-lbs of compactive energy as committed to in the PSAR and required by the construction specification C-210, Section 13.7.1.

b. Cohesionless soil (sand): 80% relative density as determined by ASTM D-2049 was used instead of 85% as committed to in the PSAR. However, this is consistent with construction specification C-210, Section 13.7.2.

The compaction requirements implemented during construction of the plant area fill between elevations 603 and 634 were, therefore, less than the commitments made in the PSAR for cohesive and cohesionless fill material. In additon, the cohesive (clay) material was also compacted to less than that required by the Bechtel specification. (Specification C-210, Section 13.7).

A review of Specification C-210 (specification controlling earthwork contract) beginning with Revision 2, dated July 27, 1973, which was issued for subcontract showed that it contained conflicting sections relating to the plant area backfill compaction requirements.

Section 13.7, Compaction Requirements, from revision 2 to the latest revision of specification C-210 consistently specified that the backfill in the plant area shall be compacted to 95% of maximum density as determined by ASTM 1557, Method D.

Section 13.4, Testing Plant Area Backfill, of specification C-210 contained the statement that tests would be performed as set forth in Section 12.4.5, Laboratory Maximum Density and Optimum Moisture Content, which in turn specified a lesser standard, 20,000 foot-pounds per cubic foot, which is commonly referred to as the Bechtel Modified Proctor Density Test (BMP). This is contrary to the requirements of Section 13.7. Section 12 of the specification applies to Dike and Railroad Embankment Construction.

It was also noted that this control inconsistency was reflected in the applicable Midland QA Inspection Criteria, SC-1.10, Item 2.3(d) Compaction which states "Backfill material for the specified zones has been compacted to the required density as determined by Bechtel Modified Proctor Method" and yet references C-210, Section 13.7 as the inspection criteria.

The inconsistency in control is further indicated in Specification C-208 which defined the testing contract requirements of subgrade materials, Section 9.1 (Testing) required compaction tests to be in accordance with ASTM D-1557 and only when directed was the BMP compaction criteria to be used. It was determined contrary to this U.S. Testing was only orally advised that the BMP was the standard to be applied to the tests they performed of plant area fill.

Through interviews and an examination of internal documents it was ascertained that because of these inconsistencies, the question of the applicable compaction standard for cohesive materials in the plant area was a recurring one.

The following is a summary of the documentation regarding the confusion of the compaction requirements for plant area fill:

1. Letter 7220-C-210-77 dated June 10, 1974, (subcontracts to Field Engineering) states "there has been some confusion as to the interpretaion of the following item: 13.7 Compaction Requirement: all backfill in the plant area and berm shall be compacted to not less than 95% of maximum density as determined by modified Proctor method

(ASTM 1557, Method D), with the exception that Zones 4, 4A, 5, 5A, and 6 Materials need no special compactive effort other than as described in Section 12.8.1 (emphasis included in specification). Quality Control questioned whether the exception stated above applies only to Zones 4, 4A, 5, 5A, and 6 or did construction have to abide by Section 12.8.1 for Zones 1 and 2. Section 12.8.1 clearly requires Zone 2 material to be placed with a 50 ton rubber tired roller with a minimum of four roller passes per lift. QC's interpretation was that the field needed "to obtain 95% of maximum density by the modified Proctor method (ASTM 1557, Method D), with no restrictions as to the method used to obtain these results."

2. Letter 7220-C-210-23, dated June 24, 1974, (field Engineering to construction) responded to Item 1 above. It states, "We have reviewed your June 10, 1974, IOM concerning compactive effort required on Zones 1 and 2 in the plant and berm backfill areas. We agree with your interpretation; i.e. a 95% of maximum density is the acceptance criteria, and the number of roller passes listed in Paragraph 12.8.1 does not apply to plant and berm backfill. We feel the specification is now clear and no FCR is required."

3. Letter BCBE-370, dated July 25, 1974, (field construction to project engineering) lists outstanding items requiring Project Engineering's action. This includes the question, "Is the 95% compaction required in the plant area to be 95% of Bechtel Modified or 95% of ASTM-1557, Method D."

4. Letter BEBC-456, dated August 1, 1974, (Project Engineering to Field Construction) states that Geotech is addressing the question posed in BCBE-370 (Item 3 above).

5. Memorandum from Geotech to Bechtel Field, dated September 18, 1974, responds to the question raised in BCBE-370 (Item 3 above). It states, "It is our opinion that all the compaction requirements that are needed for Zone II material in the plant fill is as stated in 13.7 with the exception that Zones 4, 4A, 5, 5A, and 6 materials need no special compactive effort other than described in Section 12.8.1." Geotech reiterates the specification requirement of 95% of ASTM 1557, Method D. This was confirmed with the Geotech personnel.

6. Telecon dated September 9, 1974, from R. Grote (Field Engineering) to Rixford (Project Engineering) states, "I made an analogy (an exaggeration admittedly but applicable) that if the compaction could be acheived with a herd of mules walking over the fill it would be acceptable as long as it got the required 95% compaction. Rixford agreed."

7. Telecon Consumers to Bechtel Engineering dated September 19, 1974, expressed Consumers Power Company concern about what they felt was a lack of control of compaction in the plant area fill. CPCo addressed the added responsibility this lack of control places on the inspector. Bechtel told CPCo that it "was the inspector's job to make sure we got proper placement, compaction, etc."

8. Telecon dated September 18, 1974, by Bechtel Field Engineering to Bechtel Project Engineering discussed compaction requirements for specification C-210. It stated, "Compaction acceptance is based on meeting an 'end product' requirement, i.e. 95% of maximum density only. No method of achieving this 'end product' is specified or is required. Rixford fully agrees with the above."

9. Telecon dated October 7, 1977, from Bechtel Field Engineering to Bechtel Project Engineering states, "QA has asked for clarification of subject specification (C-210), Section 13 for plant area and berm backfill. Section 13.4 for testing of materials refers to Section 12.4 and therefore, requires the Bechtel Modified Proctor Density Test for Compaction of cohesive backfill. Section 13.7 for compaction of the same materials refers to testing in accordance with ASTM D-1557, Method D Proctor, without specific reference to Bechtel Modification." Bechtel Engineering responded to this question as follows: "This apparent conflict is clarified by Specification C-208, Section 9.1.a, direction to the testing subcontractor, which calls for ASTM D 1557 test for these materials and also allows Bechtel Field (the contractor) to call for the Bechtel Modification of that test. Either method is therefore acceptable to project engineering."

10. Telecon dated October 7, 1977, from Bechtel QA to Bechtel Project Engineering questions, "Is the intent of Paragraph 13.7 of Specification C-210 that the test be run to the 'Bechtel' modified proct r test as is indicated in the FSAR Paragraph 2.5.4.5.3 and in response to NCR 88." Engineering's response was "yes."

Various interviews were held with Bechtel construction field engineers, U. S. Testing personnel and Bechtel Ann Arbor Geotech and Project Engineering personnel to ascertain their understanding of the compaction requirements. Four predominant versions of the understood compaction requirements were stated by various individuals within the Bechtel organization. They are as follows:

a. Specification C-210 required the contractor to perform compaction to the ASTM 1557, Method D, however, the testing requirements would be performed to the less stringent "Bechtel Modified Test Method."

b. The required compaction and testing was always understood to be based on the "Bechtel Modified Test Method."

c. The required compaction and testing was always understood to be based on the standard ASTM 1557, Method D requirements.

d. A tacit understanding had been established to use the Bechtel Modified Method, but to exceed this requirement by enough to also satisfy the requirement of ASTM 1557, Method D.

It is apparent from the above four distinctly different understandings of the compaction requirements, that the apparent confusion was not resolved. A member of the Bechtel QA staff in Ann Arbor who had previously been a QA Engineer at the Midland site said that QA audits of QC inspection criteria did not identify the above inconsistencies.

This failure to accomplish activities affecting the quality of the plant area fill in accordance with procedures is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion V as identified in Appendix A. (329/78-20-03; 330/78-20-03)

Review of Moisture Control Requirements for Plant Area Fill

Specification C-210, Section 13.6 (Moisture Control) requires moisture control of the plant area fill material to conform to Section 12.6. The moisture control requirement in Section 12.6.1 states, in part, "Zone 1, 1A and 2 material which require moisture control, shall be moisture conditioned in the borrow areas," and that "water content during compaction shall not be more than two percentage points below optimum moisture content and shall not be more than two percentage points above optimum moisture content."

Contrary to the above, Bechtel QA identified in SD-40 dated July 22, 1977, that "the field does not take moisture control tests prior to and during placement of the backfill, but rather rely on the moisture results taken from the in-place soil density tests."

The following is a summary of the documentation that followed the identification of the above deviation from specification C-210.

1. Letter BCBE-1533R (dated August 15, 1977) field to project engineering states, "it was found that densities meeting specification requirements could be attained, irrespective of the use of moisture tests," and that "moisture tests were not used to control backfill moisture." The field requested "that project engineering agree to acceptance of backfill materials installed in the past, along with the records thereof, irrespective of the use of the moisture tests."

2. Letter BEBC-1859 (dated September 30, 1977) responsed to the fields request in BCBE-1533R. Engineering states, "It should be noted that it is ideal to control the moisture of backfill material at the borrow areas by conditioning" and that "the procedure used to take moisture content tests after compaction would not have direct impact on the quality of work." Engineering then agreed with the field request that "backfill placed prior to modification of testing methods to be accepted as is."

3. Telecon October 10, 1977, (Bechtel QA Site to Bechtel Engineering, Ann Arbor) indicated that, "there are no moisture requirements at the time of density testing, only density requirement. The moisture requirement is prior to compaction."

4. Telecon October 13, 1977, (Bechtel Engineering to Bechtel QA Site) changed what was indicated in the telecon on October 10, 1977, (Item 3 above). Engineering then stated, "The moisture requirement (± 2% of optimum) is mandatory and must be implemented at the time of placement and testing." This is contrary to what was stated on October 10, 1977.

5. Letter BCBE-1669R (dated November 18, 1977) once again is a field request to Bechtel engineering requesting, "written clarification of the 2% tolerance on backfill moisture content during compaction."

6. Letter BEBC-1998 (dated December 15, 1977) provides engineering's response to BCBE-1669R requesting clarification of the moisture requirement. Engineering stated, "The moisture content of the soil should be within 2% of optimum <u>during</u> placement and compaction. However, this property of the soil is not necessarily a measure of its adequacy <u>after</u> compaction."

7. Letter 0-1631 (dated December 21, 1977) closes QA Action Request SD-40 (dated July 22, 1977) which first identified the moisture control deficiency.

8. Telecon (dated April 7, 1978) from Field Engineering and Quality Control to Project Engineering once again requests them "to clarify BEBC-1998" (December 15, 1977), Item 6 above. Two situations were presented to engineering as follows: (a) The moisture sample taken from the borrow area at the start of the shift is acceptable, however, the moisture test taken in conjunction with the density test fails while compaction was attained; and (b) The moisture sample taken from the borrow area at the start of the shift fails and the material is conditioned to meet moisture content required,

however, the moisture test later fails at the time the passing compaction test is taken. Engineering responded, "the above two situations are acceptable as is." This response is contrary to the direction previously given in telecon dated October 13, 1977 (see Item 4 above).

9. Letter GLR-249 (April 16, 1978) is a Bechtel Site QA request to Project Engineering to resolve the moisture content situation and "to provide clear direction for the control of moisture content." QA recommends "one possible solution would be to delete the requirement to control the moisture content and rely on the compaction requirement only for completion of soils work."

10. Letter BEBC-2286 (June 1, 1978) was Project Engineering's response to GLR-249 (Item 9 above). It states, "moisture content is not necessarily a measure of a soil's adequacy to act as a foundation or backfill material," and that "soil with the specified density following compaction would not be rejected on the basis that its moisture content was not controlled in the borrow area."

Based on the reviews of documentation, moisture control had not been implemented as the specification required. In addition, the matter had not been resolved for the period of time from the issuance of QA Action Request SD-40 on July 22, 1977, until June, 1978, during which time soils safety-related work continued.

According to the licensee, although moisture control was not strictly followed in accordance with specification requirements, final density tests were used as a basis for acceptance of soil placement.

As pointed out to the licensee, moisture control is a required control point to assure attainment of percent compaction specified in specification C-210.

This failure to assure that conditions adverse to quality are promptly identified and corrected to preclude repetition is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion XVI as identified in Appendix A. (329/78-20-04; 330/78-20-04)

Review of Subgrade Preparation for Plant Area Fill

The Dames and Moore report on foundation investigation submitted with PSAR Amendment 3, dated August 13, 1969, states, "the clay soils are susceptible to loss of strength due to frost action, disturbance and/or the presence of water. If the construction schedule requires that foundation excavation be left open during the winter, it is recommended that excavation operations be performed such that at least

3 1/2 feet of natural soil or similar cover remain in place over the final subgrade or overlying the mud mat. This layer of protective material is necessary to prevent the softening and disturbance of subgrade soils due to frost action." The licensee indicated that instructions for winter protection of foundation excavations were transmitted by sketch C-271.

The Dames and Moore report also stated, "If filling and backfilling operations are discontinued during periods of cold weather, it is recommended that all frozen soils be removed or recompacted prior to the resumption of operations."

After review of the applicable sections of specification C-210 (i.e. Sections 12.5.1, 12.10, 10.1 and 11) the inspector has determined that the Bechtel specification did not provide specific instructions for removal or recompaction of frozen/thawed soils upon resumption of work after the winter period to preclude the effects of frost action on the compacted subgrade materials.

This failure to assure that regulatory commitments as specified in the license application are translated into specification, drawings or instructions is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion III. (329/78-20-05; 330/78-20-05)

Review of Nonconformance Reports Identified for Plant Area Fill

The following examples of nonconformance and audit reports regarding the plant area fill were reviewed relative to the cause of the nonconformance and the engineering evaluation and corrective action:

	No.	Nonconforming Condition	Engineering Evaluation
(1)	CPCo QF-29 (10/14/74)	Failure to perform inspection and testing of structural backfill (sand) delivered to jobsite 29 of 30 day in Aug. and Sept. 74. Bechtel QC not informed of deliveries.	"Use as is" based on samples taken from stock pile.
(2)	CPCo QF-52 (8/7/75)	Moisture control out of tolerance of specification C-210, Section 13.6.	Accepted in place material with low moisture.
(3)	CPCo QF-68 (10/17/75)	Compaction test had been calculated using incorrect maximum lab density. Test recorded as passing was actually a failure.	Failing tests were cleared by subsequent passing tests.

(4)	Bechtel NCR 421 (5/5/76)	Material placed did not meet moisture requirements.	Engineering stated that this ramp area is temporary and would be removed. This was removed based on note added to NCR 421 on 3/18/77.

Note: In the vicinity of this ramp a Geotech engineer determined the material to be "soft" and directed a test pit to be dug for investigation in September 1978 after the D. G. Bldg. settlement was identified.

(5)	CPCo QF-120 (9/21/76)	Lift thickness exceeded maximum of 4" in areas not accessible to roller equipment. Insufficient monitoring of placing crews. Laborer foreman not familiar with requirements.	Material was removed and recompacted.
(6)	CPCo QF-130 (10/18/76)	Inspection plan C-210-4, Rev. 0, permits 12" lift thickness for areas inaccessible to rollers caused by "misinterpretation of specification requirements. Spec. permitted 4" lift thickness.	Corrected inspection plan requirements.
(7)	CPCo QF-147 (2/2/77)	Failure to perform inspection and testing of structural backfill (sand) on 12/1/76, 12/14/76 and 1/11/77 (same as QF-29 dated 10/14/74) material lacked gradation test requirements.	Engineering accepted the material in place "use as is."
(8)	CPCo QF-172 (7/8/77)	Moisture control out-of-tolerance and compaction criteria not met.	Engineering accepted materials.
(9)	CPCo QF-174 (7/15/77)	Gradation requirements for Zone 1 materials not met.	Engineering accepted materials.

(10)	CPCo QF-199 (11/4/77)	Moisture content not met; compaction requirements for cohesive and cohesionless soil not met. Materials had been accepted using incorrect testing data.	Issued Bechtel NCR's No. 1004 and 1005; No. 1004 still open; No. 1005 "accepted as is."
(11)	CPCo QF-203 (11/22/77)	Gradation requirement not met yet materials accepted.	Engineering "accepted as is."
(12)	CPCo Audit F-77-21 (5/77 & 6/77)	Moisture content requirements not met; test frequency not met.	Bechtel QC to inform foreman directing soils work of requirements.
(13)	CPCo Audit F-77-32 (10/3/77)	Compaction requirement for both cohesive and cohesionless materials not met; moisture requirements not met; tests had been accepted yet failed requirements.	Project Engineering to justify the materials these failing tests represent. NCR QF-195 still open.
(14)	Bechtel NCR 686 (2/1/77)	Same deficiency as NCR 698.	Accepted, "use as is."
(15)	Bechtel NCR 698 (2/9/77)	Structural backfill (sand) was delivered without acceptance tests on Oct. 26, 29, Nov. 12, 1976 and Jan. 11, 12, 1977.	Engineering accepted "use as is."
(16)	Bechtel NCR 1005 (10/26/77)	Moisture content requirements not met.	"Accepted as is" based on density test only.

Based on a review of the above nonconformance and audit reports corrective action regarding nonconformances related to plant fill was insufficient or inadequate as evidenced by the repeated deviations from specification requirements.

This failure to assure that the cause of conditions adverse to quality are identified and that adequate corrective action be taken to preclude repetition is considered an item of noncompliance with 10 CFR 50, Appendix B Criterion XVI as identified in Appendix A. (329/78-20-06; 330/78-20-06)

Review of Calculations of Settlement for Plant Area

A review of the settlement calculations for the structures in the plant area was performed during a visit to the Bechtel, Ann Arbor Engineering office. Specific attention was given to structures founded on plant area "compacted fill." The following specific findings were made:

1. FSAR, Section 3.8.4.1.2 (Diesel Generator Building) indicates the foundation of the DGB to be continuous footings with independent pedestals for each of the Diesel Generators. Contrary to the structural arrangement described in the FSAR, the settlement calculations for the DGB were performed on the premise that the building and equipment loads would be uniformly distributed to the foundation material by a 154' x 70' foundation mat. The settlement calculations were performed between August 1976 and October 1976 by Bechtel Geotech Division.

   Discussion with the Geotech Engineer who performed the settlement calculations indicated that he had not been informed of the design change of the foundation until late August 1978 when the excessive settlements of the DGB and pedestal became apparent.

2. FSAR Figure 2.5-47 indicates the load intensity for the DGB to be 4 KSF (4000 lbs. per sq. ft.); however, the settlement calculations reviewed indicate a uniform load of 3 KSF (3000 PSF). This appears to be a conflict between the FSAR and settlement calculations.

3. The settlement calculations for the borated water storage tanks were performed assuming a 54' diameter circular foundation mat with an assumed uniform load of 2500 PSF. Instead, the tanks are supported on a continuous circular spread footing and compacted structural backfill as detailed on the construction drawings. The Geotech engineer was also not made aware of the revised foundation detail.

FSAR Figure 2.5-48 (Estimated Ultimate Settlements) indicates the anticipated ultimate settlement for Unit 1 and 2 plant structures. The values indicated for the Diesel Generator Building and Borated Water Storage Tanks are the values developed assuming uniformly distributed loads founded on mat foundations as was indicated in the settlement calculations reviewed even though the actual design and construction utilizes spread footings. The FSAR does not indicate the foundation type assumed in the settlement calculations and therefore the values in the FSAR figure appear to represent the settlements estimated for the as-constructed spread footing foundation.

4. During a review of the settlement calculations, it was observed that the compression index (C_c) for the compacted fill between elevations 603 and 634 in the plant area was assumed to be 0.001 (estimate based on experience). FSAR Section 2.5.4.10.3.3 (Soil Parameters) indicates the soil compressibility parameters used in the settlement calculation are presented in Table 2.5-16. This table indicates that for the plant fill elevations 603 to 634, the compression index used was 0.003. Contrary to the FSAR value, 0.001 was used in the settlement calculations reviewed. This value is directly used to determine the estimated ultimate settlement of structure supported by plant fill material.

Based on the above examples, measures did not assure that specific design bases, included in design documents, were translated into the license application resulting in inconsistencies between design documents and the FSAR. This is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion III as identified in Appendix A. (329/78-20-07; 330/78-20-07)

Discussions with CPCo personnel responsible for the technical review and format indicated that a comparison between the design documents and FSAR had not been performed. Likewise, Bechtel personnel indicated that a detailed comparison for the technical accuracy of design documents to the FSAR statements had not been performed; instead reliance was placed on the originator's input.

According to the Civil Engineering Group Supervisor, a mat foundation was considered for the DGB only during the conceptual stage. All drawings generated show a spread footing foundation. The supervisor stated that the Geotech engineer apparently based his calculations on the conceptual stage information. He went on to say that an individual in Geotech was responsible for checking the calculations and the first thing he is supposed to do is determine that the basis for the calculations is correct. He said that apparently this was not done.

Review of Settlement of Administration Building Footings

During the investigation, it was disclosed that the Administration Building at the Midland Site had experienced excessive settlement of the foundation footings. Although the Administration Building is a non-safety-related structure, it is supported by plant area fill material compacted and tested to the same requirements as material supporting safety-related structures and therefore pertinent to the current settlements being experienced by the Diesel Generator Building. The following are the events relating to the settlement of the Administration Building footings.

During the end of August, 1977, a Bechtel field engineer observed a gap between a slab and the grade beam of the Administration Building. On August 23, 1977, a survey was taken of the settlement. The results indicated that the footings supporting the grade beam had experienced settlement ranging from 1.32" (north side) to 3.48" (south side). This settlement took place between July 1977, and the end of August 1977. The footings were supported by "random fill" (Zone 2 material).

The concrete footings on the order of 7' 6" by 7' 6" by 1' 9" deep were removed along with the grade beam. The random fill material was also removed. According to U. S. Testing personnel, it was observed during excavation of the fill material that there were voids of 1/4" to 2" or 3" within the fill and these were associated with large lumps of unbroken clay measuring up to 3 feet in diameter.

The Civil Field Engineer assigned responsibility for plant fill work said that, although he was no soils expert, it was his opinion that the problem was caused by the presence of pockets of water due to drainage from the steam tunnel. The Lead Civil Field Engineer also indicated a drainage problem caused the Administration Building footings settlement. They were, however, unclear as to how the water pockets were formed, i.e. whether they were formed as the fill was being placed or how they could develop after the fill was compacted.

The excavated fill was replaced with concrete and the design of individual footings was changed to a continuous spread footing design for support of the building.

As a result of the settlement of the Administration Building footings a total of seven borings were taken of which five were in the Administration Building area, one in the Evaporator Building area and one south of the Diesel Generator Building. In the Administration Building area the foundation material was found to be "soft" with "spongy characteristics." The two other borings did not indicate unusual material properties in that the blow counts were reasonable. These borings were taken in September 1977.

The licensee indicated that reports from Bechtel concluded that the primary cause of the settlement in the Administration Building area was insufficient compaction of the fill. Bechtel also concluded that "deviations from specific compaction requirements was the result of repeated erroneous selection of compaction standard," i.e. the incorrect optimum moisture-density curve was used for the soil material being compacted. In effect, the moisture-density curve was erroneously assumed to represent the soil being used and therefore soil was compacted to less than maximum density.

Bechtel personnel, including the Civil Group Supervisor, Project Engineering, the Field Project Engineer, the Lead Civil Field Engineer, and the Chief Civil QC Inspector, all stated that the Administration Building footing settlement was regarded as a localized problem. The question as to the adequacy of the entire plant area fill did not arise even though the following similarities existed between the Administration Building area and rest of plant fill; (a) same soil specification applied, (2) same material (random fill) was used and (3) same control procedures and selection of laboratory compaction standards was used. The Diesel Generator Building area required even more fill than other safety-related structures since its base is located at a higher elevation than the others.

Review of Interface Between Diesel Generator Building Foundation and Electrical Duct Banks

A review of the design interface between the electrical and civil sections of the Bechtel organization was performed to determine whether the design accounted for the interaction of the electrical duct banks and spread footings on the differential settlement of the northside of the DGB. It was determined that the electrical and civil groups made accommodations in the design to permit settlement of the spread footings around the electrical duct banks by including a styrofoam "bond breaker" around the duct banks. Both electrical and civil groups reviewed and approved electrical Drawing E-502 which includes the appropriate detail.

However, Bechtel Drawing C-45 which identifies Class I fill material areas permits the use of Zone 2 (random fill) which includes "any material free of humus, organic or other deleterious material." This, in effect, does not preclude the use of concrete around the electrical duct banks beneath the spread footings. Due to the difficulty in compacting, Bechtel elected to replace the soil material with concrete. Letter from project engineering to field construction, dated December 27, 1974, states, "lean concrete backfill is considered acceptable for replacement of Zone 1 and 2." The instruction is considered inadequate, in that, the concrete placed around the duct banks restricted the settlement on the north side of the DGB where electrical duct banks enter through the footing. This contributed to the excessive differential settlement in the North-South direction across the building.

This failure to prescribe adequate instructions for activities affecting the quality of safety-related structures is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion V as identified in Appendix A. (329/78-20-07; 330/78-20-07)

Review of Soils Placement and Inspection Activities for Plant Area Fill

A subcontractor, Canonie Construction Company, South Haven, Michigan, performed the major portion of the earthwork at the Midland site. Although Canonie was primarily engaged to construct the cooling pond dike, they also performed most of the plant area fill work. Bechtel, however, also performed plant fill work prior to and after Canonie left the site in mid-October 1977. The last Canonie daily QA/QC fill placement report is dated October 16, 1977.

According to Canonie QA/QC records the first fill in the DGB area was placed in late October and early November 1975. No further fill was placed in the area until July 1976. After that time, fill work in the area was interspersed with soils work in other areas.

While it would be difficult to identify the soil work performed by Bechtel versus that performed by Canonie, records reviewed indicated that most of the Bechtel work was done during the latter part of 1976 and continued through 1977 and 1978. Although most of the Bechtel work related to placing sand around piping and ducts after they were laid and placing sand adjacent to walls, some motorized work compacting clay fill was also done by Bechtel.

Regarding the plant fill work performed by Bechtel, CPCo Audit Report No. F-77-21 dated June 10, 1977, identified a number of deficiencies which recommended the corrective action to be as follows: (1) "the foremen directing the soils work should be instructed as to the required moisture content limits" and (2) "the foreman directing the soils work should be instructed as to the correct test frequency requirements." Interviews with two such Bechtel foremen confirmed the fact that they were directing soil operations. They indicated they received their instruction regarding lift thicknesses and testing requirements verbally from field engineering through a general foreman.

Bechtel design criteria C-501 (Page 8) and PSAR Amendment No. 3 (Dames and Moore Report, Page 16) states that, "Filling operations should be performed under the continuous technical supervision of a qualified soils engineer who would perform in-place density tests in the compacted fill to verify that all materials are placed and compacted in accordance with the recommended criteria."

Based on the above, the soils activities were not accomplished under the continuous technical supervision in accordance with Bechtel design criteria. This failure to provide a qualified soils engineer to perform technical supervision for activities affecting quality as required by specifications and the PSAR is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion V. (329/78-20-08; 330/78-20-08)

The foremen indicated that Bechtel Field Engineers and QC inspectors were rarely in the areas where soils activities were going on. The foremen decided when and where tests were taken. The locations of tests were approximated by pacing or visually estimating distances from columns or building walls. Lift thicknesses were determined visually, usually without the use of grade stakes.

Soils testing services are provided by U. S. Testing Company based on the requirements of Specification C-208. The two U. S. Testing technicians who said they performed an estimated 90% of the soil testing during the years 1975-77 indicated that they rarely saw a Bechtel field engineer or QC inspector in the areas where plant fill activities were going on. One technician said he could recall only one occasion when a QC inspector was present when he took an in-place density test. The other technician estimated he had contact with a QC inspector in the field about once a month. A Bechtel QC inspector, however, was assigned to the testing laboratory on a full-time basis.

U.S. Testing personnel stated that erroneous test locations were a chronic problem regarding the Bechtel placed fill. The location of a test was usually given at the time of the test by a labor foreman or a laborer if the foreman wasn't there. Sometimes, however, a foreman was not familiar with the area in which he was working and the location was not provided until sometime after the test. It became necessary on occasion to withhold test results as a means of getting the test location. Test elevations were approximated sequentially.

The technicians further advised that rarely did a Bechtel QC inspector request a test. Normally, labor foremen requested them. On occasion a technician passing through an area would be asked by a foreman if a test should be taken. Upon completion of in-place tests, the results were usually communicated to the foreman directing the work. Test failures were also reported by telephone to QC or Field Engineering. A weekly report of test was provided to Bechtel QC and Field Engineering who reviewed any test failures and resolved them.

U. S. Testing personnel advised that they were requested to take tests of clay fill while it was raining and in order to do so, plastic was held over them to protect their equipment while the test was made. Even though it was raining, the fill placement work was not stopped on some occasions. A Bechtel foreman confirmed that density tests were on occasion taken while it was raining. While this is not contrary to the specification instructions, it is contrary to standard practice.

U. S. Testing personnel indicated that when moisture was added, the procedure did not include blending the material which resulted in mushy seams. It is commonly accepted good parctice to disc the fill after spraying it with water to add needed moisture. A Bechtel foreman stated that if moisture was needed they compacted 6" then sprinkled it and then added another 6".

The field engineer who was assigned responsibility for plant fill work stated he did not spend full time on soils work since he also had responsibility for two structures, the steam tunnel and general yard work. He said he tried to get out to the area where fill work was being done once a day. Some times he did and sometimes he did not. He indicated it was his impression that the QC Inspector responsible for the soils work on the day shift visited those work areas once or twice a week. He confirmed that only oral instructions were furnished to the foremen whom he felt were conscienticus. The main problem he experienced with the foreman was maintaining proper lift thickness.

The QC inspector who was primarily responsible for the plant fill work is no longer employed by Bechtel. The QC inspector who was responsible for the plant fill work on the night shift stated that he tried to devote about one hour a night to the plant fill activities. He indicated that during 1976-1977 there was much emphasis being placed on cadwelding and rebar work and it was necessary to spend the majority of his time on those activities. He maintained that he did have fairly frequent contacts with the technicians who performed the in-place density tests, particularly when test failures occurred. He indicated it was his impression that the labor foremen were directing fill placement adequately.

Review of Inspection Procedures

The following procedures which are relative to backfill operations at Midland Units 1 and 2 between August 1974 through December 1977 were reviewed.

a. Bechtel Master Project QC Instruction for Compacted Backfill - C-1.02 was issued for construction October 18, 1976, and it is presently the current instruction which is used by Bechtel QC (when Bechtel is the inspection agency, providing first level inspections during backfill operations). Further, this instruction was used by Bechtel QC when monitoring the activities of other inspection agencies (Canonie) when such agencies were performing the first level inspections of backfill operations during the time periods of October 18, 1976, until June 28, 1977.

b. Bechtel Quality Control Master Inspection plan for Plant Foundation Excavation and Cooling Pond Dikes (Plant Area Backfill and Berm Backfill) - Procedure No. C-210-4 was the instruction utilized by Bechtel QC when monitoring the activities of other inspection agencies that were providing the first level inspections of backfill operations (this instruction was utilized during time periods prior to October 18, 1976).

c. Bechtel Quality Control Master Inspection Plan for Structural Backfill Placement - No. C-211-1 is an instruction utilized by Bechtel QC when performing first level inspection of backfill activities prior to October 18, 1976.

Bechtel Procedure C-1.02, listed above, was written as a replacement for both Procedures C-210-4 and C-211-1. The inspection activities which were delineated in Procedures C-210-4 and C-211-1 were compared with those described in Procedure C-1.02. The following are some of those activities which were compared:

			Inspection Code for--		
		Activities/Task Description	C-210-4	C-211-1	C-1.02
Backfill Material					
(*)	1.	Free of brush, roots, sod, snow, ice or frozen soil.		I	S(V)
(*)	2.	Material moisture conditioned to required moisture content.	S	I	S(V)
	3.	Structural backfill used with 3" of plant structure, shall be cohesionless and free-draining.		I	
(*)	4.	Material not placed upon frozen surface.		I	S(V)
	5.	Foundation approved prior to backfill placement.	H	H	R/H
	6.	Prior to start of work, area free of debris, trash and unsuitable material.			I(V)

Compaction Requirements

	1. Cohesionless material compacted not less than 80% relative density.	S	S	S(V)
(*)	2. Cohesive material compacted to not less than 95% max. density.	W	S	S(V)
(*)	3. Zones 1, 1A, 2 and 3 material in uncompacted lifts not exceeding 12"; areas not accessible to roller equipment the material placed in uncompacted lifts no exceeding 4".	W	I	S(V)

Material Testing

1. Verify testing and test results are as per engineering requirements.			
a. Materials	S	S	S(V)
b. Moisture	S	S	S(V)
c. Compaction	S	S	S(V)
2. Review lab test report verifying:			
a. Proper test method.	R	R	R
b. Proper test frequency.	R	R	R
c. Technical adequacy.	R	R	R

I - Inspection point
H - Hold point
W - Witness point
S - Surveillance (V) - visual
R - Review records

Those activities identified by an (*) asterisk indicate inspection requirements which have been relaxed from the original procedural requirements.

It is considered that the relaxation of actions relating to the confirmation that soils placement activities were conducted according to specifications contributed to inadequate compaction of foundation and fill material and the increase incidence of deviations from specifications regarding lift thickness, moisture control and frequency of testing.

This failure to provide adequate inspection of activities affecting quality is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion X. .(392/78-20-09; 330/78-20-09)

Exit Meetings

Members of the NRC staff met with Consumers Power Company and Bechtel Corporation at the NRC Region III office on February 23, 1979 to present the scope, purpose, and preliminary findings of the investigation. That meeting was subsequently followed by a second meeting held on March 5, 1979, during which Consumers Power Company responded to the preliminary investigation findings. The documents used during these meetings were transmitted to Consumers Power Company by NRC letter dated March 15, 1979.

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

Rec'd 11/22/78
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Dorl
Per Jim Gallagher
w/ consultant
NOTE REPORT NOT TO BE RELEASED TO PUBLIC UNTIL PROPRIETARY REVIEW COMPLETE
DW

Docket No. 50-329
Docket No. 50-330

Consumers Power Company
ATTN: Mr. Stephen H. Howell
Vice President
1945 West Parnall Road
Jackson, MI 49201

Gentlemen:

This refers to the inspection conducted by Mr. E. J. Gallagher of this office on October 24-27, 1978, of activities at the Midland Nuclear Plant, Units 1 and 2, authorized by NRC Construction Permits No. CPPR-81 and No. CPPR-82 and to the discussion of our findings with Messrs. J. L. Corley and T. C. Cooke and others of your staff at the conclusion of the inspection.

The enclosed copy of our inspection report identifies areas examined during the inspection. Within these areas, the inspection consisted of a selective examination of procedures and representative records, observations, and interviews with personnel.

No items of noncompliance with NRC requirements were identified during the course of this inspection.

In accordance with Section 2.790 of the NRC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations, a copy of this letter and the enclosed inspection report will be placed in the NRC's Public Document Room, except as follows. If this report contains information that you or your contractors believe to be proprietary, you must apply in writing to this office, within twenty days of your receipt of this letter, to withhold such information from public disclosure. The application must include a full statement of the reasons for which the information is considered proprietary, and should be prepared so that proprietary information identified in the application is contained in an enclosure to the application.

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We will gladly discuss any questions you have concerning this inspection.

Sincerely,

R. F. Heishman, Chief
Reactor Construction and
Engineering Support Branch

Enclosure: IE Inspection
Reports No. 50-329/78-12
and No. 50-330/78-12

cc w/encl:
Central Files
Reproduction Unit NRC 20b
PDR
Local PDR
NSIC
TIC
Ronald Callen, Michigan Public
Service Commission
Dr. Wayne E. North
Myron M. Cherry, Chicago

OFFICE	RIII	RIII	RIII	RIII	RIII
SURNAME	Gallagher/bk	Spessard	Heishman	Vandel	Cook
DATE	11/14/78				

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

R .GION III

Report No. 50-329/78-12; 50-330/78-12

Docket No. 50-329; 50-330 License No. CPPR-81; CPPR-82

Licensee: Consumers Power Company
1945 West Parnall Road
Jackson, MI 49201

Facility Name: Midland Nuclear Power Plant, Units 1 and 2

Inspection At: Midland Site, Midland, MI

Inspection Conducted: October 24-27, 1978

Inspector: R. L. Spessard for E. J. Gallagher 11/14/78

Approved By: R. L. Spessard R. L. Spessard, Chief 11/14/78
Engineering Support Section 1

Inspection Summary

Inspection on October 24-27, 1978 (Report No. 50-329/78-12; 50-330/78-12)
Areas Inspected: 10 CFR 50.55(e) report concerning settlement of diesel generator foundation and building; backfill specifications and quality control instructions; preliminary soils test results from core boring investigation; site implementing procedures; performance of soils testing; and diesel generator building and pedestal details. The inspection involved a total of 36 inspector-hours onsite by one NRC inspector.
Results: No items of noncompliance or deviations were identified.

DETAILS

Persons Contacted

Principal Licensee Employees (Consumers Power Company)

*T. C. Cooke, Project Superintendent
*J. L. Corley, Station Head IE and TV
*D. E. Horn, Civil Supervisor, QAE
*R. M. Wheeler, Civil Engineer
*B. H. Peck, Construction Supervisor
*R. Bauman, Project Engineer
*G. S. Keeley, Project Manager
*D. B. Miller, Site Manager

Bechtel Associates Professional Corporation

*L. A. Dreisbach, PQAE
*R. L. Castleberry, Project Engineer
*W. L. Barclay, PFQCE
*P. A. Martinez, Project Manager
*A. Boos, Project Field Engineer
J. Betts, Field Engineer
A. Marshall, Geotechnical Engineer
S. Blue, Geotechnical Engineer
J. Wazeck, Geotechnical Engineer
N. Swanberg, Chief Engineers Staff
B. McConnel, Civil Design Group
P. K. Chen, Civil Design Group
T. Lieb, Quality Control Engineer

U.S. Testing Laboratory

J. Speltz, Lab Supervisor

NRC Resident Inspector

*R. Cook, Inspector Since when?

*Denotes those present at exit meeting.

Functional or Program Areas Inspected

1. Followup of Reportable Occurrence (10 CFR 50.55(e)) - Settlement of Diesel Generator Foundations and Building

In accordance with the requirements of 10 CFR 50.55(e), Consumers Power Company notified the NRC Region III office of a reportable occurrence relative to the settlement of the diesel generator foundations and building.

a. Deficiency

The Bechtel Foundation Data Survey Program (spec. C-76) generated data that indicated the settlement of the diesel generator foundations was greater than anticipated. Nonconformance Report No. 1482 was generated on August 21, 1978 to document the occurrence.

* Due to the magnitude of the settlements observed, a soils boring program was initiated.

b. Safety Implications

Large settlements can pose safety problems for the building. These structures are monitored for settlement during construction and operation as part of the foundation data survey program. Unusual settlements of the structure would be detected before the diesel generators would be rendered inoperable due to resulting distortions.

when initiated?
where is data?

c. Activities in Progress

(1) Foundation Data Survey Program has been expanded to include additional data locations and to increase the frequency of monitoring these locations to a weekly basis rather than the previous 60 day basis.

(2) A Boring program has been initiated to provide better definition of the compacted fill conditions supporting the diesel generator building as well as other plant structures, e.g., Class 1 tanks, transformer foundations and plant fill area. Soil samples have been recovered for laboratory tests. Details of these tests are provided in later sections of this report.

d. Planned Activities for Future Work

Discussions with licensee representatives indicate the following planned activities for future work relative to diesel generator building foundations and other plant structures:

(1) Extend bench mark monitors for settlement study.

(2) Install inclinometers

Too late!

(3) Preload diesel generator building and foundations; both inside and around the building with 20 to 22 feet of sand for approximately 5 to 7 months.

(4) Build retaining wall to separate preload material from turbine building on the north side.

(5) Check calculation to see if turbine building can carry effect of preload surcharge.

(6) Monitor condensate lines under diesel generator building.

(7) Monitor soil movement during preload.

(8) Provide freeze protection around diesel generator area during winter.

(9) Monitor concrete cracks using stain gauges.

(10) Monitor pore water pressure in soil.

(11) Cut loose the four electrical duct banks which run under the building and project vertically becoming an integral part of the structure.

(12) Continue filling pond from elevation 622' to 627'.

(13) Identify item effected by the structure, i.e. plant safety, operations and layout.

e. Other Activities to be Planned

(1) Possible core borings in cooling pond dike area to verify integrity of dikes.

(2) Continue visual inspection of dikes for movement.

f. Other Structures Being Monitored for Settlement

(1) Borated water storage tank foundations
(2) C.W. intake structure
(3) Emergency diesel fuel oil tank
(4) Service water valve pits
(5) Chlorination building
(6) Radwaste building
(7) oling towers

2. Review of Preliminary Data Compiled through Soil Borings in Diesel Generator Building Area

A review of the preliminary report data compiled by Goldberg, Zoino, Dunnicliff and Associates, consultants in geotechnical engineering was performed. This investigative soils work is being performed in accordance with the specification for technical services for soils testing, C-79(Q), Rev. 0, issued September 8, 1978. Tests are performed in accordance with applicable quality assurance requirements included in the specification, in particular, test control, control of measuring equipment, handling and storage of materials and document control.

A total of 23 core borings to various elevations into and through the compacted fill and into natural soil in and around the diesel generator building have been performed. In addition, dutch cone probes were taken to determine the bearing capacity of the in-place soils. Soil samples were recovered from the borings in order to perform a battery of soil tests which include: soils classification, mechanical analysis, atterberg limits, natural moisture contents, unit weights, compaction, unconfined compressive strength, unconsolidated-undrained triaxial compression tests, consolidation tests and organic content determination.

Preliminary results of the investigative soils borings work indicate the fill under the diesel generator building has variable strength properties. For example:

a. Unconfined compressive strength tests range from 163 PSF (boring DG 2, sample 5) to 5230 PSF (boring DG 1) with the majority of results less than 2000 PSF.

b. Blow counts through the fill range from 3 to 6 blows per foot (DG 2) to 2 to 40 blows per foot (DG 12), and as much as 100 blows per foot in some areas.

c. Dutch cone probes to determine bearing capacities indicate less than 5 kips per square foot (KSF) in probe Nos. 1, 2, 4, 8, 10. 5 KSF is the design bearing capacity based on discussion with the Bechtel design staff.

d. Penetrometer tests were performed in test pit No. 1 between elevations 628' and 616' in the east bay of the diesel generator building. Results indicate an unconfined compressive strength average of 1.0 ton per square foot (TSF) with a range from 0 to 4.5 TSF.

The final evaluation of the soils borings in the diesel generator area is expected to be presented to Consumers Power Company during the week of November 6, 1978. This information is planned to be presented to the NRC some time thereafter.

3. Review of FSAR Commitments Versus Site Implementing Procedures

The inspector found the following discrepancies between commitments in the FSAR and the requirements in applicable site implementing specifications, procedures and drawings:

a. FSAR Table 2.5-14 (Summary of Foundations Supporting Seismic Category I and II Structures) identifies the supporting soil material under the diesel generator building as being, "controlled compacted cohesive soils." In addition, FSAR Table 2.5-9 (Minimum Compaction Criteria) identifies soil type and function. Under "support of structures" the soil type is identified as clay which is a cohesive soil.

   However, construction detail drawings C-109 R2 and C-117 R6 identify the material in this area as "zone 2" material. Zone 2 material is identified in FSAR Table 2.5-10 as "Random Fill," described as any material free of organic or other deleterious material. In the field variety of material has been used for the diesel generator building, e.g. sands, clay, silty sand, clayey sand and lean concrete. A review of the records indicate sands have been used between elevations 594' to 608', areas of elevation 611' to 613' and areas between 616' and 628'. Lean concrete was permitted to be used indiscriminately throughout. This indicates the extent of the variability of the material used under the diesel generator building foundation.

b. FSAR Table 2.5-21 (Summary of Compaction Requirements) identifies "random fill" to require a compaction effort of a minimum of 4 passes with specified equipment. This requirement of 4 passes was not an imposed criteria in Bechtel specification C-210 R6 nor was it an inspection requirement of Bechtel Quality Control Instruction for Backfill, C-1.02. In addition, FSAR section 2.5.4.5.3 (fill) states, "the four passes were required for each substitute roller."

   Discussion with QC field personnel indicated that documentary evidence was not available to determine that the required number of passes were performed. However, it was commented that at times more than 4 passes were required in order to attain the minimum compaction.

c. FSAR Section 3.8.5.5 states, that "settlements of shallow spread footings founded on compacted fill are estimated to be on the order of 1/2 inch or less." The site survey program has identified settlements in the diesel generator foundation and building to range from 0.55 inches to 2.30 inches and in excess of 3.0 inches for the diesel generator pedestal, as of September 1978.

d. FSAR Figure 2.5-47 indicates the foundation of the diesel generator building is at elevation 634'; however, design drawing C-1001(Q) R5 indicates the spread footing and pedestal are at elevation 628' and locally lowered to elevation 625' in the sump areas. Since the ground water elevation will be raised to 627', a hydrostatic pressure will reduce the net effective structure load on the foundation material. This should be reflected in table accompanying FSAR figure 2.5-47.

4. Review of Specifications for Site Soils Activities

The inspector reviewed the following procedures and specifications for installation and testing of site soil materials:

a. Bechtel Specification C-210, Revision 6, dated April 25, 1978, Sections 12 and 13, Plant Area Backfill Requirements.

b. Bechtel Specification C-211, Revision 4, dated September 21, 1977, Structural Backfill.

c. Bechtel QC Instruction for Compacted Backfill, C-1.02, Revision I.

An apparent conflict was identified during review of the specifications. Specification C-210, Section 13.7.1 requires all cohesive backfill in the plant area to be compacted to not less than 95% maximum density, as determined by ASTM D-1557, Method D which requires an effective compactive effort of 56,000 ft-lbs of energy per cubic foot of soil. However, Section 13.4 (testing) of the specification requires testing of materials placed in the plant area to be performed in accordance with tests listed in Section 12.4. This section, in particular Section 12.4.5.1 (cohesive soils), requires lab maximum densities to be determined using ASTM D-1557, Method D provided a compactive energy equal to 20,000 foot pounds per cubic foot is applied (Bechtel Modified Proctor Density). To date, the Bechtel modified proctor density for determining maximum proctor density versus optimum moisture content has been utilized, as committed to in FSAR Table 2.5-9. Furthermore, Bechtel Quality Control Instruction C-1.02, Section 2.4 (testing) references the applicable inspection criteria, including both Sections 13.7 and 12.4 of specification C-210 which includes the discrepancy described above.

As a result of this conflict, the actual in-place compaction would be less using the Bechtel modified proctor than using the standard ASTM D-1557, Method D. This is due to the fact that the compactive energy exerted using the Bechtel modified method is less than that using the standard ASTM method (i.e. 20,000 ft-lbs versus 56,000 ft-lbs of energy).

During a review of the specifications, the inspector was informed that Bechtel had contracted Dames and Moore to perform the original site soils and backfill study, as documented in a report dated March 15, 1969. On page 16 of this report the compaction criteria for support of structures is recommended to be 100% of the maximum density using a compactive effort of 20,000 ft-lbs (similar to Bechtel Modified Proctor Density). However, this 100% of maximum density using 20,000 ft-lbs of compactive effort corresponds to 95% compaction using the standard ASTM D-1557, Method D. As previously described, specification C-210 did not incorporate the Dames and Moore recommendation.

Furthermore, Dames and Moore report (page 15) states that, "all fill and backfill materials should be placed at or near optimum moisture content in nearly horizontal lifts approximately 6 to 8 inches in loose thickness." This recommendation was not adopted by Becthel, in that specification C-210, Section 12.5.3 permits an uncompacted lift thickness of 12 inches.

A further review of specification C-210, Section 12.6 (moisture control) indicates that zone 2 material, known as "random fill", was permitted to have a moisture content tolerance of "not more than 2 percentage points below optimum moisture and not more than 2 percentage points above optimum moisture." A review of the moisture-density curves for the material (random fill) placed in the diesel generator area indicates steep, sloped moisture-density curves, and therefore, a $\pm$ 2% range for moisture control can significantly effect the in-place density of the material used.

5. Review of NRC Question No. 362.2 on FSAR Section 2.5.4.5.1

This question concerns whether a natural sand layer near elevation 600', as identified in FSAR Figure 2.5-21, had been removed during construction or if the sand tested out to be greater than 75% relative density. The licensee had not responded to this question as of the date of this inspection.

An internal Consumers Power Company memorandum from B. H. Peck to J. L. Corley indicates that a review of records had not yielded any verification that the sands were removed or that tests were performed to confirm the in-place density of the natural sands. The current boring program will also be used as a data base for confirming the in-place condition of the natural sand layer identified in FSAR Section 2.5.4.5.1. The licensee informed the inspector that the results of this survey will provide the basis for their answer to NRC Question No. 362.2.

6. Cracks in Concrete Structural Wall and Footing in the Diesel Generator Building

The inspector observed the structural concrete crack that has developed in the east exterior wall and footing of the diesel generator building. The crack was observed by representatives of Bechtel Geotech and Consumers Power Company.

As of September 22, 1978, the settlement along the east side of t e building, as measured by the survey data program, ranges from 0.55" to 2.48", a differential settlement of 1.93 inches. The crack is expected to have been induced due to flexure caused by the differential settlement. Discussions with Bechtel design staff personnel at the site indicate that the crack is being evaluated along with the settlement survey and will continue to be monitored during preload of the structure.

ACI 318-71 (Commentary) Section 10.6.4 limits flexural cracks to 0.013 inches (13 mils) when exposed to the outside elements. The crack was observed to be larger than the ACI limit for flexure. The licensee is committed to this standard in FSAR Section 3.8.6.2.

7. Observation of Soil Testing in Compacted Fill Areas

The inspector observed U.S. Testing Lab personnel performing the following soil tests:

a. Lab Test ASTM D-1557-66T, Moisture-Density Relations of Soils, Method D, which determines the moisture-density relation by compacting cohesive soil in a standard mold in 5 layers with a 10 pound weight dropping 18 inches, 56 times in each layer. The density per cubic foot is calculated for given moisture conditions. This information yields a curve which indicates the maximum lab density (proctor density) at an optimum moisture content. This value is then compared to the in-place field dry density to yield the percent (%) compaction.

b. Field Test ASTM D-1556-64, Density of Soils In-place by Sand Cone Method, which determines the in-place field dry density for the soil which is compared to the maximum lab density, determined as described above in paragraph (a) (proctor density), to yield the % compaction.

The above tests were observed to be performed in accordance with the applicable test standards.

8. Diesel Generator Building and Pedestal Foundation Details

The diesel generator building is founded on approximately 35 feet of compacted fill with its foundation support provided by a 10 foot wide, 2'-6" thick spread footing supporting the structure above. The footing and walls are cast-in-place reinforced concrete. The diesel generator pedestal is independent of the surrounding structure and consists of a 6'-6" thick mass reinforced concrete pedestal to support and distribute the load of the diesel generator.

Passing underneath the diesel generator building in the north-south direction are two condensate water lines (non-safety related) and a series of four electrical duct banks (safety-related) that run under the building and project vertically becoming an integral part of the structure in each of the four diesel generator bays. Bechtel design staff personnel indicated that the condensate lines and duct banks have influenced the differential settlement in local areas of the structure.

Of significance is that the original ground water level prior to plant construction was approximately at elevation 601'. Subsequent to construction of the cooling water pond, the ground water table has risen to elevation 622', and it is planned to be raised to its maximum elevation of 627'. This increased ground water level has stabilized in the compacted fill beneath the diesel generator building at elevation 622'. The licensee is evaluating the effects of this increase in ground water level on the 35 feet of compacted fill material in the plant fill area.

Exit Interview

The inspector met with site staff representatives (denoted in Persons Contacted) at the conclusion of the inspection on October 27, 1978. The inspector summarized the purpose and findings of the inspection. The licensee acknowledged the findings reported herein.

In summary, the licensee has reported the deficiency and had initiated an extensive soils testing investigation of the foundation materials. The final results of these tests are scheduled to be complete by

November 6, 1978 and are to be presented to the NRC staff shortly thereafter. The deficiency reported in the 50.55(e) report will be reviewed after the proposed resolution to the settlement of the plant structures has been established. Additionally, this matter has been referred to IE Headquarters for evaluation.

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

November 1, 1978

Docket No. 50-329
Docket No. 50-330

MEMORANDUM FOR: H. D. Thornburg, Director, RCI, IE

FROM: James G. Keppler, Director, RIII

SUBJECT: MIDLAND 1 AND 2 EXCESSIVE SETTLEMENT OF DIESEL GENERATOR BUILDING FOUNDATIONS (A/I F30437H1)

Pursuant to 10 CFR 50.55(e), Consumers Power Company (CPC) notified RIII on September 7, 1978 that the settlement of the Diesel Generator Building foundations was greater than anticipated and, therefore, a soils boring program was started to determine the cause and extent of the problem. A copy of CPC's report is attached.

An inspection was conducted at the Midland site on October 24-27, 1978 to review this matter, and the results will be documented in Inspection Report No. 50-329/78-12; 50-330/78-12. The following summarizes the pertinent inspection findings:

1. The excessive total and differential settlements of the Diesel Generator building foundation and generator pedestals appear to be the result of several contributing factors. These are: variable properties of random fill material used to support the structure, influence of condensate piping and electrical conduit banks under a portion of the building, compaction requirements, raising the natural ground water level approximately 20 feet by filling the cooling water pond, and the design and construction sequence of the generator pedestals and spread footing foundations for the building.

2. The FSAR specifies "controlled, compacted cohesive soils" be used as the supporting soils for the Diesel Generator Building, portions of the Auxiliary Building, Borated Water Storage Tank foundation, Diesel Fuel Oil Tank foundation, Radwaste Building and other structures. However, the supporting soil actually used for these structures was random fill material (Zone 2), which is defined as any material free of humus, organic or other deleterious material. The material included sand, silts, clay and lean concrete.

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XA

3. The applicable specifications, procedures and drawings contained conflicting requirements, were at variance with FSAR requirements and/or did not implement recommendations of the A-E's consultant (Dames & Moore) in such areas as: percent compaction requirements, lift thickness, required number of passes with specified equipment and type of fill material.

4. Settlement of the structures listed in paragraph 2 above has been observed, and it continues to be monitored along with that of the Diesel Generator Building. The A-E categorizes the settlement of these structures as not as severe as that of the Diesel Generator Building at this time.

5. The A-E has contracted Goldberg, Zoino, Dunnicliff & Associates (Consultant in Geotechnical Engineering) to perform laboratory tests on soil samples obtained during the soils boring program including a series of soils classification tests and determination of engineering soils properties.

6. The final results of the A-E's investigative soils test program and the A-E's recommended alternatives and actions concerning the resolution of this problem are scheduled to be presented to CPC during the week of November 6, 1978. CPC is desirous of making a presentation concerning their plans on this matter to the NRC approximately one week after the meeting with their A-E.

In our view, this deficiency has the potential for affecting the design adequacy of several safety related structures at the Midland site. As such, we believe that the responsibility for evaluation and resolution of this problem should be transferred to NRR since their evaluation of the application is in progress. Additionally, we believe that this deficiency is relevant and material for Board notification pursuant to MC 1530 and, therefore, recommend that this matter be forwarded to NRR for Board notification.

If you have questions or comments, please contact us.

James G. Keppler

James G. Keppler
Director

Enclosure:
Letter from CPC
dtd 9/29/78

cc w/encl:
J. G. Davis
G. H. Reinmuth

Consumers Power Company

Stephen H. Howell
Senior Vice President

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

July 9, 1979
Howe 199-79

US Nuclear Regulatory Commission
Att Mr Harold R Denton
Office of Nuclear Reactor Regulation
Washington, DC 20555

MIDLAND PROJECT -
DOCKET NO 50-329 AND 50-330 -
RESPONSE TO 10 CFR 50.54 REQUEST ON PLANT FILL -
FILE 0485.16 SERIAL 7260

Enclosed are ten (10) copies of Revision 2 to Consumers Power Company's response of April 24, 1979 to your 10 CFR 50.54(f) request regarding plant fill dated March 21, 1979.

Revision 2 includes the final response to Questions 17 and 20 (previously identified as interim responses). Revision 2 also introduces the plan to use a permanent dewatering system in lieu of the chemical grouting of sands to eliminate the potential for liquefaction; the response to Question 12 has been updated to reflect this change. A "Summary of Revisions to the 10 CFR 50.54(f) Responses" page identifies all changes included in Revision 2.

Consumers Power Company

Dated July 9, 1979

by Stephen H Howell
Stephen H Howell, Senior Vice President

Sworn and subscribed to before me on this 9th day of July 1979.

Betty L. Bishop
Notary Public, Jackson County, Michigan
My commission expires September 21, 1982

B001
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1/1

CC JGKeppler (w/4 att)
NRC, Region III

7907110416
19pp.

SUMMARY OF REVISIONS
TO THE
10 CFR 50.54(f) RESPONSE
PREPARED ON
JULY 9, 1979

The following revisions have been incorporated into the responses previously submitted on April 24, 1979, and July 9, 1979:

1. Cover sheet: Added date of revision.

2. Preface: Added a new paragraph and second page to describe the modification of several earlier responses pursuant to grouting of sands.

3. Completion status page: Revised to reflect completion of Questions 17 and 20. Also revised to indicate future revision of Questions 4 and 15 to remove reference to grouting of sands.

4. Page 12-1: Added a new paragraph to describe the inclusion of the dewatering system.

5. Table 12-1, Pages 1, 3, and 4: Revised the table to include the dewatering system in lieu of grouting treatment, and made other minor corrections of previously submitted material.

6. New attachment to Table 12-1: Added, for information, a copy of FSAR Figure 2.5-47, Revision 18.

7. Question 17

   a) Pages 17-1, 17-2, and 17-3 and Table 17-1: Revised as necessary to complete the response.

   b) New Table 17-2 and Figure 17-2: Added information to complete the response.

   c) Note: No change to Figure 17-1.

8. Question 20

   a) Page 20-1: Revised as necessary to complete the response.

   b) New Page 20-2: Added page to complete the response.

RESPONSES TO THE

NRC 10 CFR 50.54(f) REQUEST

REGARDING PLANT FILL

FOR

MIDLAND PLANT UNITS 1 and 2

CONSUMERS POWER COMPANY

DOCKET NUMBERS 50-329 AND 50-330

Consisting of:

1. Preface
2. Completion Status of Each Response
3. Responses to the 22 Questions

Report Date: April 24, 1979
Revision 1: May 31, 1979
Revision 2: July 9, 1979 | 2

PREFACE

Subsequent to the March 5, 1979, meeting at the NRC Region III offices, additional soils investigation work has been performed at the Midland jobsite to further evaluate the questionable plant fill material. To date, about 45 additional borings have been performed, including some borings taken through the base mat structural slabs to evaluate the fill materials directly beneath several Seismic Category I buildings. Locations of borings performed in 1978 and 1979, including these recent borings, are shown in Figure 12-1 (attached to the Question 12 response). In addition to the borings, crack mapping and settlement monitoring of the diesel generator building and several other Seismic Category I structures are currently underway.

These subsequent investigations have identified several areas of questionable fill material. These areas are described in Table 12-1. Table 12-1 also summarizes the planned remedial actions for each area.

Concurrent with the investigations described above, several other significant activities have been performed and/or completed since early March 1979. Preloading of the diesel generator building with approximately 20 feet of granular fill material has been completed. The roof slab of the diesel generator building was poured last month, and the construction of this building is now complete. The emergency diesel fuel oil tanks have been filled with water, and the settlements resulting from this load test have been recorded. Various pipes in the plant area have been profiled. An extensive engineering review and analysis of these site investigations are currently being performed.

The following responses to the 22 questions transmitted in Mr. H.R. Denton's March 21, 1979, letter to Consumers Power Company include input from the various investigations and evaluations. Upon conclusion of these investigations, the final safety analysis report (FSAR) requirements will be reviewed and updated to reflect the results of these evaluations.

Please note that additional activities are required to complete several of the responses. An interim response, including a scheduled completion date, has been included where additional information is needed.

Since the initial submittal of this report in April 1979, several responses have been completed and review and reanalysis continues. Based on further review, several earlier responses 2 have now been modified. To eliminate any liquefaction potential of the sands, the use of a permanent dewatering system in lieu of chemical grouting is now planned. This solution was recommended by the soil consultants, Dr. R.B. Peck and Dr. A.J. Hendron, Jr. The response to Question 12 has been revised to incorporate areal dewatering as the remedial measure for eliminating the liquefaction potential. Responses to any remaining questions which refer to chemical grouting will be reviewed and revised as required by August 1979 to eliminate conflicting remedial methods. 2

COMPLETION STATUS

Question	Response Status	Date to Complete Question (If Applicable)	Actions and/or Remarks	
1	Complete		Corrective actions are currently in process.	
2	Complete			
3	Complete			
4	Interim	August 1979	Provide acceptance criteria. Revise response pursuant to grouting of sands.	2
5	Complete			
6	Complete			
7	Complete			
8	Complete			
9	Complete			
10	Complete			
11	Complete			
12	Complete		Complete response submitted in Revision 1.	
13	Complete			
14	Interim	August 1979	Provide analysis and evaluation.	
15	Interim	December 1979	Provide evaluation.	
		August 1979	Revise response pursuant to grouting of sands.	2
16	Complete			
17	Complete		Complete response submitted in Revision 2.	2
18	Complete			
19	Complete			
20	Complete		Complete response submitted in Revision 2.	2
21	Complete			
22	Complete			

Question 12

Document the condition of soils under all safety-related structures and utilities founded on plant area fill or natural lacustrine deposits. Based on the results of investigations, compare the properties and performance of existing foundation materials under all expected loading conditions with those which would have been attained using the criteria stated in the PSAR. If the foundation materials are found to be deficient, discuss measures that will be taken to upgrade them to criteria stated in the PSAR.

Response

Soil conditions beneath safety-related structures and utilities and planned remedial measures are summarized on Table 12-1. The soil conditions described for each structure are based on the borings completed to date. Figure 12-1 shows the boring locations. These borings were made from July 1978 to April 1979. One additional boring is planned in the middle of the diesel oil fuel tanks area and three more borings are planned in the auxiliary building control tower area. Natural lacustrine deposits (sands) are addressed in the response to Question 2. Remedial measures will not necessarily result in densifying the fill to the degree of the PSAR compaction criteria, but support will be provided for the structures and utilities that will meet the intent of the PSAR in that settlement and structural response will be acceptable.

Subsequent to the above response submitted in April 1979, the boring program to document the condition of soils under and/or adjacent to safety-related structures has been completed. The soil conditions observed during this boring work are summarized in Table 12-1. Boring logs for the borings listed in Table 12-1 have been included into the FSAR, Appendix 2A (Revision 21).

This table also summarizes the planned remedial measures to correct any deficient foundation conditions. For a detailed description of the planned corrective actions, refer to Interim Report 6 to MCAR 24, which was issued in June 1979.

General areal dewatering of the power block area is planned to eliminate the liquefaction potential of any sand backfill. The dewatering system will lower the piezometric level from the present elevation of approximately 627 feet to approximately elevation 600 feet. 2

TABLE 12-1

SUMMARY OF SUPPORTING SOIL CONDITIONS AND PLANNED REMEDIAL MEASURES
FOR ALL SAFETY-RELATED STRUCTURES AND UTILITIES

Structures	Borings Performed from 7-78 to 5-79	Supporting Soil Conditions	Planned Remedial Measures	
A. Auxiliary Building(1)				
1. Control tower	AX-6, 9, 18	Medium dense to very dense sand backfill over dense glacial till with the exception of possible local void under concrete mud mat elevation 590' to 589' at boring AX-9.	Pressure grouting of void below concrete mud mat as needed.	2
2. Unit 1 electrical penetration area	AX-7, 15	Generally dense to very dense sand backfill with occasional layers of loose sand and soft clay. The backfill is underlain by dense glacial till. Concrete was also used as backfill. A layer of concrete was encountered from elevations 583.5' to 580.1' at boring AX-7.	Removal of unsuitable material and replacement by lean concrete to the extent required to ensure structural integrity	2
3. Unit 2 electrical penetration area	AX-8, 19	Medium dense to dense sand backfill with occasional medium stiff clay layers over dense glacial till, with the exception of very loose to loose sand backfill pockets encountered between elevations 596.5' to 600.5' at boring AX-19. Concrete was also used as backfill.	Corrective actions similar to the Unit 1 penetration room will be used.	
4. Railroad bay (north end)(4)	AX-1, 2, 10	Medium to very dense sand backfill over dense glacial till. Concrete was also used as backfill.	Areal dewatering to eliminate liquefaction potential	2
B. Feedwater Isolation Valve Pits				
1. Unit 1	AX-5, 11 (adjacent)	Loose to dense sand and medium stiff to very stiff clay backfill with occasional soft zones over dense glacial till. Concrete was also used as backfill.	Removal of unsuitable material and replacement by lean concrete.	
2. Unit 2	AX-4, 3, & 12 (adjacent)	Loose to dense sand and medium stiff to very stiff clay backfill with occasional soft zones over dense glacial till. Concrete was also used as backfill. A layer of concrete was encountered from elevations 585.2' to 575.5' at boring AX-4.	Removal of unsuitable material and replacement by lean concrete.	

Table 12-1 (continued)

Structures	Borings Performed from 7-78 to 5-79	Supporting Soil Conditions	Planned Remedial Measures
c. Emergency diesel fuel oil lines	DG-1 through 6 DF-4, 5, 6, 7 Q-2 SWL-1	Medium dense to very dense sand and soft to very stiff silty clay backfill over very dense sand	
d. Borated water lines	SWL-8, 8A T-9, 10, 21	Very loose to medium dense sand and medium stiff to hard silty clay backfill over very dense sand	
2. Electrical Duct Banks(2)			2. None anticipated. Discussed in detail in response to Question 13, Section 5a and Note 2.
a. Auxiliary building to the service water pump structure	Q-3 through 7, 10, 11, 12 SWL-3, SW-4, 7, 9	Soft to very stiff silty clay and medium dense to very dense sand backfill over very dense sand	
b. Auxiliary building to the diesel generator building	AX-6, 9, 18 DG-19, 9, 14, 13, 32, 28, 31, 29	Medium to very dense sand backfill over concrete and hard glacial till based on borings AX-6, AX-9, and AX-18	2
c. Diesel generator building to the emergency diesel fuel oil tanks and the service water valve pits	CT-1, 5, 6, DF-4, 5, 7 DG-7, 27, 30 Q-2	Medium dense to very dense sand and medium stiff to very stiff silty clay backfill over very dense sand	
d. Auxiliary building to the borated water tanks	SWL-8,8A T-9, 10, 21	Very loose to medium dense sand and medium stiff to hard silty clay backfill over very dense sand	

Table 12-1 (continued)

Structures	Borings Performed from 7-78 to 5-79	Supporting Soil Conditions	Planned Remedial Measures
3. Service Water Valve Pits(3)			3. None anticipated. Refer to Question 13, Section 5c, and Note 3.
a. Unit 2 pit	DG-7	Stiff to very stiff silty clay and medium dense sand backfill over hard glacial till	
b. Unit 1 pit	DG-27	Stiff to very stiff silty, sandy clay and medium dense to dense sand backfill over dense silty sand.	
F. Retaining Wall Adjacent to Service Water Pump Structure	W-4, SW-13	Borings made adjacent to the structure indicate that supporting backfill below the foundation level consists of stiff to very stiff clay. The backfill is underlain by medium dense to very dense sand.	None anticipated
G. Diesel Generator Building and Associated Utilities	DG-1 through 32	Very soft to very stiff clay with pockets and layers of very loose to dense sand backfill over medium dense to very dense sand. Concrete was also used as backfill.	Surcharge for preconsolidation and areal dewatering to eliminate liquefaction potential of sand backfill

2

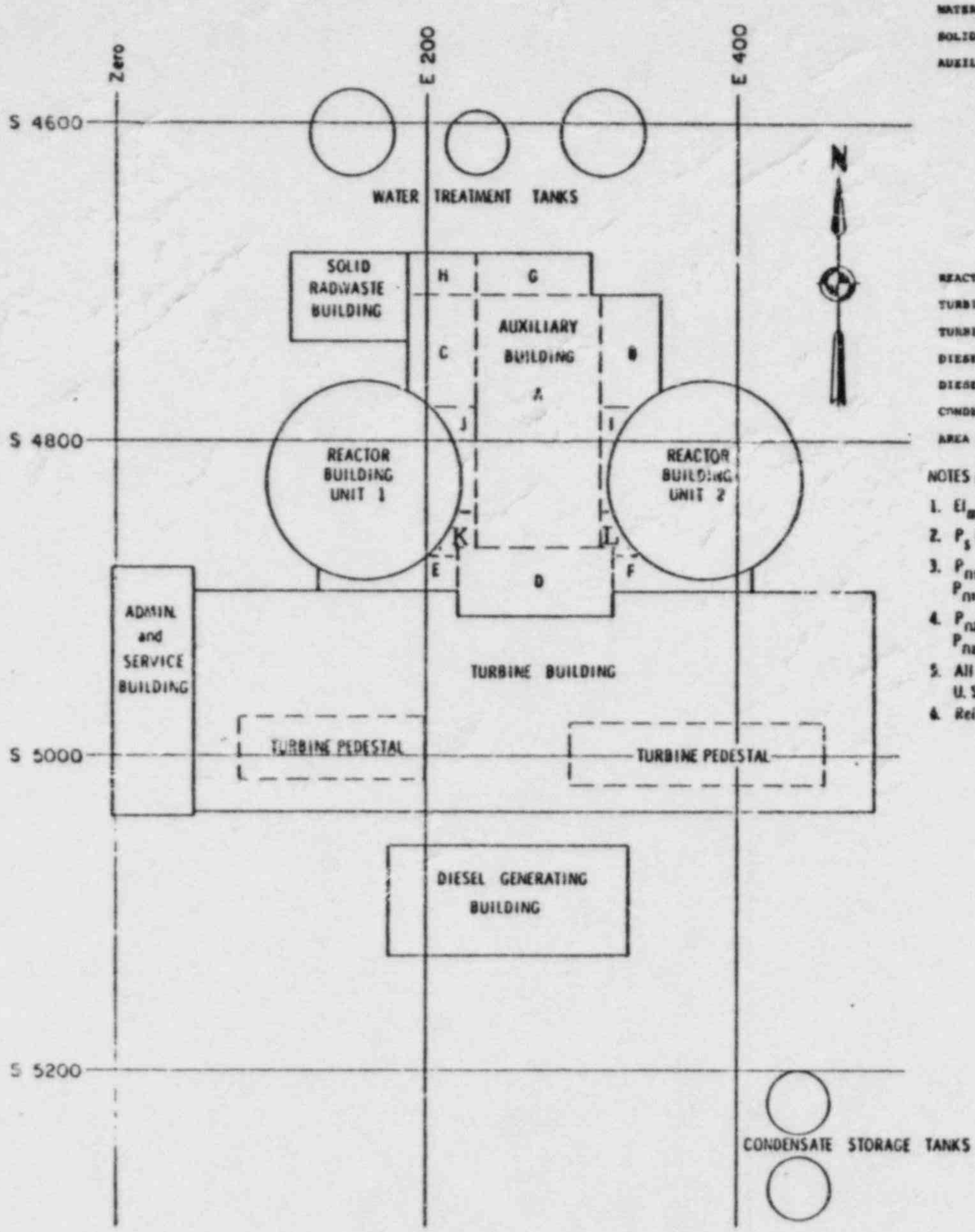
NOTES:

(1) The auxiliary building is partially founded on glacial till and partially supported on plant fill materials, as described in the above table. However, for several areas intended to be founded on glacial till, construction activities necessitated local excavation of the glacial till material (e.g., construction slopes for lower elevation excavations). Lean concrete backfill was used locally as required. This condition may occur beneath the foundation slabs adjacent to Area A (as shown on FSAR Figure 2.5-47), including Areas B, C, D, G, I, J, K, and L (as shown in the same figure). (Reduced copy of FSAR Figure 2.5-47 is attached.) 2

(2) The electrical duct banks are reinforced concrete elements enclosing PVC and rigid steel conduits thus providing a void for the cables. The following information generated during construction is being used to evaluate the adequacy of the Seismic Category I electrical duct banks in the plant area fill:

(a) A construction inspection with a rigid foam rabbit prior to cable pulling
(b) The cable pulling records

In addition, at least one conduit in each duct bank will have a continuity check made with a hard fiber composition rabbit prior to cable pulling. Existing spare conduits will be maintained as long as feasible to allow future continuity checks. At present, one spare exists for the electrical duct bank from the auxiliary building to the service water pump structure and one from the diesel generator building to the emergency diesel fuel oil tanks. At present, only the electrical duct bank from the auxiliary building to the service water structure has had cable pulled. However, the remaining conduits in that duct bank have had the continuity check made with the solid rabbit. The information did not indicate that any section of the duct bank had abnormalities or obstructions in common.



		El_m	P_s	P_{n1}	P_{n2}
WATER TANKS		629	2.5	2.5	2.5
SOLID RADWASTE BLDG.		625.3	4.5	4.5	4.4
AUXILIARY BLDG.	A	562	9.0	2.37	0.88
	B & C	579	8.5	5.33	3.65
	D	609	4.0	4.0	4.88
	E & F	609	6.0	5.0	4.88
	G	630	2.0	2.0	2.0
	H	610	3.6	3.0	3.99
	I & J	565	7.5	0.82	-0.87
	K & L	575	5.5	2.33	0.65
REACTOR BLDGS. 1 & 2		582.5	10.0	7.29	5.60
TURBINE BLDG.		609	3.0	3.0	1.68
TURBINE PEDESTALS (2)		602	5.0	4.87	3.35
DIESEL GEN. BLDG.		628	4.5	4.5	4.5
DIESEL GEN. PEDESTAL		628	1.5	1.5	1.5
CONDENSATE STORAGE TANKS		629	2.5	2.5	2.5
AREA FILL LOAD		603	4.9	0.05	2.60

NOTES:

1. El_m is the elevation of the bottom of the foundation.
2. P_s is the superimposed load intensity.
3. P_{n1} is the short term net load intensity (before the cooling water reservior filling) $P_{n1} = P_s$ - Excavation load
4. P_{n2} is the long term net load intensity (after the cooling water reservior filling) $P_{n2} = P_{n1}$ - Hydrostatic pressure
5. All units for load intensity in kips per square foot (ksf), elevations in feet from U.S.G.S. datum
6. Reference table 2.5.14.

CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Soil Pressure Diagram
Category I and II Structures
(SK-C-59, Rev 1)

FSAR Figure 2.5-47

2/79 Revision 15

Attachment to
Table 12-1

Revision 2
7/79

Question 17

Identify and document the current condition of all seismic Category I piping founded in the plant area fill. Include all piping founded in the plant area fill whose failure could adversely impact safety-related structures, foundations, and/or equipment. Also, discuss how code-allowable conditions will be assured throughout plant life. If any essential piping has now or should later approach code-allowable stress criteria or cannot be determined, what measures will you take to alleviate these conditions?

Response

Seismic Category I piping founded in the plant area fill is listed in Table 17-1. To evaluate the present condition of this piping, a representative group was selected for profiling by a Nold Aqueducer profile settlement gage, which is described in the response to Question 19. A portion of the service water lines was chosen for the investigation of Seismic Category I pipe because it goes through much of the plant fill area and it has a wide range of pipe sizes (8-inch to 36-inch diameter). When two pipelines were parallel and in the same proximity, only one was profiled. The borated water lines are scheduled to be profiled by optical means. In addition to the Seismic Category I piping, some of the non-Seismic Category I piping was also profiled by the settlement gage. 2

The piping systems profiled in and around the diesel generator building are shown in Figure 19-1. The balance of the profiled piping systems are shown in Figure 17-1, with the profiles recorded shown in Figure 17-2. The design stresses for these pipes are tabulated in Table 17-1, and the settlement stresses are tabulated in Table 17-2.

Piping systems experience loads of both a primary and secondary nature. Primary stresses are the direct, shear, or bending stresses generated by the imposed loading which are necessary to satisfy the laws of equilibrium of internal and external forces and moments. Primary stresses are due to the internal pressure, dead weight, and the seismic inertial loads. Secondary stresses are usually of a bending nature, and arise because of the differential deflections of the pipe wall. Stresses due to thermal expansion and relative end movements are of this type. Secondary stresses are not usually a source of direct failure in ductile materials upon single load application. Even if they are above the yield strength, they merely affect local deformation, which results in a redistribution of the stresses. Secondary stresses can be 2 cyclic or noncyclic. The stresses caused by differential settlement are of a noncyclic nature. This type of stress has an insignificant effect upon the strength and the strain capacity of the pipe.

For example, for a buried pipe which is 100 feet long and 10 inches in diameter, with a displacement of 12 inches at the center relative to the ends, the induced strain from secondary bending is as follows:

$$\epsilon_b = \frac{D}{2R}$$

where:

ϵ_b = bending strain
D = diameter of pipe = 10 inches
R = radius of curvature

$$R = \frac{L^2}{8\delta} \quad \text{(assuming a constant radius of curvature)}$$

where:

L = length of pipeline (inches)
δ = displacement at center (inches)

$$R = \frac{[(12)(100)]^2}{(8)(12)} = 15{,}000 \text{ inches}$$

therefore:

$$\epsilon_b = \frac{10}{(2)(15{,}000)} = 3.3 \times 10^{-4} \text{ in/in}$$

and the bending stress:

$$\sigma_b = \epsilon_b E$$
$$= (3.3 \times 10^{-4})(30 \times 10^6) = 10{,}000 \text{ psi}$$

If the yield stress was 30,000 psi, the displacement would have to be 3 x 12 = 36 inches to approach yield stress. Using the above example for a 36-inch diameter buried pipe, the displacement at the center of the pipe run would have to exceed 10 inches to approach yield stress. 2

The above discussion shows the minimal effect that differential settlement will have on the pipe stress. For ductile steel buried piping, it takes very large relative settlement to cause yield stresses and even larger settlement to cause significant strains. Furthermore, the settlement stresses are in the longitudinal direction, whereas the critical piping stresses from internal pressure are in the hoop direction. Therefore, the effect of one has very little influence on the other. The ASME code recognizes this fact and allows that the checking of settlement stress be separated from the stresses due to other loadings (Article NC-3652.3, Section III, Division 1).

For Seismic Category I piping systems, the design was carried out very conservatively as indicated in Table 17-1. Both the primary stress due to internal pressure and dead weight and secondary stresses due to seismic displacement are low compared to the code allowables. Table 17-2 indicates that settlement stresses range from 14 to 27 ksi, which is well within the code allowable of at least 45 ksi. Based on the above figures, there is no reason to believe that the stresses in Seismic Category I piping systems will ever approach the code allowables. With the inherent factor of safety in the code, the failure of these piping systems is highly improbable. 2

The structural design of non-Seismic Category I piping systems is the same as Seismic Category I systems, except for the requirement for seismic calculations and the governing code (ANSI B31.1). In Table 17-2, the settlement stresses for some of the non-Seismic Category I piping are given. The magnitude of these stresses are in the same range as those for Seismic Category I piping. Because the ANSI code does not cover the settlement condition, the ASME code allowables are used.

TABLE 17-1

SEISMIC CATEGORY I PIPING

Design Condition

Line	Pipe Profile	Primary Stress (Wt[3] + Pressure) (ksi)	Allowable Value Sh[2] (ksi)	Secondary Stress (SSE, Shear, and Compression) (ksi)	Allowable Value Sa[1] (ksi)	Remarks
Service water lines						
26"/36"-0HBC-15		2.8[4]	15.0	7.30	22.5	Parallel to 26"/36"-0HBC-16
26"/36"-0HBC-16	Yes	2.8[4]	15.0	7.30	22.5	
26"/36"-0HBC-19	Yes	2.8[4]	15.0	7.30	22.5	
26"/36"-0HBC-20		2.8[4]	15.0	7.30	22.5	Parallel to 26"/36"-0HBC-19
26"-0HBC-53		2.8	15.0	7.27	22.5	Parallel to 26"/0HBC-55
26"-0HBC-54	Yes	2.8	15.0	7.27	22.5	
26"-0HBC-55	Yes	2.8	15.0	7.27	22.5	
26"-0HBC-56		2.8	15.0	7.28	22.5	Parallel to 26"-0HBC-53
10"-0HBC-27	Yes	1.8	15.0	7.23	22.5	
10"-0HBC-28		1.8	15.0	7.23	22.5	Parallel to 10"-0HBC-27
8"-1HBC-81	Yes	1.7	15.0	7.22	22.5	
8"-1HBC-82		1.7	15.0	7.22	22.5	Parallel to 8"-1HBC-81
8"-2HBC-81		1.7	15.0	7.22	22.5	Parallel to 8"-2HBC-82
8"-2HBC-82	Yes	1.7	15.0	7.22	22.5	
8"-1HBC-310		1.7	15.0	7.22	22.5	Parallel to 8"-1HBC-311
8"-1HBC-311	Yes	1.7	15.0	7.22	22.5	
8"-2HBC-310		1.7	15.0	7.22	22.5	
8"-2HBC-311		1.77	15.0	7.22	22.5	
Borated water lines						
18"-HBC-1						Parallel to 18"-1HCB-2
18"-1HCB-2	Yes[5]					
18"-2HCB-1	Yes[5]					
18"-2HCB-2						Parallel to 18"-2HCB-1
Emergency diesel fuel lines						
11/2"-1HBC-3						
11/2"-1HBC-4						
11/2"-2HBC-3						
11/2"-2HBC-4						
2"-1HBC-497						
2"-1HBC-498						
2"-2HBC-497						
2"-2HBC-498						

(1) Equation 10, ASME Section III, Division 1, Subsection NC
(2) Equation 8, ASME Section III, Division 1, Subsection NC
(3) Because the lines are continuously supported, the stresses from dead weight are low. The assumed value is equal to 1 ksi.
(4) For the 26-inch diameter portion only.
(5) Profiled by optical means

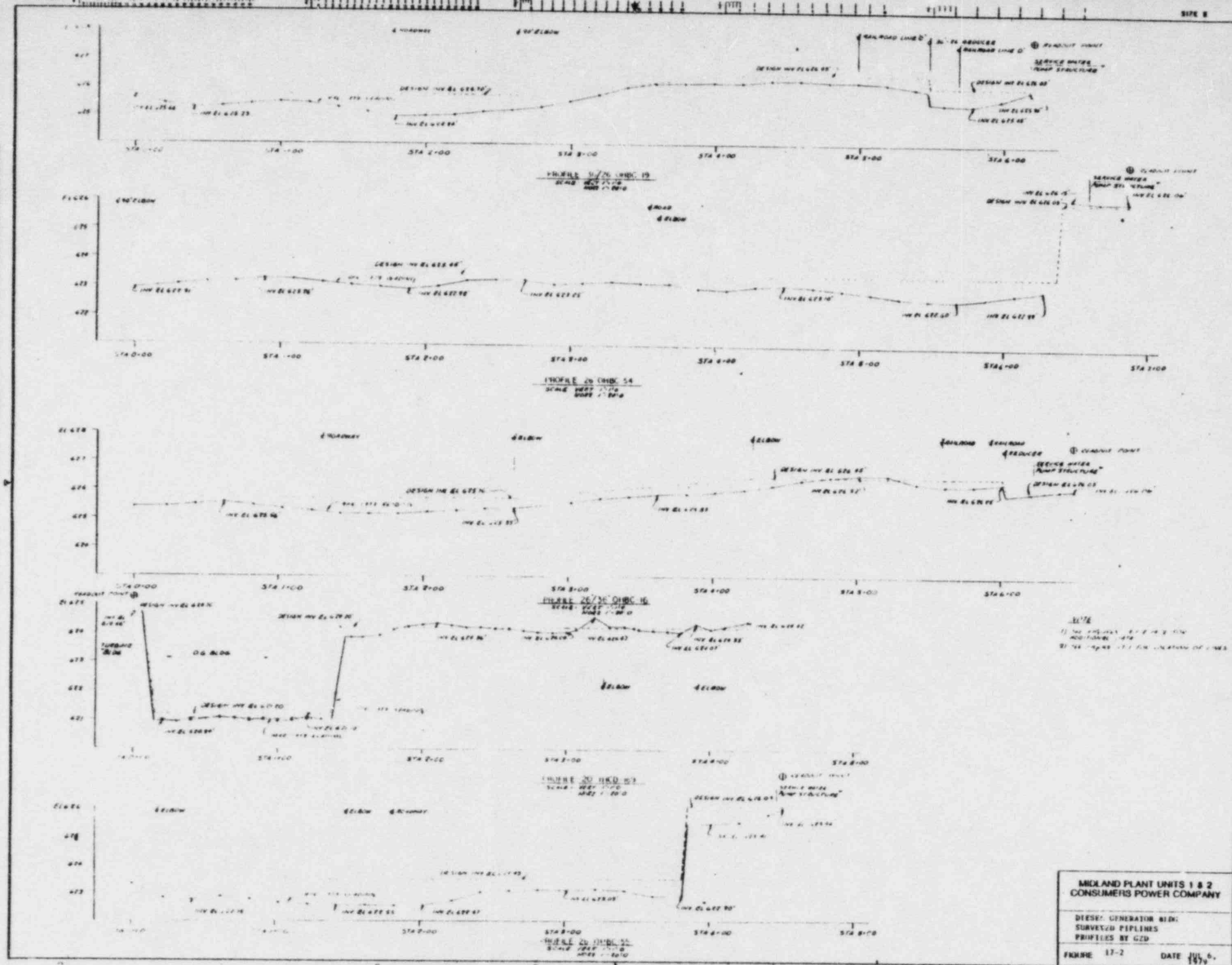
TABLE 17-2

SETTLEMENT STRESSES OF PROFILED SYSTEMS

Line	Seismic Category I	Location Shown in Figure	Profile Shown in Figure	Stress(1) (ksi)	Code Allowable(2) (ksi)
Service water lines					
26"/36"-0HBC-16	Yes	17-1	17-2	14.0	52.5
26"/36"-0HBC-19	Yes	17-1	17-2	27.0	52.5
26"-0HBC-54	Yes	17-1 & 19-1	17-2 & 19-1	22.0	52.5
26"-0HBC-55	Yes	17-1 & 19-1	17-2 & 19-1	27.0	52.5
10"-0HBC-27	Yes			21.9	45.0
8"-1HBC-81	Yes	19-1	19-1	17.7	45.0
8"-1HBC-82	Yes	19-1	19-1	11.5	45.0
8"-1HBC-311	Yes	19-1	19-1	24.1	45.0
26"-1JBD-2	No	19-1	19-1	23.0	47.1
26"-2JBD-1	No	19-1	19-1	16.1	47.1
Condensate water line					
20"-1HCD-169	No	17-1 & 19-1	17-2 & 19-1	22.0	47.7

(1) Analytical values generated from settlement gage data. Rounding in excess of the accuracy of the gage was necessary in several zones. These zones will be subjected to further investigation.
(2) Equation 10a, ASME Section III, Division 1, Subsection NC

2



SIZE B
PROFILE 20 OHBC 54
PROFILE 26/36" OHBC 16
PROFILE 20 HKD 69
PROFILE 20 OHBC 55
MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY
DIESEL GENERATOR BLDG
SURVEYED PIPLINES
PROFILES BY GZD
FIGURE 17-2
DATE JUL 6, 1979

Question 20

Provide assurance that the stress levels of all components (e.g., pumps, valves, vessels, supports) associated with seismic Category I piping systems that have been or will be exposed to increased settlement will be within their code-allowable stress limits. Also, provide assurance that deformations of active pumps and valves installed in such systems will be kept within limits for which component operability has been established.

Response

The analysis of Seismic Category I piping systems which have been or are expected to be affected by settlement will encompass the total extent of the settlement effect on the piping. Affected pump and vessel nozzle loadings will be analytically checked to verify that they are within specified or vendor-accepted limits. If necessary, flanged joints may be disassembled and the nature of the resulting separation may be used to evaluate the loads transmitted by the joint.

Equipment supports are normally designed to accept the allowable piping reaction loads, and therefore will be unaffected by settlement as long as the nozzle allowables are not exceeded.

For piping systems which have been subjected to loads induced by settlement, piping support loads will be verified by analysis to be in accordance with the design loads. The maximum differential settlement will be used to verify that pipe support loads will not become excessive, or alternately, to establish a requirement for future support adjustment.

The valves are generally stronger than the piping in which they are welded. Because the pipe (not the valve) governs the piping design, the valve deformations, if any, will be insignificant.

The status and the results of the review and analysis work described above are as follows.

Field inspection, drawing review, and stress analysis of the Seismic Category I service water piping, borated water piping, and the emergency diesel fuel lines indicate that the stress levels of all components are and will be within the code allowables. 2

As of June 27, 1979, the service water piping was not connected to the strainers and the pumps. If the predicted settlement for the plant life indicates nozzle loads exceeding allowables, steps will be taken by adding restraints and/or other design changes to meet the design requirements. The piping is now on temporary supports, so the adjustments can be made to the permanent supports if required. In summary, no active components will be affected by the differential settlement.

The borated water piping has no active pumps or valves in the first 100 lineal feet of the pipe run from the wall penetrations. The active components are sufficiently removed such that differential settlement has no effect upon their integrity. The piping has temporary and unshimmed permanent supports with a sufficient margin for adjustments. 2

The emergency diesel fuel lines are 2 inches and smaller in diameter. These lines have sufficient flexibility to withstand the differential settlement without exceeding the code allowable stresses.

At this time, there are no active components buried within the diesel generator building.

Consumers Power Company

#1

7-1-4

Stephen H. Howell
Vice President

General Offices: 1945 West Parnall Road, Jackson, Michigan 49201 • Area Code 517 788-0453

September 29, 1978
Howe-183-78

1978 OCT 3 AM 11 21

RECEIVED DISTRIBUTION SERVICES UNIT

Mr J G Keppler, Regional Director
Office of Inspection and Enforcement
Region III
US Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

MIDLAND NUCLEAR PLANT -
UNIT NO 1, DOCKET NO 50-329
UNIT NO 2, DOCKET NO 50-330
SETTLEMENT OF DIESEL GENERATOR FOUNDATIONS AND BUILDING

In accordance with the requirements of 10 CFR 50.55(e), this letter constitutes an interim report on the status of the settlement of the diesel generator foundations and building.

A description of the conditions relative to the settlements and the investigative actions planned are documented in the enclosures to this letter.

Another report, either interim or final, will be sent on or before November 17, 1978.

Stephen H Howell

Enclosures: 1) Quality Assurance Program, Management Corrective Action Report, MCAR-1, Report 24, dated September 7, 1978.

2) Letter, P A Martinez to G S Keeley, BLC-6578, MCAR-24, Interim Report #1, dated 9/22/78, with attached report.

CC: Director, Office of Inspection & Enforcement
Att: Mr John G Davis, Acting Director, USNRC (15)

Director, Office of Management
Information and Program Control, USNRC (1)

~~7810060285~~ B019|S *
7810060142
16pp. 1/15

Enclosure 1
Howe-183-78

QUALITY ASSURANCE PROGRAM
MANAGEMENT CORRECTIVE ACTION REPORT
MCAR-1

BECHTEL

REPORT NO. 24

JOB NO. 7220 Q NO. 1.40 DATE 9/7/78

I *DESCRIPTION (Including references):

The Bechtel "Foundation Data Survey Program" has indicated that the settlement of the Diesel Generator Building has been greater than expected. This has been documented in NCR-1482 dated (8/21/78). A preliminary evaluation of soil boring data from an investigation being conducted by Project Engineering indicated that the magnitude of the investigative tests and analysis of test results makes this item reportable under 10CFR50.55 e, 1, iii.

*RECOMMENDED ACTION (Optional)

1. Determine the amount of settlement of the Diesel Generator Building (DGB) and increase the frequency of foundation survey measurements to find if the settlement is or will be excessive.
2. Determine the cause of the settlement.
3. If the settlement is or will be excessive, determine what actions are required to correct the condition and preclude recurrence.

REFERRED TO [X] ENGINEERING [ ] CONSTRUCTION [ ] QA MANAGEMENT [ ] ______

WJMoring for
ISSUED BY L. A. Dreisbach 9/7/78
Project QA Engineer Date

II REPORTABLE DISCREPANCY [ ] NO [X] YES

NOTIFIED CLIENT 9/7/78
Date

[signature] 9/7/78
Project Manager Date

III CAUSE

CORRECTIVE ACTION TAKEN

RECEIVED
SEP 8 1978
QUALITY ASSURANCE

AUTHORIZED BY ______ ______
Date

DISTRIBUTION:
Project Manager — J.B. Violette
Construction Manager — S.I. Heisler
Engineering Manager — L.A. Dreisbach
Project Engineer — J. Amaral (Gaithersburg)
Proj. Supt. / Proj. Const. Mgr. or P & I Procurement Mgr. — J.E. Bashore (Norwalk)
Chief Field QC Engineer or Procurement Insp. Mgr.
QA Supervisor
Client

FORMAL REPORT TO CLIENT ______
(If Section II Applies) Date

CORRECTIVE ACTION IMPLEMENTED

VERIFIED BY ______
Project QA Engineer Date

*Describe in space provided and attach reference document.

BPC-20883
G1001651-01

Enclosure 2
Howe-183-78

Bechtel Power Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

Mail Address: P.O. Box 1000, Ann Arbor, Michigan 48106

September 22, 1978

BLC-6578

Mr. G. S. Keeley
Project Manager
CONSUMERS POWER COMPANY
1945 West Parnall Road
Jackson, Michigan 49201

Midland Units 1 and 2
Consumers Power Company
Bechtel Job 7220
MCAR 24 INTERIM REPORT 1
Files 2417/2801

Dear Mr. Keeley:

Attached is Interim Report 1 addressing the Deisel Generator Building Settlement as described in MCAR 24 (issued September 7, 1978).

As agreed with W. R. Bird on September 21, 1978, the next report will be issued November 3, 1978.

Very truly yours,

for P. A. Martinez
Project Manager

PAM/WGM/pp

cc: Mr. R. C. Bauran
Mr. W. R. Bird
Mr. J. L. Corley
Mr. B. W. Marguglio

Attachment (5 pages).

Bechtel Associates Professional Corporation

Attachment to BLC-6578

SUBJECT: MCAR #24 (Issued 9/7/78)

Settlement of the diesel generator foundations and building

INTERIM REPORT # 1

DATE: September 22, 1978

PROJECT: Consumers Power Company
Midland Plant Units 1 & 2
Bechtel Job 7220

Introduction

This report summarizes the project's actions relating to the settlement of the diesel generator foundations and building as described in MCAR #24 and NCR 1482.

The fill material in this area was placed between 1975 and 1977. Construction was started on the diesel generator building in mid-1977. The diesel generator building settlements were noticed to exceed anticipated values in July 1978. The diesel generator building construction was placed on hold on August 23, 1978. A diesel generator building soil boring program was started on August 25, 1978. Based on preliminary soil boring data evaluation, MCAR #24 was issued.

The actions requested by MCAR #24 are being performed as follows:

1) The Foundation Data Survey Program, Specification 7220-C-76, has been expanded by increasing the number of data locations and the frequency of measurements.

2) The cause of the settlement and the corrective actions required to preclude the recurrence of this condition will be addressed after the testing and monitoring programs have been evaluated.

3) The options available to resolve the existing settlement conditions will be discussed in the Corrective Actions section.

Deficiency

The Bechtel Foundation Data Survey Program (Specification 7220-C-76) generated data that indicated the settlement of the diesel generator foundations and building was greater than anticipated. Nonconformance Report 1482 was generated on August 21, 1978, describing the settlements.

The general foundation and building settlements, as of September 19, 1978, are shown on Figure 1 (attached).

Due to the magnitude of the settlements observed, a soils boring program was started. Based on the borings completed to date, the fill under the building has variable strength properties ranging from good to poor.

Further clarification of the fill deficiency will be made when the soil test results have been completed and evaluated.

An independent soils consultant has been retained to help in the data evaluation and feasibility of the corrective actions. who?

Safety Implications

Large settlements can pose possible safety problems for buildings. A preliminary evaluation of soil boring data from the investigation being conducted indicates that the magnitude of the investigative tests and analysis of test results makes this item reportable under 10 CFR 50.55 e, 1, iii.

These structures are monitored for settlement as part of the foundation data survey program. Hence, any unusual settlement of the structure would be detected before the diesel generators would be rendered inoperable due to the resulting distortions.

Activities in Progress

Several activities are in progress to generate information needed to evaluate the feasibility of possible corrective actions. The activities are:

1) The Foundation Data Survey Program has been expanded to include additional settlement data locations as well as monitoring these data locations more frequently. Building time rate of settlement curves are being developed based on this datum for a better understanding of the problem.

Bechtel Associates Professional Corporation

2) A boring program has been initiated to provide better definition of the fill conditions under the building and to obtain soil samples for laboratory tests. Dutch cone penetration tests are also being performed under the building area to better define the variable strength properties of the fill material.

Check Fill Structural Specs!

3) Laboratory tests being performed are:

   a. Shear strength tests to determine fill characteristic for bearing capacity evaluation

   b. Consolidation tests to predict building settlement for the present fill material

   c. Soil classifications

   d. Mineralogy tests to evaluate the swelling potential of the fill material

This portion of the Bechtel Report is deleted because it contains a premature discussion of possible corrective action options. Specific options will be included in subsequent reports following a complete evaluation of soil conditions.

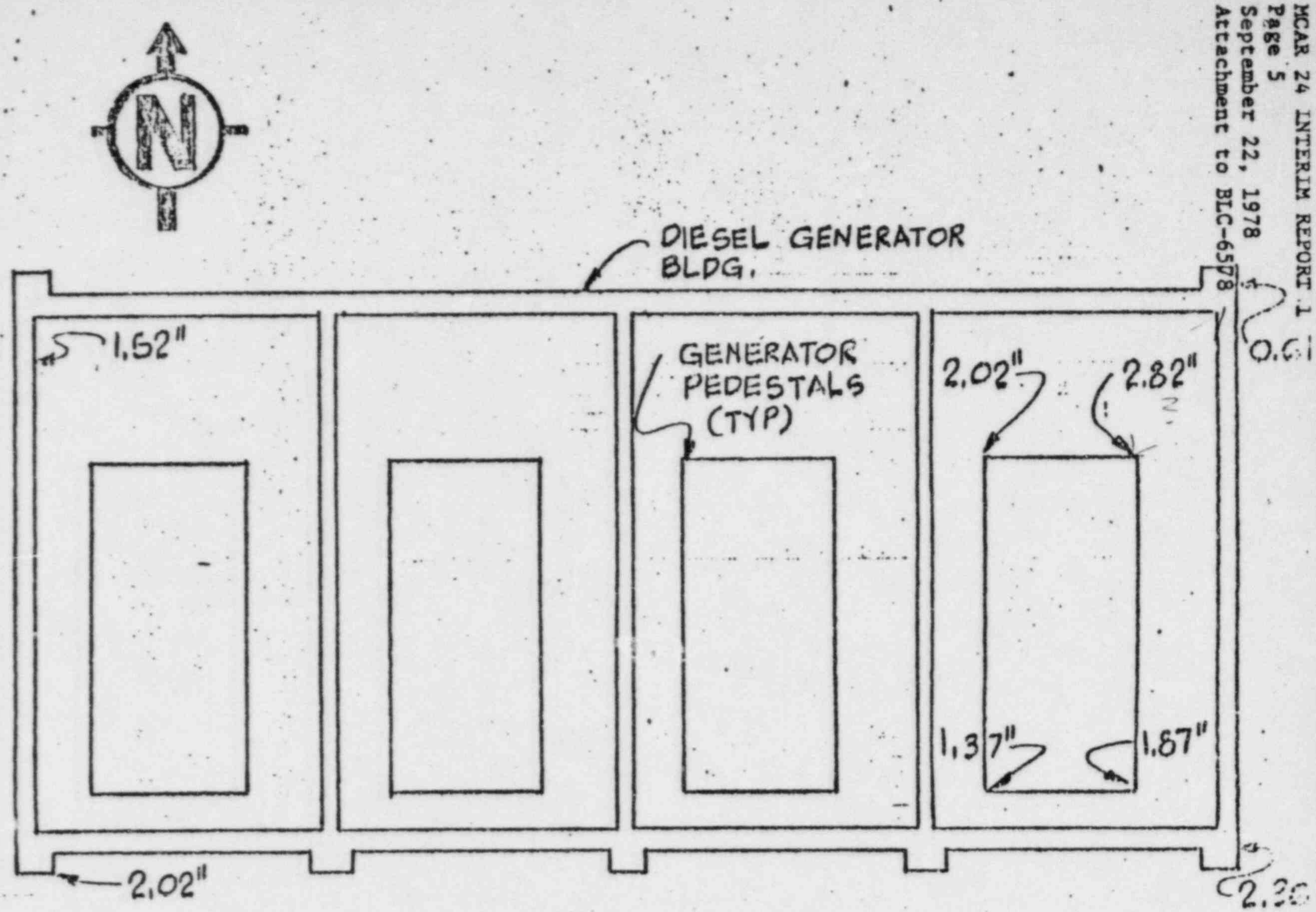
Detailed descriptions of the selected options will be presented in subsequent reports.

Submitted by:

Approved by:

Concurrence by:

JH/cap
9/19/6



DIESEL GENERATOR BLDG.

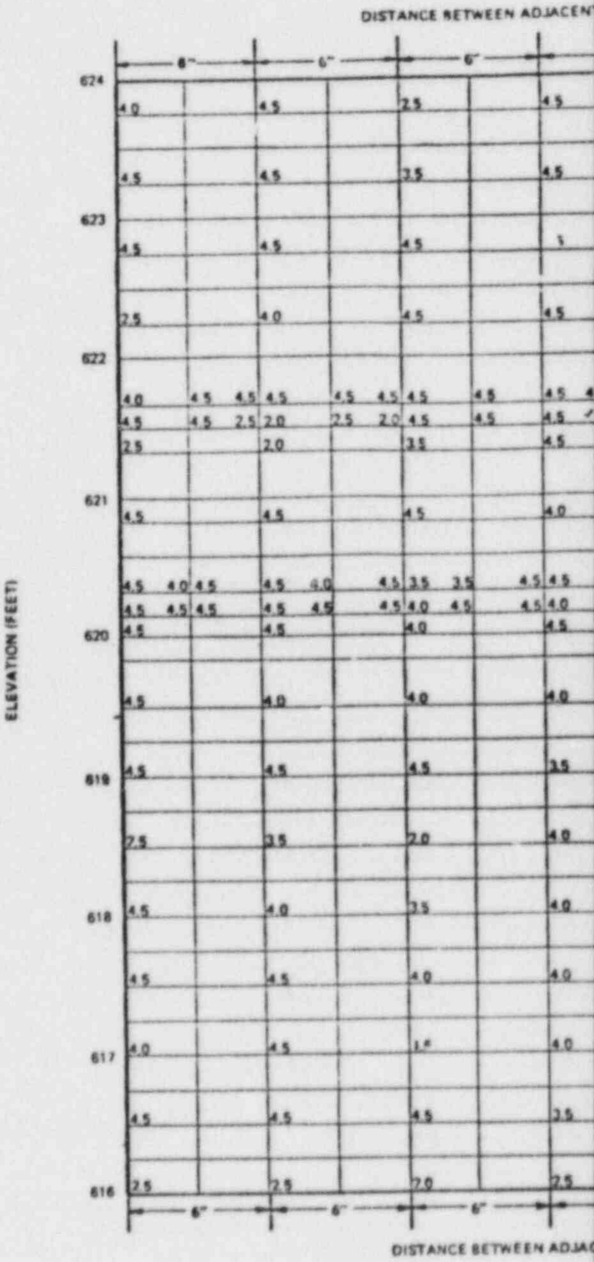
SETTLEMENT DATA AS OF 9-19-78
(INCHES)

NO.	DATE	REVISIONS	BY	CH'K	APP'R
1	9-22-78	ISSUED FOR INFO. TO MCAR # 24, INTERIM REPORT # 1	PB		

CONSUMERS POWER COMPANY
MIDLAND PLANTS UNITS 1 AND 2
MCAR # 24

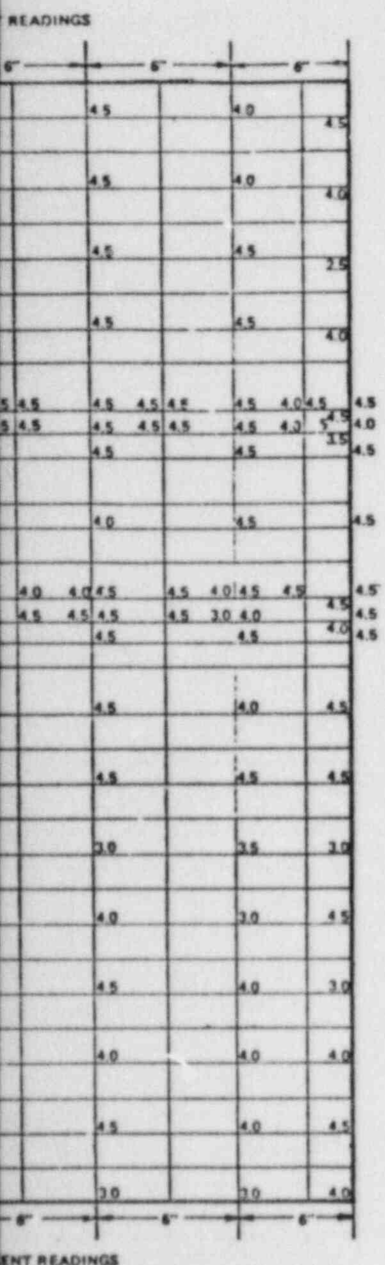
JOB No. 7220

FIGURE 1



I CERTIFY THA
THIS FRAME W
REGULAR COU
DATE STATED
ACCURATE RE
SUBMITTED TO

2-15-79 P.
DATE CA



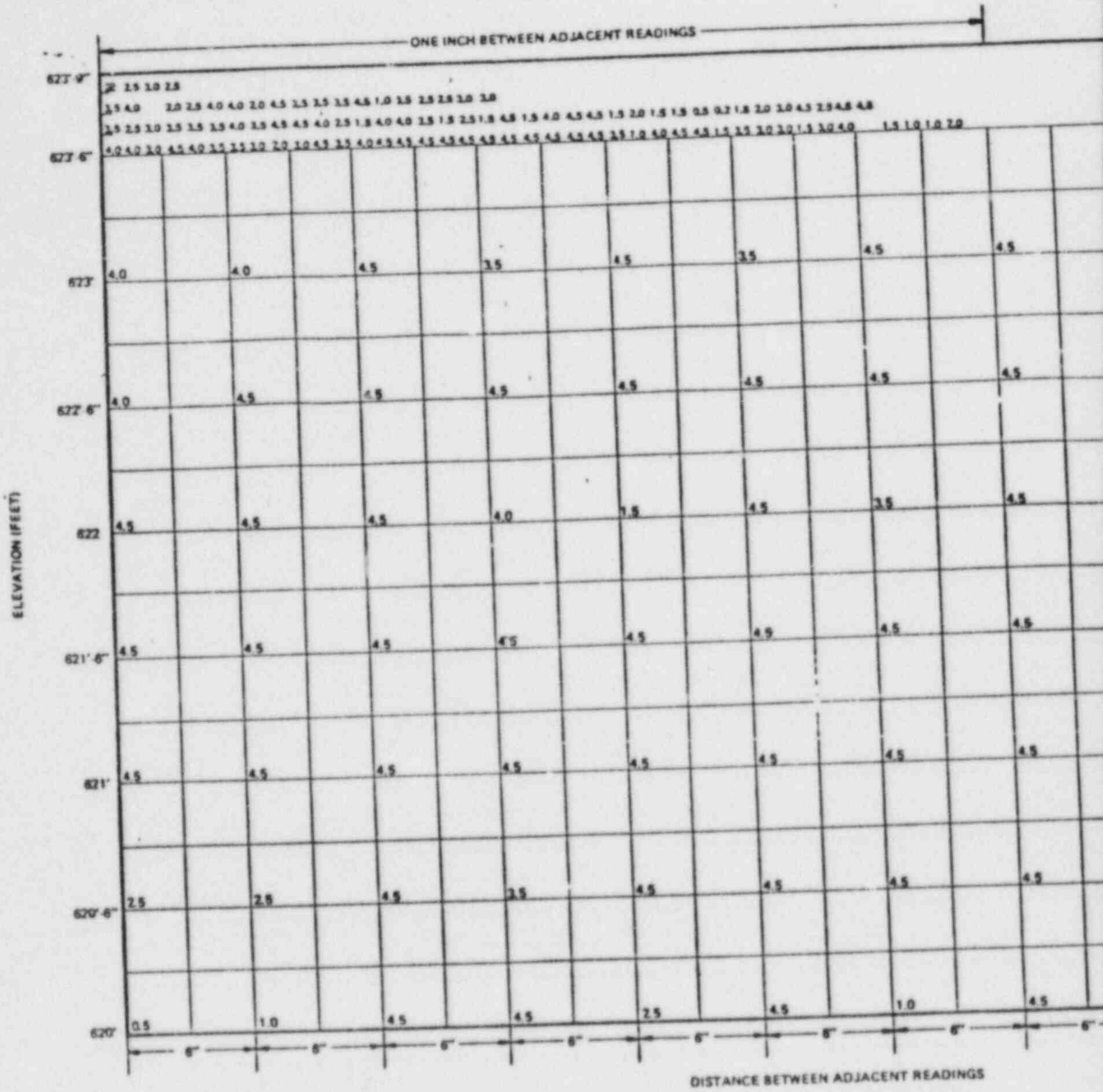
NOTES:

1. NUMBERS IN GRID REPRESENT HAND PENETROMETER READINGS IN TONS PER SQUARE FOOT. 4.5 TSF IS THE MAXIMUM READING THAT CAN BE OBTAINED WITH THE PENETROMETER USED.
2. FOR SOIL DESCRIPTION SEE TEST PIT LOGS
3. FOR LOCATION OF PIT SEE FIGURE 20

MIDLAND POWER PLANT

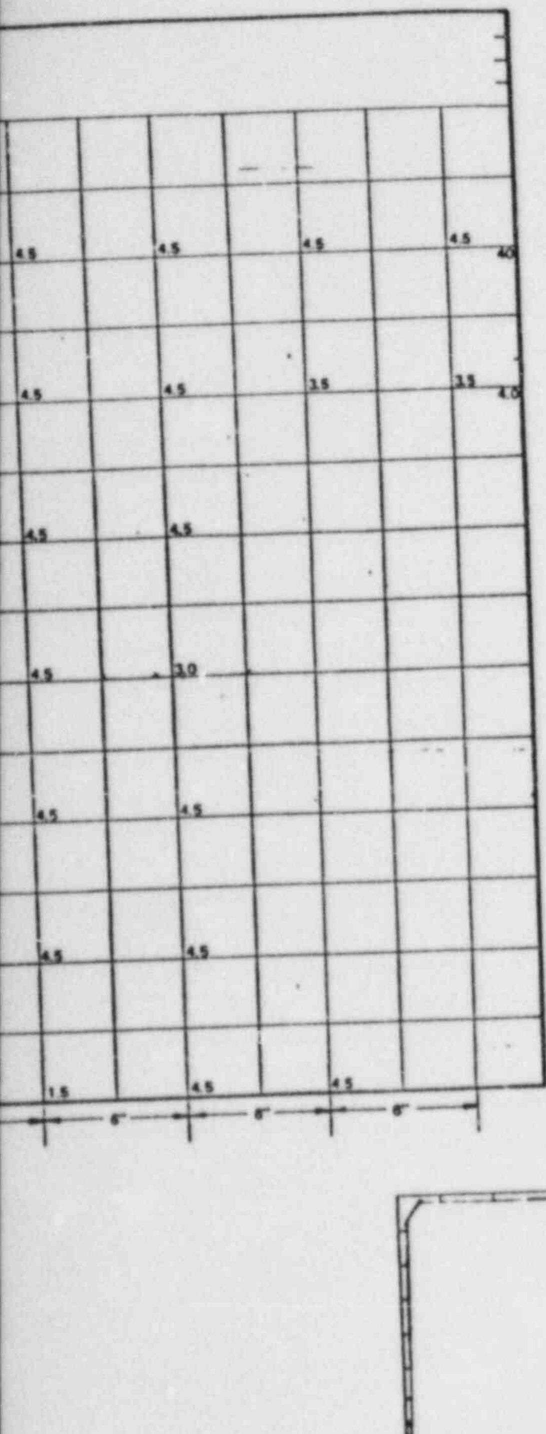
PENETROMETER READINGS
NORTH WALL OF TEST PIT NO. 3
TANK FARM AREA

DRAWING NO.	REV.
FIGURE 30	42



NOTES:

1. NUMBERS IN GRID REPRESENT HAND PENETROMETER READINGS IN TONS PER SQUARE FOOT. 4.5 TSF IS THE MAXIMUM READING THAT CAN BE OBTAINED WITH THE PENETROMETER USED.
2. FOR SOIL DESCRIPTION SEE TEST PIT LOGS
3. FOR LOCATION OF PIT SEE FIGURE 7

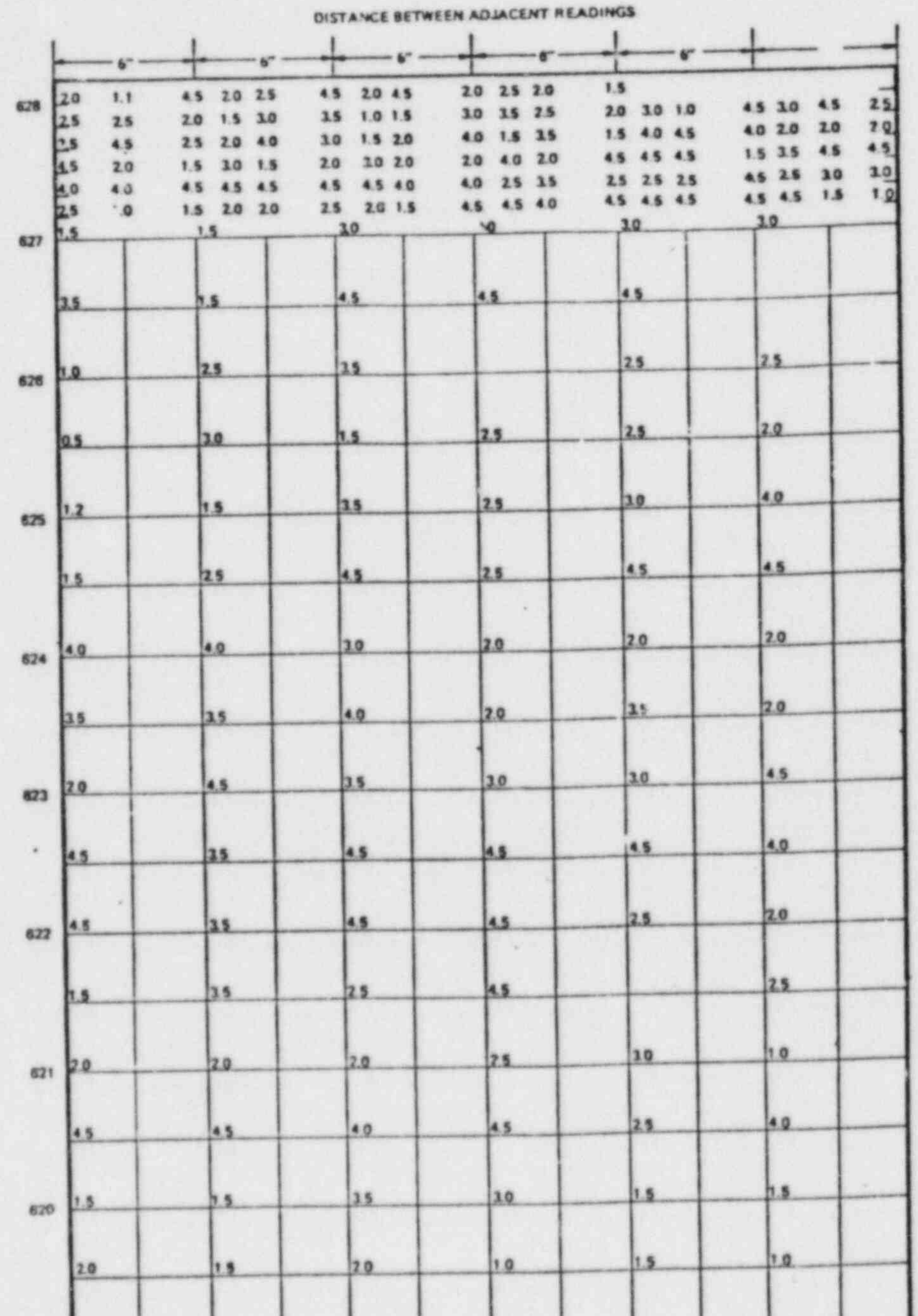


MIDLAND POWER PLANT

PENETROMETER READINGS
EAST WALL OF TEST PIT NO. 2
CONDENSATE WATER TANK AREA
SHEET 1 OF 2

DRAWING NO.	REV.
FIGURE 31	4R

10/81


DISTANCE BETWEEN ADJACENT READINGS
ELEVATION (FEET)
628
627
626
625
624
623
622
621
620
619
DISTANCE BETWEEN ADJACENT READINGS

NOTES:

1. NUMBERS IN GRID REPRESENT HAND PENETROMETER READINGS IN TONS PER SQUARE FOOT. 4.5 TSF IS THE MAXIMUM READING THAT CAN BE OBTAINED WITH THE PENETROMETER USED.
2. FOR SOIL DESCRIPTION SEE TEST PIT LOGS
3. FOR LOCATION OF PIT SEE FIGURE 7

MIDLAND POWER PLANT

PENETROMETER READINGS
EAST WALL OF TEST PIT NO. 2
CONDENSATE WATER TANK AREA
SHEET 2 OF 2

DRAWING NO.	REV.
FIGURE 32	4R

11/81

SHEET

BORING LOG

PROJECT	MIDLAND POWER PLANT
JOB NO.	7220-101
SITE	Condensate Water Tanks
COORDINATES	See location plan
BEGUN	10/3/78
COMPLETED	10/3/78
DRILLER	
DRILL MAKE AND MODEL	Backhoe
HOLE SIZE	10X20'
OVERBURDEN (FT.)	
CORE RECOVERY (FT./%)	
CORE BOXES	
SAMPLES	8
EL. TOP OF CASING	
GROUND EL.	634.0
DEPTH/EL. GROUND WATER	
SAMPLE HAMMER WEIGHT/FALL	
CASING LEFT IN HOLE: DIA./LENGTH	
LOGGED BY	A. S. Marshall

Sample Type and Diameter	Sampler Advance / Length Core Run	Sample Recovery / Core Recovery	Sample Blows	Percent Core Recovery	Penetration Blows 1st 6"	2nd 6"	3rd 6"	Elevation	Depth	Sample	Description and Classification
								634.0	0		0-16.5' Man-made fill: Sandy Clay, brown, very stiff to hard, low plasticity, moist (CL) (Fill)
O										1	
O									5	2	
O										3	
O										4	
O									10	5	
O										6	
O									15	7	
O								617.5	16.5	8	
											Bottom of pit at 16.5 feet

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENISON; P = PITCHER; O = OTHER

SITE: Condensate Water Tanks

FIGURE 40
sheet 2

G NUMBER

TP-2

...TON - TORRANCE - CALIFORNIA

...ET NO.	HOLE NO.
of 1	TP-2
...M HORIZ.	BEARING
...LIFT	TOTAL DEPTH
	15.5'
...EL. TOP OF ROCK	

NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

O=inidcates bag samples taken

HOLE NO. TP-2

Rev 4R
of 3

BORING LOG

PROJECT	MIDLAND POWER PLANT
JOB NO.	7220-101
SITE	Condensate Water Tanks
COORDINATES	See location plan
BEGUN	10/3/78
COMPLETED	10/3/78
DRILLER	
DRILL MAKE AND MODEL	Backhoe
HOLE SIZE	10X20'
OVERBURDEN (FT.)	
CORE RECOVERY (FT./%)	
CORE BOXES	
SAMPLES	8
EL. TOP OF CASING	
GROUND EL.	634.0
DEPTH/EL. GROUND WATER	
SAMPLE HAMMER WEIGHT/FALL	
CASING LEFT IN HOLE: DIA./LENGTH	
LOGGED BY:	A. S. Marshall

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS	PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	2ND 6"	3RD 6"	ELEVATION	DEPTH	SAMPLE	DESCRIPTION AND CLASSIFICATION
								634.0	0		0-16.5' Man-made fill: Sandy Clay, brown, very stiff to hard, low plasticity, moist (CL) (Fill)
O										1	
									5	2	
O										3	
O										4	
O									10	5	
O										6	
O									15	7	
O								617.5	16.5	8	
											Bottom of pit at 16.5 feet

SITE: Condensate Water Tanks

FIGURE 40
sheet 2

G NUMBER

TP-2

ON - TORRANCE - CALIFORNIA

SHEET NO.	HOLE NO.
of 1	TP-2
	BEARING
	TOTAL DEPTH
	15.5'

ELEV. TOP OF ROCK

NOTES ON:
WATER LEVELS,
WATER RETURN,
CHARACTER OF
DRILLING, ETC.

O=inidcates
bag samples
taken

HOLE NO.
TP-2

Rev 4R
of 3

SHEET

BORING LOG

PROJECT	JOB NO.
MIDLAND POWER PLANT	7220-101

SITE	COORDINATES
Condensate Water Tanks	See location plan

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE
10/3/78	10/3/78		Backhoe	10X20'

CORE RECL.	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER
		8		634.0	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
		A. S. Marshall

Sample type and diameter	Elevation	Depth	Sample	Description and classification
	634.0	0		0-16.5' Man-made fill: Sandy Clay, brown, very stiff to hard, low plasticity, moist (CL) (Fill)
O			1	
		5	2	
O			3	
O			4	
O		10	5	
O			6	
O			7	
		15		
O	617.5	16.5	8	Bottom of pit at 16.5 feet

SITE Condensate Water Tanks

FIGURE 40
sheet 2

G NUMBER

TP-2

TION · TORRANCE · CALIFORNIA

SHEET NO.	HOLE NO.
of 1	TP-2
FROM HORIZ.	BEARING
DRIFT	TOTAL DEPTH
	15.5'

ELEV. TOP OF ROCK

NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

O=inidcates bag samples taken

HOLE NO. TP-2

Rev 4R
of 3

12/81

SHEET

BORING LOG

PROJECT: MIDLAND POWER PLANT	JOB NO.: 7220-101	SHEET: 1	
SITE: Condensate Water Tanks	COORDINATES: See location plan		
BEGUN: 10/3/78	COMPLETED: 10/3/78	DRILLER:	DRILL MAKE AND MODEL: Backhoe
HOLE SIZE: 10X20'	OVERBURDEN (FT.):		
CORE RECOVERY (FT./%):	CORE BOXES:	SAMPLES: 8	EL. TOP OF CASING:
GROUND EL.: 634.0	DEPTH/EL. GROUND WATER:		
SAMPLE HAMMER WEIGHT/FALL:	CASING LEFT IN HOLE: DIA./LENGTH:	LOGGED BY: A. S. Marshall	

SAMPLE TYPE AND DIAMETER	ELEVATION	DEPTH	SAMPLE	DESCRIPTION AND CLASSIFICATION
	634.0	0		0-16.5' Man-made fill: Sandy Clay, brown, very stiff to hard, low plasticity, moist (CL) (Fill)
O			1	
		5	2	
O			3	
O			4	
O		10	5	
O			6	
O		15	7	
O	617.5	16.5	8	
				Bottom of pit at 16.5 feet

SS = SPLIT SPOON ST = SHELBY TUBE; D = DENISON; P = PITCHER; O = OTHER

SITE: Condensate Water Tanks

FIGURE 40
sheet 2

S NUMBER

TP-2

ON · TORRANCE · CALIFORNIA

OF 1	HOLE NO. TP-2
HORIZ.	BEARING
	TOTAL DEPTH 15.5'
EL. TOP OF ROCK	

NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

O=inidcates bag samples taken

HOLE NO. TP-2

Rev 4R
of 3

SHEET 1 OF

BORING LOG

PROJECT	JOB NO.
MIDLAND POWER PLANT	7220-101

SITE	COORDINATES
Condensate Water Tanks	See location plan

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)
10/3/78	10/3/78		Backhoe	10X20'	

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER
		8		634.0	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
		A. S. Marshall

SAMPLE TYPE AND DIAMETER	ELEVATION	DEPTH	SAMPLE	DESCRIPTION AND CLASSIFICATION
	634.0	0		0-16.5' Man-made fill: Sandy Clay brown, very stiff to hard, low plasticity, moist (CL) (Fill)
O			1	
		5		
O			2	
O			3	
O			4	
		10		
O			5	
O			6	
O			7	
		15		
O	617.5	16.5	8	
				Bottom of pit at 16.5 feet

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: Condensate Water Tanks

FIGURE 40
sheet 2

NG NUMBER

TP-2

ATION · TORRANCE · CALIFORNIA

SHEET NO.	HOLE NO.
1 of 1	TP-2
FROM HORIZ.	BEARING
(FT.)	TOTAL DEPTH
	15.5'
DEPTH/EL. TOP OF ROCK	

NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

O=inidcates bag samples taken

HOLE NO. TP-2

Rev 4R
of 3

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

31

April 3, 1979

MEMORANDUM FOR: Harold D. Thornburg, Director, Division of Reactor Construction Inspection, IE

FROM: James G. Keppler, Director

SUBJECT: ENFORCEMENT ACTION RE: MIDLAND DIESEL GENERATOR BUILDING AND PLANT FILL AREA

As you are aware, we have sent to Consumers Power Company a report on our two meetings held with them and a report of the investigation into the causes of the diesel generator building settlement. In my memorandum to you dated March 12, 1979, I summarized our findings and our concerns resulting from this investigation.

In view of NRR's involvement in the technical issues in this case, and the need for a determination as to the materiality of FSAR statements we consider to be false, we are not in a position at this time to recommend specific enforcement action which should be taken.

Attached to this memorandum are the specific FSAR statements and the basis for our conclusion that they are false. Also attached are copies of our letter dated March 22, 1979, which transmitted the Investigation report to the licensee and a draft Notice of Violation setting forth the items of noncompliance based on the investigation findings. The draft Notice of Violation includes all of the FSAR discrepancies described in Attachment 1 as examples of noncompliance with Criterion III of 10 CFR 50, Appendix B. If it is determined that any of these matters constitute material false statements, we assume they would then be treated separately, and removed as examples of noncompliance with this criteria.

~~8106090700~~ 14pp.

We request that the items of noncompliance be given technical and legal review and that a determination be made of the materiality of FSAR discrepancies so that upon resolution of the technical issues, we will be in a position to move more promptly toward taking enforcement action.

James G. Keppler

James G. Keppler
Director

Attachments:
1. FSAR False Statements
2. Draft Notice of Violation
3. Ltr dtd 3/22/79, with
   Investigation Report

cc w/attachments:
D. Thompson, IE

Midland FSAR Statements

1. Statement

Section 2.5.4.5.3, Fill, states: "All fill and backfill were placed according to Table 2.5-9."

Table 2.5-9, Minimum Compaction Criteria, contains the following:

			Compaction Criteria	
"Function	Zone(1) Designation	Soil Type	Degree	ASTM Designation
Support of structures		Clay	95%	ASTM D 1557-66T (modified)(2)

(1) For zone designation see Table 2.5-10.
(2) The method was modified to get 20,000 foot-pounds of compactive energy per cubic foot of soil."

Section 2.5.4.10.1, Bearing Capacity, states: "Table 2.5-14 shows the contact stress beneath footings subject to static and static plus dynamic loadings, the foundation elevation, and the type of supporting medium for various plant structures."

Table 2.5-14, Summary of Contact Stresses and Ultimate Bearing Capacity for Mat Foundations Supporting Seismic Category I and II Structures, contains, in part; the following:

"Unit	Supporting Soils
Diesel Generator Building	Controlled compacted cohesive fill.

Finding

Construction Drawing C-45, Class I fill material areas, specifies the foundation material for Class I structures to be Zone 2 material which is identified in FSAR Table 2.5-10, Gradation Ranges for Fill Material, as Random Fill and is described as "Any material free of humus, organic or other deleterious material." It was ascertained that materials other than "clay" or "controlled compacted cohesive fill" were used for support of structures.

2. Statement

Section 2.5.4.10.3.1, Plant Layout and Loads, states: "The building loads superimposed by the structures on undisturbed soil or compacted fill are given in the soil pressure plan, Figure 2.5-47."

Figure 2.5-47, Soil Pressure Diagram Category I and II Structures, shows the superimposed load density for the Diesel Generator Building to be 4.0 KSF (4000 lbs. per sq. ft.).

Finding

It was ascertained through a review of the settlement calculations and an interview of the individual who performed those calculations that 3.0 KSF was used.

3. Statement

Section 2.5.4.10.3.3, Soil Parameters, states: "The soil compressibility parameters used in the settlement calculation are presented together with soil profile in Table 2.5-16."

Table 2.5-16, Idealized Soil Profile and Parameters for Elastic Half-space Settlement and Heave Analysis, contains the following:

Layer	Idealized Soil Type	Elevation Interval (ft)	Thickness (ft)	Average $\frac{C_c \cdot r}{1+e_o}$ (1)
A	Fill (CL)	634-609	25	0.003
B	Fill (CL)	609-603	6	0.003

NOTE: Final groundwater table is taken at elevation 627.

(1) Values were estimated from the mathematical relationship between Young's Modulus and Compression and rebound indexes and averaged with those obtained from consolidation tests. Young's Modulus was estimated from empirical relationship with shear strength.

Finding

It was ascertained through a review of the statement calculations for the Diesel Generator Building and an interview with the individual who performed these calculations that an index of compressibility of 0.001 not 0.003, was used for the elevation interval 603-634.

4. Statement

Section 2.5.4.10.3.5, Analysis, states: "For settlement computations, a total of 41 settlement points are established on a grid and at selected structure locations as shown in Figure 2.5-48. . . . To account for possible time-dependent relationship, the estimated total settlements at each of the 41 points were obtained respectively by adding 25% of the calculated settlement values of loading Case A to the calculated ultimate settlement values of loading Case B. These values are presented in Figure 2.5-48."

Section 3.8.4.1.2, Diesel Generator Building, states: "The walls are supported by continuous footings with bases at elevation 628'-0". Each diesel generator rests on a 6'-6" thick reinforced concrete pedestal which is not structurally connected to the building foundation for purposes of vibration isolation."

Finding

It was ascertained through a review of the settlement calculations for the Diesel Generator Building and an interview with the individual who performed these calculations that the data in Figure 2.5-48 regarding the Diesel Generator Building are based on calculations performed on the erroneous assumption that the Diesel Generator Building was constructed on a mat foundation.

5. Statement

Section 3.8.5.5, Structural Acceptance Criteria, states: "Settlements of shallow spread footings founded on compacted fills are estimated to be on the order of 1/2 inch or less. These settlements are essentially elastic and occur as the loads are applied."

Finding

It was ascertained through an interview with the individual who wrote this section of the FSAR that the above statement was taken from the Dames and Moore report submitted as part of the PSAR. He assumed the statement was valid for inclusion in the FSAR. He said there was no other basis to support the statement.

(NOTE: In this regard the licensee has subsequently stated this statement ". . . is not applicable to the as-built configurations and conditions of the diesel generator building and has been eliminated from the FSAR in Revision 18.")

Appendix A

NOTICE OF VIOLATION

Consumers Power Company

Docket No. 50-329
Docket No. 50-330

Based on the results of an NRC investigation conducted on December 11-13, 18-20, 1978, and January 4-5, 9-11, 22-25, 1979, it appears that certain of your activities were not conducted in full compliance with NRC requirements as noted below. These items are infractions.

1. 10 CFR 50, Appendix B, Criterion III requires, in part, that measures shall be established and executed to assure that regulatory requirements and the design basis as specified in the license application for structures are correctly translated into specifications, drawings, procedures and instructions. Also, it provides that measures shall be established for the identification and control of design interfaces and for coordinates among participating design organizations.

   CPCo Topical Report CPC-1-A policy No. 3, Section 3.4 states, in part, "the assigned lead design group or organization (i.e., the NSSS supplier, A&E, supplier or CPCo) assure that designs and materials are suitable and that they comply with design criteria and regulatory requirements."

Attachment 2

CPCo is committed to ANSI N45.2 (1971), Section 4.1, which states, in part, "measures shall be established and documented to assure that the applicable specified design requirements, such as a design basis, regulatory requirements . . . are correctly translated into specifications, drawings, procedures, or instructions."

Contrary to the above, measures did not assure that design basis were included in drawings and specifications nor did they provide for the identification and control of design interfaces. As a result, several inconsistencies were identified in the license application and in other design basis documents. Specific examples are set forth below:

a. Construction Drawing C-45 (Class I fill material areas) specifies the foundation material for Class I structures to be Zone 2 material, defined as any material free of humus, organic or other deleterious material with no restrictions or gradation while FSAR Tables 2.5-9 and 2.5-14 indicate the foundation material for support of Class I structures to be controlled compacted cohesive (clay) material.

b. The FSAR is internally inconsistent in that FSAR Figure 2.5-48 indicates settlement of the Diesel Generator Building to be on the order of 3" while FSAR Section 3.8.5.5 (structural acceptance criteria) indicates settlements on shallow spread footings founded on compacted fill to be on the order of 1/2" or less. The Diesel Generator Building is supported by a continuous shallow spread footing.

c. The design settlement calculations for the diesel generator and borated water storage tanks were performed on the assumption of uniform mat foundations while these foundations were designed and constructed as spread footing foundations.

d. The settlement calculations for the Diesel Generator Building indicate a load intensity of 3000 PSF while the FSAR, Figure 2.5-47, shows a load intensity of 4000 PSF, as actually constructed.

e. The settlement calculations for the diesel generator building were based on an index of compressibility of the plant fill between elevations 603 and 634 of 0.001. These settlement values were shown in FSAR Figure 2.5-48. However, FSAR, Table 2.5-16, indicates an index of compressibility of the same plant fill to be 0.003.

f. PSAR, Amendment 3, indicated that if filling and backfilling operations are discontinued during periods of cold weather, all frozen soil would be removed or recompacted prior to the resumption of operations. Bechtel specification C-210 does not specifically include instructions for removal of frozen/thawed compacted material upon resumption of work after winter periods.

g. PSAR Amendment 3 indicates that cohesionless soil (sand) would be compacted to 85% relative density according to ASTM D-2049. However, Bechtel specification C-210, Section 13.7.2 required cohesionless soil to be compacted to not less than 80% relative density.

2. 10 CFR 50, Appendix B, Criterion V requires, in part, that activities affecting quality shall be prescribed and accomplished in accordance with documented instructions, procedures or drawings.

CPCo Topical Report CPC-1-A Policy No. 5, Section 1.0 states, in part, that, "Instructions for controlling and performing activities affecting quality of equipment or operation during design, construction and operations phase of the nuclear power plant such as procurement, manufacturing, construction, installation, inspection, testing . . . are documented in instruction, procedures, specifications . . . these documents provide qualitative and quantitive acceptance criteria for determining important activities have been satisfactorily accomplished.

CPCo is committed to ANSI N45.2 (1971), Section 6 which states, in part, "activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures or drawings."

a. Contrary to the above, instructions provided to field construction for substituting lean concrete for Zone 2 material did not address the differing foundation properties which would result in differential settlement of the Diesel Generator Building.

b. Also, contrary to the above, certain activites were not accomplished according to instruction and procedures, in that:

(1) The compaction criteria used for fill material was 20,000 ft-lbs (Bechtel modified proctor test) rather than a

compactive energy of 56,000 ft-lbs as specified in Bechtel Specification C-210, Section 13.7.

(2) Soils activites were not accomplished under the continuous supervision of a qualified soils engineer who would perform in-place density tests in the compacted fill to verify that all materials are placed and compacted in accordance with specification criteria. This is required by Bechtel Specification C-501 as well as PSAR, Ammendment 3 (Dames and Moore Report, page 16).

3. 10 CFR 50, Appendix B, Criterion X requires, in Part, that a program for inspection of activites affecting quality shall be established and executed to verify conformance with the documented instruction, procedures and drawings for accomplishing the activity.

CPCo Topical Report CPC-1-A Policy No. 10, Section 3.1, states, in part, that "work activities are accomplished according to approved procedures or instructions which include inspection hold points beyond which work does not proceed until the inspection is complete or written consent for bypassing the inspection has been received from the organization authorized to perform the inspections."

CPCo is committed to ANSI N45.2 (1971), which states, in part, "A program for inspection of activities affecting quality shall be established and executed by or for the organization performing the activity to verify conformance to the documented instructions, procedures, and drawings for accomplishing the activity."

Contrary to the above, Quality Control Instruction C-1.02 the program for inspection of compacted backfill issued on October 18, 1976, did not provide for inspection hold points to verify that soil work was satisfactorily accomplished according to documented instructions.

4. 10 CFR 50, Appendix B, Criterion XVI requires, in part, that measures shall be established to assure that conditions adverse to quality such as failures, deficiencies, defective material and nonconformances are promptly identified and corrected. In case of significant conditions adverse to quality, measures shall assure that corrective action is taken to preclude repetition.

   CPCo Topical Report CPC-1-A Policy No. 16, Section 1.0 states, in part, "corrective action is that action taken to correct and preclude recurrence of significant conditions adverse to the quality of items or operations. Corrective action includes an evaluation of the conditions that led to a nonconformance, that disposition of the nonconformance and completions of the actions necessary to prevent or reduce the possibility of recurrence."

Contrary to the above, measures did not assure that soils conditions of adverse quality were promptly corrected to preclude repetition. For example:

a. As of January 25, 1979, moisture control in fill material had not been established nor adequate direction given to implement this specification requirement. The finding that the field was not performing moisture control tests as required by specification C-210 was identified in Quality Action Request SD-40, dated July 22, 1977.

b. Corrective action regarding nonconformance reports related to plant fill was insufficient or inadequate to preclude repetition as evidenced by repeated deviations from specification requirements. For example, nonconformance reports No. CPCo QF-29, QF-52, QF-68, QF-147, QF-174, QF-172 and QF-199 contain numerous examples of repeated nonconformances in the same areas of plant fill construction.

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

MAR 22 1979

Docket No. 50-329
Docket No. 50-330

Consumers Power Company
ATTN: Mr. Stephen H. Howell
Vice President
1945 West Parnall Road
Jackson, MI 49201

Gentlemen:

This refers to the investigation conducted by Messrs. G. A. Phillip, E. G. Gallagher and G. F. Maxwell of this office on December 11-13, 18-20, 1978, and January 4-5, 9-11 and 22-25, 1979, of activities at the Midland Nuclear Plant, Units 1 and 2, authorized by NRC Construction Permits No. CPPR-81 and No. CPPR-82. The investigation related to the settlement of the diesel generator building at Midland and the adequacy of the plant area fill. The preliminary results of this investigation were discussed with Consumers Power Company and Bechtel Corporation representatives in our office on February 23 and March 5, 1979. The report on the matters discussed during those meetings were included with my letter to you dated March 15, 1979. That letter also set forth the principal matters of our concern as a result of this investigation.

Enclosed is a copy of the report of this investigation. In accordance with Section 2.790 of the NRC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations, a copy of this letter and the enclosed investigation report will be placed in the NRC's Public Document Room, except as follows. If this report contains information that you or your contractors believe to be proprietary, you must apply in writing to this office within twenty days of your receipt of this notice, to withhold such information from public disclosure. The application must include a full statement of the reasons for which the information is considered proprietary, and should be prepared so that proprietary information identified in the application is contained in an enclosure to the application.

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The results of this investigation continue to be under review by the NRC staff. Upon completion of this review you will be advised of any enforcement action to be taken by the Commission.

Should you have any questions concerning this investigation, we would be pleased to discuss them with you.

Sincerely,

James G. Keppler
Director

Enclosure: IE Investigation
Reports No. 50-329/78-20
and No. 50-330/78-20

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U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

REGION III

Report No. 050-329/78-20; 050-330/78-20

Subject: Consumers Power Company
Midland Nuclear Power Plant, Units 1 and 2
Midland, Michigan

Settlement of the Diesel Generator Building

Period of Investigation: December 11-13, 18-20, 1978 and January 4-5, 9-11, 22-25, February 23, March 5, 1979

Investigators: G. A. Phillip 3-19-79

E. J. Gallagher 3-19-79

G. F. Maxwell 3-19-79

Reviewed By: D. W. Hayes, Chief 3/19/79
Engineering Support Section 1

G. Fiorelli, Chief 3/19/79
Reactor Construction and
Engineering Support Branch

C. E. Norelius 3/19/79
Assistant to the Director

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REASON FOR INVESTIGATION

On September 7, 1978, the licensee notified Region III, by telephone, that the settlement of the Diesel Generator Building and foundations experienced constituted a matter reportable under the requirements of 10 CFR 50.55(e). Written interim reports were subsequently submitted by the licensee by letters dated September 29 and November 7, 1978. An investigation was initiated to obtain information concerning the circumstances of this occurrence to determine whether: a breakdown in the Quality Assurance program had occurred; the occurrence had been properly reported; and, whether the FSAR statements were consistent with the design and construction of the plant.

SCOPE

This investigation was performed to obtain information relating to design and construction activities affecting the Diesel Generator Building foundations and the activities involved in the identification and reporting of unusual settlement of the building. The investigation consisted of an examination of pertinent records and procedures and interviews with personnel at the Midland site, the Consumers Power Company offices in Jackson, Michigan, and the Bechtel Power Corporation offices in Ann Arbor, Michigan.

SUMMARY OF FACTS

By letter dated September 29, 1978, the licensee submitted a report as required by 10 CFR 50.55(e) concerning an unusal degree of settlement of the Diesel Generator Building (DGB). This report confirmed information provided during earlier telephone conversations on or about August 22, 1978, with the NRC Resident Inspector and on September 7, 1978, with the Region III office. This report was an interim report and was followed by periodic interim reports providing additional information concerning actions being taken to resolve the problem. Further testing and monitoring programs and an evaluation of the resulting data have been undertaken by the licensee to determine the cause of the settlement and the adequacy of the corrective action being taken. The results of these efforts will be submitted in a final report to the NRC.

Information obtained during this investigation indicates: (1) A lack of control and supervision of plant fill activities contributed to the inadequate compaction of foundation material; (2) corrective action regarding nonconformances related to plant fill was insufficient or inadequate as evidenced by the repeated deviations from specification requirements; (3) certain design bases and construction specifications related to foundation type, material properties and compaction requirements were not followed; (4) there was a lack of clear direction and support between the contractors engineering office and construction site as well as within the contractors engineering office; and, (5) the FSAR contains inconsistent, incorrect and unsupported statements with respect to foundation type, soil properties and settlement values.

DETAILS

Persons Contacted

During this investigation approximately 50 individuals were contacted. Twelve CPCo personnel which included corporate engineering and quality assurance personnel as well as site management, quality assurance and quality control personnel. Thirty-two Bechtel personnel were contacted. These largely consisted of site engineering, quality assurance, quality control, survey and labor supervisors and personnel in project engineering, quality assurance and Geotech at the Ann Arbor, Michigan office. Three individuals employed by U.S. Testing Company were also interviewed.

Introduction

On August 22, 1978, the licensee informed the NRC Resident Inspector at the Midland site that unusual settlement of the Diesel Generator Building (DGB) had been detected through the established Foundation Data Survey Program. While the licensee regarded the matter as serious it was not considered to be reportable under the provisions of 10 CFR 50.55(e) until further data was obtained.

Following the acquisition of additional data from further surveys and a core boring program which was initiated on August 25, 1978, the licensee concluded the matter was reportable and so telephonically notified Region III on September 7, 1978. The notification was followed up by a series of interim reports the first of which was submitted to Region III by letter dated September 29, 1978. Subsequent interim reports were transmitted by letters dated November 7, 1978 and January 5, 1979.

An inspection was conducted by Region III during the period October 24-27, 1978, to review the data then available; to observe the current condition of the structure; and, to review current activities. Information regarding the inspection is contained in NRC Inspection Report No. 50-329/78-12; 50-330/78-12.

On December 3-4, 1978, a meeting with NRR and Region III representatives was held at the Midland site to review the status of the problem, to discuss open items identified in the aforementioned inspection report and possible corrective actions.

Identification and Reporting of Diesel Generator Building Settlement

Surveys to establish a baseline elevation for the DGB were completed by Bechtel on May 9, 1978. As a result of these surveys, the Chief of Survey Parties noted what he considered to be unusual settlement. He indicated that from his experience he would have expected about 1/8" settlement. The July 22 data showed a differential settlement between various locations ranging from 1/4" to a maximum of 1 5/8". He promptly instructed his survey personnel to resurvey to determine whether the data was accurate. The resurvey confirmed the accuracy of the survey data. The Chief of Survey Parties reported the survey results to the Bechtel lead civil field engineer.

The lead civil field engineer said that in July 1978 the settlement of a pedestal in the DGB was noted from surveys and about a week later a 1" discrepancy was noted when scribes on the DGB were being moved up. He said that at that time he was uncertain as to whether actual settlement had occurred, the survey was in error or the apparent discrepancy was a construction error. He instructed the Chief of Survey Parties to check his survey results and to perform surveys more frequently than the 60-day intervals required by the survey program as a means of determining whether actual settlement had occurred and whether settlement continued.

The Field Project Engineer was also informed of the apparent settlement and concurred with the lead civil field engineer's actions. He said he had toured the building at that time and he saw no visible indications of stress which could be expected when unusual settlement occurs.

The lead civil field engineer said the DGB was monitored for about a month. He compared the amount of settlement being experienced with the settlement values reflected in Figure 2.5-48 of the FSAR and did not consider it reportable until those values were exceeded. When the settlement did exceed those values as indicated by survey data obtained on about August 18, 1978, he prepared a nonconformance report with the assistance of QC personnel.

The July 22 survey data was transmitted by the site to the Bechtel Project Engineering office in Ann Arbor by a routine transmittal memo dated July 26, 1978. The data was received at Ann Arbor, processed through document control on August 9, 1978, and was routinely routed to the Civil Engineering Group Supervisor. He stated he did not review the data but placed a route slip on it indicating those members of his group who should review it.

The engineer in the Civil Group, who had established the survey program and who was responsible for assuring it was being carried out, stated he reviewed the data and did not regard it as unusual. For that reason he did not bring the matter to anyone's attention but merely routed it to other personnel in the civil group. The engineer responsible for the DGB said he did not see the data before the settlement problem was identified by the field in a nonconformance report.

With the issuance of the noncomformance report, No. 1482, on August 18, 1978, CPCo was also informed of this condition. On or about August 21, 1978, the NRC Resident Inspector was orally informed of the matter by CPCo. It was indicated at that time that although CPCo regarded the matter as serious, they did not consider it to be reportable under 10 CFR 50.55(e).

Construction on the DGB was placed on hold on August 23, 1978 and a test boring program was initiated on August 25, 1978. After preliminary evaluation of soil boring data, a Management Corrective Action Report (MCAR), No. 24, was issued by Bechtel on September 7, 1978. The MCAR stated that based on a preliminary evaluation of the data, the matter was reportable under 10 CFR 50.55(e), 1, iii and Region III was so notified by telephone on that date.

The telephone notification was subsequently followed up by a letter dated September 29, 1978, from CPCo enclosing a copy of MCAR 24 and Interim Report 1 prepared by Bechtel.

On the basis of the above, it is concluded that in this instance the licensee complied with the reporting requirements of 10 CFR 50.55(e).

Review of PSAR/FSAR Commitments on Compacted Fill Material

In a previous NRC Inspection Report, No. 329/78-12; 330/78-12, an apparent inconsistency was identified between FSAR Table 2.5-14 (Summary of Foundations Supporting Seismic Category I and II Structures), Table 2.5-9 (Minimum Compaction Criteria) and the site construction drawing C-45 (Class I Fill Material Areas) regarding the type of foundation material to be used for plant area fill. Table 2.5-14 identifies the supporting soil materials for the Auxiliary Building D, E, F, and G, Radwaste Building, Diesel Generator Building and Borated Water Storage Tanks to be "controlled compacted cohesive fill." Table 2.5-9 also indicates the soil type for "support of structures" to be clay. Contrary to these FSAR commitments, drawing C-45 indicates Zone 2 (random fill) material, defined in Table 2.5-10 as "any material free of humus, organic or other deleterious material," is to be used with "no restrictions on gradation." Boring samples substantiated that Zone 2 (random fill) material was in fact used.

During this investigation a review of documentation showed that the commitment to use cohesive soils was also made in response to PSAR question 5.1.11 and submitted in PSAR Amendment 6, dated December 12, 1969, which states, "Soils above Elevation 605 will be cohesive soils in an engineered backfill." This response also indicated that certain class 1 components such as, emergency diesel generators, borated water storage tanks and associated piping and electrical conduit would be founded on this material.

CPCo quality assurance issued a nonconformance report QF-66, dated October 10, 1975, which stated that contrary to the PSAR statement (quoted above) Specification C-211 being implemented at the site required cohesionless (sand) material to be used within 3 feet of the walls of the plant area structures. The corrective action taken was for Bechtel to issue SAR Change Notice No. 0097 which stated, "The FSAR will clarify the use of cohesive and cohesionless soils for support of Class 1 structures." As noted above, the FSAR tables 2.5-14 and 2.5-9 once again stated that cohesive (clay) material was used for support of structures while the construction drawing continued to permit the use of random fill material.

This investigation included efforts to ascertain whether procedures were established and implemented for the preparation, control and review of the technical criteria set forth in the safety analysis report (SAR). This included the role of both Bechtel and CPCo in the review of the SAR. Bechtel had established control of the SAR in procedure MED 4.22 (Preparation and Control of Safety Analysis Report Revision 1, dated June 20, 1974). The SAR preparation and review flow chart requires the Engineering Group Supervisor (EGS) to review the originator's draft for technical accuracy and compliance with the standard format guide. Records indicated that Section 2.5.4 was originated by the Bechtel Geotech group on January 3, 1977. It was reviewed and approved for technical accuracy by an engineer in the civil project group on April 29, 1977. No technical inaccuracies were noted in the documentation. The Civil EGS advised that he did not personally review Section 2.5.4.

The designated engineer stated that in his review of the section he was primarily concerned with the Auxiliary Building not the Diesel Generator Building. He said the review of FSAR material was performed by members of a group set up for this purpose. Not all of the content was checked since they relied to some extent on the originator. The author of Section 2.5.4 said he was not aware that changes regarding fill material had occurred since the preparation of the PSAR. It was ascertained that Field Engineering did not review the FSAR prior to its submittal.

A partial review of the FSAR revealed that although Figure 2.5-48 indicates anticipated settlement of the Diesel Generator Building during the life of the plant to be on the order of 3 inches. Section 3.8.5.5 (Structural Acceptance Criteria) contains the following statement: "Settlements on shallow spread footings founded on compacted fills are estimated to be on the order of 1/2" or less."

Section 3.8 was prepared by Project Engineering. Geotech, who prepared Section 2.5, said they were unaware of the presence of the statement regarding 1/2" settlement in Section 3.8. The originator of Section 3.8

said that the above statement was taken from the Dames and Moore report submitted as part of the PSAR. Since the PSAR did not show any change in this regard, he assumed the statement was valid for inclusion in the FSAR. He said there was no other basis to support this statement.

CPCo also has an established procedure for the review and final approval of the SAR by procedure MPPM-13 dated June 23, 1976. Section 5.6 states that "CPCo shall approve all final draft sections of the FSAR prior to final printing." Discussion with the responsible licensee representatives for review of Section 2.5.4 indicated that a limited amount of cross-reference verification of technical content of the FSAR is performed by CPCo.

The CPCo Project Engineer in Jackson stated that the review of drawings and specifications was an owner's preference kind of thing. No attempt was made to review all drawings and specifications since they did not have the manpower or expertise for that type of review. The staff engineers of the various disciplines were asked to indicate the drawings and specifications they wanted to review.

Regarding the review of the FSAR, he said that he had prepared a memorandum to the staff engineers stating the procedure that would be followed in performing the review. An examination of this memo, dated July 28, 1976, showed that prime reviewers would perform a technical review, resolve comments made by other reviewers and perform the CPCo licensing review to assure compliance with required FSAR format and content.

As portions of the FSAR were received from Bechtel, CPCo sent comments to Bechtel. Following this review, meetings between Bechtel and CPCo were held to clearup any unresolved matters before each section was released for printing. A review of the files at CPCo relating to Section 2.5 and 3.8 showed that no comments were made concerning the above inconsistent and incorrect content. The apparent inconsistent and incorrect statements were not identified during the review of the FSAR prior to submittal and the review procedures did not provide any mechanism to identify apparent inconsistencies between sections of the FSAR.

Based on the above, measures did not assure that design basis included in design drawings and specifications were translated into the license application which resulted as an inconsistency between the design drawings and the FSAR. This is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion III as identified in Appendix A. (329/78-20-01; 330/78-20-01)

Effect of Ground Water in Plant Area Fill

Final plant grade will be established at elevation 634. The normal ground water was assumed to be at ground surface prior to construction, approximately elevation 603. The surface of the water in the cooling water pond will be at a maximum of approximately elevation 627.

The Dames and Moore report on Foundation Investigation submitted with PSAR Amendment No. 1, dated February 3, 1969, stated that, "The effect of raising the water level to elevation 625 in the reservoirs will cause the normal ground water level in the general plant area to eventually rise to approximately elevation 625. However, a drainage system will be provided to maintain the ground water level in the plant fill at elevation 603."

A supplement to Dames and Moore report was submitted in PSAR Amendment No. 3, dated August 13, 1969, which changed the above planning of a drainage system to control the ground water. The supplement states, "The underdrainage system considered in the initial report has been eliminated; consequently it is assumed that the ground water level in the plant area will rise concurrently to approximately elevation 625."

A Bechtel soils consultant theorized in a December 4, 1978, site meeting that if soils beneath the diesel generator building had been compacted too dry of optimum, changes in moisture after placement could cause the soils to settle significantly. Therefore, the total effect of the ground water being permitted to saturate the plant fill material is undetermined at this time. An evaluation of this condition is under review by the licensee. This item is considered unresolved. (329/78-20-02; 330/78-20-02)

Review of Compaction Requirements for Plant Area Fill

During the investigation a review of the history of the compaction requirements was performed in order to determine whether the compaction of the plant fill was implemented in compliance with the commitments in the PSAR and in site construction specifications.

PSAR, Amendment 1, dated February 3, 1969, presented the Dames and Moore report "Foundation Investigation and Preliminary Exploration for Borrow Materials." The recommended minimum compaction criteria for support of critical structures is stated on page 15. It indicates 95% of maximum density for "cohesive soils" as determined by ASTM D-1557-66T and 100% for "granular soils."

PSAR, Amendment 3, dated August 13, 1969, included a supplement to the Dames and Moore report entitled, "Foundation Investigation and Preliminary

Exploration for Borrow Materials." Page 16 of this report lists the recommended minimum compaction criteria for sand soils and cohesive soils. For the fill material for supporting structures the minimum compaction is 85% relative density for sand and 100% of maximum density for clay as determined by ASTM D-698 modified to require 20,000 ft-lbs. of compactive energy (equivalent to 95% of ASTM D-1557, Method D which provides 56,000 ft-lbs of compactive energy). Subsequent to the filing of Amendment 3, no amendments were made to the PSAR to indicate that the recommendations contained in the Dames and Moore report would not be followed or would be further modified.

Bechtel Specification C-210, Section 13.0 (Plant Area Backfill and Berm Backfill) indicates the compaction requirements for cohesive soil (13.7.1) to be "not less than 95% of maximum density as determined by ASTM D-1557, Method D" and for cohesionless soils (sand) (13.7.2) to be compacted "to not less than 80% relative density as determined by ASTM D-2049."

A comparison of the PSAR commitments to the specification requirements shows that the compaction commitments for cohesive soil (clay) were translated into the construction specification i.e. 95% of maximum density using ASTM D-1557, Method D (compactive energy of 56,000 ft-lbs). However, the compaction commitment in the PSAR for cohesionless soil (sand) was not the same as in the construction specification, i.e. 85% relative density versus the 80% relative density, translated in the construction specification.

The compaction requirements actually implemented were as follows:

a. Cohesive soil (clay): 95% of maximum density as determined by the "Bechtel Modified Test," a compactive energy of 20,000 ft-lbs was used instead of 56,000 ft-lbs of compactive energy as committed to in the PSAR and required by the construction specification C-210, Section 13.7.1.

b. Cohesionless soil (sand): 80% relative density as determined by ASTM D-2049 was used instead of 85% as committed to in the PSAR. However, this is consistent with construction specification C-210, Section 13.7.2.

The compaction requirements implemented during construction of the plant area fill between elevations 603 and 634 were, therefore, less than the commitments made in the PSAR for cohesive and cohesionless fill material. In additon, the cohesive (clay) material was also compacted to less than that required by the Bechtel specification. (Specification C-210, Section 13.7).

A review of Specification C-210 (specification controlling earthwork contract) beginning with Revision 2, dated July 27, 1973, which was issued for subcontract showed that it contained conflicting sections relating to the plant area backfill compaction requirements.

Section 13.7, Compaction Requirements, from revision 2 to the latest revision of specification C-210 consistently specified that the backfill in the plant area shall be compacted to 95% of maximum density as determined by ASTM 1557, Method D.

Section 13.4, Testing Plant Area Backfill, of specification C-210 contained the statement that tests would be performed as set forth in Section 12.4.5, Laboratory Maximum Density and Optimum Moisture Content, which in turn specified a lesser standard, 20,000 foot-pounds per cubic foot, which is commonly referred to as the Bechtel Modified Proctor Density Test (BMP). This is contrary to the requirements of Section 13.7. Section 12 of the specification applies to Dike and Railroad Embankment Construction.

It was also noted that this control inconsistency was reflected in the applicable Midland QA Inspection Criteria, SC-1.10, Item 2.3(d) Compaction which states "Backfill material for the specified zones has been compacted to the required density as determined by Bechtel Modified Proctor Method" and yet references C-210, Section 13.7 as the inspection criteria.

The inconsistency in control is further indicated in Specification C-208 which defined the testing contract requirements of subgrade materials. Section 9.1 (Testing) required compaction tests to be in accordance with ASTM D-1557 and only when directed was the BMP compaction criteria to be used. It was determined contrary to this U.S. Testing was only orally advised that the BMP was the standard to be applied to the tests they performed of plant area fill.

Through interviews and an examination of internal documents it was ascertained that because of these inconsistencies, the question of the applicable compaction standard for cohesive materials in the plant area was a recurring one.

The following is a summary of the documentation regarding the confusion of the compaction requirements for plant area fill:

1. Letter 7220-C-210-77 dated June 10, 1974, (subcontracts to Field Engineering) states "there has been some confusion as to the interpretaion of the following item: 13.7 Compaction Requirement: all backfill in the plant area and berm shall be compacted to not less than 95% of maximum density as determined by modified Proctor method

(ASTM 1557, Method D), with the exception that Zones 4, 4A, 5, 5A, and 6 Materials need no special compactive effort other than as described in Section 12.8.1 (emphasis included in specification). Quality Control questioned whether the exception stated above applies only to Zones 4, 4A, 5, 5A, and 6 or did construction have to abide by Section 12.8.1 for Zones 1 and 2. Section 12.8.1 clearly requires Zone 2 material to be placed with a 50 ton rubber tired roller with a minimum of four roller passes per lift. QC's interpretation was that the field needed "to obtain 95% of maximum density by the modified Proctor method (ASTM 1557, Method D), with no restrictions as to the method used to obtain these results."

2. Letter 7220-C-210-23, dated June 24, 1974, (field Engineering to construction) responded to Item 1 above. It states, "We have reviewed your June 10, 1974, IOM concerning compactive effort required on Zones 1 and 2 in the plant and berm backfill areas. We agree with your interpretation; i.e. a 95% of maximum density is the acceptance criteria, and the number of roller passes listed in Paragraph 12.8.1 does not apply to plant and berm backfill. We feel the specification is now clear and no FCR is required."

3. Letter BCBE-370, dated July 25, 1974, (field construction to project engineering) lists outstanding items requiring Project Engineering's action. This includes the question, "Is the 95% compaction required in the plant area to be 95% of Bechtel Modified or 95% of ASTM-1557, Method D."

4. Letter BEBC-456, dated August 1, 1974, (Project Engineering to Field Construction) states that Geotech is addressing the question posed in BCBE-370 (Item 3 above).

5. Memorandum from Geotech to Bechtel Field, dated September 18, 1974, responds to the question raised in BCBE-370 (Item 3 above). It states, "It is our opinion that all the compaction requirements that are needed for Zone II material in the plant fill is as stated in 13.7 with the exception that Zones 4, 4A, 5, 5A, and 6 materials need no special compactive effort other than described in Section 12.8.1." Geotech reiterates the specification requirement of 95% of ASTM 1557, Method D. This was confirmed with the Geotech personnel.

6. Telecon dated September 9, 1974, from R. Grote (Field Engineering) to Rixford (Project Engineering) states, "I made an analogy (an exaggeration admittedly but applicable) that if the compaction could be acheived with a herd of mules walking over the fill it would be acceptable as long as it got the required 95% compaction. Rixford agreed."

7. Telecon Consumers to Bechtel Engineering dated September 19, 1974, expressed Consumers Power Company concern about what they felt was a lack of control of compaction in the plant area fill. CPCo addressed the added responsibility this lack of control places on the inspector. Bechtel told CPCo that it "was the inspector's job to make sure we got proper placement, compaction, etc."

8. Telecon dated September 18, 1974, by Bechtel Field Engineering to Bechtel Project Engineering discussed compaction requirements for specification C-210. It stated, "Compaction acceptance is based on meeting an 'end product' requirement, i.e. 95% of maximum density only. No method of achieving this 'end product' is specified or is required. Rixford fully agrees with the above."

9. Telecon dated October 7, 1977, from Bechtel Field Engineering to Bechtel Project Engineering states, "QA has asked for clarification of subject specification (C-210), Section 13 for plant area and berm backfill. Section 13.4 for testing of materials refers to Section 12.4 and therefore, requires the Bechtel Modified Proctor Density Test for Compaction of cohesive backfill. Section 13.7 for compaction of the same materials refers to testing in accordance with ASTM D-1557, Method D Proctor, without specific reference to Bechtel Modification." Bechtel Engineering responded to this question as follows: "This apparent conflict is clarified by Specification C-208, Section 9.1.a, direction to the testing subcontractor, which calls for ASTM D 1557 test for these materials and also allows Bechtel Field (the contractor) to call for the Bechtel Modification of that test. Either method is therefore acceptable to project engineering."

10. Telecon dated October 7, 1977, from Bechtel QA to Bechtel Project Engineering questions, "Is the intent of Paragraph 13.7 of Specification C-210 that the test be run to the 'Bechtel' modified proctor test as is indicated in the FSAR Paragraph 2.5.4.5.3 and in response to NCR 88." Engineering's response was "yes."

Various interviews were held with Bechtel construction field engineers, U. S. Testing personnel and Bechtel Ann Arbor Geotech and Project Engineering personnel to ascertain their understanding of the compaction requirements. Four predominant versions of the understood compaction requirements were stated by various individuals within the Bechtel organization. They are as follows:

a. Specification C-210 required the contractor to perform compaction to the ASTM 1557, Method D, however, the testing requirements would be performed to the less stringent "Bechtel Modified Test Method."

b. The required compaction and testing was always understood to be based on the "Bechtel Modified Test Method."

c. The required compaction and testing was always understood to be based on the standard ASTM 1557, Method D requirements.

d. A tacit understanding had been established to use the Bechtel Modified Method, but to exceed this requirement by enough to also satisfy the requirement of ASTM 1557, Method D.

It is apparent from the above four distinctly different understandings of the compaction requirements, that the apparent confusion was not resolved. A member of the Bechtel QA staff in Ann Arbor who had previously been a QA Engineer at the Midland site said that QA audits of QC inspection criteria did not identify the above inconsistencies.

This failure to accomplish activities affecting the quality of the plant area fill in accordance with procedures is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion V as identified in Appendix A. (329/78-20-03; 330/78-20-03)

Review of Moisture Control Requirements for Plant Area Fill

Specification C-210, Section 13.6 (Moisture Control) requires moisture control of the plant area fill material to conform to Section 12.6. The moisture control requirement in Section 12.6.1 states, in part, "Zone 1, 1A and 2 material which require moisture control, shall be moisture conditioned in the borrow areas," and that "water content during compaction shall not be more than two percentage points below optimum moisture content and shall not be more than two percentage points above optimum moisture content."

Contrary to the above, Bechtel QA identified in SD-40 dated July 22, 1977, that "the field does not take moisture control tests prior to and during placement of the backfill, but rather rely on the moisture results taken from the in-place soil density tests."

The following is a summary of the documentation that followed the identification of the above deviation from specification C-210.

1. Letter BCBE-1533R (dated August 15, 1977) field to project engineering states, "it was found that densities meeting specification requirements could be attained, irrespective of the use of moisture tests," and that "moisture tests were not used to control backfill moisture." The field requested "that project engineering agree to acceptance of backfill materials installed in the past, along with the records thereof, irrespective of the use of the moisture tests."

2. Letter BEBC-1859 (dated September 30, 1977) responsed to the fields request in BCBE-1533R. Engineering states, "It should be noted that it is ideal to control the moisture of backfill material at the borrow areas by conditioning" and that "the procedure used to take moisture content tests after compaction would not have direct impact on the quality of work." Engineering then agreed with the field request that "backfill placed prior to modification of testing methods to be accepted as is."

3. Telecon October 10, 1977, (Bechtel QA Site to Bechtel Engineering, Ann Arbor) indicated that, "there are no moisture requirements at the time of density testing, only density requirement. The moisture requirement is prior to compaction."

4. Telecon October 13, 1977, (Bechtel Engineering to Bechtel QA Site) changed what was indicated in the telecon on October 10, 1977, (Item 3 above). Engineering then stated, "The moisture requirement ($\pm$ 2% of optimum) is mandatory and must be implemented at the time of placement and testing." This is contrary to what was stated on October 10, 1977.

5. Letter BCBE-1669R (dated November 18, 1977) once again is a field request to Bechtel engineering requesting, "written clarification of the 2% tolerance on backfill moisture content during compaction."

6. Letter BEBC-1998 (dated December 15, 1977) provides engineering's response to BCBE-1669R requesting clarification of the moisture requirement. Engineering stated, "The moisture content of the soil should be within 2% of optimum <u>during</u> placement and compaction. However, this property of the soil is not necessarily a measure of its adequacy <u>after</u> compaction."

7. Letter 0-1631 (dated December 21, 1977) closes QA Action Request SD-40 (dated July 22, 1977) which first identified the moisture control deficiency.

8. Telecon (dated April 7, 1978) from Field Engineering and Quality Control to Project Engineering once again requests them "to clarify BEBC-1998" (December 15, 1977), Item 6 above. Two situations were presented to engineering as follows: (a) The moisture sample taken from the borrow area at the start of the shift is acceptable, however, the moisture test taken in conjunction with the density test fails while compaction was attained; and (b) The moisture sample taken from the borrow area at the start of the shift fails and the material is conditioned to meet moisture content required,

however, the moisture test later fails at the time the passing compaction test is taken. Engineering responded, "the above two situations are acceptable as is." This response is contrary to the direction previously given in telecon dated October 13, 1977 (see Item 4 above).

9. Letter GLR-249 (April 16, 1978) is a Bechtel Site QA request to Project Engineering to resolve the moisture content situation and "to provide clear direction for the control of moisture content." QA recommends "one possible solution would be to delete the requirement to control the moisture content and rely on the compaction requirement only for completion of soils work."

10. Letter BEBC-2286 (June 1, 1978) was Project Engineering's response to GLR-249 (Item 9 above). It states, "moisture content is not necessarily a measure of a soil's adequacy to act as a foundation or backfill material," and that "soil with the specified density following compaction would not be rejected on the basis that its moisture content was not controlled in the borrow area."

Based on the reviews of documentation, moisture control had not been implemented as the specification required. In addition, the matter had not been resolved for the period of time from the issuance of QA Action Request SD-40 on July 22, 1977, until June, 1978, during which time soils safety-related work continued.

According to the licensee, although moisture control was not strictly followed in accordance with specification requirements, final density tests were used as a basis for acceptance of soil placement.

As pointed out to the licensee, moisture control is a required control point to assure attainment of percent compaction specified in specification C-210.

This failure to assure that conditions adverse to quality are promptly identified and corrected to preclude repetition is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion XVI as identified in Appendix A. (329/78-20-04; 330/78-20-04)

Review of Subgrade Preparation for Plant Area Fill

The Dames and Moore report on foundation investigation submitted with PSAR Amendment 3, dated August 13, 1969, states, "the clay soils are susceptible to loss of strength due to frost action, disturbance and/or the presence of water. If the construction schedule requires that foundation excavation be left open during the winter, it is recommended that excavation operations be performed such that at least

3 1/2 feet of natural soil or similar cover remain in place over the final subgrade or overlying the mud mat. This layer of protective material is necessary to prevent the softening and disturbance of subgrade soils due to frost action." The licensee indicated that instructions for winter protection of foundation excavations were transmitted by sketch C-271.

The Dames and Moore report also stated, "If filling and backfilling operations are discontinued during periods of cold weather, it is recommended that all frozen soils be removed or recompacted prior to the resumption of operations."

After review of the applicable sections of specification C-210 (i.e. Sections 12.5.1, 12.10, 10.1 and 11) the inspector has determined that the Bechtel specification did not provide specific instructions for removal or recompaction of frozen/thawed soils upon resumption of work after the winter period to preclude the effects of frost action on the compacted subgrade materials.

This failure to assure that regulatory commitments as specified in the license application are translated into specification, drawings or instructions is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion III. (329/78-20-05; 330/78-20-05)

Review of Nonconformance Reports Identified for Plant Area Fill

The following examples of nonconformance and audit reports regarding the plant area fill were reviewed relative to the cause of the nonconformance and the engineering evaluation and corrective action:

	No.	Nonconforming Condition	Engineering Evaluation
(1)	CPCo QF-29 (10/14/74)	Failure to perform inspection and testing of structural backfill (sand) delivered to jobsite 29 of 30 day in Aug. and Sept. 74. Bechtel QC not informed of deliveries.	"Use as is" based on samples taken from stock pile.
(2)	CPCo QF-52 (8/7/75)	Moisture control out of tolerance of specification C-210, Section 13.6.	Accepted in place material with low moisture.
(3)	CPCo QF-68 (10/17/75)	Compaction test had been calculated using incorrect maximum lab density. Test recorded as passing was actually a failure.	Failing tests were cleared by subsequent passing tests.

(4)	Bechtel NCR 421 (5/5/76)	Material placed did not meet moisture requirements.	Engineering stated that this ramp area is temporary and would be removed. This was removed based on note added to NCR 421 on 3/18/77.

Note: In the vicinity of this ramp a Geotech engineer determined the material to be "soft" and directed a test pit to be dug for investigation in September 1978 after the D. G. Bldg. settlement was identified.

(5)	CPCo QF-120 (9/21/76)	Lift thickness exceeded maximum of 4" in areas not accessible to roller equipment. Insufficient monitoring of placing crews. Laborer foreman not familiar with requirements.	Material was removed and recompacted.
(6)	CPCo QF-130 (10/18/76)	Inspection plan C-210-4, Rev. 0, permits 12" lift thickness for areas inaccessible to rollers caused by "misinterpretation of specification requirements. Spec. permitted 4" lift thickness.	Corrected inspection plan requirements.
(7)	CPCo QF-147 (2/2/77)	Failure to perform inspection and testing of structural backfill (sand) on 12/1/76, 12/14/76 and 1/11/77 (same as QF-29 dated 10/14/74) material lacked gradation test requirements.	Engineering accepted the material in place "use as is."
(8)	CPCo QF-172 (7/8/77)	Moisture control out-of-tolerance and compaction criteria not met.	Engineering accepted materials.
(9)	CPCo QF-174 (7/15/77)	Gradation requirements for Zone 1 materials not met.	Engineering accepted materials.

(10)	CPCo QF-199 (11/4/77)	Moisture content not met; compaction requirements for cohesive and cohesionless soil not met. Materials had been accepted using incorrect testing data.	Issued Bechtel NCR's No. 1004 and 1005; No. 1004 still open; No. 1005 "accepted as is."
(11)	CPCo QF-203 (11/22/77)	Gradation requirement not met yet materials accepted.	Engineering "accepted as is."
(12)	CPCo Audit F-77-21 (5/77 & 6/77)	Moisture content requirements not met; test frequency not met.	Bechtel QC to inform foreman <u>directing</u> soils work of requirements.
(13)	CPCo Audit F-77-32 (10/3/77)	Compaction requirement for both cohesive and cohesionless materials not met; moisture requirements not met; tests had been accepted yet failed requirements.	Project Engineering to justify the materials these failing tests represent. NCR QF-195 still open.
(14)	Bechtel NCR 686 (2/1/77)	Same deficiency as NCR 698.	Accepted, "use as is."
(15)	Bechtel NCR 698 (2/9/77)	Structural backfill (sand) was delivered without acceptance tests on Oct. 26, 29, Nov. 12, 1976 and Jan. 11, 12, 1977.	Engineering accepted "use as is."
(16)	Bechtel NCR 1005 (10/26/77)	Moisture content requirements not met.	"Accepted as is" based on density test only.

Based on a review of the above nonconformance and audit reports corrective action regarding nonconformances related to plant fill was insufficient or inadequate as evidenced by the repeated deviations from specification requirements.

This failure to assure that the cause of conditions adverse to quality are identified and that adequate corrective action be taken to preclude repetition is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion XVI as identified in Appendix A. (329/78-20-06; 330/78-20-06)

Review of Calculations of Settlement for Plant Area

A review of the settlement calculations for the structures in the plant area was performed during a visit to the Bechtel, Ann Arbor Engineering office. Specific attention was given to structures founded on plant area "compacted fill." The following specific findings were made:

1. FSAR, Section 3.8.4.1.2 (Diesel Generator Building) indicates the foundation of the DGB to be continuous footings with independent pedestals for each of the Diesel Generators. Contrary to the structural arrangement described in the FSAR, the settlement calculations for the DGB were performed on the premise that the building and equipment loads would be uniformly distributed to the foundation material by a 154' x 70' foundation mat. The settlement calculations were performed between August 1976 and October 1976 by Bechtel Geotech Division.

   Discussion with the Geotech Engineer who performed the settlement calculations indicated that he had not been informed of the design change of the foundation until late August 1978 when the excessive settlements of the DGB and pedestal became apparent.

2. FSAR Figure 2.5-47 indicates the load intensity for the DGB to be 4 KSF (4000 lbs. per sq. ft.); however, the settlement calculations reviewed indicate a uniform load of 3 KSF (3000 PSF). This appears to be a conflict between the FSAR and settlement calculations.

3. The settlement calculations for the borated water storage tanks were performed assuming a 54' diameter circular foundation mat with an assumed uniform load of 2500 PSF. Instead, the tanks are supported on a continuous circular spread footing and compacted structural backfill as detailed on the construction drawings. The Geotech engineer was also not made aware of the revised foundation detail.

FSAR Figure 2.5-48 (Estimated Ultimate Settlements) indicates the anticipated ultimate settlement for Unit 1 and 2 plant structures. The values indicated for the Diesel Generator Building and Borated Water Storage Tanks are the values developed assuming uniformly distributed loads founded on mat foundations as was indicated in the settlement calculations reviewed even though the actual design and construction utilizes spread footings. The FSAR does not indicate the foundation type assumed in the settlement calculations and therefore the values in the FSAR figure appear to represent the settlements estimated for the as-constructed spread footing foundation.

4. During a review of the settlement calculations, it was observed that the compression index (C_c) for the compacted fill between elevations 603 and 634 in the plant area was assumed to be 0.001 (estimate based on experience). FSAR Section 2.5.4.10.3.3 (Soil Parameters) indicates the soil compressibility parameters used in the settlement calculation are presented in Table 2.5-16. This table indicates that for the plant fill elevations 603 to 634, the compression index used was 0.003. Contrary to the FSAR value, 0.001 was used in the settlement calculations reviewed. This value is directly used to determine the estimated ultimate settlement of structure supported by plant fill material.

Based on the above examples, measures did not assure that specific design bases, included in design documents, were translated into the license application resulting in inconsistencies between design documents and the FSAR. This is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion III as identified in Appendix A. (329/78-20-07; 330/78-20-07)

Discussions with CPCo personnel responsible for the technical review and format indicated that a comparison between the design documents and FSAR had not been performed. Likewise, Bechtel personnel indicated that a detailed comparison for the technical accuracy of design documents to the FSAR statements had not been performed; instead reliance was placed on the originator's input.

According to the Civil Engineering Group Supervisor, a mat foundation was considered for the DGB only during the conceptual stage. All drawings generated show a spread footing foundation. The supervisor stated that the Geotech engineer apparently based his calculations on the conceptual stage information. He went on to say that an individual in Geotech was responsible for checking the calculations and the first thing he is supposed to do is determine that the basis for the calculations is correct. He said that apparently this was not done.

Review of Settlement of Administration Building Footings

During the investigation, it was disclosed that the Administration Building at the Midland Site had experienced excessive settlement of the foundation footings. Although the Administration Building is a non-safety-related structure, it is supported by plant area fill material compacted and tested to the same requirements as material supporting safety-related structures and therefore pertinent to the current settlements being experienced by the Diesel Generator Building. The following are the events relating to the settlement of the Administration Building footings.

During the end of August, 1977, a Bechtel field engineer observed a gap between a slab and the grade beam of the Administration Building. On August 23, 1977, a survey was taken of the settlement. The results indicated that the footings supporting the grade beam had experienced settlement ranging from 1.32" (north side) to 3.48" (south side). This settlement took place between July 1977, and the end of August 1977. The footings were supported by "random fill" (Zone 2 material).

The concrete footings on the order of 7' 6" by 7' 6" by 1' 9" deep were removed along with the grade beam. The random fill material was also removed. According to U. S. Testing personnel, it was observed during excavation of the fill material that there were voids of 1/4" to 2" or 3" within the fill and these were associated with large lumps of unbroken clay measuring up to 3 feet in diameter.

The Civil Field Engineer assigned responsibility for plant fill work said that, although he was no soils expert, it was his opinion that the problem was caused by the presence of pockets of water due to drainage from the steam tunnel. The Lead Civil Field Engineer also indicated a drainage problem caused the Administration Building footings settlement. They were, however, unclear as to how the water pockets were formed, i.e. whether they were formed as the fill was being placed or how they could develop after the fill was compacted.

The excavated fill was replaced with concrete and the design of individual footings was changed to a continuous spread footing design for support of the building.

As a result of the settlement of the Administration Building footings a total of seven borings were taken of which five were in the Administration Building area, one in the Evaporator Building area and one south of the Diesel Generator Building. In the Administration Building area the foundation material was found to be "soft" with "spongy characteristics." The two other borings did not indicate unusual material properties in that the blow counts were reasonable. These borings were taken in September 1977.

The licensee indicated that reports from Bechtel concluded that the primary cause of the settlement in the Administration Building area was insufficient compaction of the fill. Bechtel also concluded that "deviations from specific compaction requirements was the result of repeated erroneous selection of compaction standard," i.e. the incorrect optimum moisture-density curve was used for the soil material being compacted. In effect, the moisture-density curve was erroneously assumed to represent the soil being used and therefore soil was compacted to less than maximum density.

Bechtel personnel, including the Civil Group Supervisor, Project Engineering, the Field Project Engineer. the Lead Civil Field Engineer, and the Chief Civil QC Inspector, all stated that the Administration Building footing settlement was regarded as a localized problem. The question as to the adequacy of the entire plant area fill did not arise even though the following similarities existed between the Administration Building area and rest of plant fill; (a) same soil specification applied. (2) same material (random fill) was used and (3) same control procedures and selection of laboratory compaction standards was used. The Diesel Generator Building area required even more fill than other safety-related structures since its base is located at a higher elevation than the others.

Review of Interface Between Diesel Generator Building Foundation and Electrical Duct Banks

A review of the design interface between the electrical and civil sections of the Bechtel organization was performed to determine whether the design accounted for the interaction of the electrical duct banks and spread footings on the differential settlement of the northside of the DGB. It was determined that the electrical and civil groups made accommodations in the design to permit settlement of the spread footings around the electrical duct banks by including a styrofoam "bond breaker" around the duct banks. Both electrical and civil groups reviewed and approved electrical Drawing E-502 which includes the appropriate detail.

However, Bechtel Drawing C-45 which identifies Class I fill material areas permits the use of Zone 2 (random fill) which includes "any material free of humus, organic or other deleterious material." This, in effect, does not preclude the use of concrete around the electrical duct banks beneath the spread footings. Due to the difficulty in compacting, Bechtel elected to replace the soil material with concrete. Letter from project engineering to field construction, dated December 27, 1974, states, "lean concrete backfill is considered acceptable for replacement of Zone 1 and 2." The instruction is considered inadequate, in that, the concrete placed around the duct banks restricted the settlement on the north side of the DGB where electrical duct banks enter through the footing. This contributed to the excessive differential settlement in the North-South direction across the building.

This failure to prescribe adequate instructions for activities affecting the quality of safety-related structures is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion V as identified in Appendix A. (329/78-20-07; 330/78-20-07)

Review of Soils Placement and Inspection Activities for Plant Area Fill

A subcontractor, Canonie Construction Company, South Haven, Michigan, performed the major portion of the earthwork at the idland site. Although Canonie was primarily engaged to construct the cooling pond dike, they also performed most of the plant area fill work. Bechtel, however, also performed plant fill work prior to and after Canonie left the site in mid-October 1977. The last Canonie daily QA/QC fill placement report is dated October 16, 1977.

According to Canonie QA/QC records the first fill in the DGB area was placed in late October and early November 1975. No further fill was placed in the area until July 1976. After that time, fill work in the area was interspersed with soils work in other areas.

While it would be difficult to identify the soil work performed by Bechtel versus that performed by Canonie, records reviewed indicated that most of the Bechtel work was done during the latter part of 1976 and continued through 1977 and 1978. Although most of the Bechtel work related to placing sand around piping and ducts after they were laid and placing sand adjacent to walls, some motorized work compacting clay fill was also done by Bechtel.

Regarding the plant fill work performed by Bechtel, CPCo Audit Report No. F-77-21 dated June 10, 1977, identified a number of deficiencies which recommended the corrective action to be as follows: (1) "the foremen directing the soils work should be instructed as to the required moisture content limits" and (2) "the foreman directing the soils work should be instructed as to the correct test frequency requirements." Interviews with two such Bechtel foremen confirmed the fact that they were directing soil operations. They indicated they received their instruction regarding lift thicknesses and testing requirements verbally from field engineering through a general foreman.

Bechtel design criteria C-501 (Page 8) and PSAR Amendment No. 3 (Dames and Moore Report, Page 16) states that, "Filling operations should be performed under the continuous technical supervision of a qualified soils engineer who would perform in-place density tests in the compacted fill to verify that all materials are placed and compacted in accordance with the recommended criteria."

Based on the above, the soils activities were not accomplished under the continuous technical supervision in accordance with Bechtel design criteria. This failure to provide a qualified soils engineer to perform technical supervision for activities affecting quality as required by specifications and the PSAR is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion V. (329/78-20-08; 330/78-20-08)

The foremen indicated that Bechtel Field Engineers and QC inspectors were rarely in the areas where soils activities were going on. The foremen decided when and where tests were taken. The locations of tests were approximated by pacing or visually estimating distances from columns or building walls. Lift thicknesses were determined visually, usually without the use of grade stakes.

Soils testing services are provided by U. S. Testing Company based on the requirements of Specification C-208. The two U. S. Testing technicians who said they performed an estimated 90% of the soil testing during the years 1975-77 indicated that they rarely saw a Bechtel field engineer or QC inspector in the areas where plant fill activities were going on. One technician said he could recall only one occasion when a QC inspector was present when he took an in-place density test. The other technician estimated he had contact with a QC inspector in the field about once a month. A Bechtel QC inspector, however, was assigned to the testing laboratory on a full-time basis.

U.S. Testing personnel stated that erroneous test locations were a chronic problem regarding the Bechtel placed fill. The location of a test was usually given at the time of the test by a labor foreman or a laborer if the foreman wasn't there. Sometimes, however, a foreman was not familiar with the area in which he was working and the location was not provided until sometime after the test. It became necessary on occasion to withhold test results as a means of getting the test location. Test elevations were approximated sequentially.

The technicians further advised that rarely did a Bechtel QC inspector request a test. Normally, labor foremen requested them. On occasion a technician passing through an area would be asked by a foreman if a test should be taken. Upon completion of in-place tests, the results were usually communicated to the foreman directing the work. Test failures were also reported by telephone to QC or Field Engineering. A weekly report of test was provided to Bechtel QC and Field Engineering who reviewed any test failures and resolved them.

U. S. Testing personnel advised that they were requested to take tests of clay fill while it was raining and in order to do so, plastic was held over them to protect their equipment while the test was made. Even though it was raining, the fill placement work was not stopped on some occasions. A Bechtel foreman confirmed that density tests were on occasion taken while it was raining. While this is not contrary to the specification instructions, it is contrary to standard practice.

U. S. Testing personnel indicated that when moisture was added, the procedure did not include blending the material which resulted in mushy seams. It is commonly accepted good parctice to disc the fill after spraying it with water to add needed moisture. A Bechtel foreman stated that if moisture was needed they compacted 6" then sprinkled it and then added another 6".

The field engineer who was assigned responsibility for plant fill work stated he did not spend full time on soils work since he also had responsibility for two structures, the steam tunnel and general yard work. He said he tried to get out to the area where fill work was being done once a day. Some times he did and sometimes he did not. He indicated it was his impression that the QC Inspector responsible for the soils work on the day shift visited those work areas once or twice a week. He confirmed that only oral instructions were furnished to the foremen whom he felt were conscientious. The main problem he experienced with the foreman was maintaining proper lift thickness.

The QC inspector who was primarily responsible for the plant fill work is no longer employed by Bechtel. The QC inspector who was responsible for the plant fill work on the night shift stated that he tried to devote about one hour a night to the plant fill activities. He indicated that during 1976-1977 there was much emphasis being placed on cadwelding and rebar work and it was necessary to spend the majority of his time on those activities. He maintained that he did have fairly frequent contacts with the technicians who performed the in-place density tests, particularly when test failures occurred. He indicated it was his impression that the labor foremen were directing fill placement adequately.

4. Review of Inspection Procedures

The following procedures which are relative to backfill operations at Midland Units 1 and 2 between August 1974 through December 1977 were reviewed.

a. Bechtel Master Project QC Instruction for Compacted Backfill - C-1.02 was issued for construction October 18, 1976, and it is presently the current instruction which is used by Bechtel QC (when Bechtel is the inspection agency, providing first level inspections during backfill operations). Further, this instruction was used by Bechtel QC when monitoring the activities of other inspection agencies (Canonie) when such agencies were performing the first level inspections of backfill operations during the time periods of October 18, 1976, until June 28, 1977.

b. Bechtel Quality Control Master Inspection plan for Plant Foundation Excavation and Cooling Pond Dikes (Plant Area Backfill and Berm Backfill) - Procedure No. C-210-4 was the instruction utilized by Bechtel QC when monitoring the activities of other inspection agencies that were providing the first level inspections of backfill operations (this instruction was utilized during time periods prior to October 18, 1976).

c. Bechtel Quality Control Master Inspection Plan for Structural Backfill Placement - No. C-211-1 is an instruction utilized by Bechtel QC when performing first level inspection of backfill activities prior to October 18, 1976.

Bechtel Procedure C-1.02, listed above, was written as a replacement for both Procedures C-210-4 and C-211-1. The inspection activities which were delineated in Procedures C-210-4 and C-211-1 were compared with those described in Procedure C-1.02. The following are some of those activities which were compared:

Activities/Task Description	Inspection Code for-- C-210-4	C-211-1	C-1.02
Backfill Material			
(*) 1. Free of brush, roots, sod, snow, ice or frozen soil.		I	S(V)
(*) 2. Material moisture conditioned to required moisture content.	S	I	S(V)
3. Structural backfill used with 3" of plant structure, shall be cohesionless and free-draining.		I	
(*) 4. Material not placed upon frozen surface.		I	S(V)
5. Foundation approved prior to backfill placement.	H	H	R/H
6. Prior to start of work, area free of debris, trash and unsuitable material.			I(V)

Compaction Requirements

1. Cohesionless material compacted not less than 80% relative density.	S	S	S(V)
(*) 2. Cohesive material compacted to not less than 95% max. density.	W	S	S(V)
(*) 3. Zones 1, 1A, 2 and 3 material in uncompacted lifts not exceeding 12"; areas not accessible to roller equipment the material placed in uncompacted lifts no exceeding 4".	W	I	S(V)

Material Testing

1. Verify testing and test results are as per engineering requirements.			
a. Materials	S	S	S(V)
b. Moisture	S	S	S(V)
c. Compaction	S	S	S(V)
2. Review lab test report verifying:			
a. Proper test method.	R	R	R
b. Proper test frequency.	R	R	R
c. Technical adequacy.	R	R	R

I - Inspection point
H - Hold point
W - Witness point
S - Surveillance (V) - visual
R - Review records

Those activities identified by an (*) asterisk indicate inspection requirements which have been relaxed from the original procedural requirements.

It is considered that the relaxation of actions relating to the confirmation that soils placement activities were conducted according to specifications contributed to inadequate compaction of foundation and fill material and the increase incidence of deviations from specifications regarding lift thickness, moisture control and frequency of testing.

This failure to provide adequate inspection of activities affecting quality is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion X. .(392/78-20-09; 330/78-20-09)

Exit Meetings

Members of the NRC staff met with Consumers Power Company and Bechtel Corporation at the NRC Region III office on February 23, 1979 to present the scope, purpose, and preliminary findings of the investigation. That meeting was subsequently followed by a second meeting held on March 5, 1979, during which Consumers Power Company responded to the preliminary investigation findings. The documents used during these meetings were transmitted to Consumers Power Company by NRC letter dated March 15, 1979.

Consumers Power Company

Stephen H. Howell
Senior Vice President

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

April 24, 1979
Howe 121-79

US Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Attn: Harold R Denton
Washington, DC 20555

MIDLAND PROJECT
DOCKET NO 50-329, 50-330
RESPONSE TO 10 CFR 50.54 REQUEST ON PLANT FILL
FILE: 0485.16 SERIAL: 6915

Transmitted are ten copies of the response to your 10 CFR 50.54(f) Request Regarding Plant Fill dated March 21, 1979. This response includes: 1) a matrix outlining the status of the responses, 2) a preface describing soils investigation work performed subsequent to our March 5, 1979 meeting at the NRC Region III Office, and 3) either a complete or interim response to each of the 22 questions.

The matrix describes the status of our response to each question. For those cases in which future activities must be completed, the completion date has been listed. Specific activities which will be performed subsequent to this submittal are detailed in the interim report.

Consumers Power Company

Dated: April 24, 1979

by Stephen H Howell
Stephen H Howell, Senior Vice President

Sworn and subscribed to before me on this 24th day of April 1979.

Betty L. Bishop
Notary Public, Jackson County, Michigan
My commission expires September 21, 1982

~~7904250617~~ 1p

RESPONSES TO THE

NRC 10 CFR 50.54(f) REQUEST

REGARDING PLANT FILL

FOR

MIDLAND PLANT UNITS 1 and 2

CONSUMERS POWER COMPANY

DOCKET NUMBERS 50-329 AND 50-330

Consisting of:

1. Preface
2. Completion Status of Each Response
3. Responses to the 22 Questions

Report Date: April 24, 1979

~~7904250618~~ 150 pp.

PREFACE

Subsequent to the March 5, 1979, meeting at the NRC Region III offices, additional soils investigation work has been performed at the Midland jobsite to further evaluate the questionable plant fill material. To date, about 45 additional borings have been performed, including some borings taken through the basement structural slabs to evaluate the fill materials directly beneath several Seismic Category I buildings. Locations of borings performed in 1978 and 1979, including these recent borings, are shown in Figure 12-1 (attached to the Question 12 response). In addition to the borings, crack mapping and settlement monitoring of the diesel generator building and several other Seismic Category I structures are currently underway.

These subsequent investigations have identified several areas of questionable fill material. These areas are described in Table 12-1. Table 12-1 also summarizes the planned remedial actions for each area.

Concurrent with the investigations described above, several other significant activities have been performed and/or completed since early March 1979. Preloading of the diesel generator building with approximately 20 feet of granular fill material has been completed. The roof slab of the diesel generator building was poured last month, and the construction of this building is now complete. The emergency diesel fuel oil tanks have been filled with water, and the settlements resulting from this load test have been recorded. Various pipes in the plant area have been profiled. An extensive engineering review and analysis of these site investigations are currently being performed.

The following responses to the 22 questions transmitted in Mr. H.R. Denton's March 21, 1979, letter to Consumers Power Company include input from the various investigations and evaluations. Upon conclusion of these investigations, the final safety analysis report (FSAR) requirements will be reviewed and updated to reflect the results of these evaluations.

Please note that additional activities are required to complete several of the responses. An interim response, including a scheduled completion date, has been included where additional information is needed.

COMPLETION STATUS

Question	Response Status	Date to Complete Question (If Applicable)	Actions and/or Remarks
1	Complete		Corrective actions are currently in process.
2	Complete		
3	Complete		
4	Interim	August 1979	Provide acceptance criteria.
5	Complete		
6	Complete		
7	Complete		
8	Complete		
9	Complete		
10	Complete		
11	Complete		
12	Interim	May 1979	Complete soils investigation work and implement remedial measures.
13	Complete		
14	Interim	August 1979	Provide analysis and evaluation.
15	Interim	December 1979	Provide evaluation.
16	Complete		
17	Interim	June 29, 1979	Evaluation of Category I piping.
18	Complete		
19	Complete		
20	Interim	June 29, 1979	Complete review and analysis work.
21	Complete		
22	Complete		

Question 1

Your quality assurance (QA) program, which falls under the provisions of 10 CFR 50, Appendix B, was applicable to the technical information that went into the PSAR and FSAR and the design and construction of the diesel generator building. In our view, the unusual settlement problem at the site points to an apparent lack of implementation of certain QA program requirements. Therefore, provide the following:

(a) Identify those quality assurance deficiencies that contributed to this problem, the possibilities of these deficiencies being of a generic nature and affecting other areas of the facility, and describe the corrective actions you have taken to preclude these deficiencies from happening in the future.

(b) What assurance exists that the apparent areas of contradictions in the PSAR and FSAR as described by I&E during the meetings of February 23 and March 5, 1979, do not exist in other sections of the PSAR and FSAR dealing with matters other than fill?

(c) Investigate other activities not associated with the fill, but important to safety for other systems, components, and structures of the Midland facility to determine if quality assurance deficiencies exist in view of the apparent breakdown of certain quality assurance controls. Identify those items investigated and the results of your investigation.

(d) Considering the results of your investigation on Item (c) above, describe your position as to the overall effectiveness of your QA program for the design and construction of the Midland Plant.

Response (to Question 1, Part a)

Appendix I provides the quality assurance deficiencies. Each item included in Appendix I has been classified as a deficiency for the purpose of assuring that each item is addressed for generic implications. The items may be Items of Noncompliance identified by the NRC, deficiencies identified by Bechtel or CPCo, or conditions which have not been ruled out as possibly contributing to the diesel generator building settlement problem. Appendix I also provides:

1. A detailed discussion of each deficiency, including its scope and possible generic implications

2. The corrective actions taken to correct each deficiency associated with the settlement problem

3. If the deficiency has generic implications, actions taken to preclude recurrence of the same or similar deficiency

Response (to Question 1, Part b)

The Midland Final Safety Analysis Report (FSAR) was prepared in accordance with Bechtel's Engineering Department Procedure (EDP) 4.22, Preparation and Control of Safety Analyses Reports. The Bechtel-originated FSAR sections were written based upon information, requirements, criteria, and commitments contained in the various documents identified in the Midland Project FSAR Section References form (Attachment 1-1).

These sections, as well as those originated by CPCo or B&W, were distributed for internal Bechtel interface coordination with review by project discipline groups, off-project support groups, and the discipline chief engineers. Documentation of this coordination and resolution of comments were maintained by the use of three additional forms: Midland Project FSAR Interface Routing Slip (Attachment 1-2), Midland Project FSAR Interface Comment Closure (Attachment 1-3), and Midland Plant FSAR Chief Engineer's Comment Closure (Attachment 1-4). Finally, the individual FSAR sections were distributed to CPCo and B&W and a three-company meeting was held to review and approve the final sections. The purpose of this overall procedure was to ensure that all appropriate licensing and project design documents were considered when preparing the FSAR sections and that appropriate interface coordination was conducted.

The Midland FSAR was submitted to the NRC at an earlier point in the project schedule than would have normally occurred in order to provide additional time for the operating license hearings due to the forecasted intervention. Consequently, some of the material required to be included in the FSAR was not available at the time of its initial submittal, or was supplied based upon preliminary design information. As the design and construction continued, the appropriate sections of the FSAR were revised or updated to include the necessary information.

In addition, 973 official NRC questions were issued on the Midland docket (850 on the FSAR and 123 on the environmental report). Several of these questions resulted in design changes. As these changes were made, the appropriate sections of the FSAR were revised. An audit of Bechtel Project Engineering was conducted by Bechtel Quality Assurance on

January 22 through 30, 1979, to ensure that there is a system by which design changes are reflected in the FSAR and that this system is properly implemented. In addition, there were numerous CPCo QA audits which included this aspect.

To identify and track missing information in the FSAR, an Amendment/Commitment List was created. This list gives the appropriate FSAR section reference, a brief description of the missing information and the action required to resolve the open item, the due date for closure, and the responsible organization. An example of the Amendment/Commitment List is included as Attachment 1-5.

Through the above procedures and actions, the FSAR and project design documents are constantly being reviewed and compared against each other. When inconsistencies are identified, they are corrected. However, there are some sections of the FSAR that are essentially inactive (e.g., the FSAR section relates to items for which the design, procurement, and construction phases have been completed and there have been no recent document changes or NRC questions to prompt a review of the section).

Prior to the identification and investigation of the diesel generator building settlement starting in August 1978, FSAR Section 2.5 and Subsection 3.8.5 (which were the areas of contradictions in the PSAR and FSAR as described by I&E during the meetings of February 23 and March 5, 1979) were considered inactive. All of the major plant backfill operations were completed, no significant revisions to the related civil specifications or calculations were made, and only two NRC questions were received at that time. These two NRC questions were related to Section 2.5 and dealt with the seismicity of the Michigan region.

Although the above activities have been and are now being implemented, it has been decided that in order to provide assurance that areas of contradiction do not exist in other sections of the PSAR and FSAR dealing with matters other than fill, the following additional actions will be taken.

1. A PSAR Commitment List was created in 1973 to identify and track design commitments made in the PSAR and related licensing documents. A sample sheet from this list is included as Attachment 1-6. Several revisions of this list were issued to update the "status" and "disposition document" columns. This list was also used in developing FSAR Table 1.3-2, Significant Design Changes, which identifies the significant changes made since issuance of the construction permit. To assure that the PSAR design commitments were properly dispositioned through incorporation into a project design

document or the FSAR, a final review and update of the PSAR Commitment List will be completed by September 28, 1979.

2. To assure that no areas of contradiction exist between the FSAR, PSAR, and project design documents, a review of sections of the FSAR that are determined to be inactive will be completed by September 28, 1979. For this purpose, an inactive FSAR section is defined as any section for which the basic technical content has not changed since the initial preparation of the FSAR and for which there are no outstanding unanswered NRC questions or identified Safety Evaluation Report open items. Any inconsistencies identified during these review activities will be resolved and all appropriate changes will be made to the FSAR. A review of the remaining sections of the FSAR is not considered necessary because of the ongoing review process described above.

3. EDP 4.22, Preparation and Control of Safety Analysis Reports, provides a system for controlling the preparation and revision of safety analysis reports. This procedure will be reviewed by June 29, 1979, although there are no apparent needed improvements noted at this time.

4. A Quality Assurance audit will be made of the three actions noted above.

Response (to Question 1, Part c)

The previous discussions describe known quality assurance deficiencies relating to the diesel generator building settlement, corrective actions taken with regard to the deficiencies as they apply to the settlement problem, and actions taken for the deficiencies as they apply generally.

In addition to these specific actions previously noted, other actions related to the generic nature of the deficiencies identified have been taken or are in progress. These resulted from CPCo and Bechtel's implementation of their QA programs. A brief description of these actions follows.

1. A review was completed by Bechtel Quality Assurance in January 1978 of the use of the Field Change Request and Field Change Notice to obtain clarifications of specifications and drawings. This review concluded that there is an awareness of the need for specificity in specification and drawing preparation on the Midland project.

2. A review of specifications covering items such as references, tolerances, and clarity of the specifications was undertaken by Bechtel and CPCo in late 1977. This

study resulted in revision of several specifications. Most of the specifications used by construction were included, but the soils and concrete specifications were not used because the status of this construction was nearing completion. A review will be undertaken and completed by June 29, 1979, of specifications not included in the initial study, but still in use in the field. This review will cover the same areas as the original study. Specifications C-210 and C-211 have been the subject of review subsequent to the discovery of the settlement problem, and have been revised to provide a better definition of the requirements.

3. During the specification review, Bechtel Quality Control and CPCo QA also reviewed each active Quality Control Instruction (QCI) in use to ensure the callout of adequate inspection criteria. Where additional clarification of specifications was considered necessary, this information was forwarded to Bechtel Project Engineering for resolution and included in the study discussed previously.

4. During September 1977, Bechtel QA revised their monitoring program to provide for more in-depth verification of QA program requirements. At the same time, Bechtel QA management audits were increased from one to two per year. Bechtel QA engineers assigned to the site have been increased from five in 1977 to a present level of eight.

5. In 1976, CPCo QA instituted a program of overinspection of certain Q-listed construction activities. To implement this program, CPCo QA personnel at the site were increased from 5 to an average of 20 over the period from 1976 to 1978 to support new activities (mechanical, electrical, etc) being started. CPCo QA personnel in the Jackson office were increased from one to six (excluding the Audit and Administration Section).

   a. Areas that were subject to overinspection included the following:

      (1) Reinforcing steel installation - initiated in June 1976 on a sampling basis, and in October, 1976, for 100% review

         (a) 1976 - 53 inspections

         (b) 1977 - 306 inspections

         (c) 1978 - 145 inspections

(2) Structural embedment installation - 100% (initiated during June 1977)

(a) 1977 - 168 inspections

(b) 1978 - 84 inspections

(3) Vendor x-ray interpretation - initiated in late 1978 and presently 100% review for radiographs received

(4) Field radiograph interpretation - sample basis started concurrent with the start of radiography

b. Other areas subject to a total increase in audits and overinspections included, but were not limited to:

(1) Mechanical activities

(2) Electrical activities

Overinspections in these areas total 101 for the last 6 months of 1978.

c. Audits conducted in all areas by CPCo site QA personnel are as follows:

(1) 1976 - 76 audits

(2) 1977 - 48 audits

(3) 1978 - 51 audits

6. Resident engineers have been assigned at the site to aid construction in the proper interpretation of drawings and specifications, aid in the resolution of problems such as interferences, and provide clear direction of the specification intent. These residents have been increased in number from 1 in March 1976, to the current figure of 22.

7. In April 1978, Bechtel QA initiated supplementary guidelines to indicate certain criteria for initiating tracking charts to aid in identifying trends in any particular area for repetitive occurrences. These charts are issued monthly to CPCo and Bechtel QA management.

The composite effect of these actions is to provide increased assurance of program compliance in all areas.

Response (to Question 1, Part d)

The preceding discussions describe various discrepancies discovered as a result of the settlement investigation, corrective actions associated with the soils activity, and corrective actions planned or taken in other areas to assure that these deficiencies do not exist and are precluded elsewhere. This discussion also describes reviews and corrective actions which were taken prior to the advent of the settlement problem, but which continue to apply generically. It is emphasized that the settlement monitoring program (by which the settlement problem was initially detected) was an integral and continuing part of the overall Midland Quality Assurance Program.

It is CPCo's position that the Midland Quality Assurance Program being implemented on the Midland Project is effective.

CATEGORY I
DESIGN ACTIVITIES

A. Deficiency Description:

1. Inconsistency Between Specifications And The Dames & Moore Report

   A number of consultant reports have been added as appendixes to the PSAR. These reports contain numerous and sometimes conflicting recommendations. These reports are subject to be construed as commitments. For example, the Dames & Moore Report (referenced as an attachment to the PSAR in Amendment 3 to the PSAR) makes certain recommendations relating to the compaction and protection of soils. Certain of these recommendations were not specifically called out as requirements in the implementing specification.

2. Lack Of Formal Revisions Of Specifications To Reflect Clarification Of Specification Requirements

   Conflicts existed between Sections 13.7 and 12.4 of Specification C-210 relating to the laboratory standard to be used. These paragraphs were the subject of clarification communications.

   a. Specification C-210, Revisions 2 through 4, Section 13.7 originally required cohesive soils to be compacted to not less than 95% of "...modified proctor method (ASTM 1557, Method D)."

   b. Specification C-210, Revisions 5 and 6, Section 13.7.1, Cohesive Soils, states, "All cohesive backfill in the plant area and the berm shall be compacted to not less than 95 percent of maximum density as determined by ASTM D 1557, Method D."

   c. Specification C-210, Revisions 2 through 6, Section 13.4, Testing, states, "Testing of all materials placed in the plant area and the berm will be performed in accordance with the tests listed in Section 12.4"

   d. Specification C-210, Revisions 2 through 6, Section 12.4.5.1, Cohesive Soils, states: "The maximum dry density and optimum moisture content of cohesive material will be determined in the laboratory in accordance with ASTM Designation D 1557, Method D, provided that the sample is prepared in 4 layers, each compacted with 25 blows with a 10 pound hammer dropping 18 inches giving a compactive energy equal to 20,000 foot-pounds per cubic foot. (Bechtel modified Proctor Density test)."

3. Inconsistency Of Information Within The FSAR Relating To Diesel Generator Building Fill Material And Settlement

The FSAR submitted to the NRC (through Amendment 17) contained certain inconsistencies:

a. Tables 2.5-9 and 2.5-14 identify the foundations under the diesel generator building to be cohesive fill. The actual material specified and used was random fill, which includes cohesive and cohesionless material and concrete.

b. FSAR Subsection 3.8.5.5 indicates a settlement of 1/2 inch for shallow spread footings (such as the diesel generator building). FSAR Table 2.5-48 indicates a settlement of the diesel generator building of approximately 3 inches.

4. Inconsistency Between Basis For Settlement Calculations For Diesel Generator Building And Design Basis

a. Settlement calculations for the diesel generator building differ from the design requirements in the following ways:

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

(2) An index of .001 was used rather than the index of .003 shown in Table 2.5-16 in the FSAR.

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

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

5. Inadequate Design Coordination in the Design of the Duct Bank

   Four vertical duct banks were designed and constructed without sufficient clearance to allow a relative vertical movement between the duct bank and the building, and therefore restricted the settlement of the diesel generator building.

B. Discussion Of The Deficiency, Its Scope, And Generic Implications: (The numbers below correspond to the numbers under Part A above.)

1. Project engineering specifications meet the commitment for compaction of soil as stated in PSAR Amendment 3, dated August 13, 1969. PSAR Subsection 2.8.4.1 states, "All fill and backfill materials are adequately compacted to insure stability of the fill and to provide adequate support for structures founded on this fill without excessive settlement." Specifications C-210 and C-211 provide sufficient criteria by which to ensure that the fill is adequately placed to prevent excessive settlement.

   As stated in PSAR Subsection 2.8.1, Introduction, "This section presents the summarized results of studies of the foundation investigation phase...." Although the Dames & Moore report is referenced in this subsection, it was not intended to be a PSAR commitment except for those portions specifically indicated in the PSAR.

   Therefore, the differences between the Dames & Moore recommendations (or other consultant recommendations) and the specification requirements do not indicate a failure to meet commitments in the PSAR. These recommendations were considered by Bechtel Project Engineering and appropriate ones were committed to in the PSAR and included as requirements in the specifications.

2. Letters, TWXs, telecons, and memorandums are often used to clarify the intent of the specifications. It is possible that in some situations the clarification provided through the above methods may have modified the specification without formally changing the wording of the specifications. This is considered potentially generic to other areas.

3. Refer to the response to Question 1, Part b.

4. The diesel generator building settlement calculations were based on preliminary information supplied by Bechtel Project Engineering in March 1976 which included a uniform loading of 3,000 psf over the entire building. The calculations were checked in the San Francisco office in March 1977. The final design was released by Bechtel Project Engineering in March 1977.

   A fill soil compressibility factor of .001 which was used in the original settlement calculation was later determined to be less appropriate than factor of .003, and a factor of .003 was stated in the FSAR. The individual responsible for the original calculation did not become aware of this change until after the diesel generator settlement problem surfaced. Thereafter, he determined that the change, in this case, would result in a predicted settlement that was insignificantly different from that predicted in the original calculation. This was not noted in the original calculation.

   Checking of the calculation was completed prior to completing the coordination of the final design configuration. The original calculations were based on a uniform load of 3,000 psf and a mat foundation, whereas the final design was based on a uniform load of 4,000 psf and a spread footing foundation. The originator of the calculation was aware of this change on a timely basis, but it was determined that because conservatism was used in the calculations, the change in results using the final design parameters would be small and within the accuracy limits of the analysis. However, this was not noted in the calculation.

   Although it is felt that this is an isolated case, to assure compliance with the requirements of EDP 4.22, and EDP 4.37, refer to Part C (below) for a discussion of the corrective action.

5. Project design Drawings E-502 and C-1001, Revision 2 and C-1002, Revision 2 resulted in a 1-inch separation gap being specified between the duct banks and the diesel generator building foundations to allow for differential settlement. The applicable electrical drawings indicate

minimum dimensions only, and do not reflect as-built dimensions. Therefore, the cognizant engineer went to the jobsite, measured the exposed duct banks, and designed the openings in the footings accordingly. At the time of this jobsite visit, the backfill and a mud mat covered the enlarged cross-sectional area of the duct banks below the footings. From the information available to the engineer, it was not apparent that the duct bank under the opening was larger than the part projecting through the mud mat.

Coordination failed to identify a second electrical drawing, Drawing E-42, Sheet 33, Revision 4, which shows that buried duct banks have more concrete cover over the conduits in the duct than was required for the exposed duct bank above the footing level. As a result, the design did not specify a vertical gap between the bottom of the footings and the enlarged duct bank section.

Coordination of drawings is accomplished in accordance with EDP 4.46. This procedure requires a coordination print to be utilized and signed by the affected discipline engineers. Only the last revision of the coordination print is required to be retained.

Most interdisciplinary interfaces are self-evident as to interferences that may arise from other design or construction. There are specific design bases for the separation between Seismic Category I systems, and between Seismic Category I and non-Seismic Category I systems. Below grade interfaces are not easily accessible for later verification, whereas accessible interfaces will be subject to walkdown inspections at the completion of construction. This final check will verify compliance with separation criteria and the absence of interferences.

Based on the above, we do not consider this case to be generic, but rather an anomaly. This is supported by the fact that Bechtel Quality Assurance and Quality Engineering have completed 16 monitors and audits in the area of design coordination over the last 16 months, and have not identified any significant deficiencies.

C. Actions Taken To Correct The Deficiency Associated With The Settlement Problem: (The numbers below correspond to the numbers under Parts A and B above.)

1.a. Specifications C-210 and C-211 have been revised by issuance of Specification Change Notices (SCNs) C-210-9001 (March 30, 1979) and C-211-9001 (April 2, 1979), which provide for:

(1) Maximum density of cohesive soils using ASTM D 1557, Method D, with a minimum compaction of 95%;

(2) Moisture verification of adequacy to be at the time of field density testing;

(3) Maximum loose lift thickness of 8 inches for motorized equipment and 4 inches for hand-held equipment;

(4) Minimum compaction of 85% relative density for cohesionless soils.

1.b. A complete review of the Dames & Moore Report will be completed and a documented disposition will be made for any other apparent differences between the Report recommendations and the project specifications. This review will be completed by June 29, 1979.

2. Specifications C-210 and C-211 have been revised as previously stated in Section C.1.a above.

On April 3, 1979, the Midland Project Engineering Group Supervisors were reinstructed that the only procedurally correct methods of implementing specification changes are through the use of specification revisions or SCNs. This was reiterated in an IOM to the Group Supervisors from the Midland Project Engineer on April 11, 1979.

3. Pertinent portions of FSAR Sections 2.5 and 3.8 are being reviewed, and FSAR change notices have been and may be written to correct the inconsistencies and to add clarification to the material presented. FSAR change notices were incorporated into the FSAR in Revision 18 (dated February 28, 1979). The remainder of these reviews will be completed by June 29, 1979.

4.a. Settlement calculations will be made again subsequent to the completion of the diesel generator building surcharge operation.

4.b. The importance of updating support documents (such as calculations) as new design information becomes available in order to avoid discrepancies has been reiterated by an internal memorandum to the Bechtel Geotech Design Team dated April 12, 1979.

4.c. A recent Bechtel Quality Assurance audit of the Bechtel Geotech Section was conducted in February, 1979. Although the results of this audit indicated that this area is effectively controlled, additional audits will be performed in this area on a 6-month cycle until completion of soils work.

5.a. Provisions were made to allow independent vertical movement between the diesel generator building and the duct banks.

5.b. Bechtel Project Engineering will review design drawings for cases where ducts penetrate vertically through foundations. The possibility of the duct being enlarged over the design requirements and the effect this enlargement may have upon the structure's behavior will be evaluated by June 1, 1979. Proper remedial measures will be taken if the investigation shows potential problems.

D. Corrective Actions Taken To Preclude Recurrence Elsewhere: (The numbers below correspond to the numbers under Parts A, B, and C above.)

1. Engineering Department Project Instruction (EDPI) 4.1.1 (issued in July 1974) provides a system requiring that design criteria, contained in documents such as the PSAR or FSAR, be incorporated into the design. This requirement was previously found in the Bechtel Job Procedure (7220) entitled, "Design Document Requirements Procedure."

   EDPI 4.1.1, Revision 0, Paragraph 3.1 states: "The Discipline Engineer who originates a design document shall fill out the attached Design Requirement Verification Checklist (DRVCL) as he develops the design document to assure that all applicable design criteria contained in each referenced document has been incorporated into the design document and to verify that no omission or conflict exist. If a particular Design Requirements Document is not applicable to the design document, place 'N/A' in the space provided for identification."

Exhibit 1 to EDPI 4.1.1 includes a "PSAR/FSAR" category and a "Bechtel discipline standards" category.

To assure that this system is being implemented, Bechtel QA conducted an audit of this system on January 22 through 30, 1979. This audit resulted in two findings for which corrective actions are scheduled to be completed by May 18, 1979.

2.a. A review of the references, tolerances, and clarity of the specifications was undertaken by Bechtel and CPCo in late 1977. This study resulted in appropriate revisions to several specifications. Most of the specifications used for construction were included in this study, but the soils and concrete specifications were not because the status of this construction was nearing completion at that time.

2.b. Using the installation of the reactor building spray pump and ancillary system as a study mechanism, Bechtel and CPCo performed a dimensional tolerance study. The purpose of this study was to evaluate drawing and specification tolerances and clarity. This study was concluded in early 1978, and preceded the majority of the mechanical and electrical installations. The generic findings resulting from this study were applied to other mechanical and electrical drawings and specifications, and they have been revised as needed.

2.c. A review of those specifications being used for remaining construction and not included in the studies described in Parts 2.a and 2.b above will be completed by June 29, 1979.

2.d. EDPI 4.49.1, Specification Change Notice, will be revised by May 1, 1979, to incorporate clarifications and instructions concerning use of specification change notices.

2.e. A specific review of the FSAR and specification requirements for the qualification of electrical and mechanical components has been made as part of the corrective action relating to CPCo's 50.55(e) report on component qualification.

3. Refer to the response to Question 1, Part b.

4. Calculational techniques and actual analysis will be audited to sample the effectiveness of the

design calculational process. Recent audits have been conducted of the ITT Grinnel hanger design and CPCo relay setting calculations. Bechtel will, on a yearly basis, audit each of their design disciplines.

5. No further actions are required on this item.

CATEGORY II
CONSTRUCTION ACTIVITIES

A. Deficiency Description:

1. Insufficient Compactive Effort Used In Backfill Operation

There are no records available to indicate that the various types of compaction equipment used for structural backfill were evaluated or qualified to handle the specified lift thicknesses and that appropriate lift thicknesses were established for each type of equipment.

2. Insufficient Technical Direction In The Field

The Dames & Moore Report and the Civil-Structural Design Criteria 7220-C-501, Revision 9, Section 6.1.1 state, in part, "Filling operations shall be performed under the technical supervision of a qualified soils engineer...."

Technical direction and supervision were provided by Field Engineers and Superintendents who were assigned the responsibility for soils placement. The direction and supervision were not sufficiently employed.

B. Discussion Of The Deficiency, Its Scope, And Generic Implications: (The numbers below correspond to the numbers under Part A above.)

1. Areas of low density appear to be mostly confined to structural backfill placed in confined areas using vibratory type hand-operated equipment and in areas placed under Specification C-210 where equipment was not prequalified and acceptance was by test. The equipment was evaluated for its ability to handle lift thicknesses of up to 12 inches based on achieving satisfactory in-place test results. However, the specific type of equipment used and the number of passes needed to achieve the required density were not recorded.

Category III provides a discussion of the generic implications of the quality control and testing factors which had a primary inpact on equipment qualification.

2. The soils tests during plant fill operations generally showed good compaction, and this informa-

tion was utilized by field personnel in determining the amount of direction necessary. Soils operations are unique and there are no physical attributes available to supervisory personnel by which to check the quality of the compactive effort other than the test results. Each lift is subsequently covered by the following lift. For most other work (such as piping), the results of the work efforts remain visible (such as alignment at subassembly closure points), or subsequent inspections can be made or repeated to verify the quality (e.g., hydrostatic tests, nondestructive examinations, and functional tests).

C. Actions Taken To Correct Deficiencies Associated With Settlement Problems: (The numbers below correspond to the numbers under Parts A and B above.)

1. Prior to the resumption of soils work in the plant area, compaction equipment will be reevaluated or requalified as to material type (cohesionless or cohesive soil), lift thickness, number of passes or rate of coverage (i.e., compaction effort), and compaction achieved based on field and laboratory density testing. This will be documented.

2.a. Permanent fill operations will not be conducted unless a Field Soils Engineer is onsite to provide technical direction for the operations. SCN C-211-9001 adds this requirement. In addition, a Soils Engineer from the Bechtel Design Section will be assigned to provide an overview of the field operation. The duties and responsibilities of these personnel will be defined prior to the resumption of soils operations.

2.b. CPCo will implement overinspection for soils placement, utilizing a specific overinspection plan.

D. Corrective Action Taken To Preclude Recurrence Elsewhere: (The numbers below correspond to the numbers under Parts A, B, and C above.)

1. A review of specifications and procedures used for construction will be made to identify all construction equipment requiring qualification. This review will be completed by June 29, 1979.

2. The duties and responsibilities for field engineers and field crafts supervision are defined in Field

Procedure FPG-3.000. This procedure will be reviewed by May 31, 1979 to assure the clarity and completeness of the definition of duties and responsibilities, although there is no apparent need for improvement at this time.

CATEGORY III
QUALITY CONTROL AND TESTING ACTIVITIES

A. Deficiency Description:

1. Inadequate Quality Control Inspection Of Placement Of Fill

Bechtel Quality Control inspection of soils work did not identify deficiencies which may have contributed to placement of fill that appears to have densities in place that are lower than those specified.

2. Inadequate Soil Moisture Testing

Prior to 1978, moisture content was controlled by tests taken after compaction. Few or no tests were taken on the fill prior to compaction, as required by Specification C-210, Section 12.6. Attachment 1-7 describes the methods that were used for soil control during the various stages of soil placement.

3. Incorrect Soil Test Results

A review of soils test reports indicates that there are some reports which contain errors and inconsistencies in the data. Technical direction, surveillance, and test report reviews by Bechtel Quality Control did not identify these errors and inconsistencies.

In addition, a preliminary review of these reports also indicates other possible problems with the compaction test data. Attachment 1-8 presents the preliminary findings of this review.

4. Inadequate Subcontractor Test Procedures

U.S. Testing's QA Program, Revision 6, dated March 20, 1978, did not provide procedures or instructions, as required by Specification G-22, for the following areas:

a. Developing and updating the family of proctor curves;

b. Visually selecting the proper proctor curve;

c. Developing additional proctor curves for changing materials occurring between normal frequency curves;

d. Alternative methods of determining the proper laboratory maximum density where visual comparison is not adequate.

Specification G-22, Revision 1, dated June 22, 1973, is an attachment to Specification C-208 and specifies the requirements for U.S. Testing's QA Program. Section 3.1.5 requires that this program provide instructions, procedures, and drawings.

B. Discussion Of The Deficiency, Its Scope, And Generic Implications: (The numbers below correspond to the numbers under Part A above.)

1. The inspection for soils was accomplished by surveillance which did not require extensive documentation of the specific characteristics inspected. In other construction areas for which surveillance is employed, acceptance is based on the final inspection of the physical characteristics after completion of the construction activity and the final inspection results are documented on a characteristic-by-characteristic basis. As such, the application of a defect prevention surveillance is not a generic problem where final inspections of record also exist. This item is considered to have generic implications in areas where inspection of processing methods, equipment, and personnel during construction is intended as an inspection of record requiring clear direction and recording of the specifics.

2. Prior to 1978, Section 12.6 of Specification C-210 was interpreted by field personnel as follows: "during compaction" was interpreted as the entire process of placing, compacting, and testing fill. The moisture content was measured during the density test, which was taken immediately after compaction. Therefore, by field interpretation, the moisture content was measured "during compaction" and the fill was not tested in its loose state. Reconditioning was done after testing. A summary of moisture measurements taken for each time period of construction is given in Attachment 1-7.

   When cohesive soils are used, moisture control in the borrow areas or stockpiles is for the purpose of minimizing the construction impact of performing moisture conditioning in the area where fill is being placed and compacted.

The specifications, as now revised, require that the moisture content for cohesive soils be within $\pm 2\%$ of optimum moisture at the time of field density testing. The specification further states that field density tests are to be taken immediately following compaction.

Moisture conditioning of soil (preconditioning of material) is unique to fill placement and is, therefore, not generic to other areas or disciplines.

3. Bechtel's quality control of testing performed by the testing laboratory subcontractor included steps to verify that the test results were reported as either percent compaction or relative density (as appropriate to the material being tested), the specification compaction requirement was met, the moisture content was within the required limits (when required for cohesive soils), and the report form was properly completed providing date of test, location, elevation, and laboratory chief's signature attesting to procedure compliance.

   This item is considered to be potentially generic to other testing performed by this subcontractor. It is not considered generic to the activities performed by the nondestructive examination (NDE) subcontractor, as indicated by recent monitors and audits as follows:

   a. Since January 1978, there have been ten audits of the NDE subcontractor's operations completed by CPCo, Bechtel, an Authorized Inspection Agency, and the subcontractor's management. The findings resulting from these audits do not indicate any significant or repetitive problems.

   b. Bechtel Quality Control surveys the NDE subcontractor's testing operations and reviews all Q-listed radiographic film for final acceptance.

   c. The authorized inspector reviews ASME radiographs and surveys other NDE.

   d. CPCo QA provides an overinspection of NDE on a sampling basis.

4. The inadequacy of the test laboratory subcontractor's test procedures is considered to be potentially generic to other testing performed by this subcontractor. It is not considered generic to the testing performed by the NDE subcontractor for the reasons cited in Part 3 immediately above.

C. Actions Taken To Correct Deficiency Associated With The Settlement Problem: (The numbers below correspond to the numbers under Parts A and B above.)

1.a. PQCI C-1.02, Compacted Backfill, is being revised to include a Daily Soil Placement Report, which is to be used in each area where soils work is being performed. This report will include:

(1) Area sketch showing areas of placement;

(2) Identification of equipment being used;

(3) Identification of supporting personnel;

(4) Recording lift thickness measurements (by elevation differences) which are representative of the fill being placed;

(5) Compactive effort used (rate of coverage or number of passes);

(6) Location by grid coordinates and elevation of all tests taken and testing frequencies.

1.b. Bechtel Quality Control "surveillance" will be changed in PQCI C-1.02 to "inspection" for inspections of record prior to the resumption of soils operations.

1.c. As previously noted under Category II, Section C.2.b, CPCo will perform overinspection on a sampling basis.

2.a. SCN C-210-9001, issued on March 29, 1979, and SCN C-211-9001, issued April 4, 1979, provide more direction as to the manner in which moisture is to be controlled in the field.

2.b. Bechtel Quality Control will continue to review field moisture and density test results to verify that moisture content is within the required moisture limits. When test results are not acceptable, the area affected will be identified to the Field Soils Engineer for appropriate action. The corrective action taken will be documented by

Bechtel Quality Control on the Daily Soils Placement Report, Discrepancy Report, or Nonconformance Report, as appropriate.

2.c. In addition, when cohesive material is used from borrow areas and stockpiles, moisture tests may be taken for production control. Such information will be provided to the Field Soils Engineer for his evaluation of the need for any preconditioning of materials prior to placement and compaction. Final acceptance of moisture content will be at the time of compaction testing, as required by the specifications.

2.d. The CPCo commitment given in Section C.1.c above also applies here.

3.a. An in-depth review of testing and test results is being conducted by Bechtel. The Bechtel Geotech group is leading the investigation. This investigation will include:

(1) Borings taken in areas placed throughout construction;

(2) Test pits;

(3) Laboratory tests on samples from borings and test pits;

(4) Analysis of past test results (Some preliminary results are given in Attachment 1-8.);

(5) Overlay plots of all tests.

This will be completed by July 31, 1979.

3.b. PQCI C-1.02 is being revised to improve the clarity of the specific items covered by Bechtel Quality Control's inspection of U.S. Testing's soils compaction test reports.

3.c. CPCo will perform overinspection of the U.S. Testing soils testing activities and reports, utilizing a specific overinspection plan.

4.a. Selection of proctor curves will no longer be a problem because each field density test will be accompanied by a separate laboratory standard compaction test which will provide a direct comparison. This has been directed by a letter to U.S. Testing and has also been reflected in SCN C-208-9004 dated April 13, 1979.

4.b. An in-depth audit of U.S. Testing's operations will be performed by Bechtel by May 31, 1979. This audit will include an evaluation of the need for any other procedures.

D. Corrective Actions Taken To Preclude Recurrence Elsewhere: (The numbers below correspond to the numbers under Parts A, B, and C above.)

1. Bechtel Quality Control has initiated a review of all active Quality Control Instructions (QCIs). This review is being performed to identify those QCIs similar to PQCI C-1.02 which provide for defect prevention surviellances. Modifications will be made to these QCIs to distinguish between the defect prevention surveillances and the final inspections of record, recognizing that the final inspections of record may be made during or at the completion of the construction activity. The final inspections of record will be required to be documented, whereas the surveillances for defect prevention will not be required to be documented. The review is scheduled to be completed by May 15, 1979. Modifications to QCIs will then commence as necessary in accordanace with SF/PSP G-6.1.

2. No additional action is required.

3.a. Quality Control Instructions will be evaluated to ensure that the documentation characteristics which are to be inspected (i.e., review callouts) are clearly specified. This will be completed by June 29, 1979.

3.b. The laboratory testing subcontractor is also performing other testing work, such as that for concrete materials and reinforcing steel mechanical splices. Through reviews of test results, test procedures, equipment used, and personnel performing the tests, similar deficiencies as addressed above are not apparent.

3.c. An in-depth Bechtel QA Project and Engineering audit of U.S. Testing operations covering testing and implementation of their QA program will be conducted in late April or early May 1979. This audit will consider generic elements.

4. No additional action is required.

5. Additional Actions Applicable Across the Board:

a. During May and August of 1977, a review of all QCIs was performed jointly by CPCo and Bechtel to accomplish the following:

(1) Delineate inspection technique (visual, measurement, or visual and measurement);

(2) Assure the existence of adequate inspection criteria (reference specifications, drawings, etc, as required);

(3) Modify the inspection record to require that the QC Engineer utilizes the acceptance criteria as stated in the source document and records the actual inspection results;

(4) Delineate interfaces;

(5) Clarify instructions to the Bechtel Quality Control Engineer;

(6) Clarify the scope of the inspection.

b. CPCo Project Management and QA reviews field procedures (new and revised) and CPCo QA reviews QCIs (new and revised) in line with Bechtel before release.

c. In 1978, CPCo implemented an overinspection plan to independently verify the adequacy of construction and the Bechtel inspection process, with the exception of civil activities. Reinforcing steel and embeds were covered in the overinspection. CPCo, however, has audited and surveilled other civil activities numerous times, as indicated in the individual engineer's activity logs.

d. CPCo reviews onsite subcontractor QA manuals and covers their work in the audit process.

e. An ongoing effort is improving the "surveillance" mode called for in the QCIs by causing more specific accountability as to what characteristics are inspected on what specific hardware and in some cases changing "surveillance" to "inspection."

f. Bechtel is working to incorporate scientific sampling plans for inspection areas, whereas the existing practice is to use percentage sampling.

CATEGORY IV
QUALITY ASSURANCE ACTIVITIES

A. Deficiency Description:

1. Inadequate Corrective Action For Repetitive Conditions

There have been nonconformances which could be considered to be repetitive. NCRs documenting these nonconformances include, but are not limited to, QF-29, QF-52, QF-68, QF-120, QF-130, QF-147, QF-172, QF-174, QF-199, QF-203, Audit Findings F-77-21, and F-77-32, NCR 421, NCR 686, NCR 698, and NCR 1005.

Quality Assurance Department Procedure C-101, Revision 1, Paragraph 1.0 states, in part, "This procedure provides a mechanism for identifying quality trends, and initiating corrective action to prevent recurrence...."

The reviews made in accordance with the procedure did not identify the need for additional process corrective actions beyond those which had been taken already as part of the dispositions for the individual nonconformance reports.

2. The Bechtel Quality Assurance Audit and Monitor Program did not identify the problems relating to the settlement. This lack of identification of problems by the audit program contributed to a conclusion that soils operations were adequately controlled.

B. Discussion Of The Deficiency, Its Scope, And Generic Implications: (The numbers below correspond to the numbers under Part A above.)

1. Bechtel implements a trend program to assist in the determination of additional actions needed to correct repetitive problems. This program includes all noncompliances, including CPCo NCRs and AFRs. The repetitive problems concerning soils operations were included in this program, but the Bechtel and CPCo individuals responsible for review of the trend program outputs did not identify the need for corrective actions in addition to those already taken. This item could be generic to other areas where repetitive nonconformances have occurred.

In addition, the CPCo program to detect significant conditions adverse to quality did not identify a need to take corrective action beyond that outlined in CPCo NCRs and AFRs.

2. The use of auditing and monitoring to detect such problems is considered to have possible generic implications in other areas, even though it is recognized that an audit program only samples operations.

C. Actions Taken To Correct The Deficiency Associated With The Settlement: (The numbers below correspond to the numbers under Parts A and B above.)

1. See Section D.1.a and D.1.b below.

2. See Section D.2 below.

D. Corrective Actions Taken To Preclude Recurrence Elsewhere: (The numbers below correspond to the numbers under Parts A, B, and C above.)

1.a. An in-depth review of the Bechtel trend program data will be undertaken by Bechtel QA management to assure the identification of any other similar areas that were not analyzed in sufficient depth in the past reviews. This will be completed by June 1, 1979. If the results of this review indicate a need for additional corrective actions, these will be taken as required by the existing program.

1.b. An in-depth training session will be given to Midland QA Engineers covering the settlement problem and methods to identify similar conditions in the future. This will be completed by June 1, 1979.

CPCo Quality Assurance personnel have been directed to require timely corrective action when the purpose of the corrective action is either to prevent recurrence of the nonconformance or to acquire additional information as to the nature or degree of the nonconformance.

2. An in-depth training session will be given to all CPCo and Bechtel QA Engineers and Auditors to increase their awareness of the settlement problem and discuss auditing and monitoring techniques to increase audit effectiveness. This will be done by June 1, 1979.

Attachment 1-1

DATES

REV. A ____________
REV. B ____________
REV. C ____________

MIDLAND PROJECT
FSAR SECTION REFERENCES

Job No. 7220

Section No. ______________________ Rev. ______

Section Title ______________________

Originating Discipline ______________________

The following documents were reviewed while preparing the above titled section of the FSAR (indicated by Section No., Rev. No., etc.):

1. Regulatory Guide 1.70, Rev. 2, Section ______________________

2. NRC Standard Review Plan, Section ______________________
   NRC Branch Position Papers ______________________

3. DRL Safety Evaluation, Section ______________________

4. PSAR Section or Questions ______________________

5. Unincorporated SAR Change Notice
   Incorporated by This Text ______________________

6. Unincorporated SAR Change Notice
   Considered ______________________

7. Regulatory Guides No./Rev. ______________________

8. Project Regulatory Guide Position
   Considered NA ________ YES ________

9. Responses to NRC Regulatory Guide
   Questions No. ______________________

10. Supplemental Environmental Report Section ______________________

11. Final Environmental Report Section ______________________

12. System Description/Rev. ______________________

13. Dwgs. or Specs./Rev. ______________________

14. BESSAR Section Reviewed ______________________

15. BESSAR Section Adapted ______________________

    BESSAR Section Found Non-Applicable Because ______________________
    ____

BY: ______________________
Originating Engineer

CHECKED: ______________________
FSAR Coordinator

Attachment 1-2

MIDLAND PROJECT
FSAR INTERFACE ROUTING SLIP

Attached is the following FSAR Sub-Section(s) for your review:

TITLE: ______________________________

NUMBER(S): ______________________ rev. __________

Please return to ________________ , 8th floor, after review is completed by your discipline. Please keep routing slip with the FSAR text material. Please initial all comments for historical tracking purposes.

In order to be able to maintain our FSAR schedule, all comments must be returned no later than five (5) working days after the issue date below. We appreciate your cooperation in expediting review and return to us in the shortest possible time.

Thank you,

____
FSAR Administrator

Comments: Refer questions to:

FOR INFORMATION ONLY

COORDINATION PRINT
JOB 7220

DATE ____________

TO	INITIAL	DATE
Architech		
Civil		
Control Sys		
Electrical		
Geotech		
Nuc Eng		
Plant Desgn		
Mechanical		
Don Riat		
FSAR Coor		
return to: CINDY FINE	by:	

Attachment 1-3

MIDLAND PROJECT FSAR
INTERFACE COMMENT CLOSURE

Job No. 7220 Date ____________________

Section No. ______________________ Rev. ________

Section Title ______________________________

Originating Discipline ______________________

The above titled section has been reviewed by the following disciplines. The initials below, of the EGS or his designee, indicate satisfactory resolution of his group's comments.

1. ____________________

2. ____________________

3. ____________________

4. ____________________

5. ____________________

____

____

Prepared: ____________________
Originating Engineer

Approved: ____________________
Discipline Team Leader

Attachment 1-4

MIDLAND PLANT FSAR
CHIEF ENGINEER'S COMMENT CLOSURE

Job No. 7220 Date ______________

Section No. ______________

Section Title ______________

Originating Discipline ______________

The above titled section has been reviewed by the following chief engineers and all comments are closed. Original DRNs are attached for the project files.

1. ______________

2. ______________

3. ______________

The text changes required to resolve Chief's Comments have been coordinated as necessary with the following affected disciplines. The initials below, of the EGS or his designee, indicate satisfactory resolution of the Chief's comments which affect his discipline.

1. ______________

2. ______________

3. ______________

Prepared: ______________
Originating Engineer

Approved: ______________
Discipline Team Leader

AMENDMENT/COMM   MENT LIST

MIDLAND 1&2-FSAR
(Sorted by Sections)

Section	Page/ Table	Area/ System	Missing Information	Date Due	Responsibility Company	Responsibility Group	Closed by Amendment
1.2	FIG 1.2-22	Equipment location figure	Revise Drawing M-19 to eliminate incomplete sections (V)	N/S	Bechtel	PD/M	
1.5.8	1.5-3	Blowdown forces on internals and core (Licensing Issue 1)	Results of reactor internals and core analyses	04/80	B&W	-	
1.7	TBL 1.7-10 and 1.7-11	ESFAS, HPI lube oil pumps	Revise J-237, J-238, and J-239 logic diagrams with regard to RAS actuating HPI lube oil pumps (Q&R 211.124)	04/79F	Bechtel	CS	
2.5.4.13.1	2.5-69	Benchmark locations	Survey settlement measurements (TBL 2.5-14A) will be submitted yearly until commercial operation	N/S	Bechtel	CV/GT	
2.5	TBL 2.5-14	Contact stresses and ultimate bearing capacity for foundations supporting seismic Category I and II structures (Licensing Issue 44)	Provide ultimate bearing capacity and factor of safety for the diesel generator building, solid radwaste building, and condensate, primary, and borated water storage tanks (footnote 2)	N/S	Bechtel	CV	
2.5	TBL 2.5-16	Idealized soil profile and parameters	Provide average values for layers A and B	07/79	Bechtel	CV	
3.5	FIG 3.5-10 through 3.5-14	Licensing commitment: equipment locations for missile protection study	B&W to review figures (M-45 through M-49) (Refer to Bechtel-1235, 2-22-79)	04/79F	B&W		
3.5	FIG 3.5-10 through 3.5-14	Reactor building internal missile study	Revise figures to indicate changes in plant layout and missile protection design (M-45 through M-49)	N/S	Bechtel	PD	
3.6.2.1.1	3.6-9	Pipe break locations	Finite element analysis on primary loop, B&W (Mt. Vernon) provides detailed analysis of pipe stress, radial and axial (A)	07/79	Bechtel (JPK)	M	

Attachment 1-5

SECTION	COMMITMENT	PSAR PAGE	REV.	RESPONSIBILITY	STATUS	DISPOSITION DOCUMENT
3.2.3.1.13	A 1/6 scale model test of the reactor and internals is being performed... final variations in flow will be determined when the tests are completed.	3-34	4	-W------------	Incorporated	FSAR Section 4.4.2.5 Rev 0
3.2.3.1.1f 1.1f	The reactor trip point is 147.5% rated power, and the maximum over-power which is 114%, will not be exceeded under any condition.	3-35	0	-PC-----------	Incorporated	FSAR Ch 15 Rev 0, Section 3A, R.G. 1.49
3.2.3.2.4	At the present time, an analog computer simulation is being developed to evaluate the performance of the vent valves in the plenum chamber. This analysis will be used to demonstrate that adequate steam relief exists so that cooling of the core will be accomplished.	3-64	4	-W------------	Incorporated	FSAR Sections 1.5.4, 6.2.1.3.2, Rev 0 (Supp 2 to S.E.R. of Midland Plant Units 1 & 2: NRC, July 1977)
3.2.4.1	The reactor internal components are designed to meet the requirements specified in section 3.2.4.1 of the PSAR.	3-65	4	-W-----------I	Incorporated	FSAR Section 3.9.5 Rev 0
	Material for the reactor internals bolting will be subjected to rigid quality control requirements to insure structural integrity. The bolts will be inspected for surface flaw indications after all fabrication operations have been completed. Torque values will be specified for the final assembly to develop full-bolting capability. All fasteners will be lock-welded to insure assembly integrity.	3-66	4	BW-m-----qF-QI	Closed	E-Spec 08-1023000012-01 describes torquing and locking requirements; fastener inspection is also in this E-Spec.

Attachment 1-6

Time Period	Moisture Measurements to Aid Compaction: As Practical in the Borrow Area	Moisture Measurements to Aid Compaction: Loose Fill Prior to Compaction ($\pm 2\%$)	Moisture Measurements to Aid Compaction: During Compaction ($\pm 2\%$)	Control for Final Acceptance: Moisture	Control for Final Acceptance: Density
Prior to August 1, 1977	No measurements taken	No measurements taken	No measurements taken	Measurements taken (moisture controlled here)	Tests taken (density controlled here)
August 1, 1977, to winter of 1977-1978	Measurements taken, but not compared to laboratory standard	No measurements taken	No measurements taken	Measurements taken	Tests taken (density controlled here)
1978 to 3/29/79	Measurements were taken and controlled in at least one of these areas		No measurements taken	Measurements taken	Tests taken (density controlled here)
3/29/79	Measurements may be taken	Measurements may be taken	No measurements taken	Measurements taken (moisture controlled here)	Tests taken (density controlled here)

PRELIMINARY RESULTS OF REVIEW OF COMPACTION SOIL TEST DATA

Described below are preliminary findings:

- Indicated in the chart below and attached Pages 2 through 9 are examples of certain laboratory standard compaction tests which were used many times more than would be expected. Many tests plot outside the appropriate zero air voids curve.

Soil Classification Standard	Approximate Number of Times Referenced	Approximate Number of Times Outside Zero Air Voids
RD-61	556	-
RD-59	65	-
RD-55	555	-
BMP-270	220	85
BMP-271	135	50
BMP-269	225	20
BMP-277	150	70
BMP-278	80	45

- The time span over which standards were used has been found to be as long as 24 months.

- Retesting of failing tests may have improperly used different standards with lower maximum densities and resulted in passing tests.

- Certain errors in actual calculations have been discovered.

- There is some evidence that proctor curves that do not represent the materials may have been erroneously selected.

- There are indications that moisture readings obtained with the Nuclear Moisture-Density Device might be in error.

****

HISTOGRAM OF COMPACTION FOR CLASSIFICATION   F061

FOR THIS CLASSIFICATION, MAX LAB DRY DENSITY =   125.3

****

RANGE, % COMP.	HIST %	TEST COUNT
< 55	2.9	16
55-60	1.6	9
60-65	3.1	17
65-70	3.4	19
70-75	3.6	20
75-80	4.9	27
80-85	12.1	67
85-90	10.6	59
90-95	14.6	81
95-100	14.9	83
100-105	12.1	67
105-110	6.7	37
110-115	4.5	25
115-120	2.2	12
120-125	1.3	7
> 125	1.8	10

TOTAL COUNT OF TESTS =   556

****

HISTOGRAM OF COMPACTION FOR CLASSIFICATION R059

FOR THIS CLASSIFICATION, MAX LAB DRY DENSITY = 126.3

****

RANGE, % COMP.	HIST %	TEST COUNT
< 55	3.1	2
55-60	.0	0
60-65	.0	0
65-70	3.1	2
70-75	1.5	1
75-80	4.6	[illegible]
80-85	4.6	[illegible]
85-90	7.7	5
90-95	6.2	4
95-100	16.9	11
100-105	10.8	7
105-110	15.4	10
110-115	10.8	7
115-120	4.6	3
120-125	3.1	2
> 125	7.7	5

TOTAL COUNT OF TESTS = 65

ATTACHMENT 1-8

****

HISTOGRAM OF COMPACTION FOR CLASSIFICATION B055

FOR THIS CLASSIFICATION, MAX LAB DRY DENSITY = 109.7

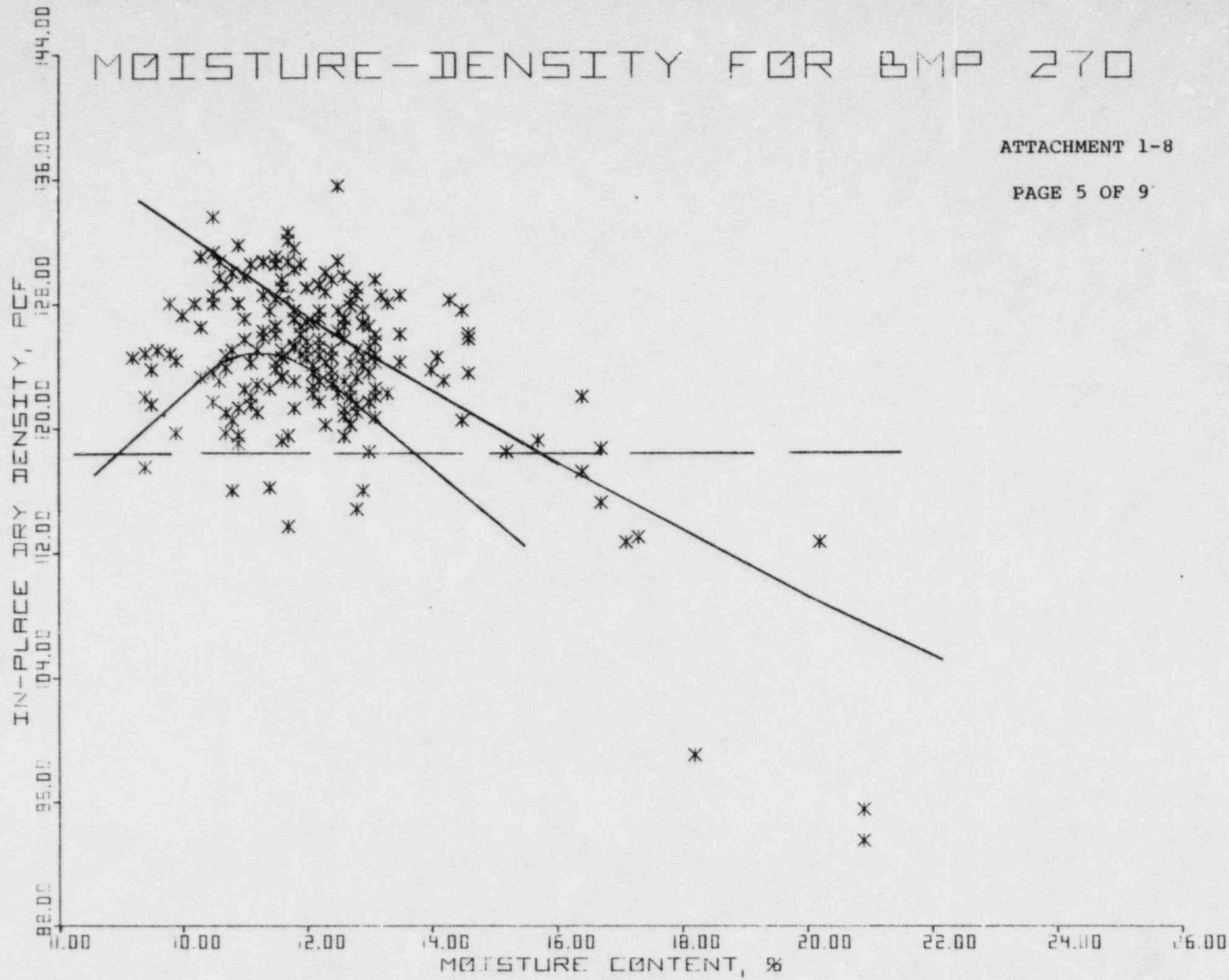
****

RANGE, % COMP.	HIST %	TEST COUNT
< 55	.4	2
55-60	.0	0
60-65	.2	1
65-70	1.4	8
70-75	.4	2
75-80	2.2	12
80-85	3.4	19
85-90	4.0	22
90-95	10.3	57
95-100	11.9	66
100-105	15.5	86
105-110	13.5	75
110-115	12.4	69
115-120	10.3	57
120-125	6.7	37
> 125	7.6	42

TOTAL COUNT OF TESTS = 555

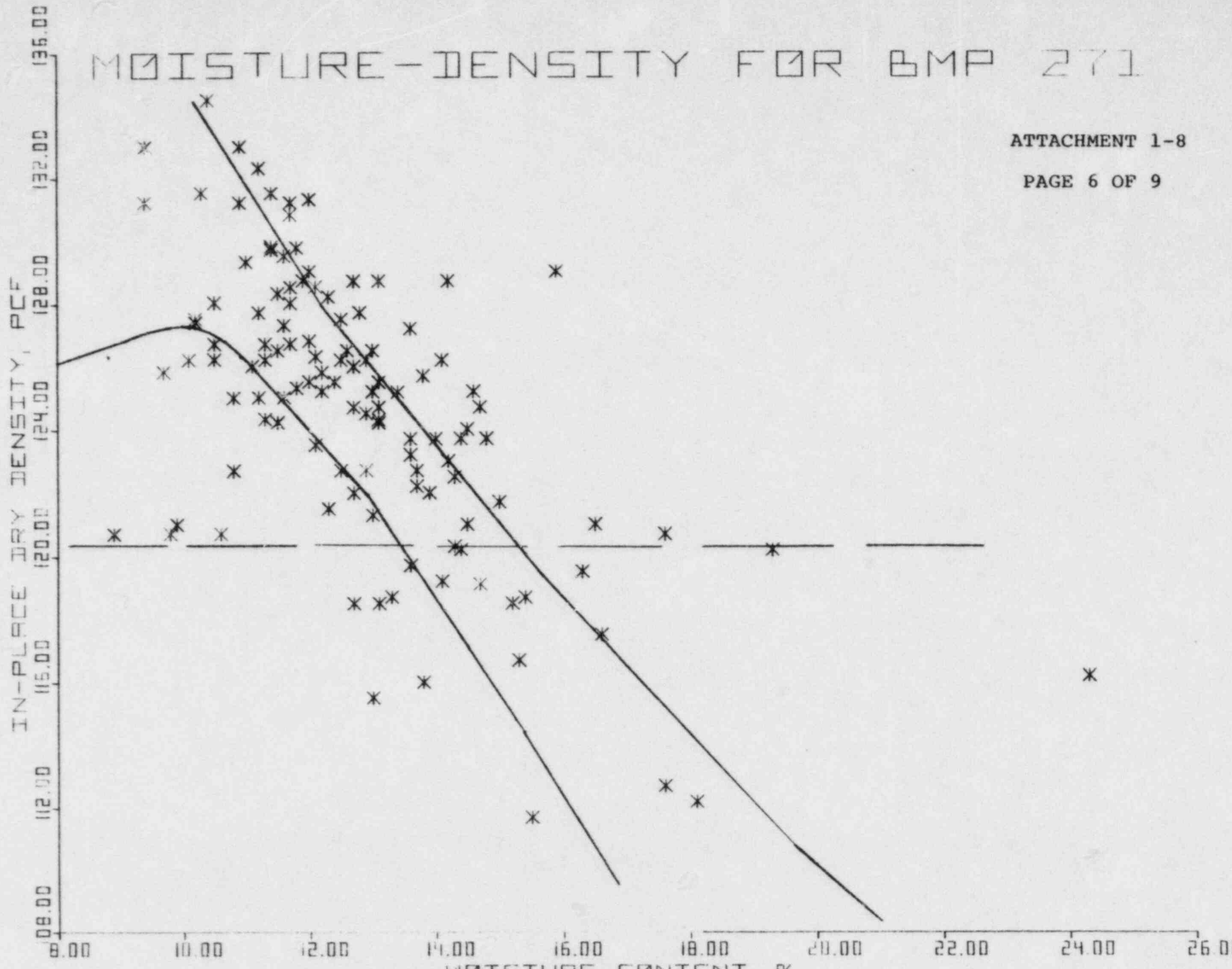
ATTACHMENT 1-8

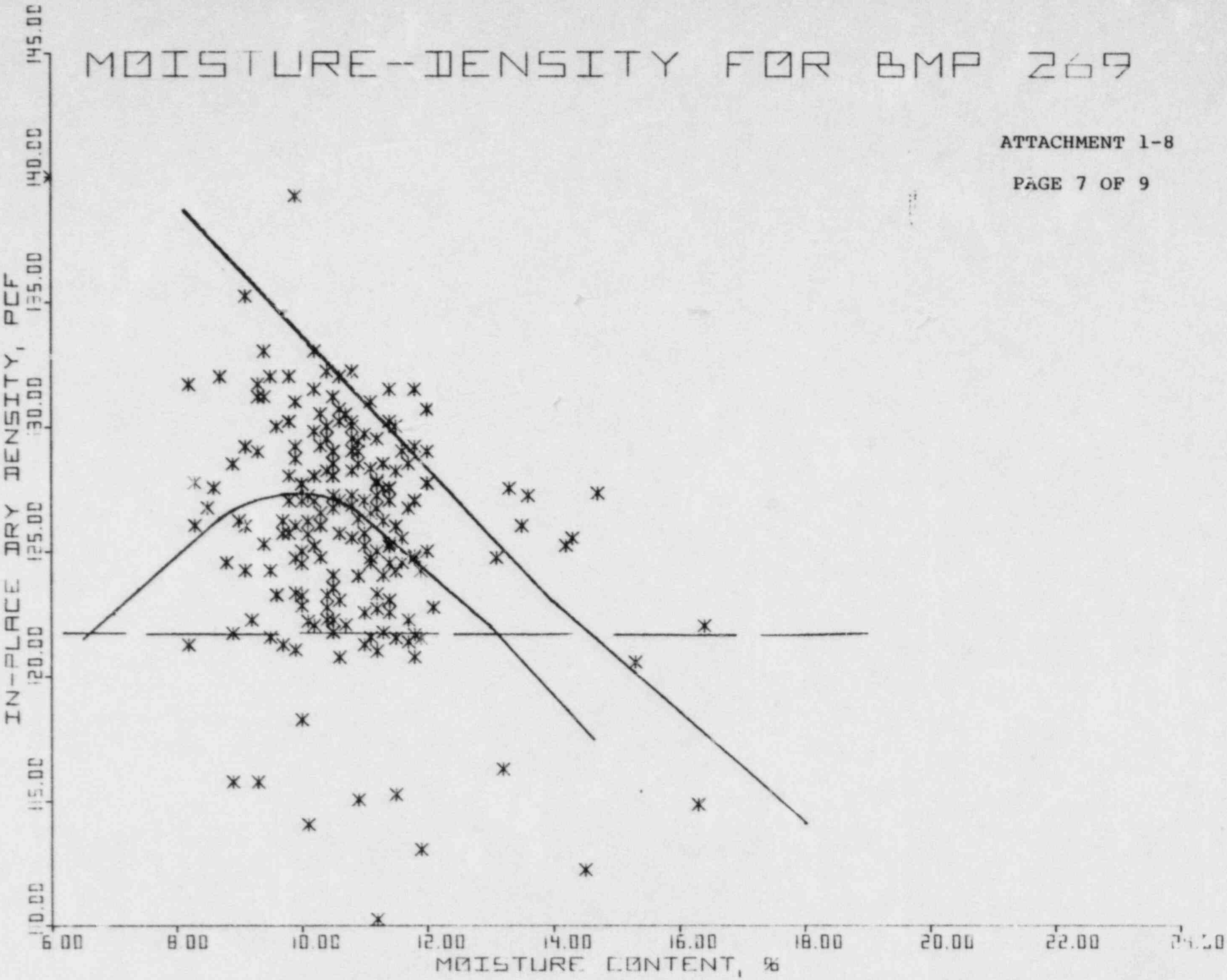
PAGE 5 OF 9



ATTACHMENT 1-8

PAGE 6 OF 9



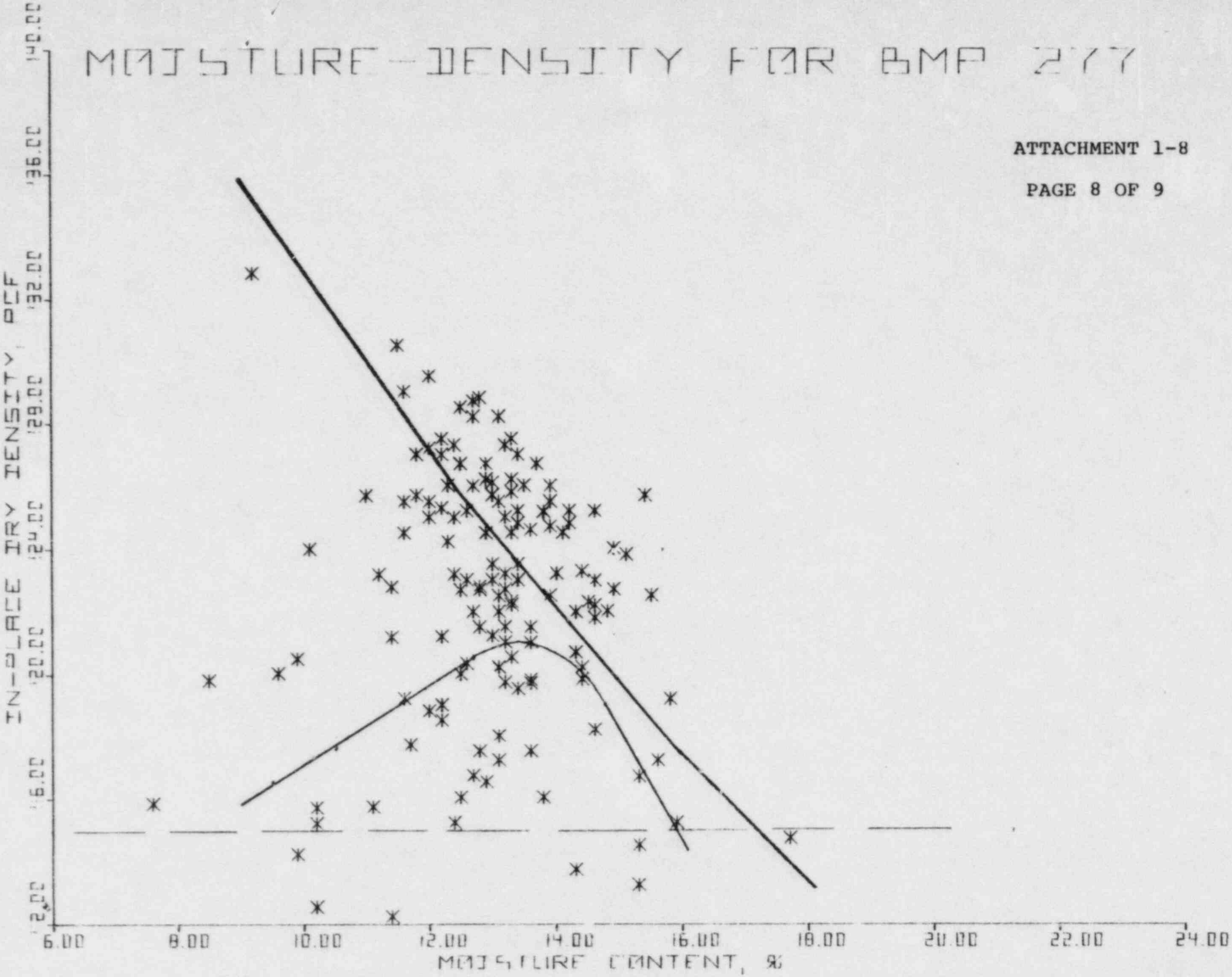


ATTACHMENT 1-8

PAGE 7 OF 9

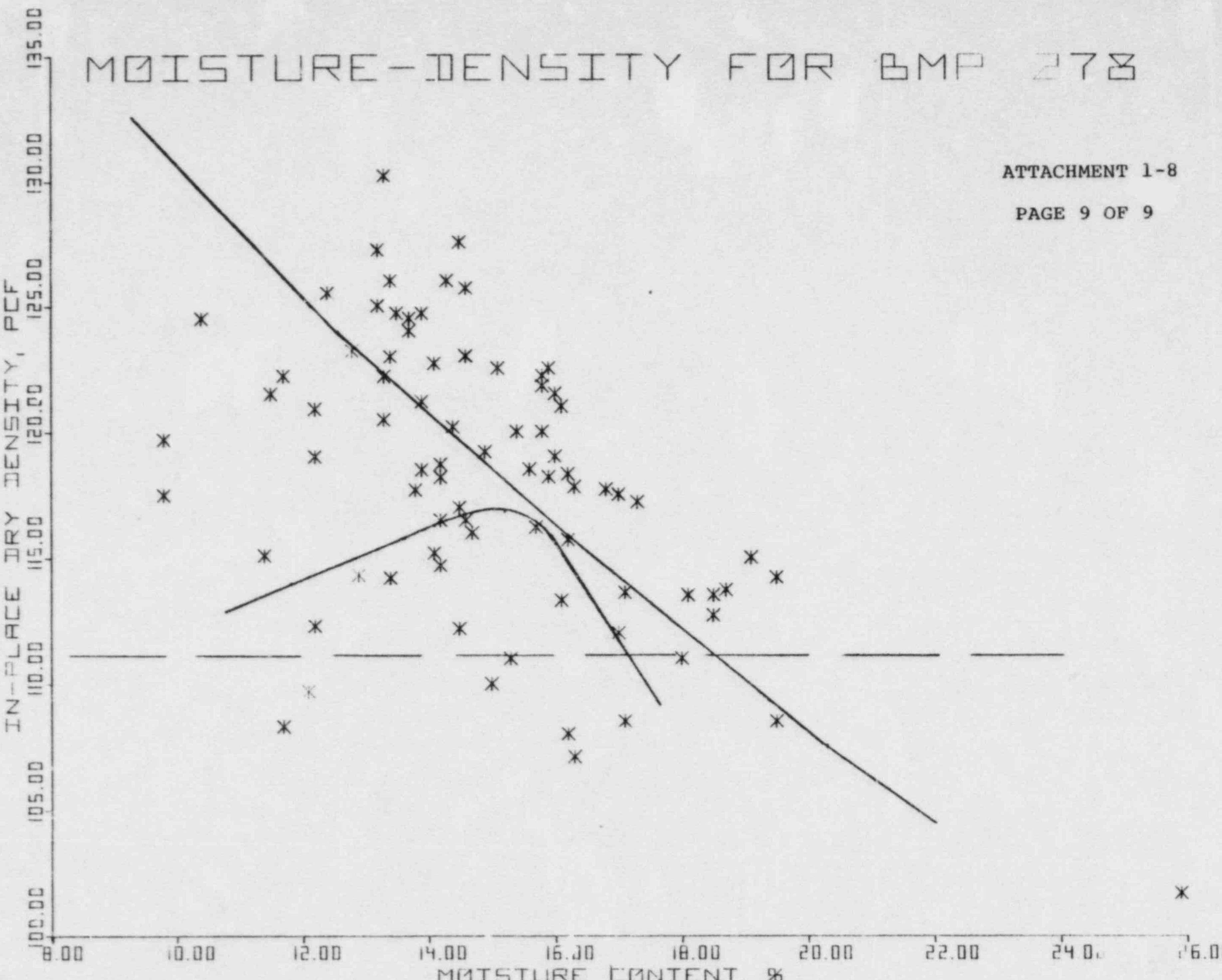
ATTACHMENT 1-8

PAGE 8 OF 9



MØISTURE-DENSITY FØR BMP 278

ATTACHMENT 1-8



Question 2

Discuss the consideration given to, and estimate the cost of, grouting and natural lacustrine deposits (sands) upon which safety-related structures are founded.

Response

The safety-related structures that have natural beach, dune, or lacustrine sands beneath them are the borated water storage tanks, service water pump structure, diesel generator building, diesel fuel oil storage tanks, and auxiliary building railroad bay. With the exception of 2.5 feet of loose sand encountered between elevations 599 feet and 601.5 feet in boring SW-6 below the fill-supported portion of the service water pump structure, all of the natural sands beneath the structures are medium dense to very dense, and are not subject to liquefaction or significant settlement under load. Therefore, they require no treatment.

Grouting of the loose natural sand at the service water pump structure is not required because that portion of the structure will be underpinned with piles.

Question 3

During the meeting on March 5, 1979, you stated that on August 21, 1978, construction survey data indicated a settlement approaching the maximum value given in FSAR Figure 2.5-48. However, your response to staff request 362.12 by FSAR Revision 18 states, "In July 1978, the settlement of the diesel generator building exceeded the anticipated values shown in FSAR Figure 2.5-48." Clarify this apparent inconsistency.

Response

The response to Question 362.12 in FSAR Revision 18 dated February 1979 will be clarified in the May 1979 ammendment of the FSAR. This response was originally derived from MCAR 24, Interim Report 1, dated September 22, 1978 (attached to the interim 10 CFR 50.55(e) report transmitted to the NRC on September 29, 1978), which states that "the diesel generator building settlements were noticed to exceed anticipated values in July 1978." The "anticipated values" referred to in this report were not the "estimated ultimate settlement" values given in FSAR Figure 2.5-48. (Estimated ultimate settlement is defined as the estimated value predicted for a 40-year plant life.) Instead, these "anticipated values" were merely values of settlement that were greater than the amount of settlement which would have been expected under usual conditions for the elapsed time. The preparer of the FSAR revision erroneously combined these two unrelated values.

The July 1978 settlement readings were within the estimated maximum settlement values given in the FSAR. The settlement readings of the building are recorded in Figures 3 and 4 of MCAR 24, Interim Report 3, dated December 27, 1978 (attached to the interim 10 CFR 50.55(e) report transmitted to the NRC on January 5, 1979).

Question 4

Specify and justify the acceptance criteria which you will use to judge the acceptability of the fill, structures, and utilities upon conclusion of the preload program. Compare these criteria with that to which the material was to have been compacted by the original requirements set forth in the PSAR. The response should consider all areas where preloading is either planned or in progress (i.e., diesel generator building, borated water storage tanks, diesel fuel oil storage tanks, Unit 1 transformer, condensate storage tanks, and others still under evaluation). Describe how conformance to these criteria will result in assurance that unacceptable residual settlements cannot reasonably be expected to occur over the life of the plant. For each such area, state the extent of residual settlement which will be permitted and the basis for each limit.

Response

The criteria and the extent to which residual settlements will be permitted will be provided by August 1979. The manner in which acceptability criteria for the fill will be developed is discussed in the following paragraphs. Acceptability of the structures and utilities will be determined based on their ability to accommodate the predicted fill settlements.

The compaction requirements set forth in the PSAR were based on the premise that significant engineering properties, strength, and compressibility are related to degree of compaction. Where the engineering properties can be established by other, more direct means, the degree of compaction becomes irrelevant.

The surcharge and the completed portion of the diesel generator building will produce stresses in the fill that, at all depths, will exceed those that will prevail when the structure is operational. The surcharge will remain until excess pore pressures are essentially dissipated and the rate of residual settlement becomes small and can be predicted conservatively by extrapolation. It can then be concluded with assurance that, after removal of the earthen surcharge, the rate of settlement will be considerably less than the aforementioned prediction. Because of the initial variability of the degree of compaction of the fill, it is unlikely that the compaction requirements of the PSAR will be satisfied at all points, but because of the ensured favorable settlement characteristics due to the surcharge, the design intent of the PSAR will be met.

The preloading at any structure serves the following purposes:

1) A primary benefit of preloading a building is that most of the settlement and differential settlement occurs before the building is put into service. Connections to the building can then be made after most of the differential settlement has already taken place, which will ensure a reliable design for the connections affected by differential settlement.

2) The preload is also a full scale load test of the foundation soils. Data obtained during preloading will provide a reliable relationship between settlement and load which will be used to predict residual settlements of the structure.

3) The preload consolidates soft areas of clay fill, resulting in improved and much more uniform engineering properties of the fill.

As a result of the improved, more uniform engineering properties of the fill and based on the full scale load test characteristic of the preloaded fill, a reliable prediction of upper limits of residual settlement will be possible. This will provide the assurance needed that unacceptable settlements will not occur during the life of the plant.

Preloading will also be carried out at the borated water storage tanks and diesel fuel oil storage tanks. The purpose of this preloading is to make a full scale test of the foundation soils. Therefore, in these two areas, the tanks will be filled with water and settlement rates will be monitored. In the unlikely event that these tests indicate the need for any corrective action, this will be undertaken as discussed more fully in the response to Question 6.

The preloading will not improve the quality of any loose sand significantly. Where loose sands are present that would affect the performance of a structure, the sands will be treated. The details of this treatment will be provided in August 1979.

Following removal of the preload fill at the diesel generator building and the locations of other buildings where preloading has been applied to reduce settlements, dynamic moduli measurements will be made. The data from these measurements will be used to evaluate the seismic response of the structures supported by the fill to determine that they satisfy the commitment made in the PSAR.

Question 5

To what extent will additional borings and measurements be taken after completion of preloading programs to ascertain that the material has been compacted to the original requirements set forth in the PSAR?

Response

As mentioned in the response to Question 4, preloading to loads comparable to the weight of the structure supported by the fill will consolidate soft clay areas and improve and make more uniform the engineering properties of the fill. Furthermore, the preload is, in effect, a full scale load test and will yield load settlement relationships that are more reliable and representative of the foundation conditions than evaluations based on sampling and soil testing.

Because the preload will improve the engineering properties of clay fill and provide reliable, positive information on performance that applies to all of the preloaded fill, the data obtained can be used to predict residual settlements with confidence. The indirect procedure of evaluating the percent compaction at sample locations in borings and relating them to the whole body of fill under investigation is not as positive as the direct measurement of performance during preloading.

For the stated reasons, it is unnecessary to make additional explorations for the purpose of making comparison with the PSAR density criteria. It is planned to monitor the settlement of the structures during the life of the plant to provide a record of performance.

Question 6

You propose to fill the borated water storage tanks and measure the resulting structure settlements.

(a) On what basis do you conclude a surcharge no greater than the tank loading will achieve compaction to the extent intended by the criteria stated in the PSAR? What assurance is provided by the technique that residual settlement for the life of the plant will not be excessive?

(b) A similar procedure is proposed for other tanks, including the diesel fuel oil storage tanks, and should also be addressed.

(c) The borated water storage tanks have not yet been constructed and are to be located upon questionable plant fill of varying quality. Provide justification why these safety-related tanks should be constructed prior to assuring the foundation material is suitable for supporting these tanks for the life of the plant. For example, can the tanks be removed with reasonable effort without significant impact?

Response (to Question 6, Part a)

The field exploration program in the area of borated water storage tanks shows that the fill consists of stiff to very stiff sandy clay fill. This condition is suitable for the support of these tanks. To confirm this and demonstrate that the fill is satisfactory, the tanks will be constructed and filled with water in order to make a full scale test of the foundation soils. The piping connections will be delayed until most of the settlement has taken place under the load. The tank filling will provide reliable information for predicting long-term settlement, which will allow a conservative design of piping connections. While the degree of compaction set forth in the PSAR may not be satisfied at all points, the PSAR design intent will be met because the fill will have been subjected to a full scale load test which will allow a reliable prediction of long-term settlement. The full scale load test provides direct and reliable assurance that unpredicted long-term settlements will not occur.

Response (to Question 6, Part b)

The diesel fuel oil storage tanks have been filled with water and are being monitored to predict future settlement and to assess the need for remedial work required to ensure limited residual settlement. These tanks have a weight that is approximately the same as that of the fill they replace, and are supported on medium to stiff sandy clay fill. The tanks are surrounded with backfill consisting of loose to dense sands and very soft to stiff clays. Locations of borings made in this area are shown in Figure 12-1. If results of the evaluation made on these tanks cannot ensure limited residual settlements, the tanks will be surcharged in excess of their full weight or removed and reconstructed. The precise corrective measures considered to be appropriate will be provided when the evaluations of the load test have been completed. There are no Seismic Category I tanks supported on fill other than the borated water storage tanks and the diesel oil fuel tanks.

Response (to Question 6, Part c)

As described in the response to Part a, the exploratory program in the area shows the materials to be suitable for support of the tanks. However, in order to provide justification for this conclusion, the tanks will be constructed and filled as a full scale test of the soils beneath them. A reliable estimate of long-term settlement will be determined based on the measured settlements of the loaded tanks. All connections to the tanks will be made after most of the settlement has taken place. Although removal of the tanks after construction would be both costly and require a schedule delay, the tanks are accessible, and removal remains a viable alternative if unanticipated settlements occur that require remedial action.

Question 7

Describe in detail how you will determine the adequacy of the electrical duct banks in view of the previous loading caused by contact of the diesel generator building foundation with these banks. Describe corrective measures which may be taken in the event of unacceptable results.

Response

Four electrical duct banks run south from the auxiliary building under the turbine building foundation and then turn upward and pass through the footings of the diesel generator building as shown in Figures 7-1 and 7-2. Exploration revealed that the duct banks were in direct contact with the footings and were restraining the diesel generator building settlement.

Parts of the diesel generator building footings and/or parts of the duct bank steps were removed to provide a 12-inch clearance for a vertical joint between the ducts and building footings. This was done to prevent direct load transfer from the building to the duct banks.

A summary of survey data taken during the duct bank isolation period is presented below:

	Bay 1 (inches)	Bay 2 (inches)	Bay 3 (inches)	Bay 4 (inches)
Building settlement before isolation of ducts, November 10, 1978	1.56	.95	.97	1.09
Building settlement after isolation of ducts, November 24, 1978	1.85	1.72	2.34	2.72
Rebound (upward movement) of ducts, November 24, 1978 (measured at top of duct bank)	-	.06	.12	.18

Note: Bay locations are shown in Figure 7-1.

During the week immediately after the duct banks were isolated, the east end of the diesel generator building (Bay 4) experienced the largest settlement and the duct bank in Bay 4 had the largest rebound. It is therefore assumed that the duct bank in Bay 4 was supporting the largest imposed building load of the four duct banks. Based on visual observations of the gaps between the building footings and the mud mat, an estimated two-thirds of the east wall of the diesel generator building, or approximately 1,000 kips, was supported by the duct bank in Bay 4.

The duct bank deflection was assumed to be equal to the diesel generator building settlement before isolation. Based on this assumption, the 1.56-inch deflection of Bay 1 and the 1.09-inch deflection of Bay 4 could result in strains in the duct bank reinforcing steel at Point A (see Figure 7-2) which exceed the yield strain. This estimate of strain is based on conservative assumptions and is therefore considered to be an upper limit value.

The load transferred from the building to the duct bank was a one-time load which caused the duct bank to settle directly under the vertical section of the duct as shown by the small amount of rebound measured after the building load was released. Thus, the bending which could have caused the reinforcing steel at Point A to exceed the yield strain is due to settlement. Settlement primarily induces additional strain, which is a self-limited effect and will not affect the ultimate strength of the duct bank.

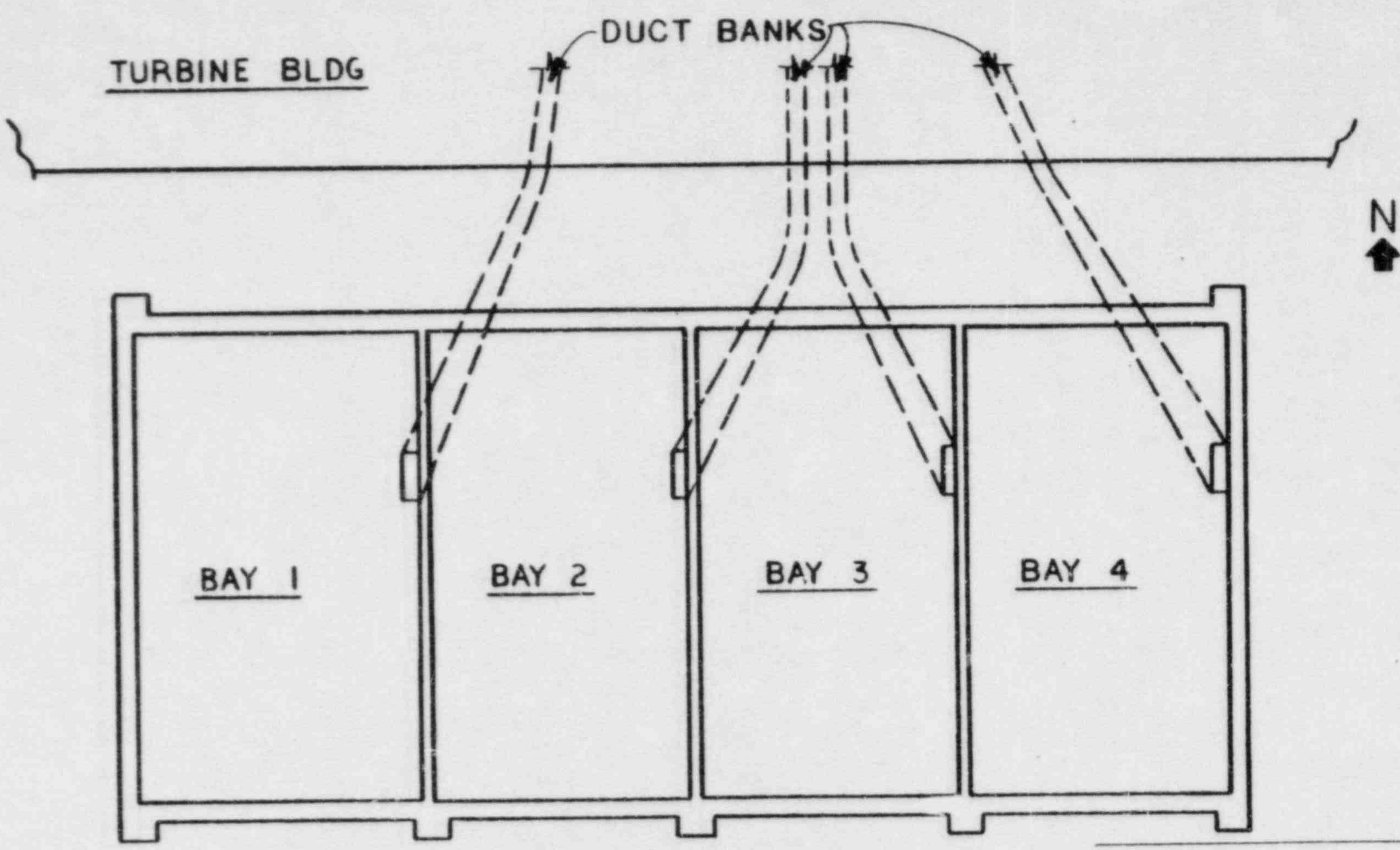
The function of the duct banks is to provide a space in the ground through which cables may be pulled. They also provide a casing around the cables to protect them during future construction activities in the area. The duct banks are not required to provide a watertight boundary around the cables. Therefore, cracking of the duct banks due to differential settlement does not affect their design functions.

The assumed 1,000-kip load previously mentioned is the highest that will occur during the life of the plant. The load due to settlement of the duct banks during the diesel generator building preload program will be larger than the load during the life of the plant, but less than the assumed 1,000-kip load.

The strains induced in the duct banks due to seismic effects are small (less than 10% of the yield strain) and, when added to the possible strains from settlement, will have no further effect on the function of the duct banks. Therefore, if the duct banks are still intact and continuous with no obstructions after the diesel generator building load has been removed and if the duct banks remain intact after the preload program has been completed, they will be able to withstand all future operating loads.

All four duct banks were checked for continuity and obstructions after they were isolated from the diesel generator building footings. This was accomplished by pulling a segmented, hard fiber composition rabbit through each conduit (see Figure 7-3). The rabbit was pulled through the conduit by hand. No obstruction was detected during the pulling of the rabbit. The continuity check will be performed again after the preload program is completed. The results of this check, along with the results of the duct bank settlement survey, will be available after August 1979.

In the event that any significant obstructions 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.

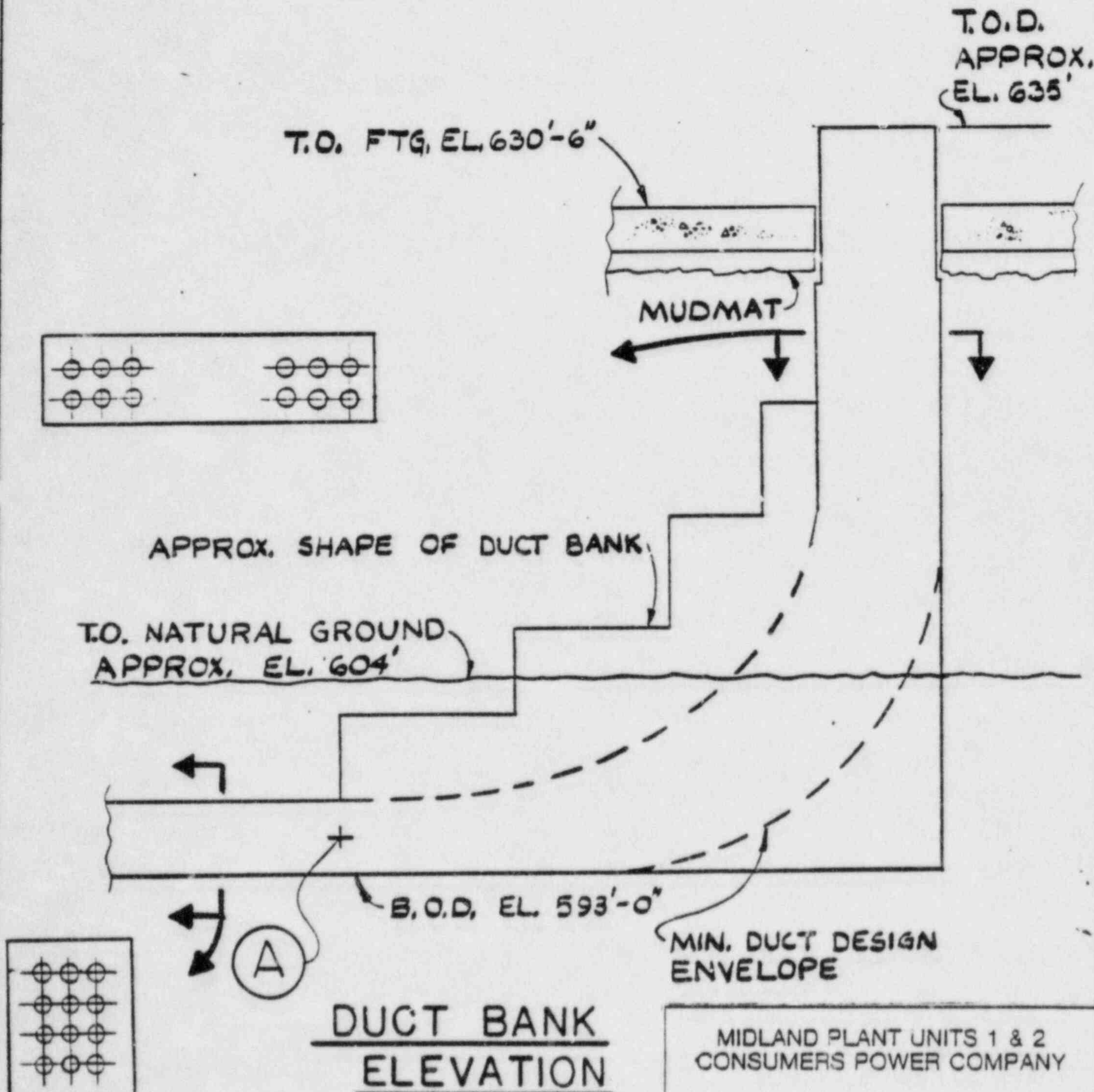


DIESEL GENERATOR BLDG
DUCT BANK LAYOUT

MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

ELECTRICAL
DUCT BANK LAYOUT

FIGURE 7-1 DATE: 4 24 79



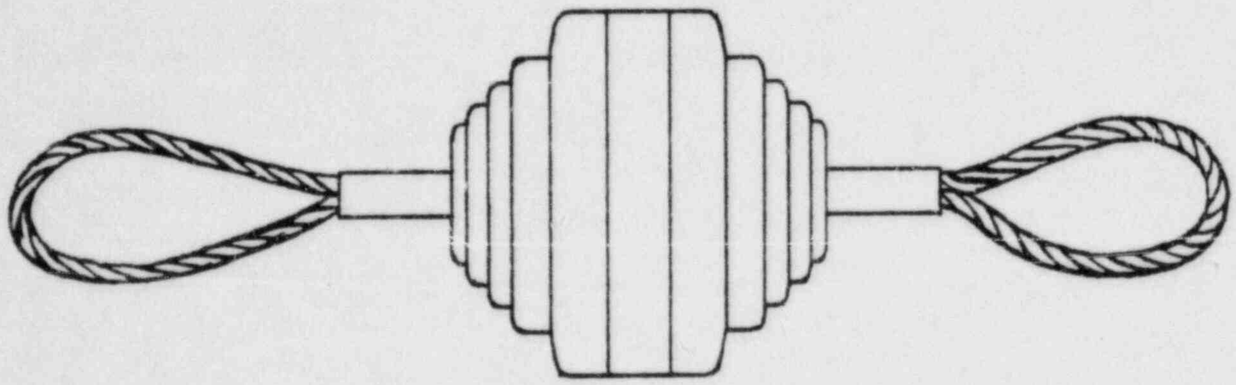
DUCT BANK
ELEVATION
(LOOKING EAST)

MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

ELECTRICAL
DUCT BANK ELEVATION

FIGURE 7-2 DATE: 4/24/79

G-0588



INSIDE DIAMETER OF CONDUIT = 4¼"
OUTSIDE DIAMETER OF MANDREL = 3¾"

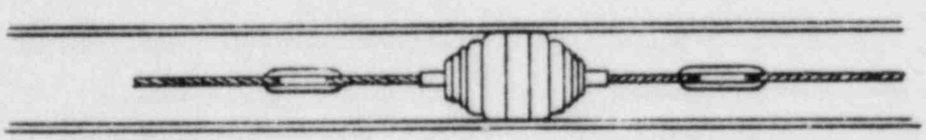


DIAGRAM OF MANDREL (RABBIT) USED TO CHECK CONDUITS

MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

RABBIT
FOR ELECTRICAL DUCT

FIGURE 7-3 DATE: 4/24/79

Question 8

What tolerance is placed upon the alignment of the diesel generator, and upon what is this limit based? How will the present differential settlement of the diesel generator pedestals be corrected? Discuss the extent and rate of residual settlement of the diesel generator pedestals predicted over the life of the plant. In view of the variability of the foundation material indicated by Bechtel's Interim Report 4 to MCAR 24 which was forwarded by your letter of February 23, 1979, how can long-term differential settlement be predicted with sufficient confidence to assure reliable start-up and operation of the diesel generators when needed? What surveillance program (and inspection frequency) for the pedestals do you intend to conduct to assure detection of misalignment before these limits can be reached? What corrective action, and the basis therefor, do you propose if these limits should be approached?

Response

Differential settlement of the diesel generator pedestals will have no effect on alignment of the engine and generator because they both are mounted on the same foundation. According to Delaval Turbine, Inc. of Oakland, California (the manufacturer of the four identical diesel generators), a 5-degree combined backward tilt and roll of the pedestal or a forward tilt of 1.4 degrees and roll of 5 degrees combined will not affect the performance of the engine and generators. The present tilt and roll is less than 0.4 degree. The diesel generators at Midland are similar in design to marine engines designed and manufactured by Delaval Turbine, Inc. which are subjected to tilt and roll larger than 5 degrees at frequent cycles. Therefore, the 5-degree combined backward tilt and roll criteria for diesel generators (for a one-time occurrence like settlement) is conservative.

The effects of differential settlement on the nozzle forces and moments or displacement for the piping system at the interface of the diesel generators are discussed in Question 18.

Figure 8-1 is a graphical representation of the time settlement rate of the diesel generator pedestal corners. Weekly settlement values are indicated on the chart. As of April 6, 1979, pedestal 3 had the greatest roll at 0.083 foot (.24 degree) and 0.068 foot (.31 degree). Figure 8-3 identifies settlement values at their respective corners along with tilt and roll.

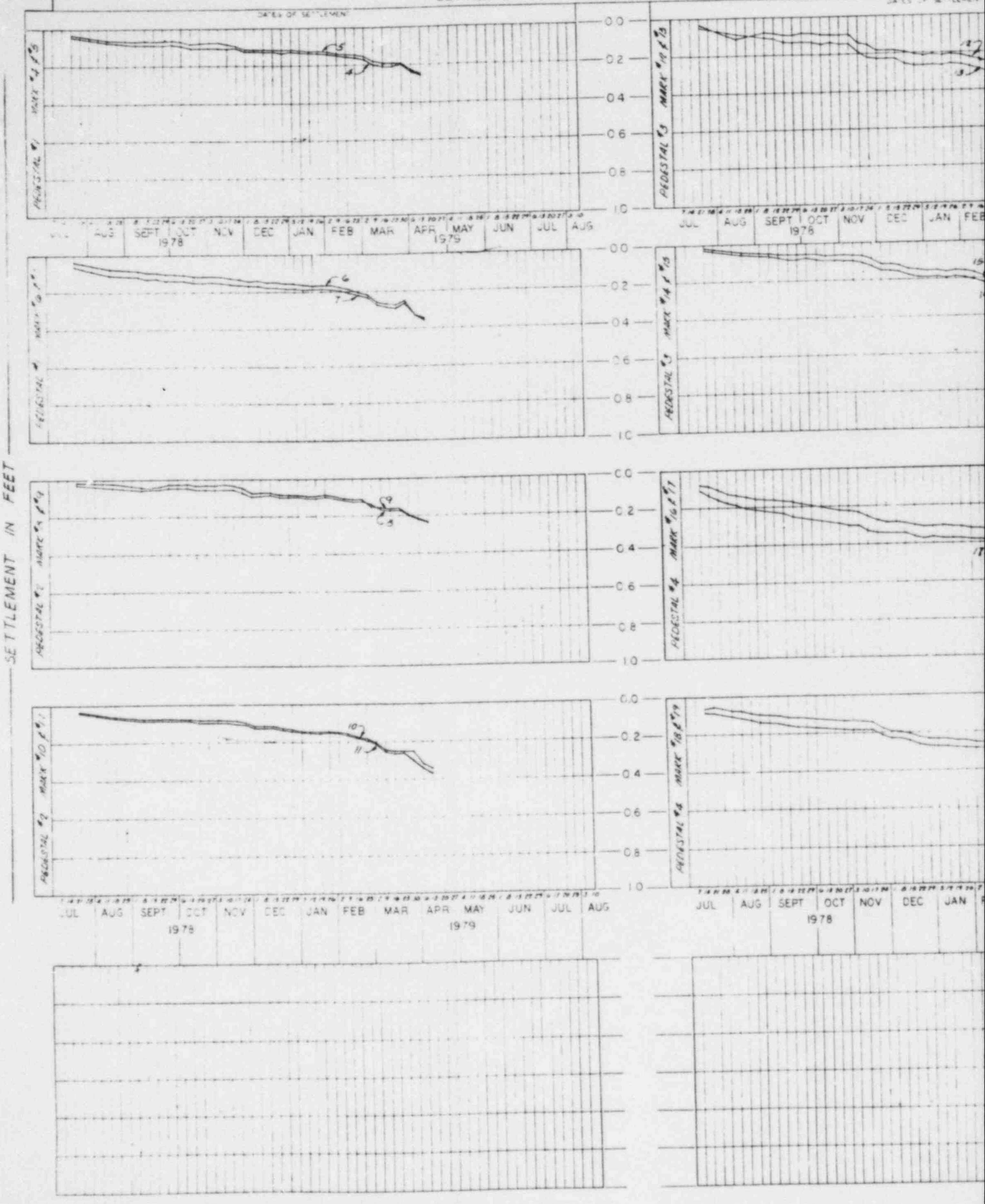
Each diesel generator is located on one foundation pedestal independent of the building structure. The dimensions of the four identical foundations are shown in Figure 8-2. The foundation for the diesel generator is a reinforced concrete structure having a minimum compressive strength of 4,000 psi. The dimensions and composition of the pedestal are such that it has enormous bending and torsional stiffness. Therefore, the top of the pedestal after settlement will generally lie within one plane and will not be warped to any significant extent.

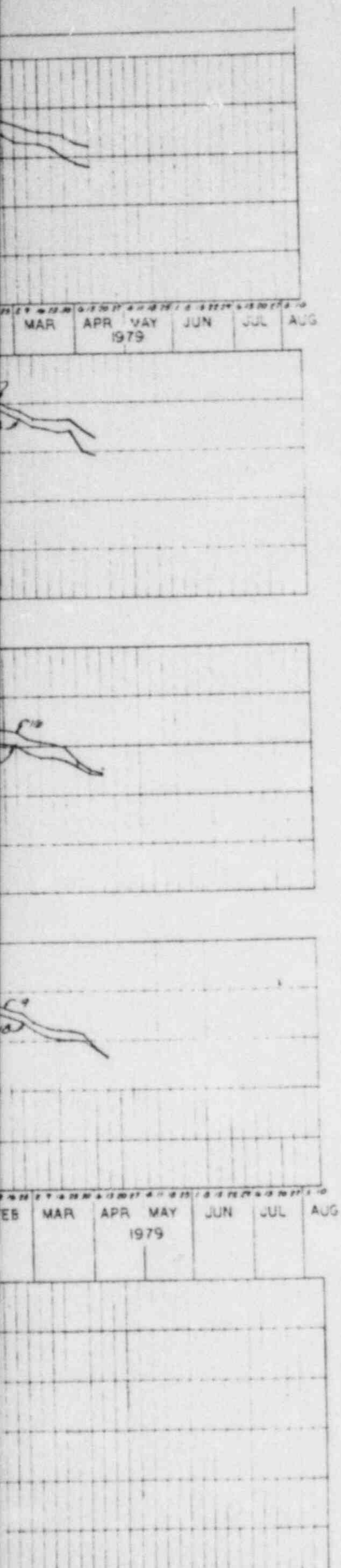
The diesel generators will be set in a level position irrespective of the amount of differential settlement between the corners of the pedestal. It will be achieved by a suitable layer of grout on the pedestal. If the thickness of grout required to level the machine is judged to be excessive, the first few inches of concrete from the pedestal will be removed and replaced by a layer of concrete as required to provide a surface suitable for setting the machine in a level position.

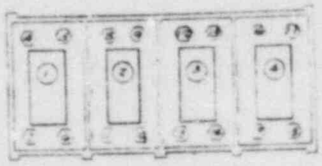
The weight of the pedestal and the surcharge load now being applied on top of the pedestal area is at least two times the total weight of the operating diesel generator and pedestal. The purpose of the surcharge operation is to consolidate the fill material in and around the diesel generator building and reduce the residual settlement during the life of the plant. Although the fill material is variable, its settlement properties can be evaluated from a full scale test under a surcharge load as discussed in the response to Question 4.

The points presently being monitored for settlement on the pedestal corners are used for the foundation settlement data survey. It is required that these points be monitored on a 60-day cycle throughout the construction phase and for the first year of operation. After 1 year of operation, the frequency will be reviewed and possibly modifed, if necessary. If the manufacturer's tolerance on the pitch and roll of the equipment is exceeded due to settlement, the diesel generators will be realigned by shimming.

SETTLEMENT OF DIESEL GENERATOR BUILDING







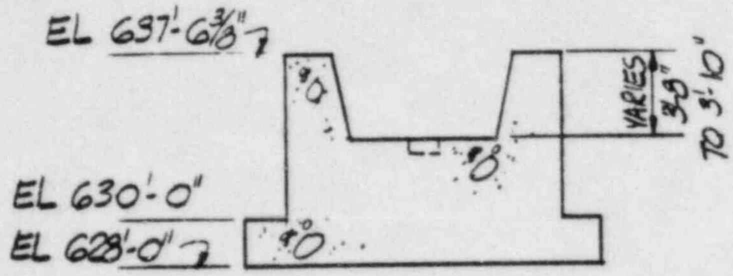
KEY PLAN

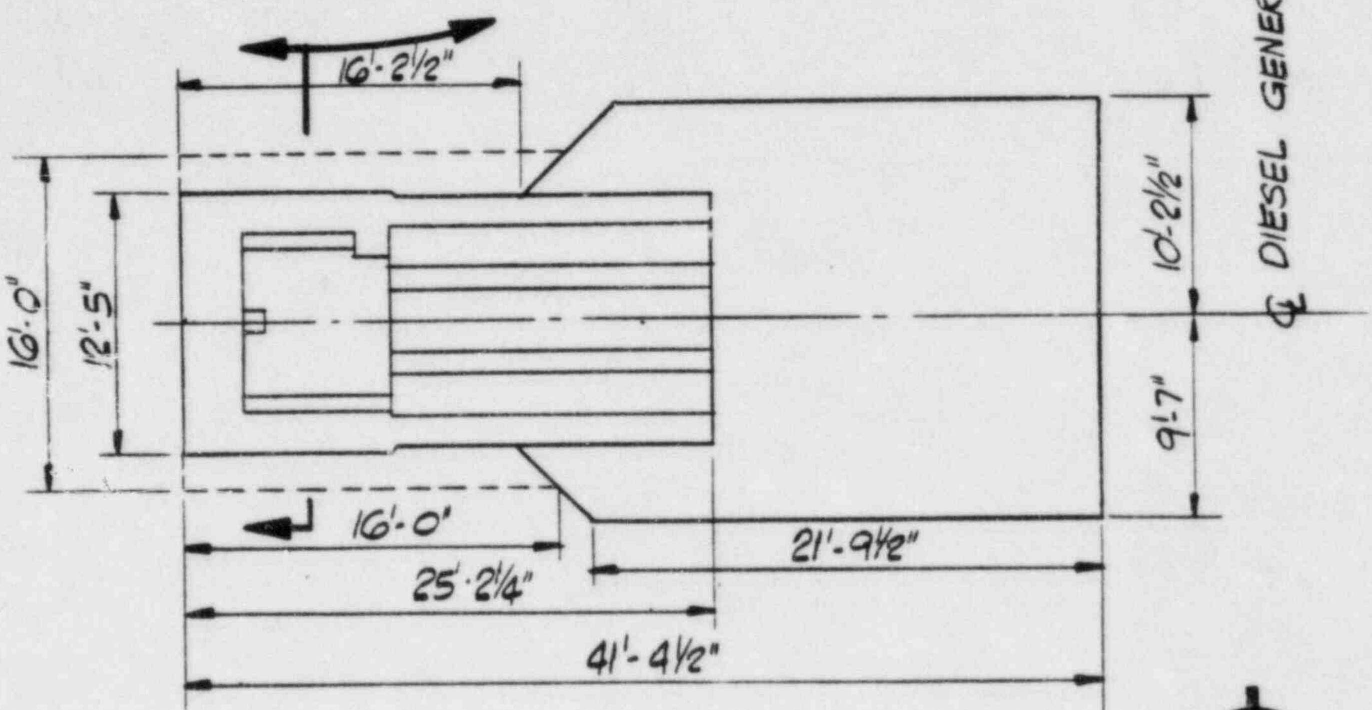
UPDATED AS OF
6-17-79

MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

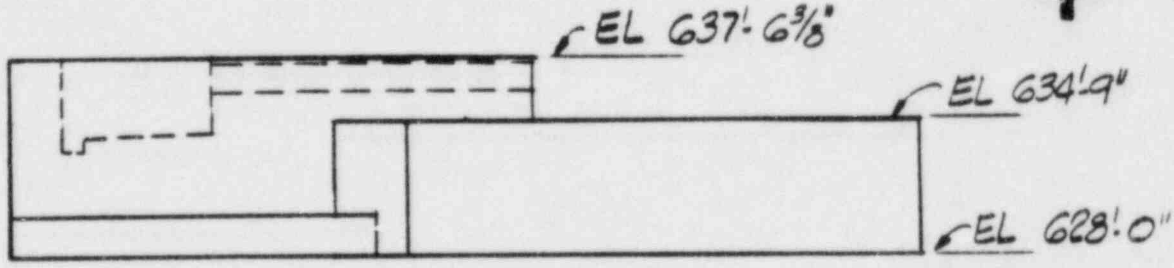
DIESEL GENERATOR BLDG
SETTLEMENT DATA
PEDESTAL MARKERS

FIGURE 8-1 DATE 4 24 79





PLAN
1/8" = 1'-0'



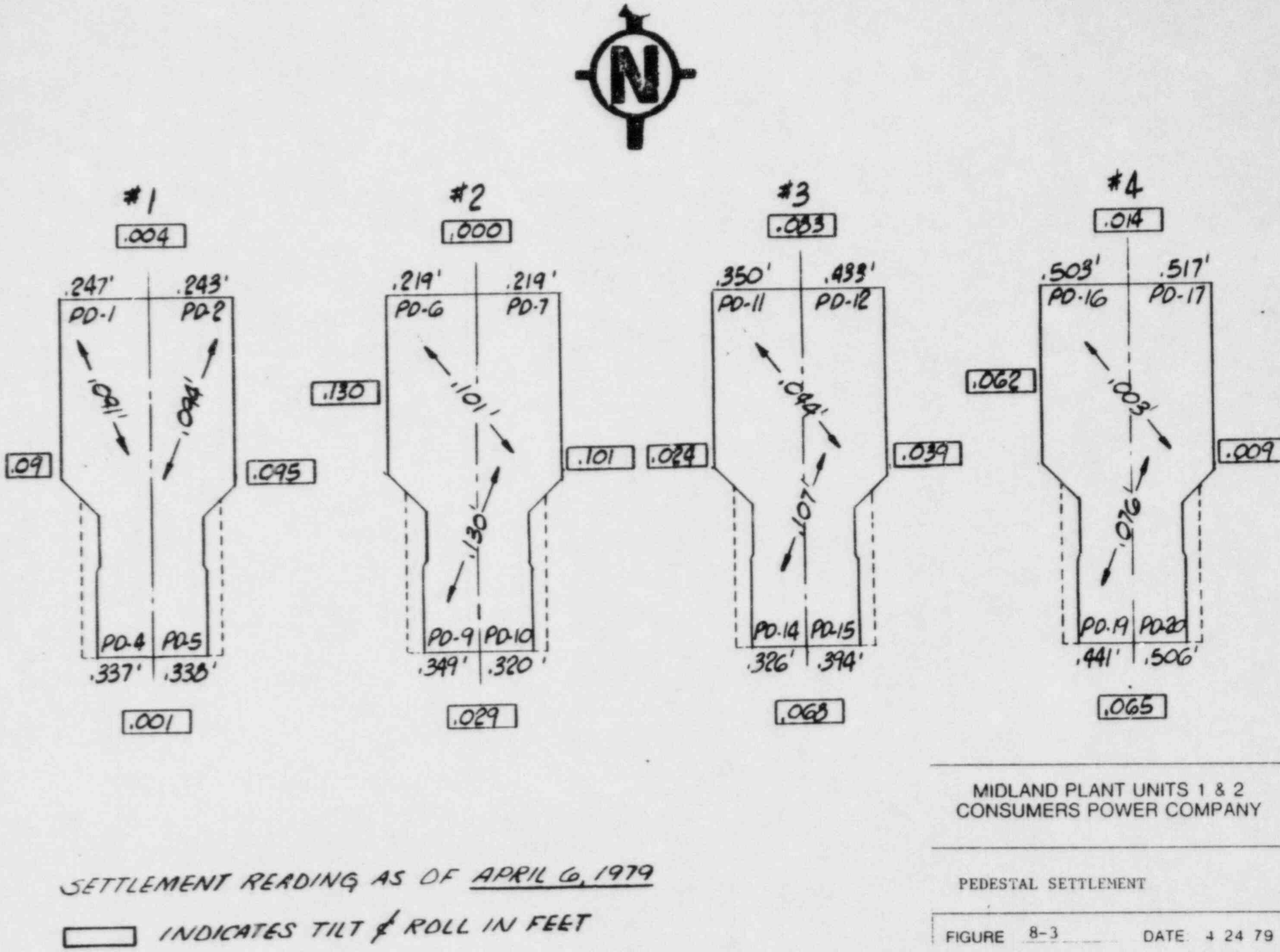
ELEVATION
1/8" = 1'-0'

DIESEL GENERATOR
PEDESTAL

MIDLAND PLANT UNITS 1 & 2 CONSUMERS POWER COMPANY	
DIESEL GENERATOR PEDESTAL	
FIGURE 8-2	DATE: 4.24/79

51

G-0588



MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

PEDESTAL SETTLEMENT

FIGURE 8-3 DATE 4 24 79

Question 9

Based on the information provided in your Interim Report Number 4, it appears that the tests performed on the exploratory borings indicate soil properties that do not meet the original compaction criteria set forth in the PSAR and specification for soils work. Provide assurance that the soil under other Class I structures not accessible to exploratory borings meets the control compaction requirements.

Response

Subsequent to the submittal of Interim Report 4 to MCAR 24, additional borings have been made beneath the Category I structures on fill, including borings through the foundation structural slabs. These structures are the auxiliary building railroad bay, electrical penetration areas, control tower area, feedwater isolation valve pits, and service water pump structure (fill portion only).

The response to Question 12 includes information on the quality of the fill beneath the fill-supported portions of the structures and the planned remedial treatment presently under consideration for corrective treatment, where required, to meet the intent of the PSAR commitments.

Question 10

You have stated that the fill is settling under its own weight. What assurance is provided that the fill has not and will not settle locally under structures with rigid mat foundations, such as portions of the auxiliary building or service water pump structure.

Response

The fill-supported portion of the service water pump structure, Unit 1 and 2 electrical penetration rooms of the auxiliary building, and Unit 1 and 2 valve pits have rigid mat foundations supported by fill that may settle locally under its own weight and will require corrective treatment. The planned remedial treatment for each is given in the response to Question 12.

Based on the exploratory borings, the control tower and railroad bay of the auxiliary building are supported by competent fill which is not expected to settle locally under its own weight, and no remedial treatment is required except as noted in the response to Question 12.

Question 11

In view of the variations indicated by present borings, what assurance exists that vertical borings taken adjacent to structures are sufficiently representative of fill conditions under the structure?

Response

Borings adjacent to structures were intended to provide a preliminary evaluation of the overall plant fill. These borings, except in the case of the diesel generator building, were in the more accessible locations (i.e., immediately adjacent to, rather than within, the structures).

Additional borings were made through the structural slabs of fill-supported structures to determine the quality of the compacted fill beneath the structures (e.g., borings taken were within the service water pump structure, feedwater isolation valve pit, electrical penetration areas, control tower area, and railroad bay of the auxiliary building). These additional borings provide information representative of fill conditions under the structures and, along with previous borings which were made adjacent to structures, define the fill conditions in order to determine which structures will require corrective treatment.

Question 12

Document the condition of soils under all safety-related structures and utilities founded on plant area fill or natural lacustrine deposits. Based on the results of investigations, compare the properties and performance of existing foundation materials under all expected loading conditions with those which would have been attained using the criteria stated in the PSAR. If the foundation materials are found to be deficient, discuss measures that will be taken to upgrade them to criteria stated in the PSAR.

Response

Soil conditions beneath safety-related structures and utilities and planned remedial measures are summarized on Table 12-1. The soil conditions described for each structure are based on the borings completed to date. Figure 12-1 shows the boring locations. These borings were made from July 1978 to April 1979. One additional boring is planned in the middle of the diesel oil fuel tanks area and three more borings are planned in the auxiliary building control tower area. Natural lacustrine deposits (sands) are addressed in the response to Question 2. Remedial measures will not necessarily result in densifying the fill to the degree of the PSAR compaction criteria, but support will be provided for the structures and utilities that will meet the intent of the PSAR in that settlement and structural response will be acceptable.

TABLE 12-1

SUMMARY OF SUPPORTING SOIL CONDITIONS AND PLANNED REMEDIAL MEASURES
FOR ALL SAFETY-RELATED STRUCTURES AND UTILITIES

Structures	Borings Performed from 7-78 to 4-79	Supporting Soil Conditions	Planned Remedial Measures
A. Auxiliary Building(1)			
1. Control tower	AX-6, 9	Medium dense to very dense sand backfill over dense glacial till with the exception of possible local void under concrete mud mat elevation 590' to 589' at boring AX-9. how determined that it is local if only 2 borings?	Pressure grouting below concrete mud mat as needed. ?
2. Unit 1 electrical penetration area	AX-7, 15	Generally dense to very dense sand backfill with occasional layers of loose sand and soft clay. The backfill is underlain by dense glacial till. Concrete was also used as backfill. A layer of concrete was encountered from elevations 583.5' to 580.1' at boring AX-7.	Removal of unsuitable material and replacement by lean concrete.
3. Unit 2 electrical penetration area	AX-8	Medium dense to dense sand backfill with occasional medium stiff clay layers over dense glacial till. Concrete was also used as backfill.	When soil conditions are determined deficient, corrective actions similar to the Unit 1 penetration room will be used.
4. Railroad bay (north end)	AX-1, 2, 10	Medium to very dense sand backfill over dense glacial till. Concrete was also used as backfill.	Grouting of fill to reduce liquefaction potential will be used as needed.
B. Feedwater Isolation Valve Pits			
1. Unit 1	AX-5, 11 (adjacent)	Loose to dense sand and medium stiff to very stiff clay backfill with occasional soft zones over dense glacial till. Concrete was also used as backfill.	Removal of unsuitable material and replacement by lean concrete.
2. Unit 2	AX-4, 3 & 12 (adjacent)	Loose to dense sand and medium stiff to very stiff clay backfill with occasional soft zones over dense glacial till. Concrete was also used as backfill. A layer of concrete was encountered from elevations 585.2' to 575.5' at boring AX-4.	Removal of unsuitable material and replacement by lean concrete.

Table 12-1 (continued)

Structures	Borings Performed from 7-78 to 4-79	Supporting Soil Conditions	Planned Remedial Measures
C. Service Water Pump Structure - Portion on Fill	SW-1 through 9, SW-5A, SW-13	Soft to very stiff clay and loose to very dense sand backfill over medium dense to very dense sand over glacial till, with the exception of 2.5 feet of loose sand encountered between elevations 601.5' and 599.0' in boring SW-6.	Piles under the north wall to support the vertical load.
D. Tanks			
1. Diesel fuel oil storage tanks	DF-1 through 6	The tanks are supported on medium to stiff sandy clay backfill. Surrounding backfill consists of loose to dense sands and very soft to stiff clay. The backfill is underlain by dense glacial till.	Filling of the tanks with water. (If limited residual settlements cannot be assured the tanks will be surcharged in excess of full weight or removed or reconstructed.)
2. Borated water storage tanks	T-14, 15, 16, 18, C-274, 276	Medium to very stiff clay backfill with occasional medium to very dense sand layers over dense to very dense sand.	Full load test by filling of the tanks with water.
E. Seismic Category I Utilities (Piping, Duct, Banks, and Valve Pits)	SWL-1 through 8, SWL-8A, Q-1 through 9	To be provided in May 1979.	None anticipated
F. Retaining Wall Adjacent to Service Water Pump Structure	W-1 through 4	Borings made adjacent to the structure indicate that supporting backfill below the foundation level consists of stiff to very stiff clay. The backfill is underlain by medium dense to very dense sand.	None anticipated
G. Diesel Generator Building and Associated Utilities	DG-1 through 12	Very soft to very stiff clay with pockets and layers of very loose to dense sand backfill over medium dense to very dense sand. Concrete was also used as backfill.	Surcharge and grouting of loose sand fill.

(1) The auxiliary building is partially founded on glacial till and partially supported on plant fill materials, as described in the above table. However, for several areas intended to be founded on glacial till, construction activities necessitated local excavation of the glacial till material (e.g., construction slopes for lower elevation excavations). Lean concrete backfill was used to replace the glacial till. This condition exists beneath the elevation 584 foundation slab in the localized areas west of Column Line 5.6, and east of Column Line 7.4, and north of Column Line D.

Question 13

How has the lack of compaction and the increase in soil compressibility affected soil-structure interaction during seismic loading and therefore the seismic response spectra used in design?

Response

Seismic Category I structures and utilities which are partially or fully founded on fill are summarized in Table 12-1. Table 12-1 also describes the planned remedial work, if any, to be done to ensure adequate support for these structures and utilities.

Lack of compaction and increase in soil compressibility of the fill affect soil-structure interaction and, hence, the seismic responses. Lack of compaction results in a more flexible soil-structure system, and causes both structural frequency to decrease and response spectra to shift to a lower frequency range.

The impact on soil-structure interaction and seismic response spectra of the affected Seismic Category I structures and utilities are being studied. Following is a discussion of the results of this evaluation.

1) Diesel Generator Building (See Figure 13-9)

   The diesel generator building is founded on fill (Table 12-1). A surcharge program for the diesel generator building is in progress which will increase consolidation of the fill. A seismic reanalysis is being conducted to account for the current lack of compaction.

   The technique of seismic analysis, as well as the computer programs utilized, are the same as those specified in the FSAR. The structural and soil properties are also the same, with the exception of shear wave velocity (V_s) and soil density (ρ). These two properties vary with the degree of compaction.

   The analysis considered fill ranging from soil with V_s = 500 fps and ρ = 120 pcf to soil with V_s = 1,359 fps and ρ = 135 pcf (natural soil). The actual shear wave velocity after surcharge is not expected to be lower than 500 fps.

   Floor response spectra were generated and response spectra envelopes were developed for soil with properties in the range stated above. Typical response spectra envelopes for the diesel generator building are shown in Figures 13-1 through 13-8.

The impact of considering a wide range of soil compaction properties is as follows:

a) Structural response (acceleration, velocity, and displacement) is increased. This results in higher moments and shear and axial forces in the structure due to seismic loads.

b) Floor response acceleration spectra curves are widened and increased. This results in more severe seismic loads on Seismic Category I equipment, piping, and electrical systems.

Review of the diesel generator building design and Seismic Category I equipment, piping, and electrical systems will be undertaken to the enveloped seismic responses.

2) Service Water Pump Structure (see Figure 13-10)

The service water pump structure is partially founded on fill (Table 12-1). At the lower elevation, a foundation mat is founded on natural soil. At the higher elevation, a foundation mat is founded on structural backfill.

The original seismic analysis considered the soil at both elevations to be natural soil. The lack of compaction of the fill coupled with the remedial work to be done to provide adequate support will affect soil-structure interaction and seismic responses. A seismic reanalysis will be conducted to account for the revised soil-structure interaction effect. Review of both structural design and Seismic Category I equipment, piping, and electrical systems will be undertaken which will incorporate the seismic responses of the reanalysis.

3) Auxiliary Building (see Figure 13-11)

The auxiliary building is partially founded on fill (Table 12-1). The control tower, electrical penetration rooms, and railroad bay are founded on fill. The remaining areas of this structure are founded on natural soil.

The original seismic analysis developed soil springs and dampers for soil-structure interaction which accounted for the composite nature of the foundation soil. Composite translational springs and dampers were developed based on the proportionate areas of natural soil and fill underlying the structure. Composite rotational springs and dampers were developed based on the proportionate moment of inertia of natural soil and fill underlying the structure. The lack of compaction of the fill coupled with the remedial work to be done to provide adequate support may affect the soil-structure interaction and seismic responses. If a significant change of foundation properties results from the corrective action, a seismic reanalysis will be conducted to account for the revised soil-structure interaction effect. Review of both structural design and Seismic Category I equipment, piping, and electrical systems will be undertaken which will incorporate the seismic responses of the reanalysis.

4) Feedwater Isolation Valve Pits (see Figure 13-12)

Feedwater isolation vlave pits are symmetrically located at the southeast and southwest sides of each containment building immediately adjacent to the auxiliary building wings and turbine building. Each pit is a "C" shaped structure with open ends in contact with, but separate from, the containment building and buttress access shafts. Two wall panels of the valve pits are immediately adjacent to the auxiliary building and turbine building wall, and the third wall panel is in direct contact with the backfill.

The small mass and its special building layout predicate that the seismic response is not a governing factor in the structural design. Seismic design, however, considers the seismically induced dynamic earth pressure, differential displacement for piping systems, and seismic design load for main feedwater isolation valves.

The original dynamic earth pressure calculation used a soil unit weight density of 120 pcf and an internal friction angle of 30 degrees. The actual backfill soil properties are not expected to alter the original analysis results. The original main feedwater isolation valves' qualification used a highly conservative value for horizontal and vertical SSE loads. The vertical differential displacement was assumed to be 0.25 inch for pipe design, which is more than five times that of the SSE-induced displacement of the adjacent containment building at the valve pit foundation elevation.

No change in seismic response is expected due to the remedial action described in Table 12-1.

5) Underground Utilities

Underground utilities evaluated for seismically induced loads followed the procedures referenced in FSAR Subsection 3.7.3.12 and available literature. The lack of compaction of the fill surrounding the underground utilities reduces the unit density, shear modulus, and subgrade reaction of the soil, and affects the seismically induced load on these structures. Major underground utilities located on the fill in question are investigated and summarized as follows:

a) Seismic Category I Buried Piping and Duct Banks

There are two types of stresses induced by earthquake motion on long, buried structures:

1. Stress due to Free Field Seismic Wave Propagation

The portions of a long, buried structure far from the ends are assumed to move with the ground under the propagated seismic compression and shear waves. The magnitude of the strain is proportional to the site ground motion velocity and acceleration and is inversely proportional to soil compression and shear wave velocities.

The value of wave propagation velocity to be used when calculating maximum soil strain surrounding a buried structure is the effective velocity of the ground motion disturbance past the structure. For rock or very strong soils, the effective propagation velocity is equal to the in situ wave propagation velocity as measured by field or laboratory tests. If the structure is embedded in a softer layer or at a shallow depth in uniform soils, the effective propagation velocity should be taken as the propagation velocity of the underlying competent soil or rock.[1]

For example, the effective shear wave propagation velocity should not be taken as less than the shear wave velocity at a depth of 400 to 500 feet or, in any case, never less than about 2,000 fps.

[1] Hall, W.J., and Newmark, N.M.,"Seismic Design for Pipelines and Facilities," Journal of the Technical Council on Lifeline Earthquake Engineering of ASCE, No. TCI, November 1978

The original analysis for the Midland plant conservatively uses a shear wave velocity of 965 fps and 1,359 fps for buried piping and ducts, respectively. Thus, the change in soil properties due to lack of compaction has no effective impact to this type of seismically induced stresses.

2. Stress due to Soil-Building Differential Movements

The analysis of buried structures with bends or restrained ends is based on the equations for beams on an elastic foundation. Typical equations to compute the maximum stresses for a fixed end buried pipe under differential displacement are:

$$\sigma = \pm \frac{KR}{2\lambda^2 I} \Delta \qquad \text{(for bending)}$$

and

$$T = \frac{\alpha K}{\lambda A} \Delta \qquad \text{(for shear)}$$

where

K = soil spring being equal to the width of the buried structure times the coefficient of subgrade reaction

$$\lambda = \left(\frac{K}{4EI}\right)^{1/4}$$

A, I, and E are the cross-sectional area, moment of inertia, and modulus of elasticity of the buried structure, respectively.

The lack of compaction of the backfill would reduce the coefficient of subgrade reaction, and hence reduce the stresses according to the preceeding equation. The change in the differential displacement of a building founded on fill will be investigated separately, pending the results of the seismic reanalysis.

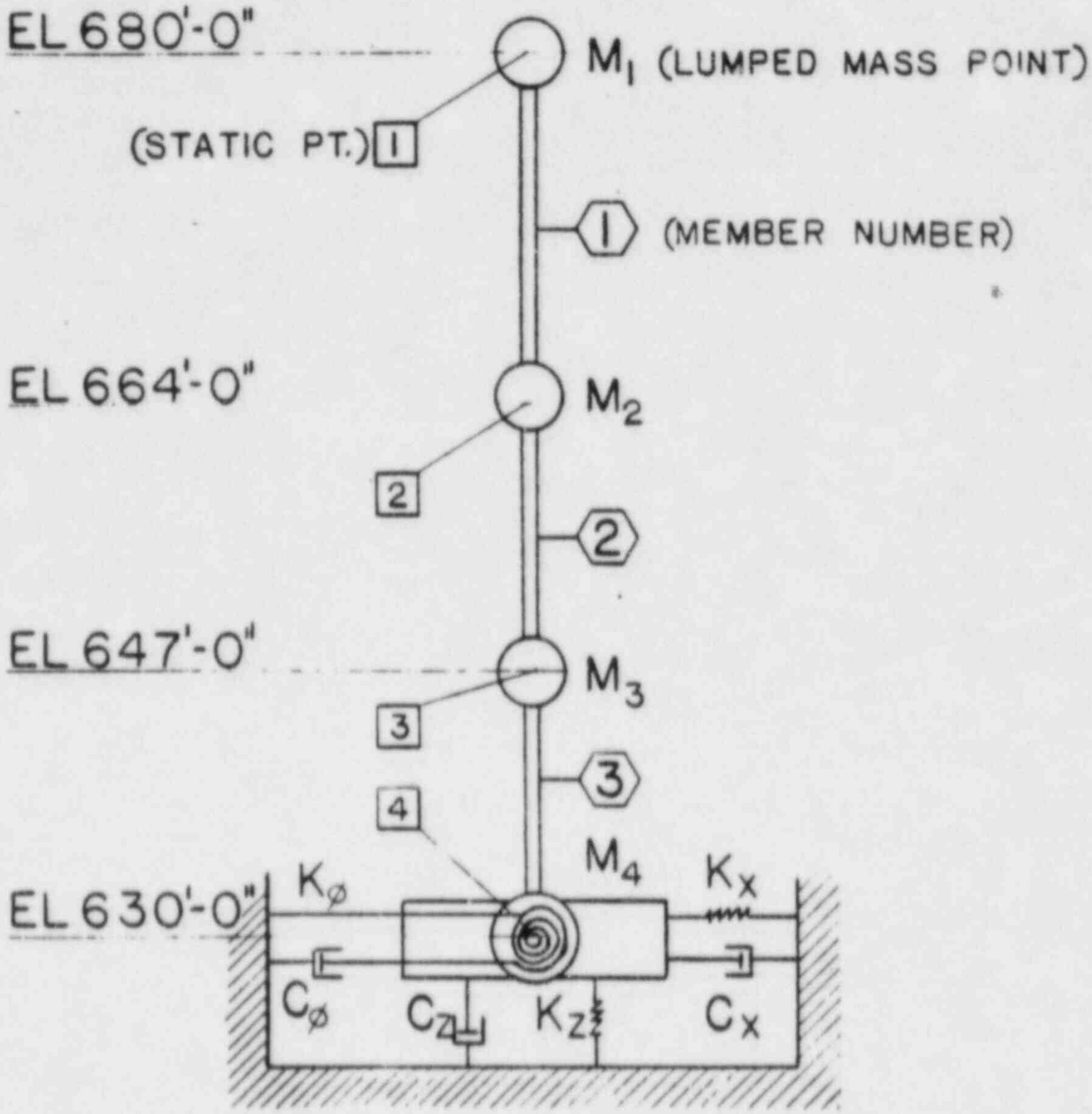
b) Diesel Fuel Oil Storage Tanks

The buried oil storage tank is considered relatively light and flexible compared to the surrounding soil. Thus, the soil-structure interaction effect due to seismic motion is negligible and the tank tends to deform with the deformation of the surrounding soil, as if the tank is not present. The seismic forces for buried tank design should include two major considerations. The seismic ground deformation imposes strains and, thus, induces stresses in the longitudinal direction and the seismic soil pressure due to ground acceleration-induced stresses in the transverse direction.

The emergency diesel oil storage tanks are approximately 42 feet long and 12 feet in diameter. The present analysis neglected the longitudinal wave propagation effect due to the small tank length versus wave length ratio. The proper wave length to be used is discussed in Section 5.a.1 above. The original analysis used 0.2 g for SSE and 0.1 g for OBE in both the horizontal and vertical directions, and a soil unit weight of 120 pcf for stress analysis in the transverse direction. The change in the compaction will have a negligible effect on the seismically induced forces used in the design.

c) Service Water Valve Pits

The service water valve pits are completely embedded and founded on fill. Seismically induced lateral soil pressure is considered in the present design. The change in compaction would have negligible effect on the seismically induced forces.



DIESEL GENERATOR BLDG.
SEISMIC MODEL

MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

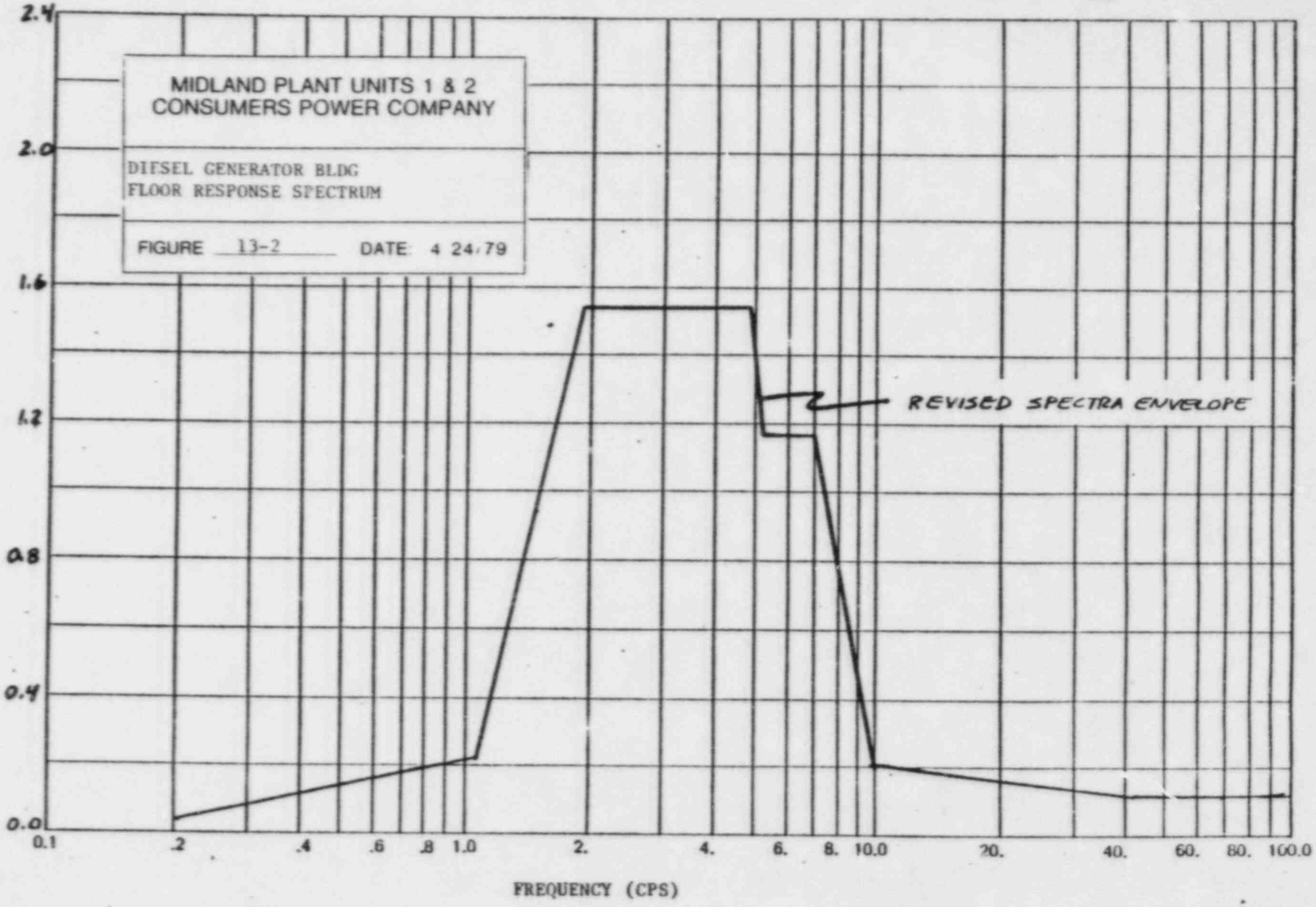
DIESEL GENERATOR BLDG
SEISMIC MODEL

FIGURE 13-1 DATE: 4/24/79

MIDLAND PLANT UNITS 1 & 2
JOB NO. 7220
DIESEL GENERATOR BLDG.

FLOOR RESPONSE SPECTRUM
MASS POINT 1 AT ELEV. 680'-0"
NORTH-SOUTH DIRECTION

OBE 6 %G GROUND ACCELERATION
(SSE USE MULTIPLIER OF 2)
DAMPING RATIO: 1.0%

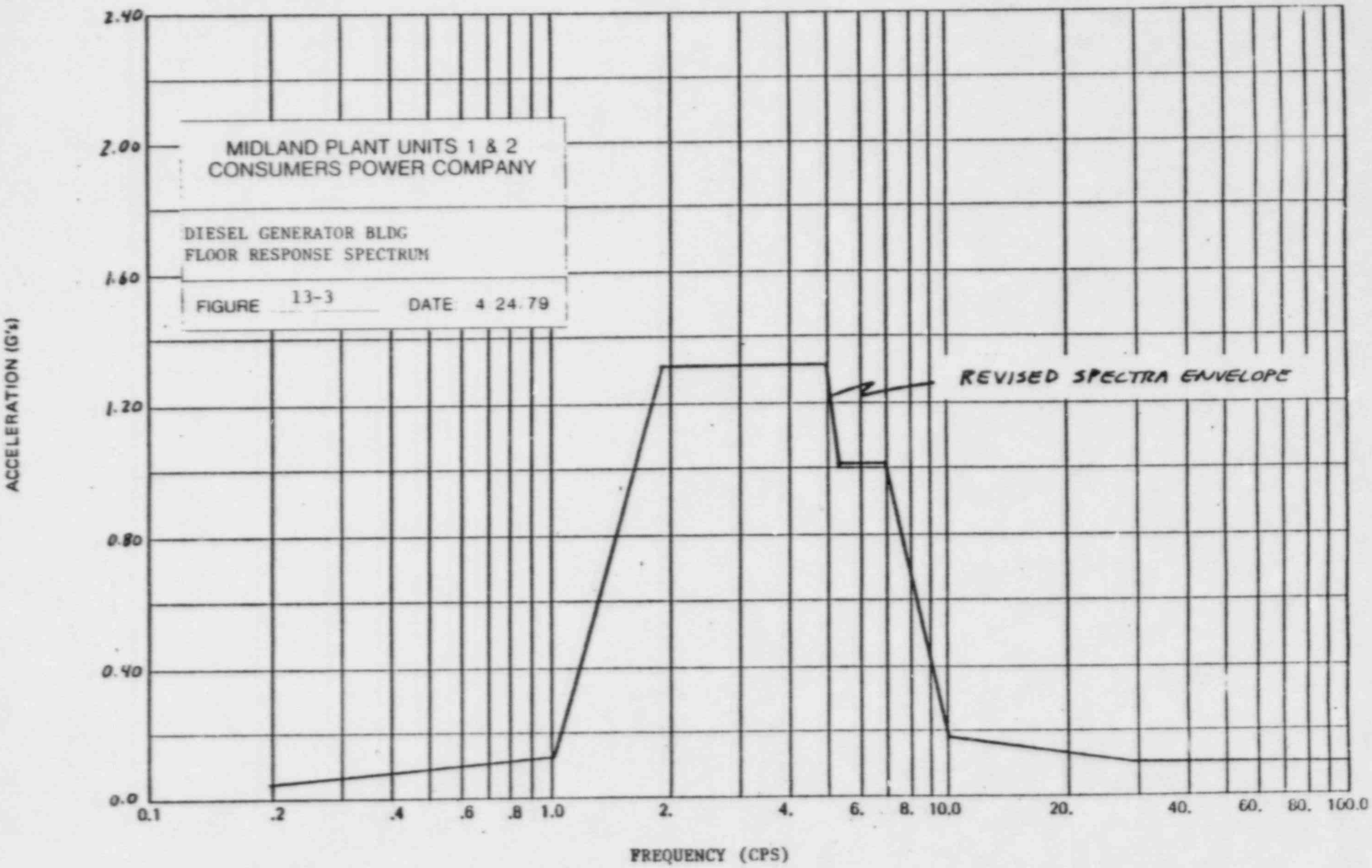


4-7-79

MIDLAND PLANT UNITS 1 & 2
JOB NO: 7220
DIESEL GENERATOR BLDG.

FLOOR RESPONSE SPECTRUM
MASS POINT 2 AT ELEV. 664'-0"
NORTH-SOUTH DIRECTION

OBE 6 %G GROUND ACCELERATION
(SSE USE MULTIPLIER OF 2)
DAMPING RATIO: 1.0 %



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CONSUMERS POWER COMPANY

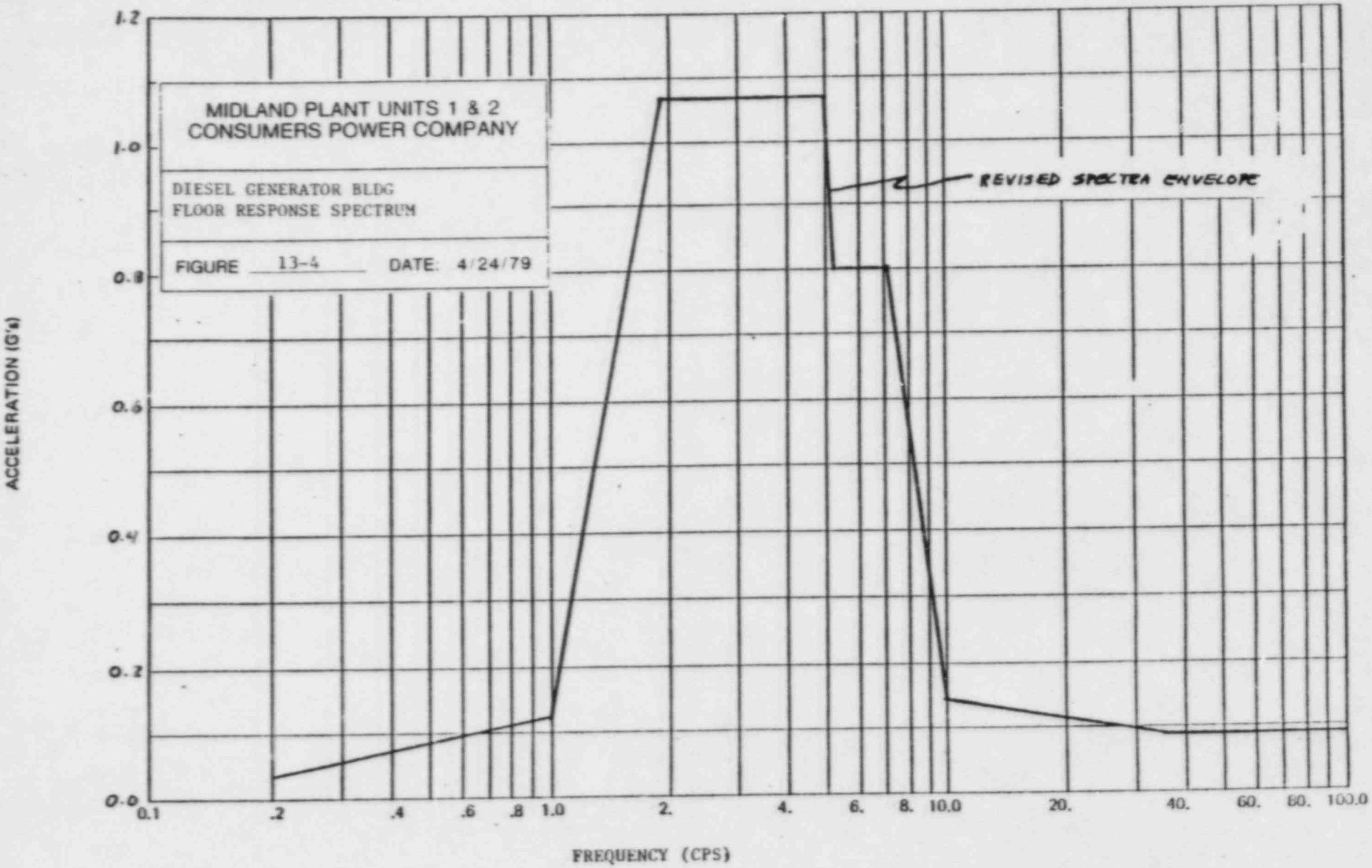
DIESEL GENERATOR BLDG
FLOOR RESPONSE SPECTRUM

FIGURE 13-3 DATE 4 24 79

MIDLAND PLANT UNITS 1 & 2
JOB NO. 7220
DIESEL GENERATOR BLDG.

FLOOR RESPONSE SPECTRUM
MASS POINT 3 AT ELEV. 647'-0"
NORTH-SOUTH DIRECTION

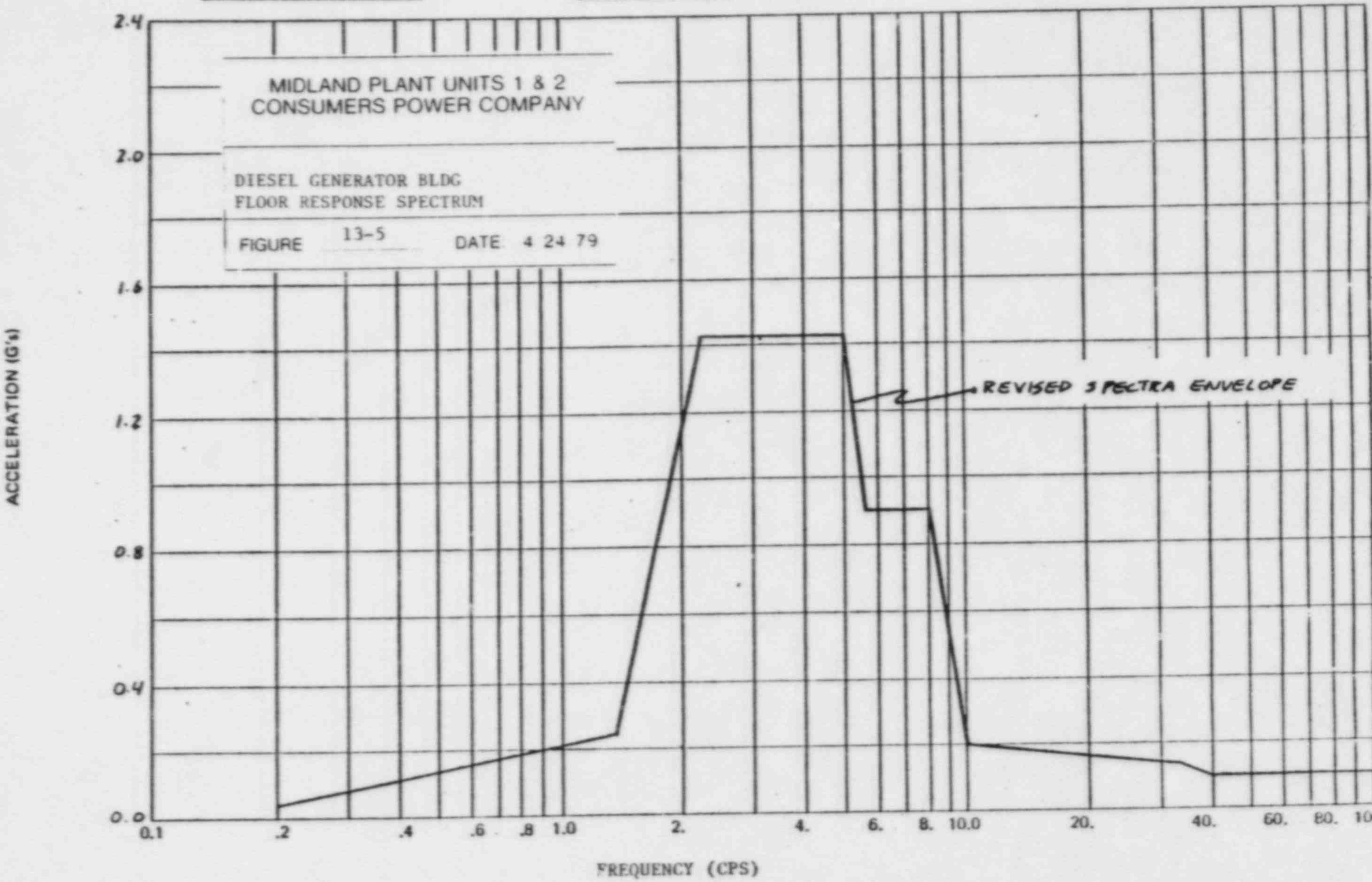
OBE 6 %G GROUND ACCELERATION
(SSE USE MULTIPLIER OF 2)
DAMPING RATIO: 1.0%



MIDLAND PLANT UNITS 1 & 2
JOB NO. 7220
DIESEL GENERATOR BLDG.

FLOOR RESPONSE SPECTRUM
MASS POINT 1 AT ELEV. 680'-0"
EAST-WEST DIRECTION

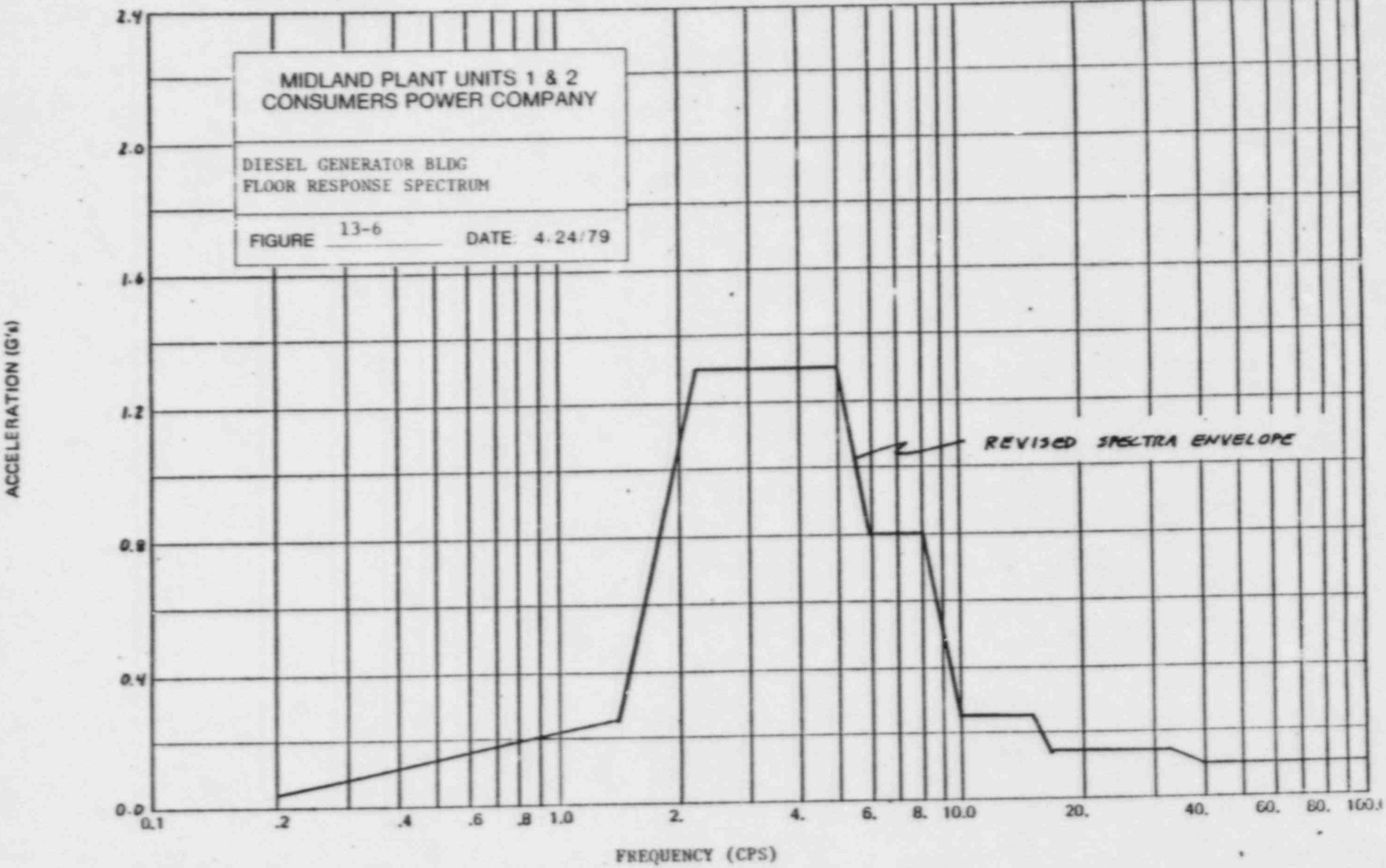
OBE 6 %G GROUND ACCELERATION
(SSE USE MULTIPLIER OF 2)
DAMPING RATIO: 1.0%



MIDLAND PLANT UNITS 1 & 2
JOB NO. 7220
DIESEL GENERATOR BLDG.

FLOOR RESPONSE SPECTRUM
MASS POINT 2 AT ELEV. 664'-0"
EAST-WEST DIRECTION

OBE 6 %G GROUND ACCELERATION
(SSE USE MULTIPLIER OF 2)
DAMPING RATIO: 1.0%



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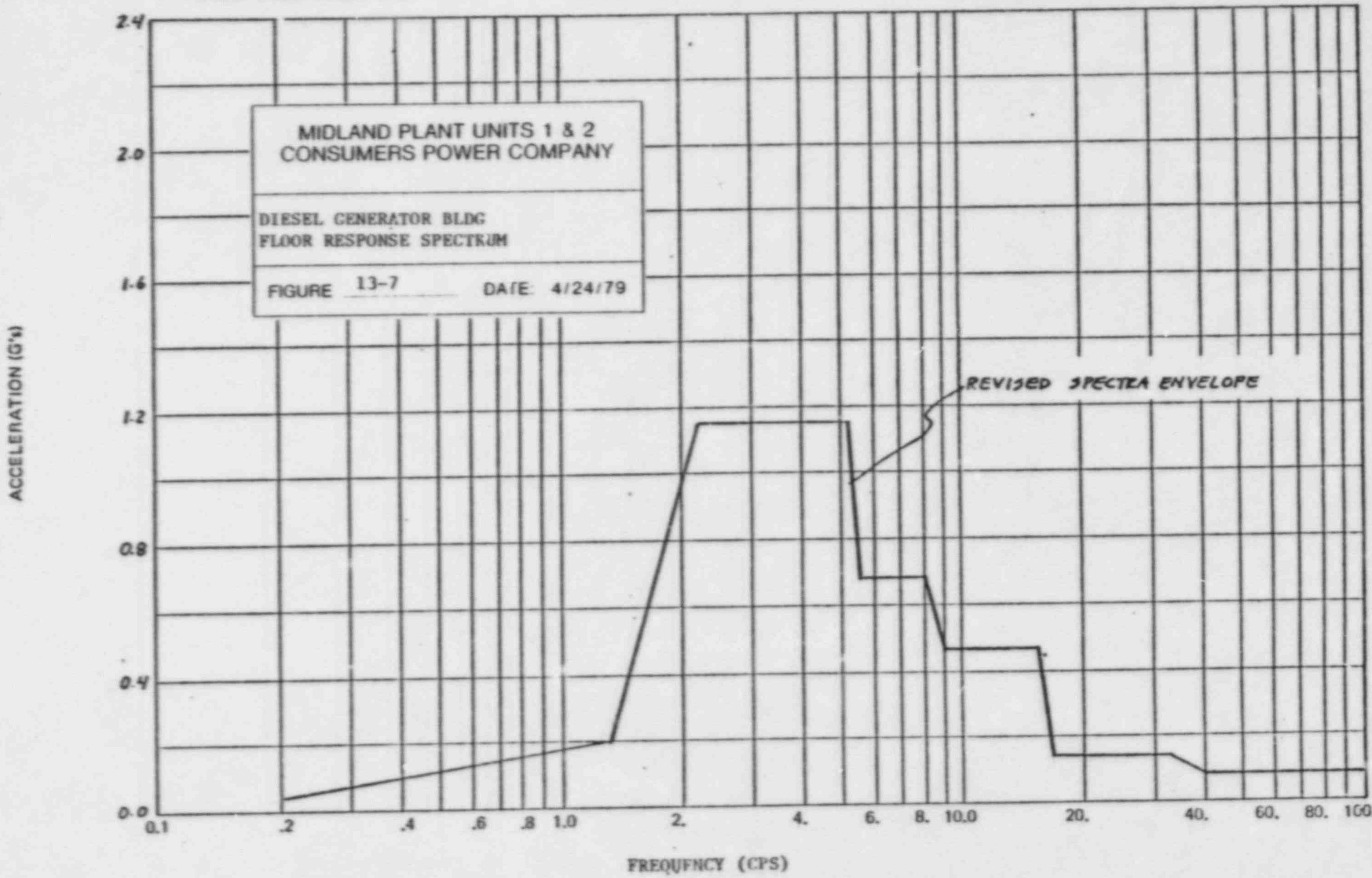
DIESEL GENERATOR BLDG
FLOOR RESPONSE SPECTRUM

FIGURE 13-6 DATE: 4.24/79

MIDLAND PLANT UNITS 1 & 2
JOB NO. 7220
DIESEL GENERATOR BLDG.

FLOOR RESPONSE SPECTRUM
MASS POINT 3 AT ELEV. 647'-0"
EAST-WEST DIRECTION

OBE 6 %G GROUND ACCELERATION
(SSE USE MULTIPLIER OF 2)
DAMPING RATIO: 1.0%



MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

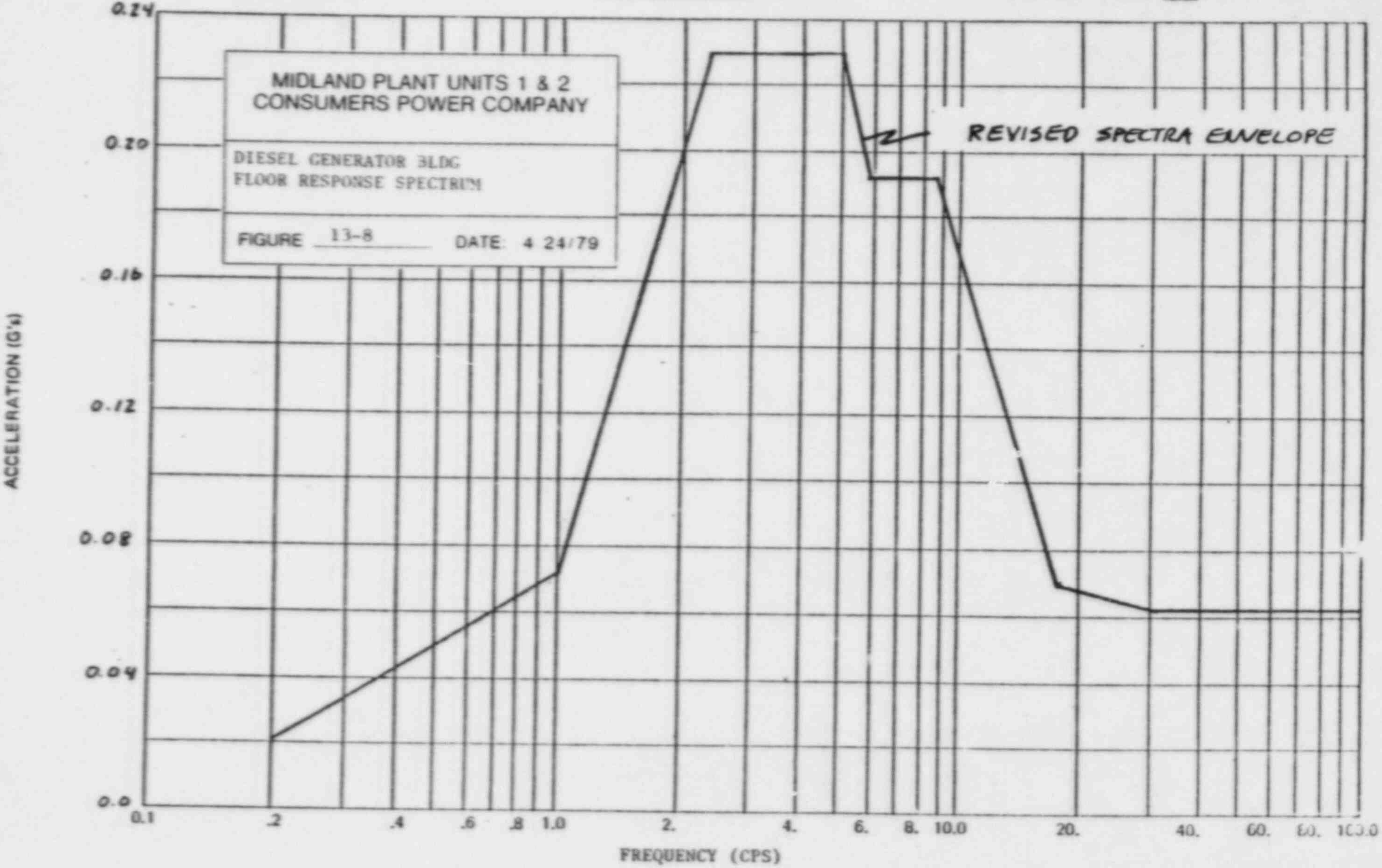
DIESEL GENERATOR BLDG
FLOOR RESPONSE SPECTRUM

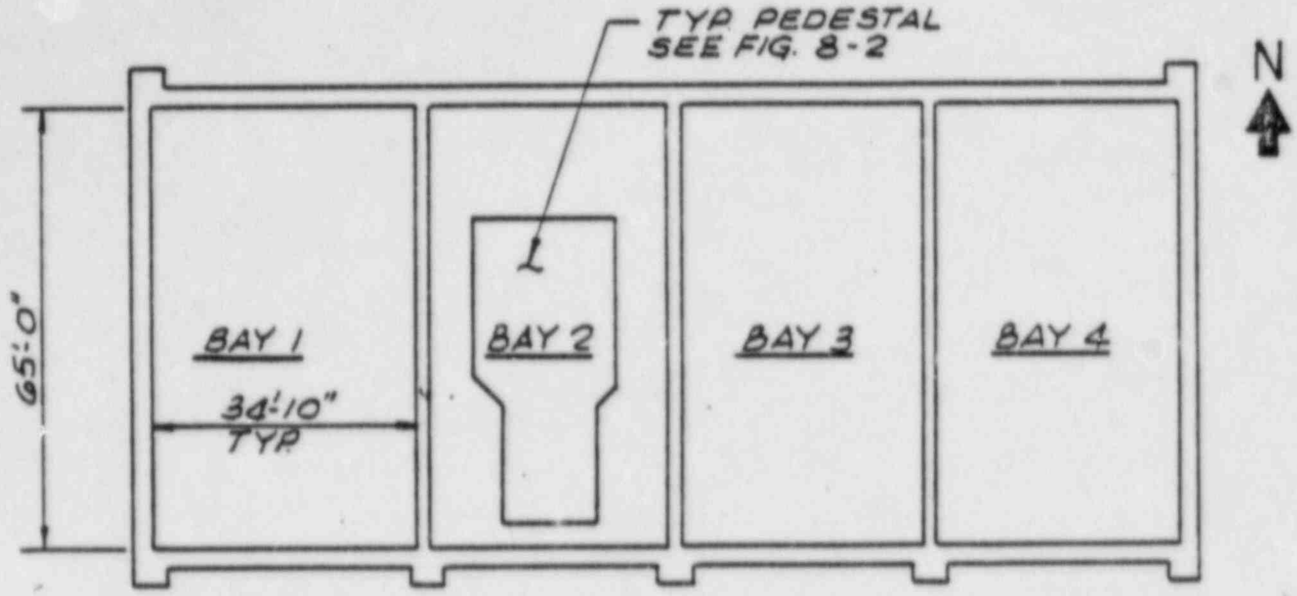
FIGURE 13-7 DATE: 4/24/79

MIDLAND PLANT UNITS 1 & 2
JOB NO. 7220
DIESEL GENERATOR BLDG.

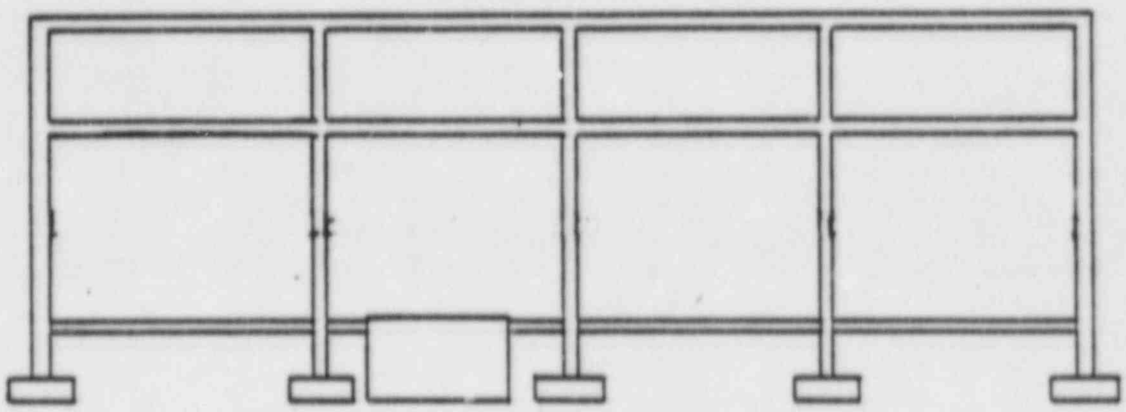
FLOOR RESPONSE SPECTRUM
ALL ELEVATIONS
VERTICAL DIRECTION

OBE 4 %G GROUND ACCELERATION
(SSE USE MULTIPLIER OF 2)
DAMPING RATIO: 1.0%

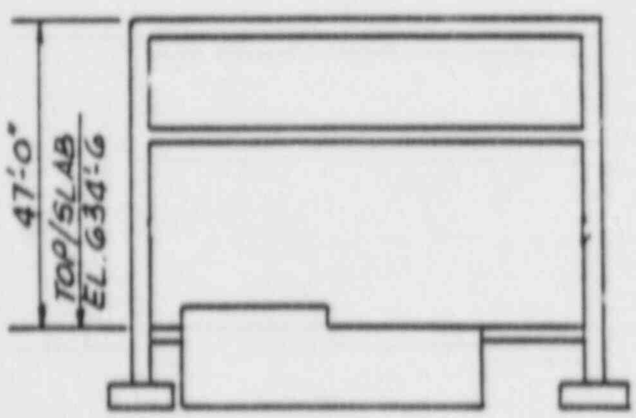




PLAN



SECTION
LOOKING NORTH

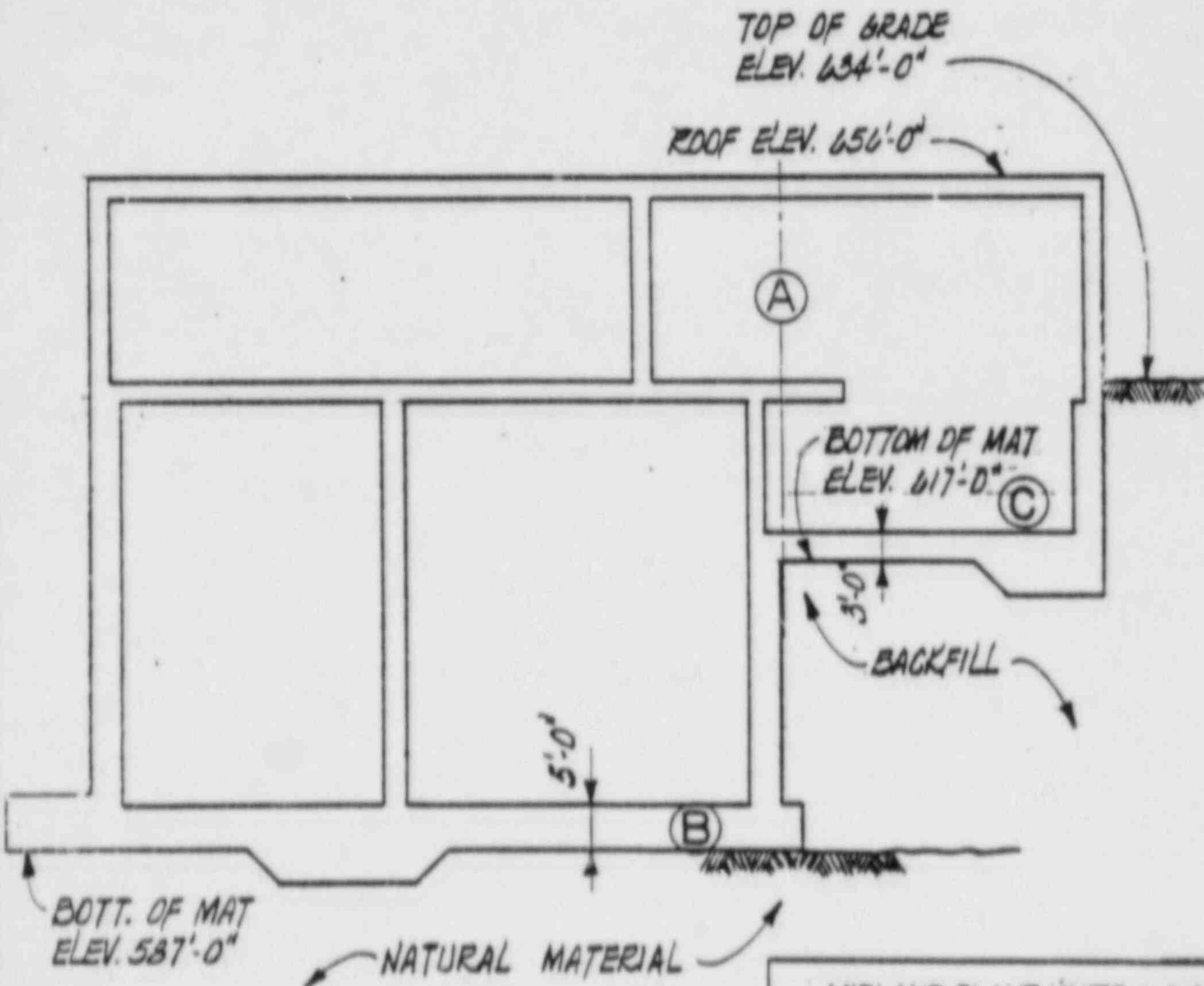


SECTION
LOOKING WEST

MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

DIESEL GENERATOR BLDG
PLAN & SECTIONS

FIGURE 13-9 DATE: 4/24/79

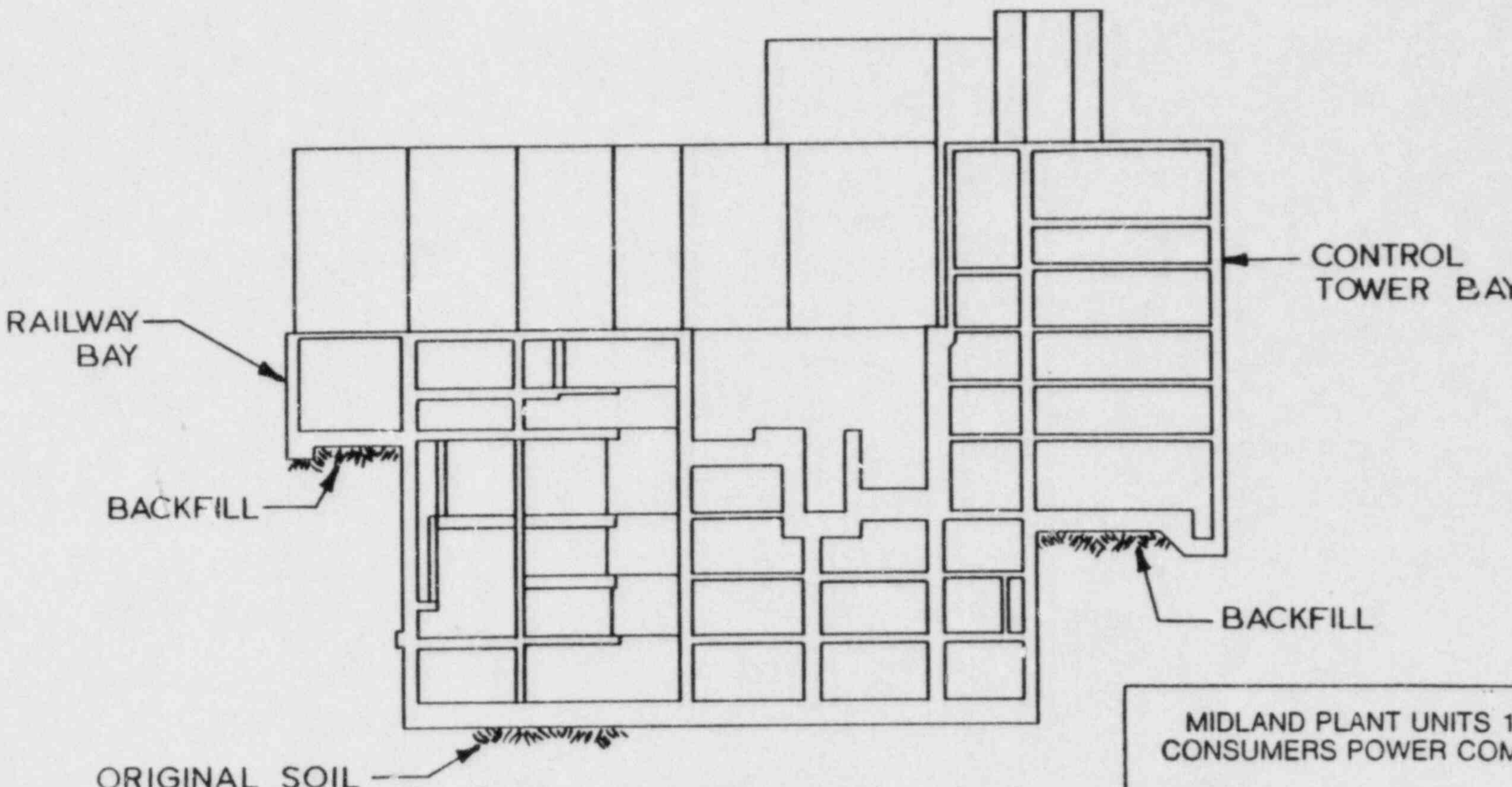


TYPICAL SECTION
(LOOKING WEST)
SERVICE WATER
STRUCTURE

MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

SERVICE WATER STRUCTURE
TYPICAL SECTION

FIGURE 13-10 DATE: 4/24/79

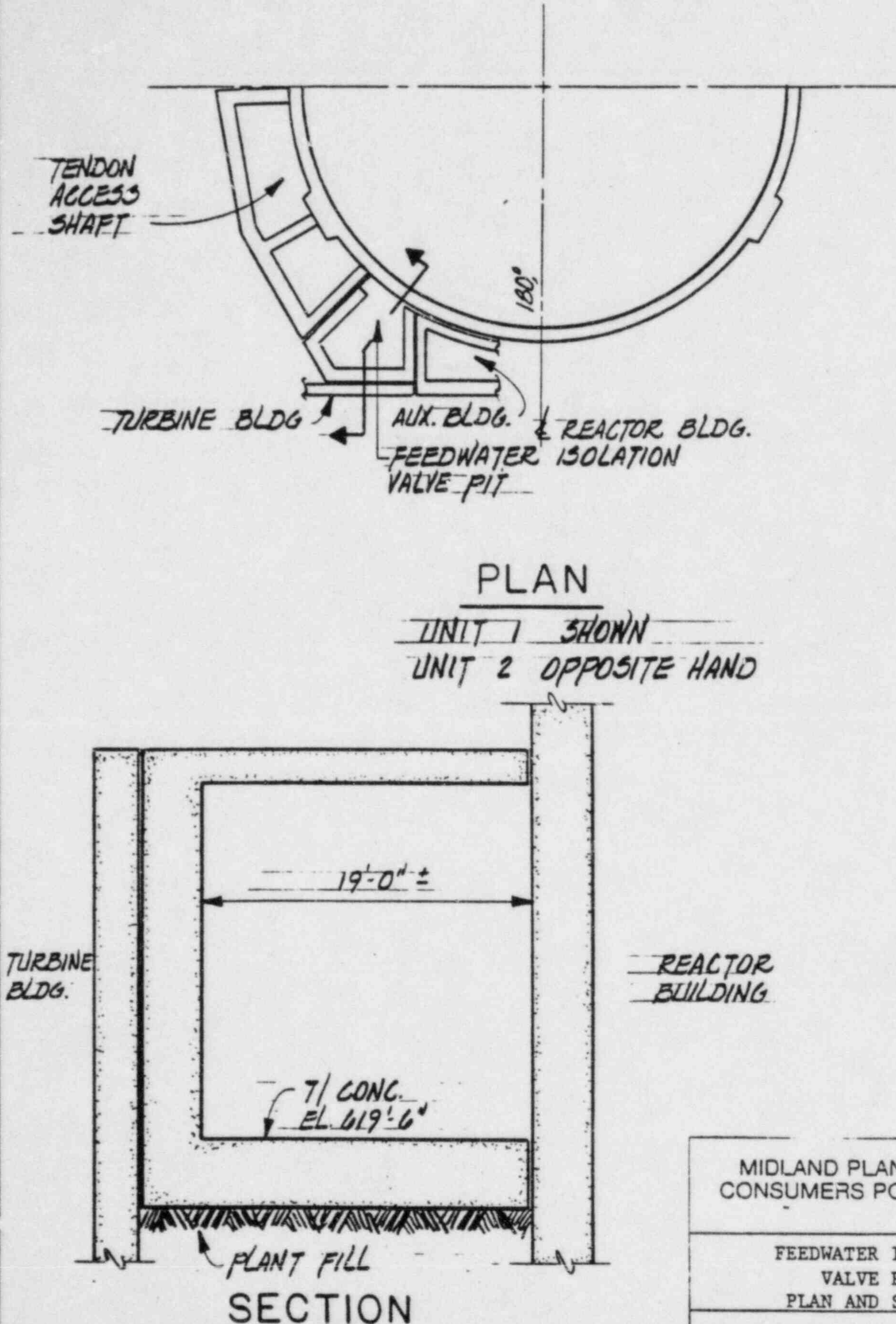


TYPICAL SECTION
AUXILIARY BUILDING

MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

AUXILIARY BLDG
TYPICAL SECTION

FIGURE 13-11 DATE: 4/24/79



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FEEDWATER ISOLATION
VALVE PIT
PLAN AND SECTION

FIGURE 13-12 DATE: 4/24/79

Question 14

For all Seismic Category I structures (including, but not limited to, the diesel generator building) which are located on fill, provide the results of an evaluation showing which structure you predict may experience settlements in excess of that originally intended, and provide an evaluation of the ability of these structures to withstand the increased differential settlement. For the diesel generator building and/or any Seismic Category I structure which exhibits cracking, evaluate the effects of the existing and/or anticipated cracks on the performance of the intended function of these buildings. The calculated stresses for Seismic Category I structures at critical locations should be tabulated and compared to that of allowable stresses as stated in the appropriate ACI Codes.

Response

The Seismic Category I structures located completely or partially on fill are identified in Figure 14-1.

1) Predicted Settlement

The present records indicate that the settlement of the diesel generator building exceeds the predicted settlement. Other Seismic Category I structures do not exceed the predicted maximum settlement. For structures founded on questionable fill, the planned remedial actions identified in Table 12-1 (attached to the response to Question 12) will restore the foundation media to a satisfactory condition. Therefore, it is not anticipated that the settlement of these buildings will exceed the ultimate settlement values shown in FSAR Figure 2.5-48.

For the borated water storage tanks, where no corrective action is required, the estimated settlement will be reviewed upon completion of the load test program discussed in the response to Question 6 and also identified in Table 12-1.

2) Effect of Differential Settlement

The effects of differential settlement within a structure can be divided into two parts:

a) Tilting

b) Curvature or distortion

Tilting is of concern in tall, narrow structures such as towers and stacks. The plant structures subjected to differential settlement do not belong to this class of structures. Tilting does not cause any additional stress in the structure, whereas a curvature or distortion will cause additional stresses. Because the stress due to curvature is strain-induced it is self-limiting in nature. Therefore, the ultimate strength of the structural member is not affected by differential settlement.

The distortion is also dependent upon the stiffness of the structure. For a rigid structure which cannot be deformed appreciably, the distortion will be reduced by redistribution of soil bearing pressures.

These observations are verified by the behavior of the diesel generator building exterior walls. The three solid walls at the north, east, and west sides of the building mainly show tilting, whereas the south wall, which is more flexible because of the presence of large openings, shows both tilting and arching.

In accordance with this criteria, only the buildings which are considered flexible, such as the diesel generator building and railroad bay in the auxiliary building, will be analyzed for differential settlement based on the stiffness at the time of distortion. The forces due to arching or distortion will be evaluated and combined with forces due to other loads as described in response to Question 15.

It is also to be noted that no extensive cracking has been observed in any of these buildings, indicating no large stress buildup in the structural members. In case the differential settlement is increased, the concrete may crack and the tensile stress will be carried by the reinforcing steel. Cracking of concrete will also reduce the stiffness of the members, and the forces and moments due to distortion will be redistributed.

3) Evaluation of Cracking

The diesel generator building, the fill-supported portion of the service water pump structure, and parts of the auxiliary building (railroad bay, electrical penetration rooms, and control tower area) have been examined for cracks in the main structural elements. The identified cracks in the diesel generator building and service water building have been mapped. They are presented in Figures 14-2 and 14-3. The majority of these cracks are shrinkage and temperature cracks, as evident from their widths and orientation.

The structural cracks that are in the diesel generator building are in the lower part of the structure and are located in the areas around the vertical electrical duct banks. They were caused by the estimated 1,000 kips of load transmitted from the building to the duct bank. Since then, the concentrated load has been eliminated by isolating the duct bank from the building. For details, refer to the response to Question 7.

In the applicable portions of the service water pump structure, the structural cracks are probably caused by the partial cantilever action of the northern part of the structure. It is theorized that the cracks on the roof slab are due to the bending tension and the cracks on the walls are due to principal tension caused by shear.

The cracks in the auxiliary building ~~are local~~ and their widths do not exceed .020 inch. These cracks are being mapped. The feedwater isolation valve pits and the borated water storage tank ring foundations will also be examined for cracks. Any significant crack will be mapped. It is anticipated that crack mapping for the auxiliary building, feedwater isolation valve pits, and ring foundations for tanks will be available in June 1979.

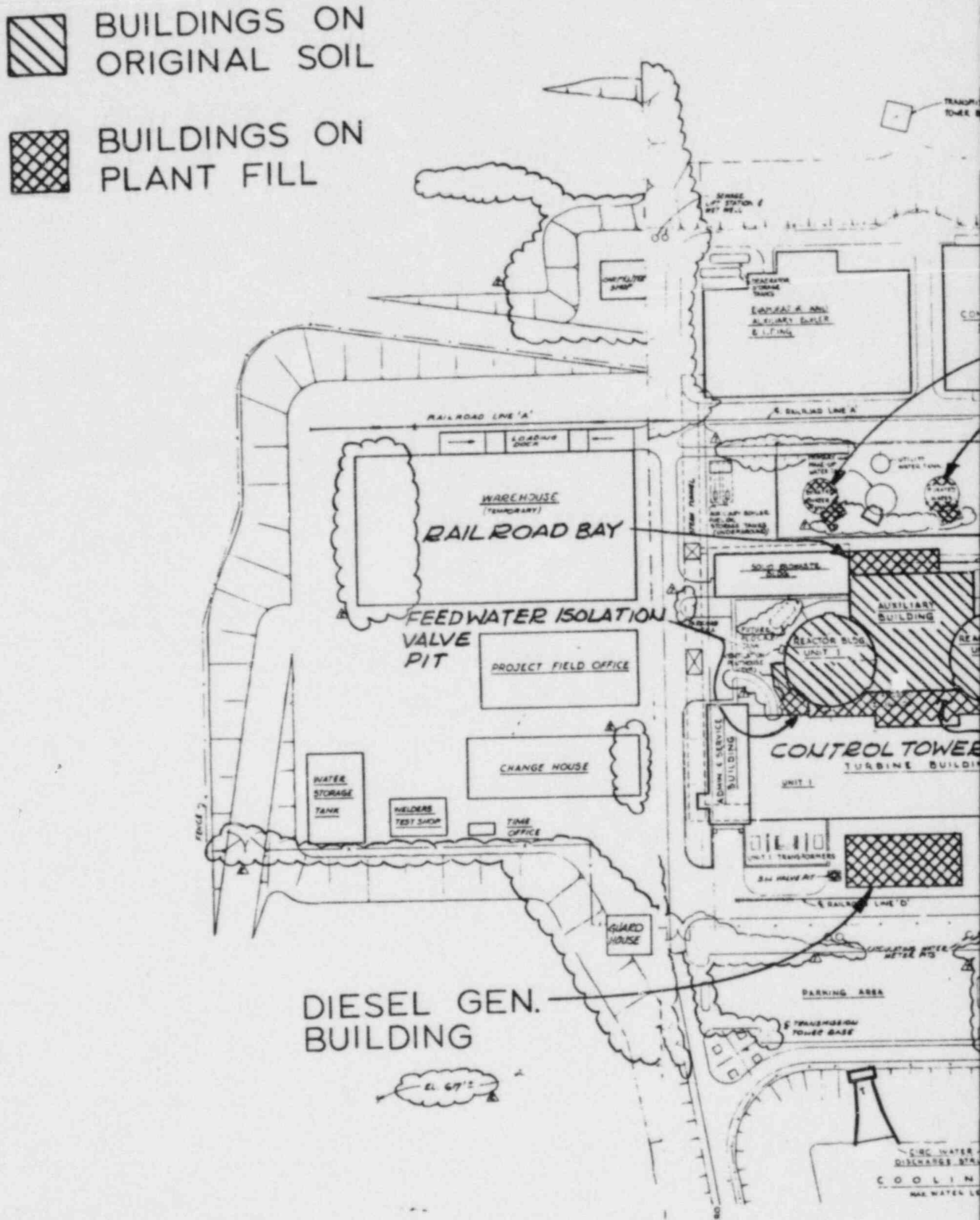
A crack in concrete indicates that the tensile strength capacity of concrete has been exceeded. Because no reliance is placed on concrete tensile strength in designing for bending and axial tensile stress, the strength of the structure (to resist these forces) is not affected by the crack. The compressive forces can be transmitted through the crack by bearing and shear force by the uncracked concrete or concrete in compression and reinforcing bars. However, the stresses in these walls are small, and only a fraction of the member capacity in shear is utilized to resist loads.

The maximum crack width encountered to date is about .030 inch. Wherever cracks are caused by loads not included in the original design (such as the cantilever action of a part of structure), their widths 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.

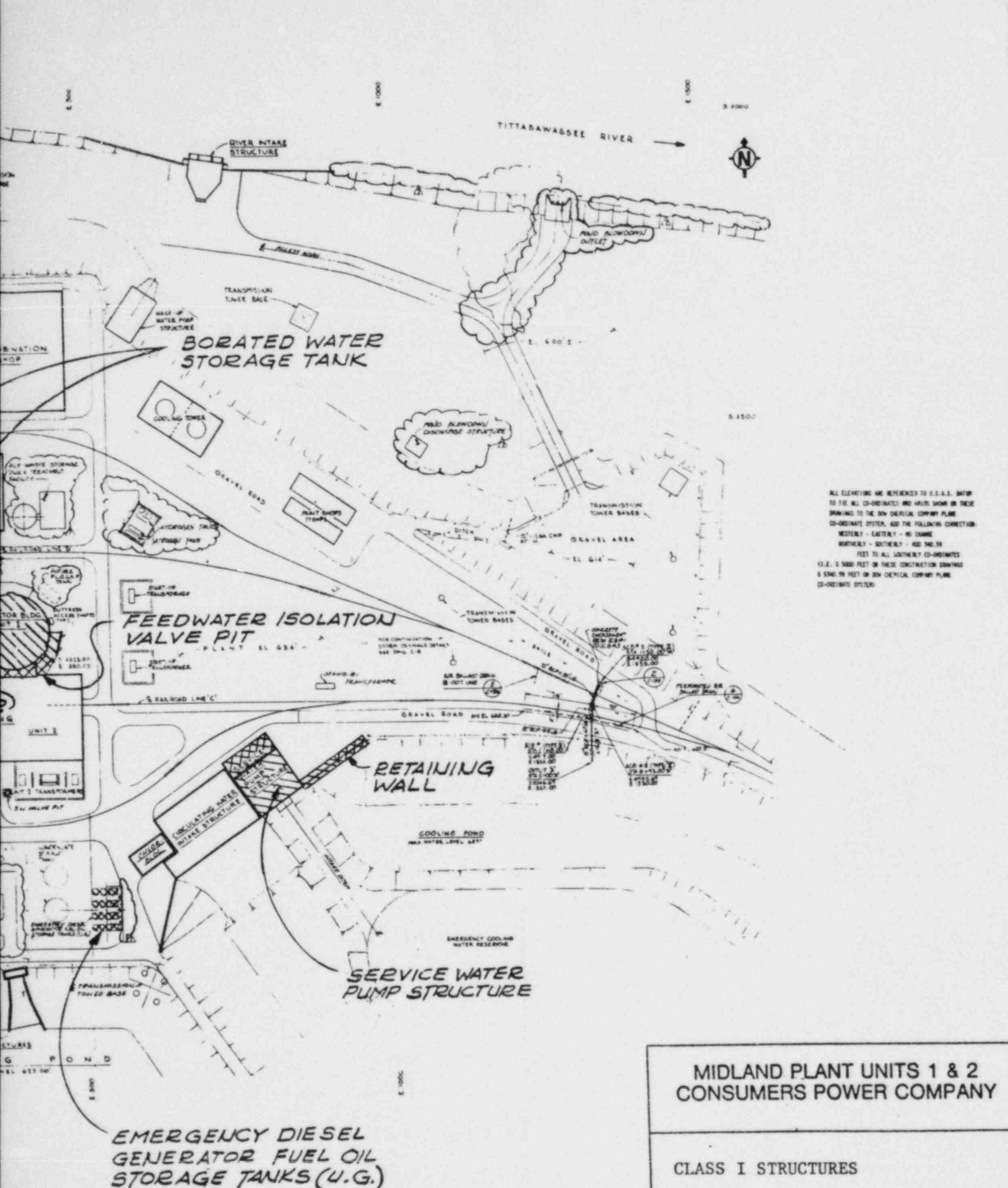
4) Comparision of Allowable versus Calculated Forces and Moments at Critical Sections

In FSAR Tables 3.8-19, 3.8-22, and 3.8-27, the calculated forces and moments for critical load combinations for the auxiliary building foundations, service water pumphouse, and diesel generator building have been compared with the allowable forces and moments. Also, in FSAR Table 3.8-20, the amount of reinforcements required has been compared with the amount of reinforcements provided for representative walls in the auxiliary building.

These load combinations do not consider the effect of differential settlement. Buildings affected by differential settlement will be analyzed for the observed differential settlement plus predicted differential settlement. The results of these analyses are expected to be available in August 1979.



BUILDINGS ON ORIGINAL SOIL
BUILDINGS ON PLANT FILL
RAILROAD LINE 'A'
LOADING DOCK
WAREHOUSE
(TEMPORARY)
RAILROAD BAY
FEEDWATER ISOLATION VALVE PIT
PROJECT FIELD OFFICE
CHANGE HOUSE
WATER STORAGE TANK
WELDERS TEST SHOP
TIME OFFICE
GUARD HOUSE
AUXILIARY BUILDING
REACTOR BLDG UNIT 1
ADMIN & SERVICE BUILDING
CONTROL TOWER
TURBINE BUILDING
UNIT 1
UNIT 1 TRANSFORMERS
PARKING AREA
DIESEL GEN. BUILDING

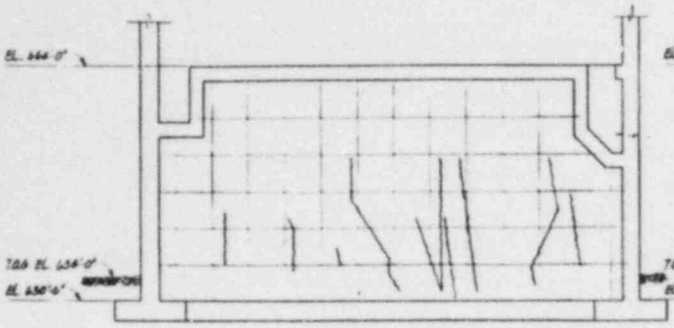


MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

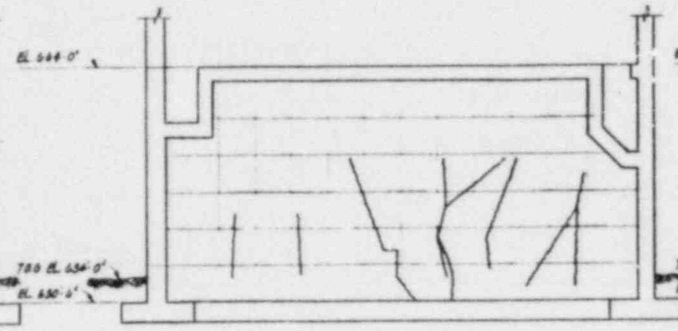
CLASS I STRUCTURES

FIGURE 14-1 DATE: 4/24/79

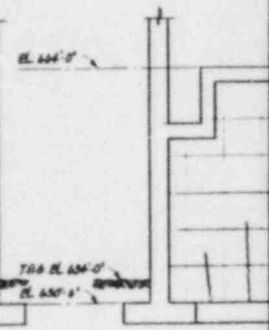
G-0588



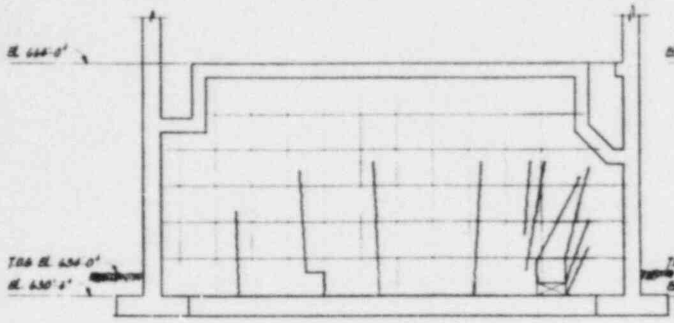
EAST WALL-EAST SIDE
LOOKING WEST



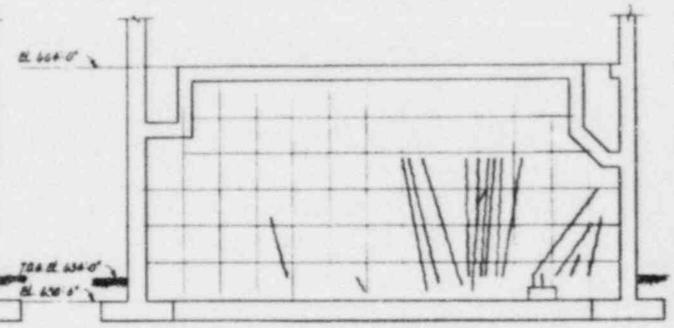
EAST WALL-WEST SIDE
LOOKING WEST



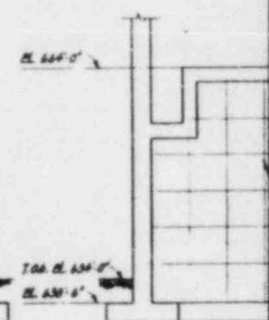
EAST C



EAST CENTER WALL-WEST SIDE
LOOKING WEST



CENTER WALL-EAST SIDE
LOOKING WEST



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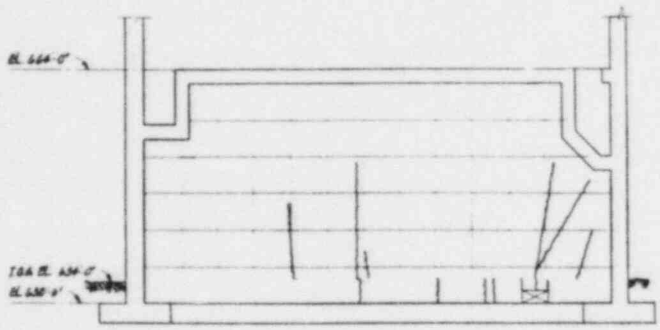
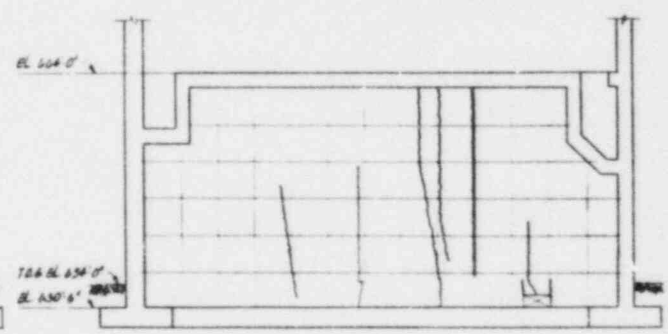


WEST CENTER WALL-EAST SIDE
LOOKING WEST



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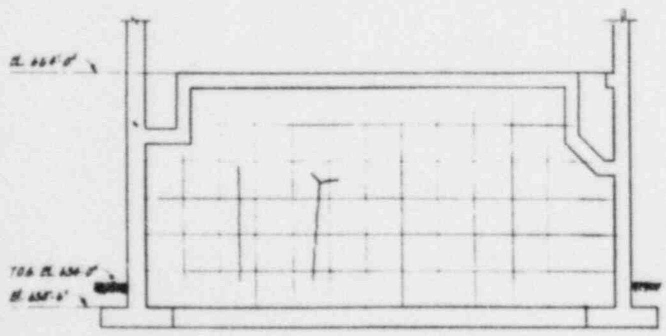
LOOKING WEST



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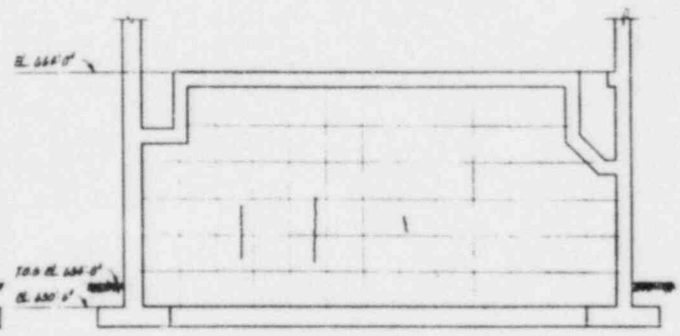
LOOKING WEST



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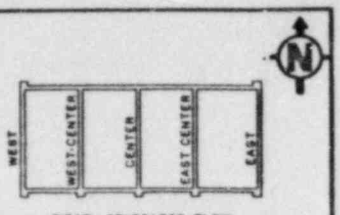
LOOKING WEST

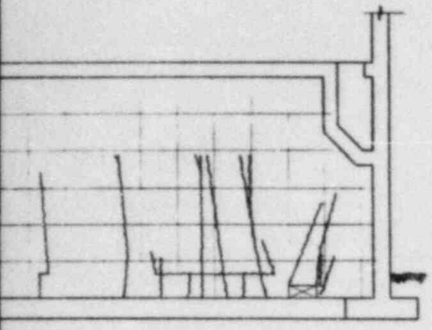


DIESEL GENERATOR BLDG

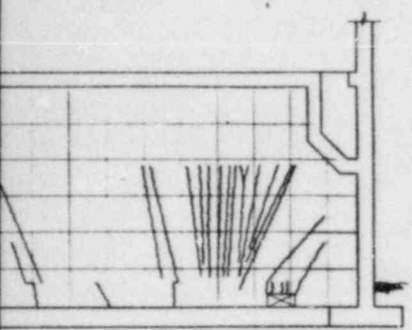
KEY PLAN

NOTES

1. CRACK SHOWN WERE MAPPED PRIOR TO PLACING THE PRELOAD (12-13-78 TO 12-18-78).
2. NORTH & SOUTH WERE NOT MAPPED SINCE NO SIGNIFICANT CRACKS WERE OBSERVED.
3. IN GENERAL, ALL CRACKS WERE HAIRLINE WITH SOME CRACKS WITH A THICKNESS OF 28 MILS AS OF 2-2-79.



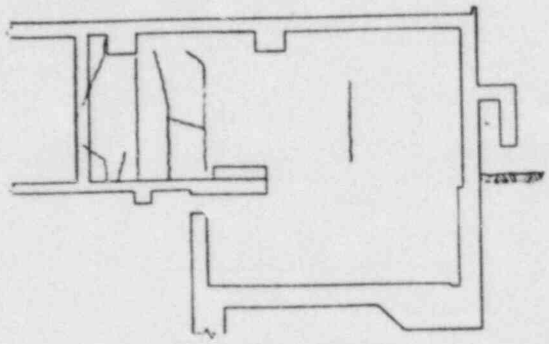
CENTER WALL-EAST SIDE
LOOKING WEST



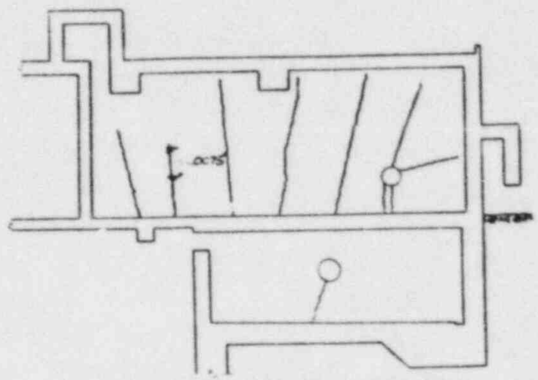
NTER WALL-WEST SIDE
LOOKING WEST

MIDLAND PLANT UNITS 1 & 2 CONSUMERS POWER COMPANY
DIESEL GENERATOR BLDG CRACK MAPPING
FIGURE 14-2 DATE: 4/24/79

G-0588



EAST WALL-EAST FACE
LOOKING WEST



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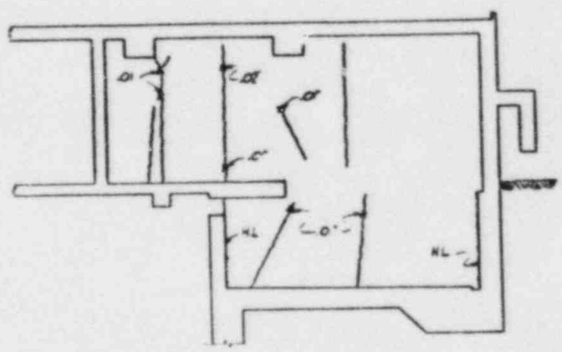
LOOKING WEST



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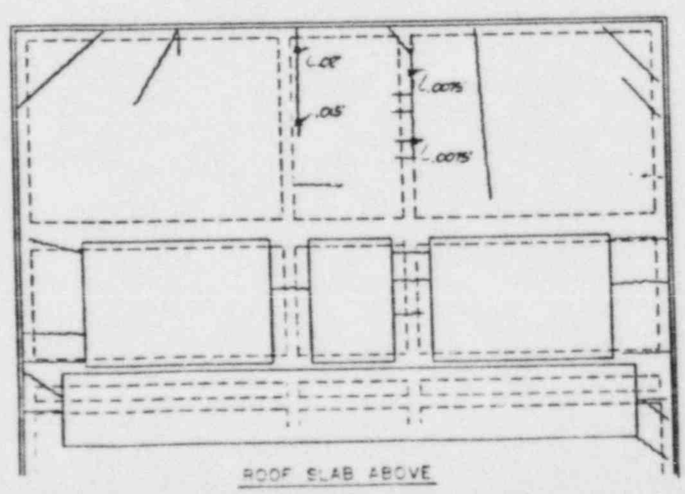
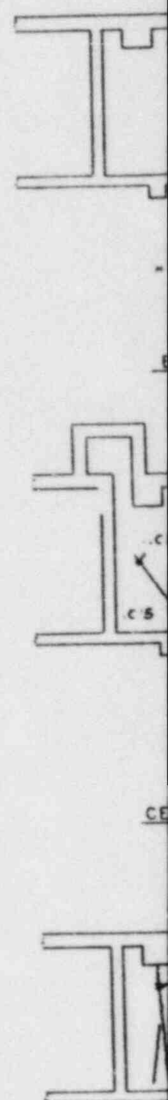
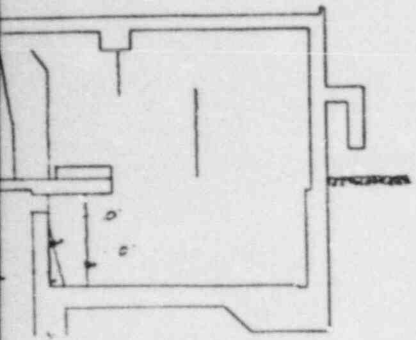
LOOKING WEST



ROOF SLAB ABOVE





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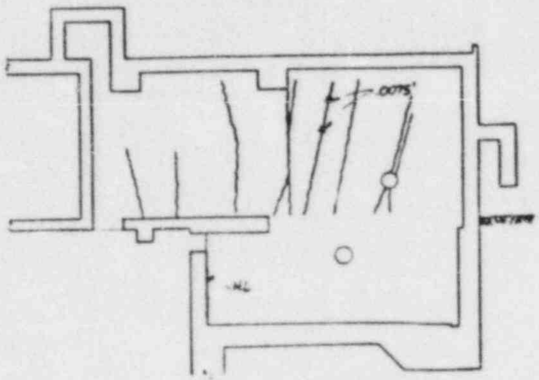
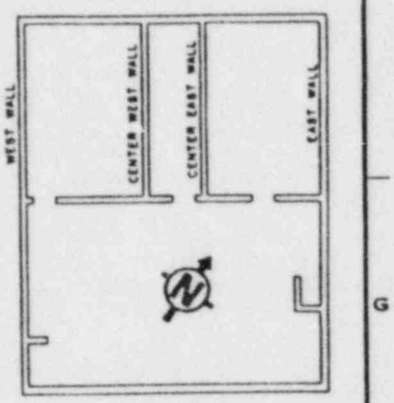
LOOKING WEST



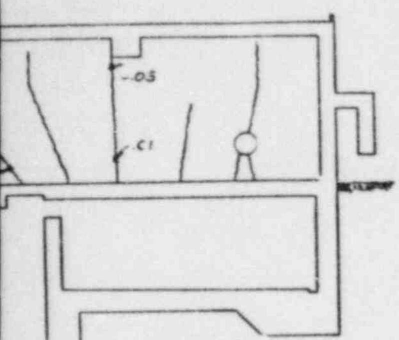
CENTER EAST WALL-EAST FACE
LOOKING WEST



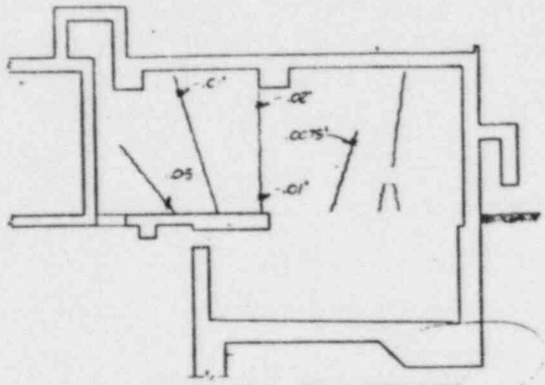
KEY PLAN

NOTES

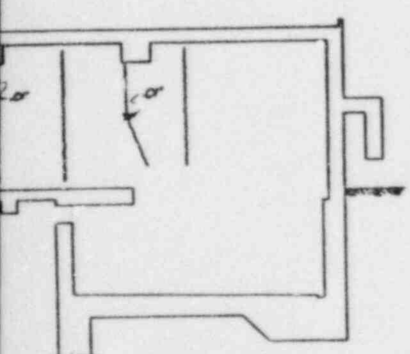
1. ALL CRACKS ARE HAIRLINE OR LESS THAN .005' THICK UNLESS NOTED



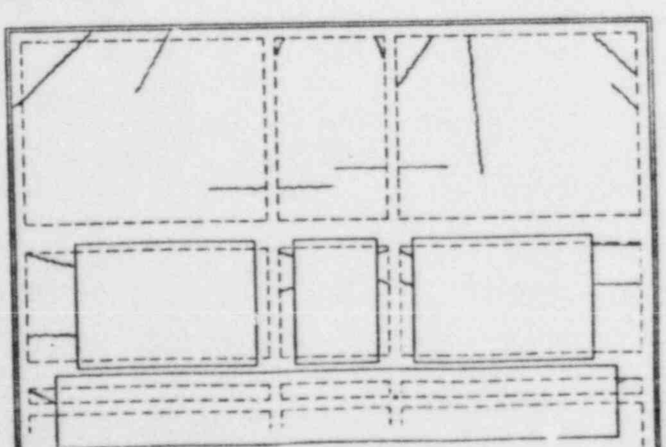
NTER WEST WALL-EAST FACE
LOOKING WEST



CENTER WEST WALL-WEST FACE
LOOKING WEST



WEST WALL-WEST FACE
LOOKING WEST



ROOF SLAB BELOW

MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

SERVICE WATER
PUMP STRUCTURE
CRACK MAPPING

FIGURE 14-3 DATE: 4/24/79

Question 15

For all seismic Category 1 structures which are partially located on fill and partially located on glacial till or original soils, provide a detailed evaluation of the ability of these structures to withstand the differential settlement. The possibility of not having a contact surface between the structures and the fill, due to settlement occurring prior to or during a seismic event, should be considered over the life of the plant.

Response

1) The soil conditions beneath structures which are founded partially upon fill and partially upon natural soil are provided in the response to Question 12. The planned remedial measures to ensure adequate load transfer to the foundation media for each structure are also outlined in the response to Question 12.

2) For Seismic Category I structures which are founded partially upon natural soil and partially upon fill material, the differential settlements will be evaluated in accordance with the provisions of the ACI 318-71 code. The code considers the differential settlement in the form of additional factored load combinations as follows:

$$U = 0.75(1.4D + 1.4T + 1.7L)$$

and

$$U = 1.4(D + T)$$

where

D = dead load
L = live load
T = cumulative effects of temperature, creep, shrinkage, and differential settlements

The code also gives factored load combinations for dead load, live load, wind, and earthquake. However, there are no requirements for combining the load from differential settlement with the extreme loads from wind and earthquake.

Differential settlement primarily induces additional strain, which is a self-limiting effect and does not affect the ultimate strength of the structural members.

The code requirement that the differential settlement effects are to be combined with dead and live loads recognizes that the differential settlements will add to the long-term applied live and dead loads. The additional cracking resulting from the combined effects of wind or earthquake loads with dead and live loads and the settlement effects will only be temporary during the event. The structure will return to its original condition after the event.

The Midland project structural design criteria for Seismic Category I structures that are partially founded upon fill will be expanded to include the differential settlement effects by the addition of the following load combinations:

Normal Operating Conditions

$$U = 1.05D + 1.28L + 1.05T$$

and

$$U = 1.4D + 1.4T$$

These loading combinations will ensure serviceability by combining the differential settlement effects with the long-term operating loads.

Severe Environmental Conditions

$$U = 1.0D + 1.0L + 1.0T + 1.0W$$

and

$$U = 1.0D + 1.0L + 1.0T + 1.0E$$

These loading combinations consider the effects of operating loads and settlement combined with either the design wind or operating basis earthquake. These additional provisions are beyond the ACI 318-77 code requirements, and are included to maintain safety margins consistent with the nuclear industry criteria (see ACI 349) because the wind and operating basis earthquake loadings are considered to occur more than once in the life of the plant.

Provisions will not be added for extreme loads such as tornado, safe shutdown earthquake, and pipe rupture because these are postulated one-time occurrences.

Completion of this evaluation is dependent upon the remedial measures selected as discussed in the response to Question 12. This evaluation will be completed in December 1979.

3) The ground motions are small during a seismic event at the Midland site (0.06 g OBE and 0.12 g SSE), and the resulting strains from an earthquake will be small. The calculations on all of the structures indicate that the structural foundations during a seismic event generate increases in bearing pressure which are well within the allowable pressures that the soils can withstand.

The main loads on the structures are already present and are far greater than any increase in load due to a postulated seismic event. In order to give assurance that no loss of contact between the structural foundations and the supporting media is credible, the following areas are discussed.

a) The fill properties under the control tower of the auxiliary building were evaluated by soil borings during the investigation program. The investigation and subsequent studies indicate that the fill settlement leading to a loss of contact between the mat foundation and the fill is unlikely for the following reasons.

1. The fill material is clean sand and concrete. The average value of the standard penetration resistance of the fill is approximately 90, based on borehole AX-6. Thus, the penetration resistance value indicates that the fill is very dense.

2. The fill has been loaded by the construction of the structures, and no appreciable settlements (0.3 inch as of March 20, 1979) have been observed or loss of contact under the control tower mat been found.

b) The foundation fill material beneath the electrical penetration area of the auxiliary building will be replaced as indicated in the response to Question 12.

c) The railroad bay of the auxiliary building is founded on sand fill. The sand fill will be grouted until a satisfactory foundation material is obtained.

d) The portion of the service water pump structure foundation on fill will be modified as stated in the response to Question 12. Driven piles will be preloaded against the existing structure and will be founded in the natural till.

6

Question 16

Since the plant area fill is apparently settling under its own weight, what assurance exists that the fill has not and will not settle locally under piping in the fill, resulting in lack of continuous support and causing additional stress not accounted for in design?

Response

The effect of fill settlement will be accounted for by evaluating the deflected shape of the representative pipes being profiled, as identified in the response to Question 19. Stresses will be evaluated as described in the response to Question 17. The local settlement due to lack of support from the plant fill will become apparent in the pipe profile, and the profile will actually define the pipe responses to these local settlements, if any. Thus, the stresses developed from the deflected shape will represent the actual stresses caused by load from settlement and/or lack of support. The buried steel pipes are ductile. They are capable of undergoing large longitudinal deformations without significantly affecting their pressure-carrying capability. Refer to the response to Question 17 for further discussion.

Soil borings are being performed in the area where the buried pipes are located. The results of this investigation are expected to be available in August 1979.

Question 17

Identify and document the current condition of all seismic Category I piping founded in the plant area fill. Include all piping founded in the plant area fill whose failure could adversely impact safety-related structures, foundations, and/or equipment. Also, discuss how code-allowable conditions will be assured throughout plant life. If any essential piping has now or should later approach code-allowable stress criteria or cannot be determined, what measures will you take to alleviate these conditions?

Response

Selected piping systems, both Seismic Category I and non-Seismic Category I, have been profiled by a Nold Aquaducer profile settlement gage as described in response to Question 19. The piping systems profiled in and around the diesel generator building are shown in Figure 19-1. Pipes being profiled in the other areas are shown in Figure 17-1. The profiles for these lines have not yet been finalized.

The impact of the failure of buried non-Seismic Category I piping on safety-related structures, foundations, and/or equipment is under evaluation. This evaluation is scheduled to be completed by June 29, 1979.

Table 17-1 shows the as-designed pipe stress condition for Seismic Category I systems without considering the differential settlement. Preliminary stress analyses of the already profiled piping systems indicate a stress due to settlement in the range of 7 to 21 ksi. These stresses are low for this type of secondary loading and have an insignificant effect on the ability of the pipe to maintain its pressure boundary.

Piping systems experience loads of both a primary and secondary nature. Primary stresses are the direct, shear, or bending stresses generated by the imposed loading which are necessary to satisfy the laws of equilibrium of internal and external forces and moments. Primary stresses are due to the internal pressure, dead weight, and the seismic inertial loads.

Secondary stresses are usually of a bending nature, generally arising because of the differential deflections of the pipe wall. Stresses due to thermal expansion and relative end movements are considered to be of this type. Secondary stresses are not a source of direct failure in ductile materials upon single load application. Even if they are above the yield strength, they merely affect local deformation, which results in a redistribution of the stresses. Secondary stresses can be cyclic in nature.

Secondary stresses due to displacement can also be noncyclic, (i.e., caused by differential settlement). This type of stress has an insignificant effect upon the strength and the strain capacity of the pipe. An example of this type of strain is caused when a pipe or pressure vessel is formed by rolling. The strain has to exceed yield in forming to remain in the deformed shape. Subparagraph NC-4650 of the ASME code (1974) allows such a forming or bending operation. The strain induced in a 24-inch radius pipe with a 1/2-inch wall thickness is as follows:

$$\epsilon_b = \frac{t}{2R} \qquad \text{(bending strain)}$$

where

t = pipe thickness

R = radius of curvature

$$\epsilon_b = \frac{.50}{2(24)} = .01 \text{ inch/inch}$$

Assuming a yield stress of 30,000 psi and a corresponding yield strain of .001 inch/inch, the material has a permanent strain of 10 times the yield.

The ultimate strain for ductile steels is in the range of .30 inch/inch, or 300 times the yield value. Because the permanent strain is small compared to the ultimate strain, there is very little loss in the ability of the pipe to resist pressure hoop stresses due to bending strain.

For a buried pipe which is 100 feet long and 10 inches in diameter with a displacement of 12 inches at the center relative to the ends, the induced strain from secondary bending is as follows:

$$R = \frac{L^2}{8\delta} \qquad \text{(assuming a constant radius of curvature)}$$

where

R = radius of curvature (inches)

L = length of pipe (inches)

δ = displacement at center (inches)

$$R = \frac{\left[(12)(100)\ ^2\right]}{8(12)} = 15{,}000 \text{ inches}$$

$$\epsilon_b = \frac{D}{2R} \qquad \text{(bending strain)}$$

where

$$D = \text{diameter of pipe (inches)}$$

$$\epsilon b = \frac{10}{2\ (15{,}000)} = 3.3 \times 10^{-4} \text{ inch/inch}$$

$$\sigma b = \epsilon bE \qquad \text{(bending stress)}$$

where

$$\sigma b = (3.3 \times 10^{-4})\ (30 \times 10^{6}) = 10{,}000 \text{ psi}$$

If the yield stress was 30,000 psi, the displacement would have to be 3(12) = 36 inches to approach yield.

In order to reach ultimate strain, the pipe would have to have a strain of 10 times the yield, with a corresponding displacement. Displacement is of the order of magnitude larger than can be realistically postulated.

The foregoing discussion shows the minimal effect differential settlement will have on pipe loading.

For ductile steel buried piping, it takes very large relative displacements to cause significant strains. Because these strains are in the longitudinal direction and the critical direction for pressure is the hoop direction, the effect on strength reduction is very small. Relative settlement has very little effect on pipe strength because it occurs in one direction (is not cyclic) and is limited relative to the amount of strain induced.

Structural design of buried piping is the same regardless of its classification, except for the requirement for seismic calculations for Seismic Category I piping systems. Primary stresses due to pressure and dead load are low, and the secondary stresses due to earthquake are also low, as listed in Table 17-1. Pipe wall thickness is anywhere from 7 to 10 times the required thickness for pressure in accordance with the ASME or ANSI codes. Therefore, there is no reason to believe that the code allowable stresses will be exceeded.

As indicated above, the calculated stresses are low for the settlement profiles that are available. If future profiles show any extreme conditions, the piping system will be analyzed and repairs will be made as necessary.

TABLE 17-1

DESIGN CONDITIONS

Line	Secondary Seismic Stress (SSE) (Shear and Compression Wave) (ksi)	Allowable Value S_A [1] (ksi)	Primary Stress (WT[3] + Pressure) (ksi)	Allowable Value S_h [2] (ksi)
8"-1HBC-81 (service water)	7.22	22.5	1.7	15.0
10"-0HBC-27 (service water)	7.23	22.5	1.8	15.0
26"-0HBC-54 (service water)	7.27	22.5	2.8	15.0

[1] Equation 10, ASME Section III, Subsection NC

[2] Equation 8, ASME Section III, Subsection NC

[3] Because lines are continuously supported, weight stresses are low. The assumed value is equal to 1 ksi.

Question 18

For all seismic Category 1 piping and all piping whose failure could adversely impact safety-related structures and/or systems, whether buried or not, describe what evaluations you plan to conduct to assure that such piping can withstand the increased differential settlement between buildings, within the same building, or within the piping system itself without exceeding code-allowable stress criteria. The potential influence due to differential seismic anchor movement should also be considered. Discuss what plans you have to assure compliance with code-allowable stress criteria throughout the life of the plant.

Response

Treatment of buried Seismic Category I piping and buried non-Seismic Category I piping whose failure could adversely impact safety-related structures or systems is presented in the response to Question 17. Failure of exposed non-Seismic Category I lines which could adversely impact safety-related structures or systems is addressed in Chapter 3 of the FSAR, and includes high energy line break analysis, jet impingement and flooding studies, and design criteria for pipe whip and separation. Therefore, only Seismic Category I exposed piping is addressed in this response.

Earlier editions than the 1977 edition of the ASME code did not address the stresses in the pipe due to differential settlement. The 1977 code is liberal for stress allowables due to such settlement. The code does not require that these stresses be combined with the other stresses in the pipe. It should be noted that most of these lines are not normally connected at both ends until late in the construction sequence of the plant. Thus, most of the anticipated differential settlement has taken place by the time of final closure. Provisions are incorporated in the piping installation specifications which require resolution of any misalignments so that these conditions do not go unnoticed.

A differential seismic allowance has been considered in the piping stress analysis. A reexamination of the stresses in all Seismic Category I connecting piping between buildings will be done as a normal iteration in the design. This analysis will consider stresses induced in the piping by differential settlements between the buildings after connection of the piping, and will also consider the additional induced stresses due to the maximum expected differential settlement over the life of the plant. This evaluation will ensure that the piping systems are designed within the acceptable limits of the applicable codes, and that the pressure integrity will be maintained under all conditions.

Except for the piping discussed above, Seismic Category I piping between structures is buried. Most of this piping has not been connected yet, and much of it enters the structures through sleeves which have clearances around the pipe. Effects of any differential settlement between buried pipe and piping within a building will be considered in the piping stress analysis, as discussed in the response to Question 17.

Within Seismic Category I buildings, only the emergency diesel generator pedestals are founded independently from the building structure. No piping connections have been made between these pedestals and the building structures to date. Most of this piping will be relatively small and will incorporate enough flexibility to accommodate more than the expected differential settlement.

The flexibility of structures is addressed in the response to Question 19. Structure deflections due to settlement variations under the structure are not expected to be of significance to piping systems within the structure. No reanalysis of the stresses in piping systems within a structure is anticipated because of these deflections.

The programs discussed are being initiated with the objective of ensuring that if settlements remain within the predicted range no further analysis, modifications, or monitoring will be required to maintain the settlement-induced stresses within the limits of the applicable codes. Only normal visual surveillance of piping and pipe supports is expected to be necessary.

Question 19

The piping in fill under and in the vicinity of the diesel generator building could have deformations induced either prior to or during the preload program. What is the present status of any deformation in the piping, and what ultimate deformations are predicted. If any deformations are or will be excessive, what actions are being or will be taken to correct the condition?

Response

All pipes which are located in the fill subjected to the influence of preloading the diesel generator building are listed in Table 19-1. Methods used to assess the condition of these pipes and the effects of the preload are profiling selected representative pipes and analysis. In addition to the above methods, gap measurements and an elevation survey were made to provide additional data as checkpoints.

Following are discussions of each of these methods.

1) Profiling Pipes

The profiling was mainly performed using a Nold Aquaducer profile gage as shown in Figure 19-3.

Selected Seismic Category I and non-Seismic Category I pipes have been profiled by the Nold Aquaducer profile gage. The pipes which have been profiled in the diesel generator building area are shown in Figure 19-1.

All pipes have not been profiled. When pipes were located in close physical proximity or considered to be placed in common trench conditions, only one of the pipes was profiled. The profile data from these pipes will be used to evaluate other pipes in close physical proximity. The profiles taken to date will be evaluated for present and future effects as described in the response to Question 17. These pipes will be profiled again after the preload is removed, which will provide information to allow a correlation between additional overall settlement and additional deflection in the pipe.

2) Analysis

Several lines which appeared geometrically sensitive to settlement and/or the preload were analyzed for an assumed settlement of 12 inches and/or 20 feet of soil surcharge at the diesel generator building. The lines analyzed were the condensate lines entering into the turbine building, the circulating water lines, and the nonsafety-related service water line entering the turbine building.

Based on the results of this analysis, the following actions were initiated.

a) The condensate lines were disconnected at the turbine building to prevent a stress buildup due to differential settlement between the diesel generator building and the turbine building.

b) The roundness of one of the circulating water lines was measured to see if internal reinforcement is needed during the preload program.

c) Profiling of the service water lines was extended to provide deflection information.

The roundness measurements taken on one circulating water line (96"-2YBJ-4) indicate that the pipe is generally oval in shape, with the vertical axis larger than the horizontal axis. These measurements give no indication that any excessive deformations have occurred due to the surcharge load.

3) Gap Measurements

The gaps between embedded sleeves and pipes entering the diesel generator building were measured at the top, bottom, and each side. The measurements were taken before the surcharge was applied, and during and after the isolation of the electrical duct banks. These measurements have not changed significantly, indicating that the pipes moved with the building. Additional measurements will be taken when the surcharge is removed. This information will be coordinated with the profile data.

4) Elevation Survey

By standard survey methods (i.e., level and transit), an elevation survey is being made of the condensate line and concrete encased guard pipe. Readings are being taken at the north and south end of the guard pipe encasement. A time versus settlement curve and location plan are shown in Figure 19-2.

Acceptable deformations due to bending in the longitudinal direction are covered in response to Question 17. However, piping subjected to the surcharge may deform in the hoop direction. Because the surcharge is a temporary load, AWWA

No. M11[1] was used to evaluate the buried pipe. The calculated radial deformation of the service and condensate water lines does not exceed 5% of the pipe diameter, which is consistent with the requirements of AWWA.

A complete evaluation of all safety-related piping will be available after completion of the preload program. It is estimated that this information will be available after August 1979.

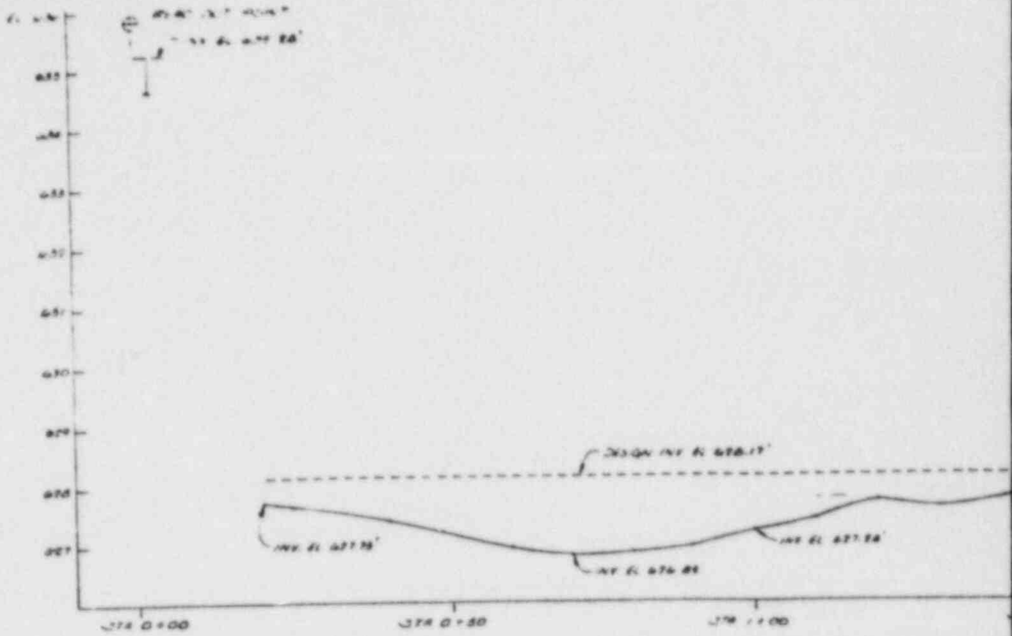
(1) American Water Works Association, Manual of Water Supply Practices - "Steel Pipe Design and Installation," 1964.

TABLE 19-1

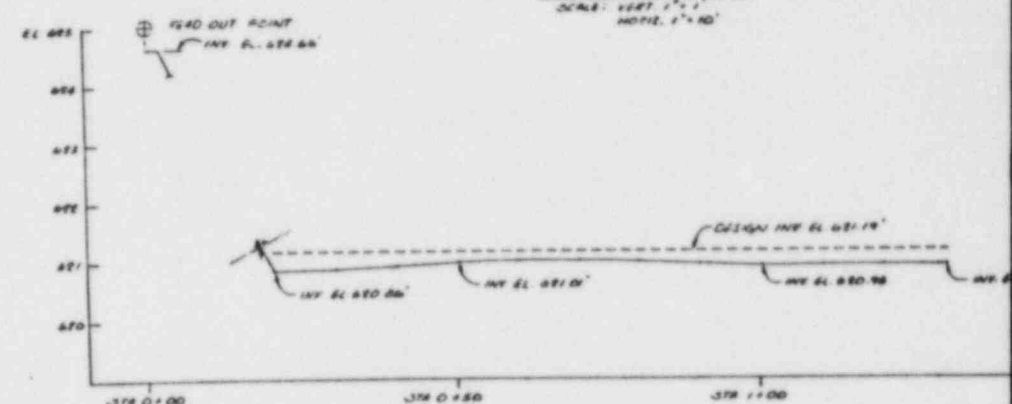
Pipe Identification		Safety-Related
A. Pipes entering diesel generator building		
Service water lines		
1HBC81, 82	8"Ø	Yes
2HBC81, 82	8"Ø	Yes
1HBC-310, 311	8"Ø	Yes
2HBC-310, 311	8"Ø	Yes
Emergency diesel oil lines		
1HBC-497, 498	2"Ø	Yes
2HBC-497, 498	2"Ø	Yes
1HBC-3, 4	1-1/2"Ø	Yes
2HBC-3, 4	1-1/2"Ø	Yes
Carbon dioxide lines		
2GBF-341	4"	No
Oily waste lines		
1JBD-537, 538	3"	No
2JBD-537, 538	3"	No
Roof drain line		
XHG	6"	No
B. Pipes in vicinity		
Service water lines		
0HBC-27, 28	10	Yes
0HBC-53, 54, 55, 56	26	Yes
Condensate water lines		
1HCD-169	20	No
2HCD-169	20	No
1HCD-513	6	No
2HCD-513	6	No

Table 19-1 (continued)

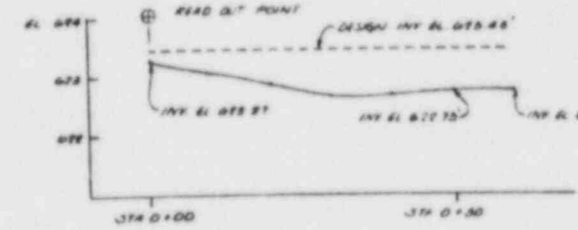
Pipe Identification		Safety-Related
B. Pipes in vicinity (continued)		
Service water lines		
1JBD-1, 2	26	No
2JBD-1, 2	26	No
Oily waste lines		
1JBD-437	8	No
Circulating water lines		
1YBJ-13	12	No
2YBJ-1, 2, 3, 4	96	No
1YBJ 3 & 4	72	No
2YBJ-8	12	No
Oily waste	6, 12, and 15	No
Sanitary sewer	6 and 8	No



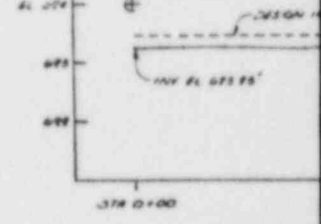
PROFILE 8"-1HBC-81
SCALE: VERT. 1"=1'
HORIZ. 1"=10'



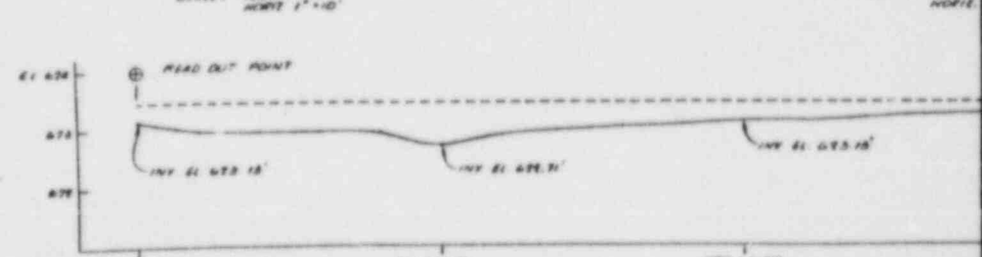
PROFILE 20"-1HCD-169
SCALE: VERT. 1"=1'
HORIZ. 1"=10'



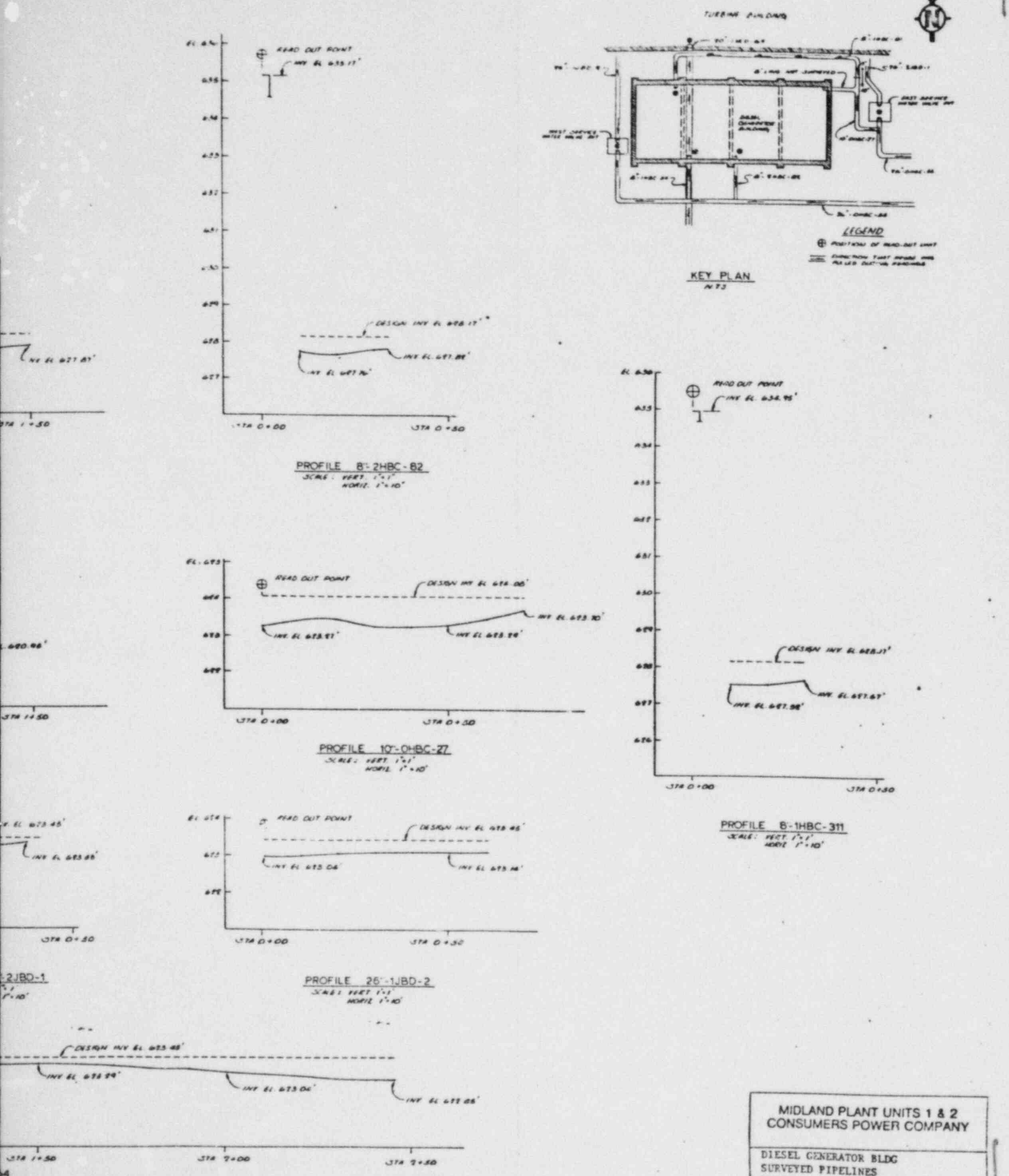
PROFILE 26"-OHBC-55
SCALE: VERT. 1"=1'
HORIZ. 1"=10'



PROFILE 26



PROFILE 26"-OHBC-5
SCALE: VERT. 1"=1'
HORIZ. 1"=10'

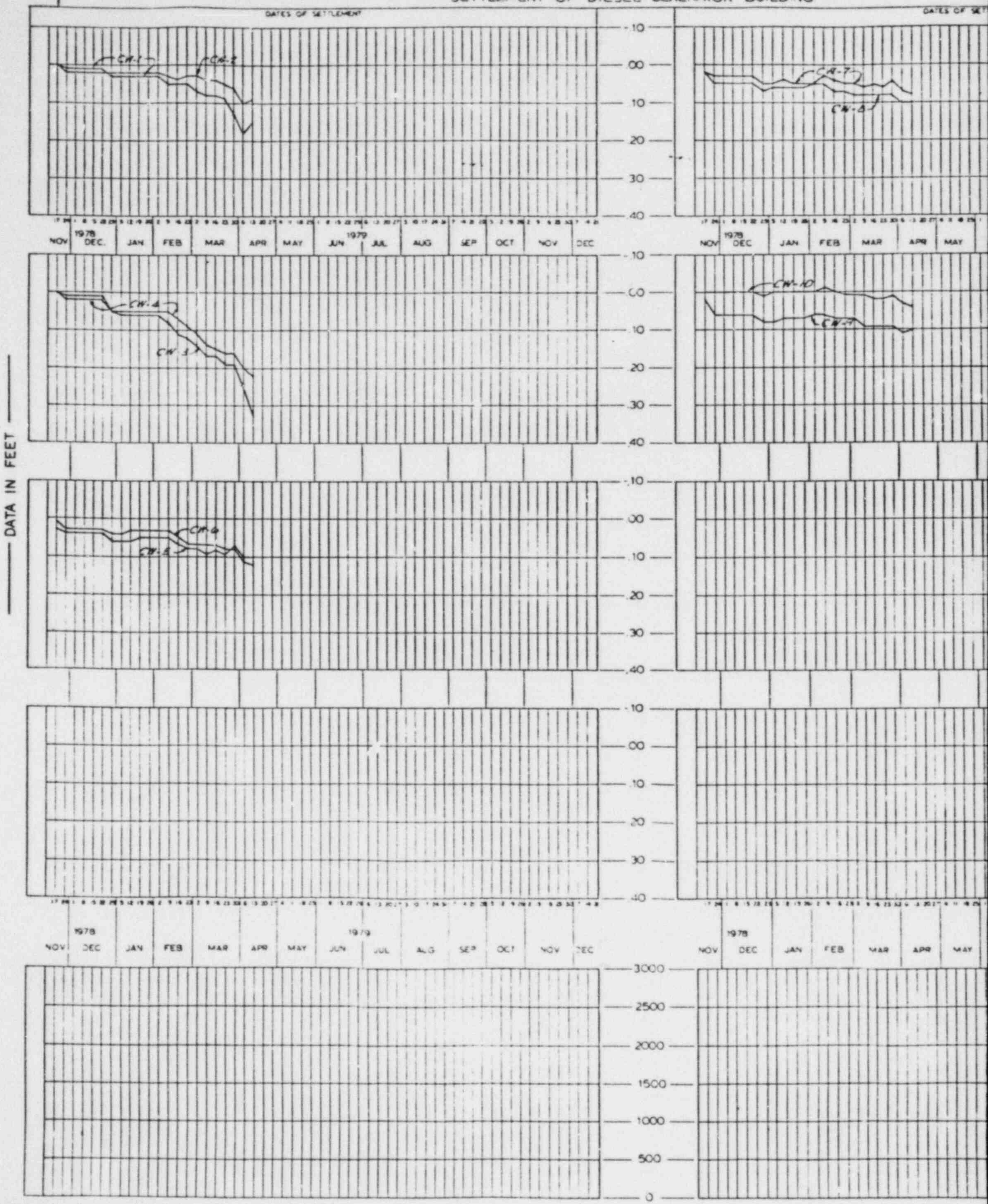


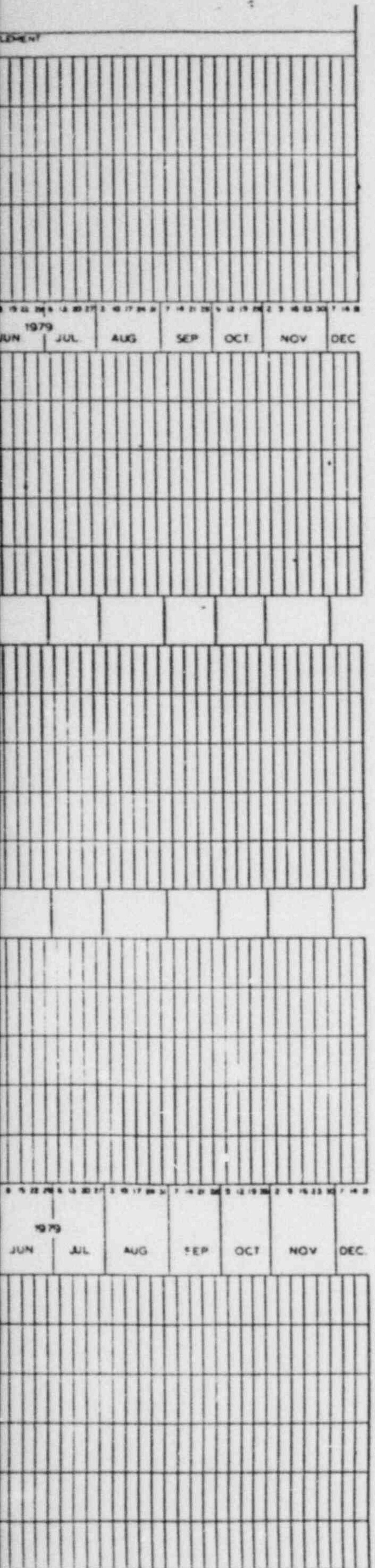
MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

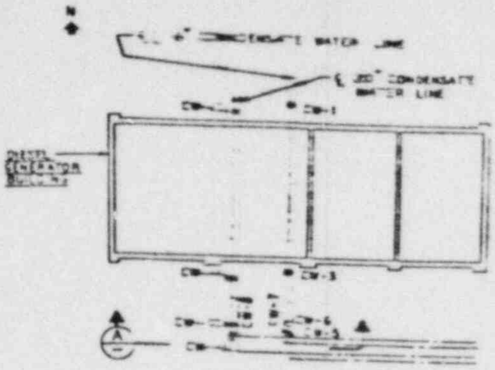
DIESEL GENERATOR BLDG
SURVEYED PIPELINES
PROFILES BY GZD

FIGURE 19-1 DATE 4/24/79

SETTLEMENT OF DIESEL GENERATOR BUILDING

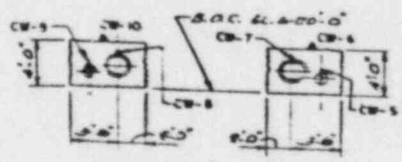






KEY PLAN

INSTRUMENT No.	INSTALLED ELEV.
CW-1	EL. 635.37'
CW-2	EL. 635.35'
CW-3	EL. 637.80'
CW-4	EL. 639.06'
CW-5	EL. 636.21'
CW-6	EL. 636.02'
CW-7	EL. 637.37'
CW-8	EL. 636.63'
CW-9	EL. 636.57'
CW-10	EL. 635.90'

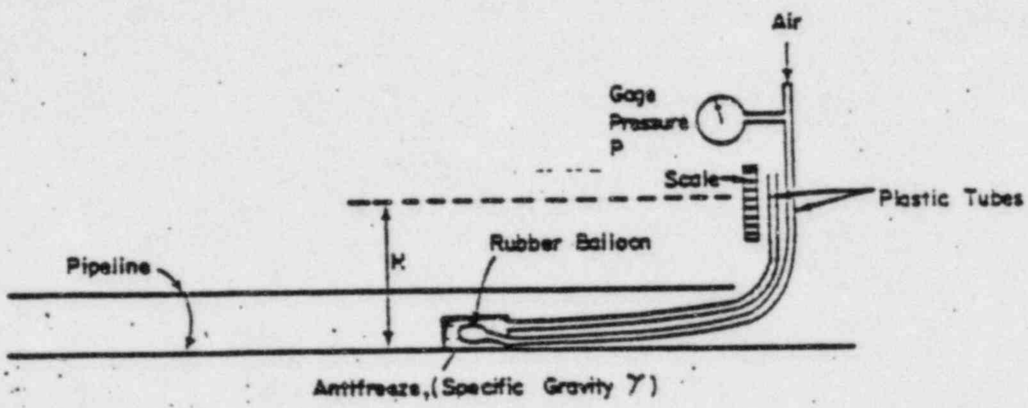


SECTION A

MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

SETTLEMENT DATA
CONDENSATE WATER LINES
AND CONCRETE ENCASEMENT

FIGURE 19-2 DATE 4-24-79



SCHEMATIC OF PIPE PROFILE SETTLEMENT GAGE

MIDLAND PLANT UNITS 1 & 2 CONSUMERS POWER COMPANY
PIPE PROFILE SETTLEMENT GAGE
FIGURE 19-3 DATE: 4/24/79

G-0588

Question 20

Provide assurance that the stress levels of all components (e.g., pumps, valves, vessels, supports) associated with seismic Category I piping systems that have been or will be exposed to increased settlement will be within their code-allowable stress limits. Also, provide assurance that deformations of active pumps and valves installed in such systems will be kept within limits for which component operability has been established.

Response

The analysis of Seismic Category I piping systems which have been or are expected to be affected by settlement will encompass the total extent of the settlement effect on the piping. Affected pump and vessel nozzle loadings will be analytically checked to verify that they are within specified or vendor-accepted limits. If necessary, flanged joints may be disassembled and the nature of the resulting separation may be used to evaluate the loads transmitted by the joint.

Equipment supports are normally designed to accept the allowable piping reaction loads, and therefore will be unaffected by settlement as long as the nozzle allowables are not exceeded.

For piping systems which have been subjected to loads induced by settlement, piping support loads will be verified by analysis to be in accordance with the design loads. The maximum differential settlement will be used to verify that pipe support loads will not become excessive, or alternately, to establish a requirement for future support adjustment.

The valves are generally stronger than the piping in which they are welded. Because the pipe (not the valve) governs the piping design, the valve deformations, if any, will be insignificant.

The reviews and analysis work described above will be completed by June 29, 1979.

Question 21

Your letter of December 21, 1978, on the settlement of the diesel generator foundations and building advised us that the use of preload to densify the existing fill material in place had been selected as the major corrective action plan. Bechtel's Interim Report 3 to MCAR 24 forwarded by your letter of January 5, 1979, identifies six alternative plans for corrective action, from which your soil consultants have advised that only two suitable options exist at that time (i.e., the preload option or the option to remove and replace the building and fill material). We require the following additional information regarding the basis for selection of these two options:

a) Provide a cost comparison of the two options. Include, by major items, an estimate of the cost of replacing each safety-related structure and utility (e.g., piping cables, etc) located on or in the questionable plant area fill. not just diesel gen. bldg!

In the event the preload option should fail to provide acceptable results, what additional costs will have occurred which would not otherwise have resulted had the removal and replacement option been selected originally? Upon what items would these additional costs have been expended?

What savings will have occurred if the preload option provides acceptable results, compared to selection of the removal and replacement option? In what items would these savings have occurred?

b) Provide a detailed comparison of the impact on construction completion between the two options. What schedule penalty is associated with an unacceptable result for the option selected?

c) Discuss for each option the probability of achieving the degree of compaction intended by the original requirements stated in the PSAR.

d) What other significant factors influenced your selection?

Response (to Question 21, Part a)

The order-of-magnitude cost estimates provided for response to this question are for contractor costs made up of field costs, engineering and home office costs, and contingencies for these cost estimates. Responses to this question exclude any CPCo costs such as AFUDC, replacement power, etc.

Cost Comparison of Preload Versus Replacement Plans

Estimates indicate a cost of $3,400,000 for the preload plan (Option 1) and $8,700,000 for the removal and replacement of building and fill material plan (Option 2). A summary of these estimates indicating major items are shown in Table 21a-1 for the preload plan (Option 1) and Table 21a-2 for the original removal and replacement plan (Option 2).

A cost of $12,200,000 is estimated for the removal and replacement of the building and fill material if the preloading plan fails to provide acceptable results (Option 3). This estimate is shown in Table 21a-3.

A summary of the estimated costs for Options 1, 2, and 3, including allowances for only additional contractor costs associated with the potential schedule delays, is shown in Table 21a-4.

Additional Costs Incurred if Preload Plan Fails

In the event the preload plan (Option 1) should fail to provide acceptable results, additional costs of approximately $26,500,000 may be incurred beyond the estimated costs which would have resulted had the removal and replacement plan (Option 2) been selected originally. These additional costs would be incurred in the following three areas:

1) An increase in the removal and replacement costs resulting from continuation of building construction

2) Costs of the preloading operation

3) Additional costs associated with the net potential delay in system turnover and fuel load of 8 months between the original replacement plan (Option 2) and anticipated replacement plan (Option 3).

A summary of this additional cost development is shown in Table 21a-5.

Savings if Preload Plan Provides Acceptable Results

If the preload plan (Option 1) provides acceptable results, a savings of approximately $18,500,000 may be obtained compared to the total estimated costs for the original removal and replacement plan (Option 2). These savings would occur in the following two areas:

1) The cost differential between the preload plan (Option 1) and the original removal and replacement plan (Option 2)

2) Additional costs associated with the net potential delay in system turnover and fuel load of 5 months between the preload plan (Option 1) and the original removal and replacement plan (Option 2)

A summary of this cost savings development is shown in Table 21a-6.

Response (to Question 21, Part b)

The estimated impact on construction completion for the preload plan (Option 1) is shown in Figure 21b-1 and for the original removal and replacement plan (Option 2) is shown in Figure 21b-2. These estimates indicate a potential for schedule delay of 2 months for the preload plan and 7 months for the original removal and replacement plan. These potential delays are due to the completion and turnover for preoperational testing of both Unit 2 diesel generators currently scheduled for February 15, 1980, and are based on the start of each option of December 15, 1978. The impact of these potential construction and system turnover delays on the preoperational testing schedule has yet to be determined. However, it is assumed for the response to this question that a similar delay potential would exist for hot functional testing and fuel load.

In the event the preload plan (Option 1) should fail to provide acceptable results and the only acceptable option was removal and replacement of the building and fill (Option 3), the estimated impact on construction completion would be as shown in Figure 21b-3. This option indicates a potential for delay of system turnover and fuel load of 15 months.

Response (to Question 21, Part c)

The preload option may not produce densities uniformly meeting the PSAR compaction criteria, but will produce foundation conditions that meet the design intent of the PSAR as discussed in the response to Question 4. Removal and replacement of the diesel generator building fill would have allowed achievement of the PSAR compaction criteria.

Response (to Question 21, Part d)

Listed below are other factors that influenced the choice of the preload over the replacement option.

1) Recognized authorities in soils and foundation engineering, Dr. R.B. Peck and Dr. A.J. Hendron, Jr., were consulted. Based on inspection of the site and the results of soil investigations, they agreed that the soils beneath the diesel generator building are of a type that will consolidate sufficiently rapidly under preload.

2) The diesel generator building is a low, two-story, heavily reinforced box structure with a great deal of reserve capacity that can tolerate the stresses induced by preloading and the differential settlement of the soil due to unevenly compacted fill.

3) The preload fill will reduce anticipated residual settlements during the life of the plant to a small and predictable value. In this respect, the preloading is a full scale load test carried out to stresses in excess of those induced by the structure, and residual settlements following preloading can be predicted conservatively.

4) Corrective treatment can be carried out without the need for extensive dewatering.

5) Preloading was the least costly feasible alternative for corrective action. Also, construction of the structure can continue while the surcharge load is being applied. Thus, this alternative will minimize the impact on the construction schedule.

TABLE 21a-1

ESTIMATE SUMMARY
FOR
PRELOAD PLAN (OPTION 1)

	Manhours	$1,000s
Soils investigation	4,300	375
Turbine building reinforcement	18,900	385
Surcharge placement, monitoring, and removal	21,300	500
Duct bank repair	2,300	30
Diesel generator storage	6,900	120
Subtotal Direct Costs	53,700	1,410
Distributable manual labor and materials	16,100	445
Nonmanual labor	21,500	285
Engineering and home office (including consultants)	27,000	920
Contingency	11,700	340
Total Bechtel Costs	130,000	$3,400

Notes:

1. Excludes costs associated with any potential schedule delays.

2. Corresponds with the schedule shown in Figure 21b-1.

TABLE 21a-2

ESTIMATE SUMMARY
FOR
ORIGINAL REMOVAL AND REPLACEMENT PLAN (OPTION 2)

	Manhours	$1,000s
Remove building	59,200	775
Remove backfill	3,000	175
Remove utilities	5,200	90
Replace backfill	13,000	285
Replace utilities	15,900	430
Replace building	117,600	2,400
Subtotal Direct Costs	213,900	4,155
Distributable manual labor and materials	64,200	1,695
Nonmanual labor	85,600	1,140
Engineering and home office	10,000	260
Contingency	74,700	1,450
Total Bechtel Costs	448,400	$8,700

Notes:

1. Estimate based on building status as of December 15, 1978, when decision was made to proceed with the preload plan.
2. Excludes costs associated with any potential schedule delays.
3. Corresponds with the schedule shown in Figure 21b-2.

TABLE 21a-3

ESTIMATE SUMMARY
FOR
REMOVAL AND REPLACEMENT AFTER PRELOADING (OPTION 3)

	Manhours	$1,000s
Remove building	92,200	1,210
Remove backfill	3,000	175
Remove utilities	5,200	90
Replace backfill	13,000	285
Replace utilities	15,900	430
Replace building	177,000	3,640
Subtotal Direct Costs	306,300	5,830
Distributable manual labor and materials	91,900	2,420
Nonmanual labor	122,500	1,630
Engineering and home office	10,000	260
Contingency	106,100	2,060
Total Bechtel Costs	636,800	$12,200

Notes:

1. Estimate based on building status as of August 15, 1979, when decision would be made to proceed with removal and replacement if the preload plan should fail to provide acceptable results.
2. Excludes costs associated with any potential schedule delays.
3. Excludes costs of preload plan.
4. Corresponds with the schedule shown in Figure 21b-3.

TABLE 21a-4

ESTIMATE SUMMARY
FOR
OPTIONS 1, 2, AND 3, INCLUDING COSTS FOR
POTENTIAL SCHEDULE DELAYS

Option 1	Manhours	$1,000s
1. Preloading costs (Table 21a-1)	130,000	3,400
2. Additional costs of 2-month delay (Figure 21b-1)		
Manual labor	30,000	540
Nonmanual labor	9,000	120
Distributable material and subcontract		110
Engineering and home office	30,000	780
Contingency		450
Subtotal of Delay Costs	69,000	2,000
Total Bechtel Costs (Option 1)		$5,400

Option 2	Manhours	$1,000s
1. Original removal and replacement costs (Table 21a-2)	448,400	8,700
2. Additional costs of 7-month delay (Figure 21b-2)		
Manual labor	220,000	4,240
Nonmanual labor	132,000	1,885
Distributable material and subcontract		850
Engineering and home office	171,000	4,755
Contingency		3,470
Subtotal of Delay Costs	523,000	15,200
Total Bechtel Costs (Option 2)		$23,900

Table 21a-4 (continued)

Option 3	Manhours	$1,000s
1. Removal and replacement after preload costs (Table 21a-3)	636,800	12,200
2. Preloading costs (Table 21a-1)	130,000	3,400
3. Additional costs of 15-month delay (Figure 21b-3)		
Manual labor	470,000	9,645
Nonmanual labor	282,000	4,290
Distributable material and subcontract		1,930
Engineering and home office	368,000	10,910
Contingency		8,025
Subtotal of Delay Costs	1,120,000	34,800
Total Bechtel Costs (Option 3)		$50,400

Notes:

1. Additional Bechtel costs associated with potential schedule delays shown in Figures 21b-1, 21b-2, and 21b-3 are order-of-magnitude estimate allowances for direct and indirect costs which would be incurred to:

   a. Maintain project staffing at a level to respond in a timely manner to the resumption and completion of testing and starting activities.

   b. Maintain the completed portions of the plant in a safe and clean condition during that period of time between the current project schedule and resumption of the preoperational testing and startup activities that are currently restained by the diesel generator system completion and turnover.

TABLE 21a-5

DEVELOPMENT OF
ADDITIONAL COSTS IF PRELOAD
PROVIDES UNACCEPTABLE RESULTS

		$1,000s
1.	Increase in Removal and Replacement Costs	
	After preload (Option 3) (8/15/79)	12,200
	Original plan (Option 2) (12/15/78)	(8,700)
	Increase in removal and replacement costs	3,500
2.	Costs of preloading plan (Option 1)	3,400
3.	Additional Costs of Net 8-month Delay	
	15-month delay costs (Option 3)	34,800
	7-month delay costs (Option 2)	(15,200)
	Additional costs	19,600
	Total Additional Bechtel Costs	$26,500

Notes:

1. Reference Tables 21a-1, 21a-2, 21a-3, and 21a-4.
2. Based on NRC assumption of removal and replacement option providing only acceptable option.

TABLE 21a-6

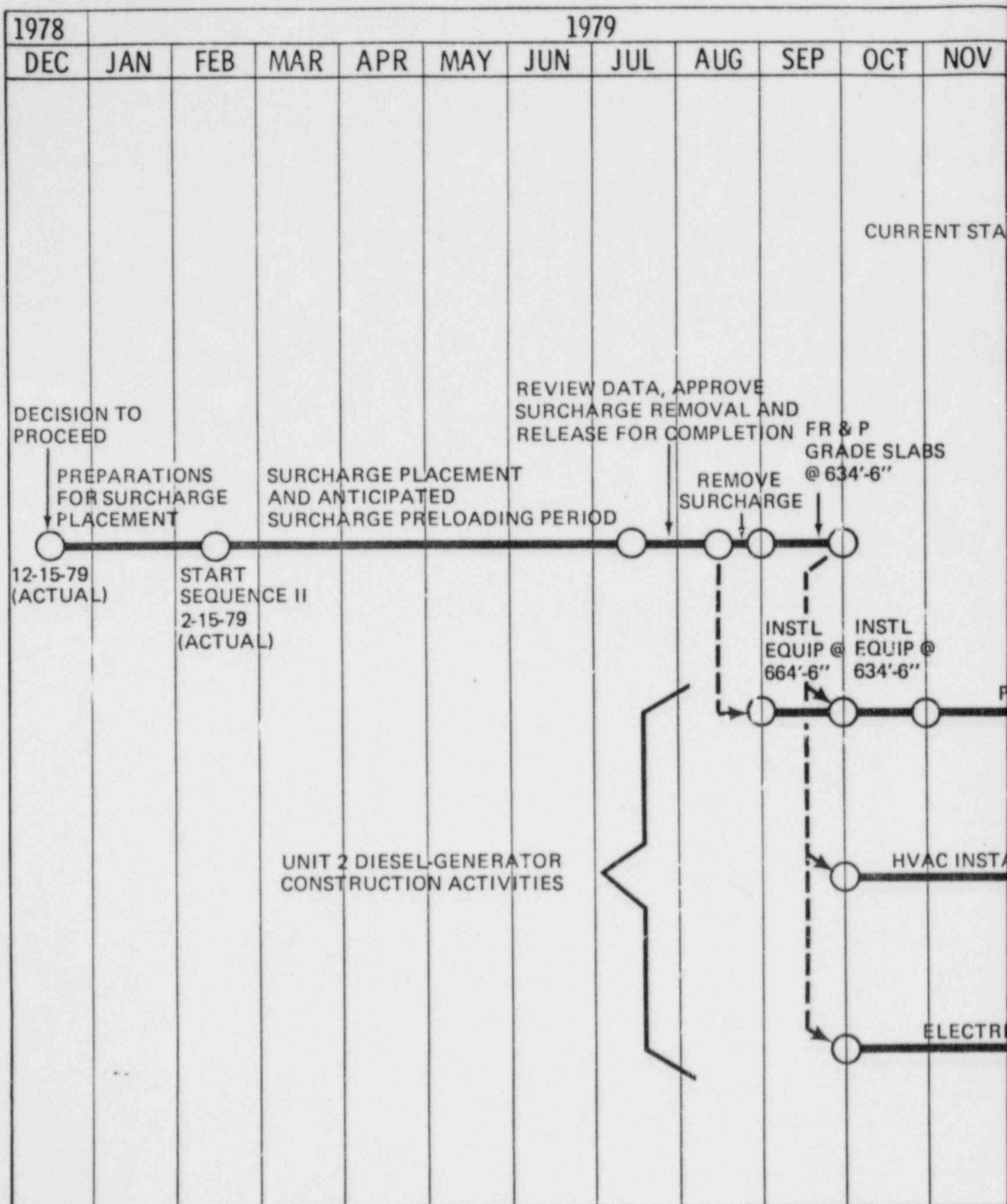
DEVELOPMENT OF
COST SAVINGS IF PRELOAD
PROVIDES ACCEPTABLE RESULTS

		$1,000s
1.	Savings in Option Costs	
	Costs of original removal and replacement plan (Option 2)	8,700
	Less costs of preloading plan (Option 1)	(3,400)
	Cost savings of utilizing preload plan	5,300
2.	Savings of Additional Costs of Net 5-Month Delay	
	7-month delay costs (Option 2)	15,200
	2-month delay costs (Option 1)	(2,000)
	Savings of additional costs	13,200
	Total Savings in Bechtel Costs	$18,500

Note:

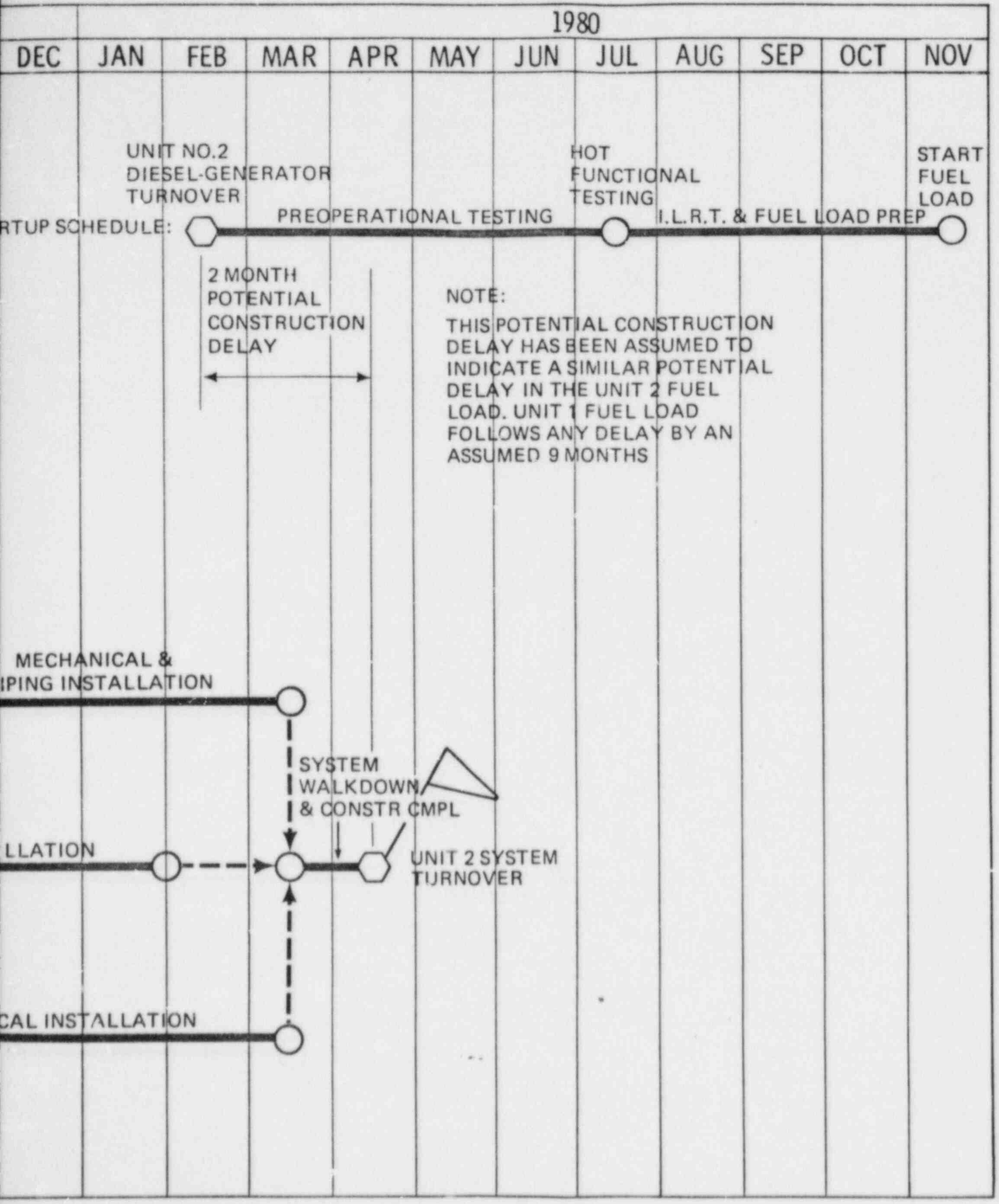
1. Reference Tables 21a-1 21a-2, and 21a-4.

OPTION 1– PRELOADING OF DIESEL (

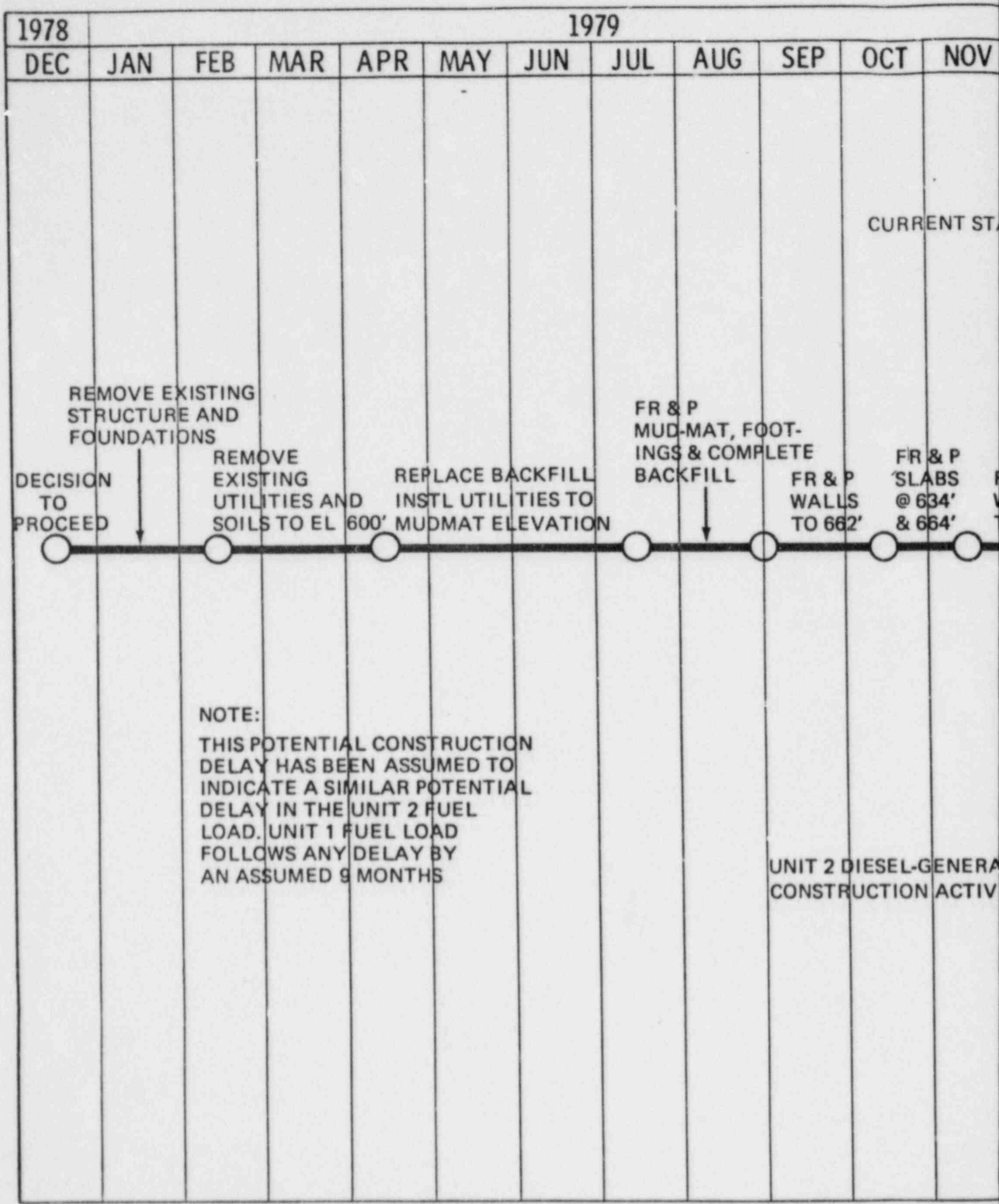


GENERATOR BUILDING SOILS

FIGURE 21.B-1

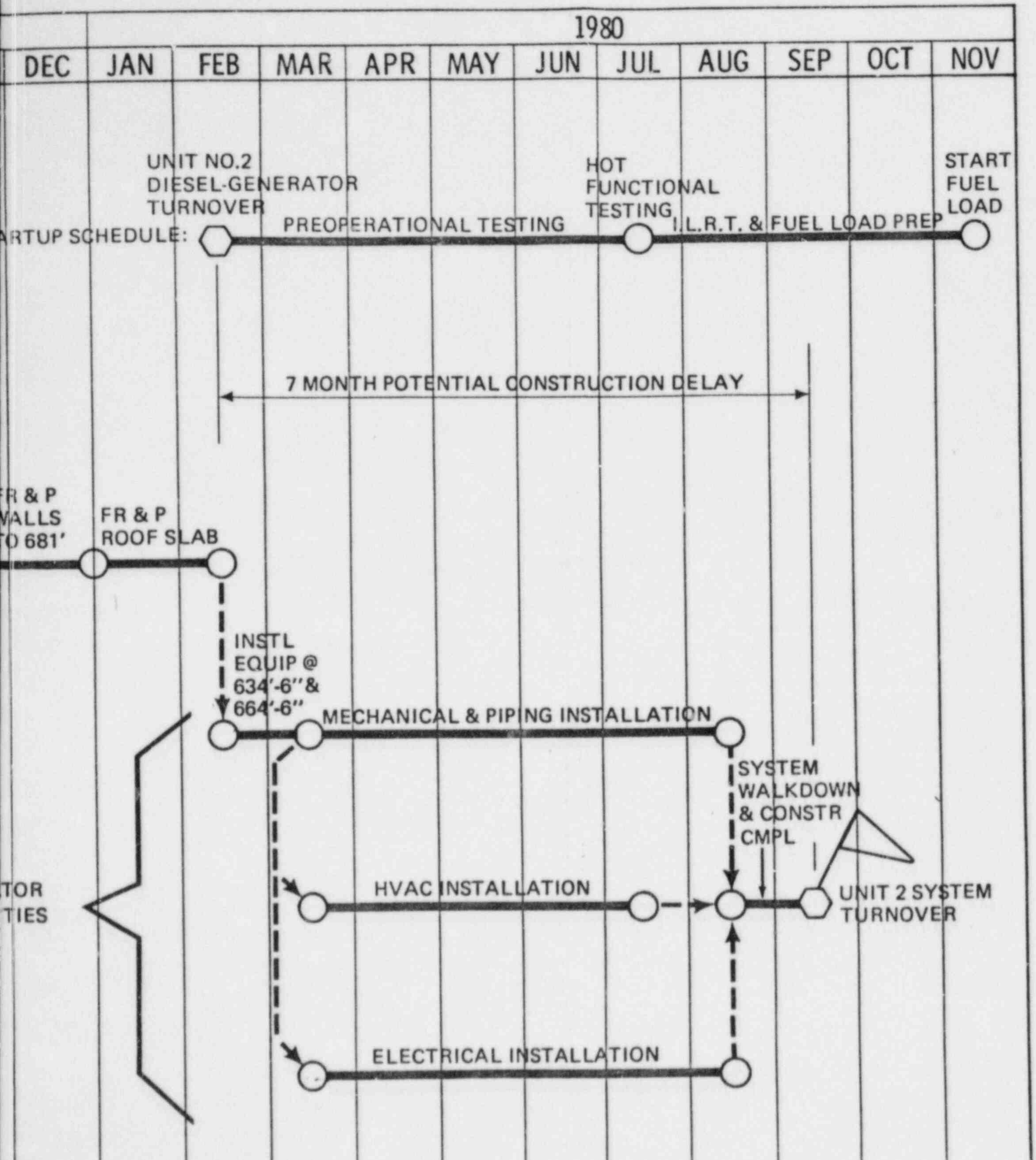


OPTION 2 – TOTAL REPLACEMENT OF

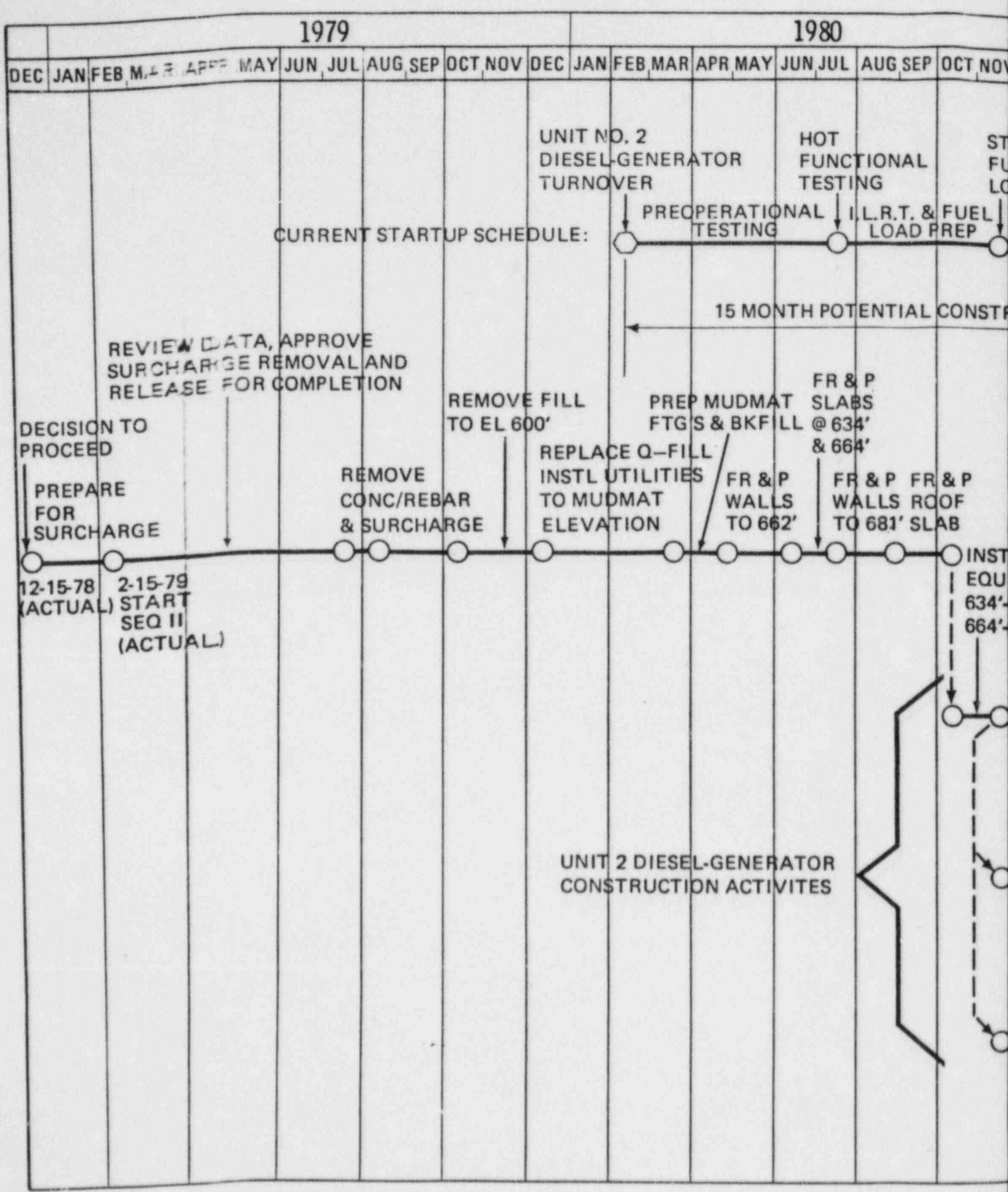


DIESEL GENERATOR BUILDING

FIGURE 21.B-2

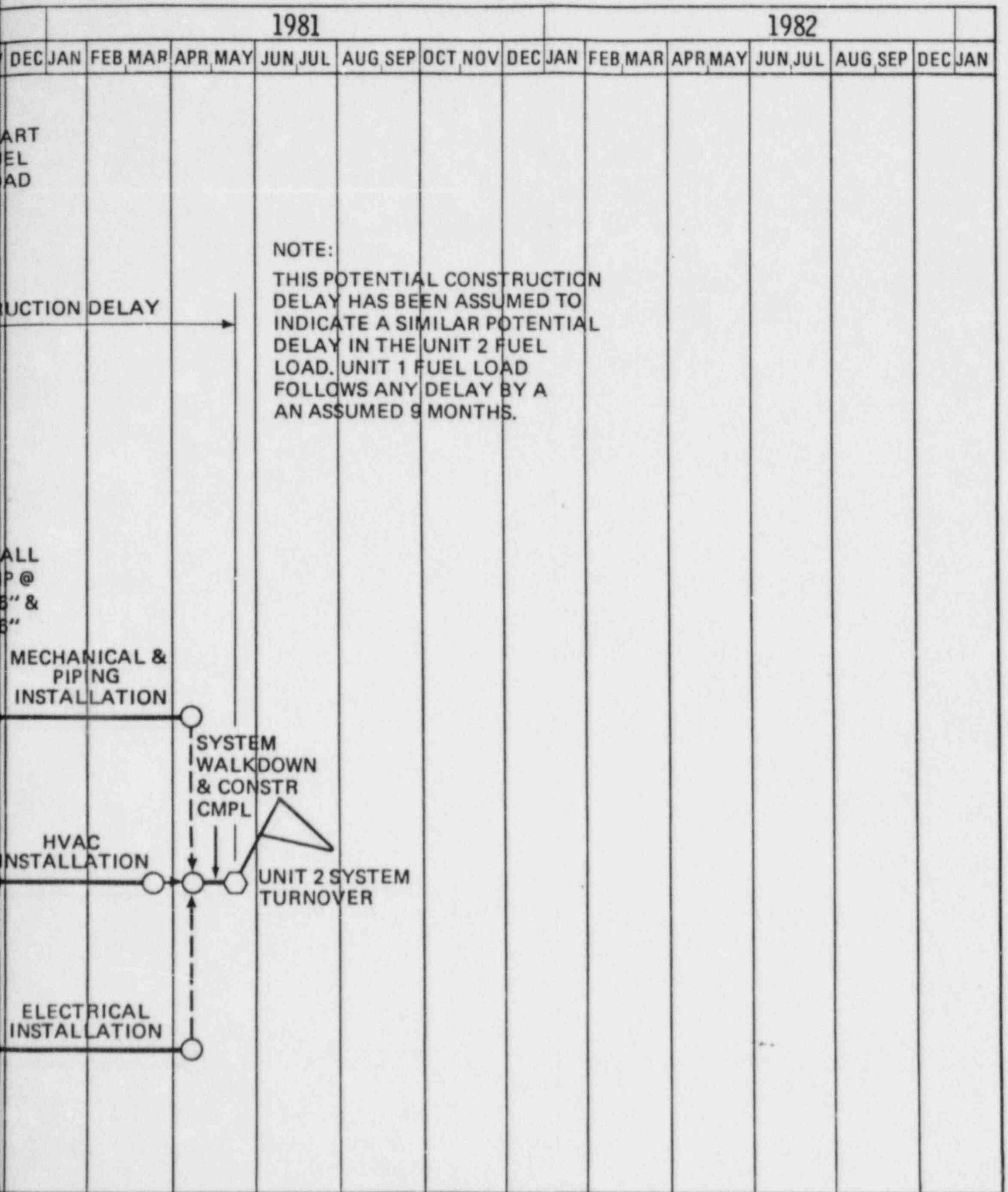


OPTION 3 – RESULTING SCHEDUL



E IF PRELOADING IS NOT ACCEPTABLE

FIGURE 21.B-3



Question 22

The following information is required using the assumption that work is to stop on all activities related to construction of structures, systems, and utilities affected by fill (whether such affect is either presently known or suspect), including any mechanical, electrical, or civil activity involving a significant expenditure of funds:

(a) Identify any schedule impacts on construction completion dates as a function of months of delay over a period of 24 months.

(b) Identify any capital costs of the delay and quantify them.

(c) Identify any other cost or schedule impacts associated with a halt or suspension of construction for a period of 3 months, 6 months, 9 months, 12 months, 18 months, and 24 months.

(d) Identify the principal construction activities which are to take place over the next 24 months, with particular reference to those activities associated with structures, systems, components, and utilities affected by fill settlement, whether such settlement is either known or suspect.

(e) For those activities identified in response to Item (d) above, identify each which is significant in terms of weight addition to structures founded totally or partly on or in fill.

(f) Identify all alternative solutions associated with the plant area fill settlement which would be foreclosed by continuation of any of the above activities.

Response (to Question 22, Part a)

The estimated impact on the current project schedule which would result from a halt or suspension of all construction progress activities within the physical boundaries of the structures, systems, and utilities founded on plant area fill which are known or suspected to have potential settlement problems is shown in Table 22a-1. It is anticipated that a halt or suspension of construction activities in these areas would result in delays in the preoperational testing and fuel load schedule of an identical or greater magnitude because the current project schedule does not include any schedule contingencies, and a significant number of plant systems would be affected, primarily because of electrical, control, and service water restraints. The plant structures and utilities affected by known or suspect settlement problems which were utilized for this schedule impact analysis are as follows:

1) Diesel generator building

2) Service water pumphouse (only that portion located on fill)

3) Borated water storage tanks 1T-60 and 2T-60

4) Emergency diesel fuel oil storage tanks

5) Underground safety-related utilities in fill

6) Main feedwater isolation valve pits, Units 1 and 2

7) Auxiliary building control tower area columns (Columns Kc to H and 5.3 to 7.8) and Unit 1 electrical penetration area (Columns K to H, west of Column 5.3)

8) Auxiliary building railroad bay (Columns A to AA and 4.55 to 7.4)

A summary of the estimated schedule impact if all construction activities were halted or suspended by individual structure is shown in Table 22a-2. This impact is to the current project schedule fuel load of Unit 2, which is November 15, 1980.

<u>Response (to Question 22, Part b)</u>

Capital costs which would be incurred as the result of any delay to the current project schedule because of a halt or suspension of all construction activities in affected structures, systems, and utilities are categorized below. These capital costs are in addition to the existing total project capital cost of $1,670 million, and would not be incurred if the project schedule is maintained.

Delay Cost Category	Current Schedule To-Go Cost as of 5-1-79 for Halted Activities	Delay Cost Basis
Bechtel Costs		
1) Manual labor associated with those construction activities halted or suspended. Estimated at 940,000 manhours	$16,815,000	Escalated 8% per year
2) Nonmanual labor associated with the above manual labor. Estimated at 290,000 manhours	$3,835,000	Escalated 8% per year
3) Material delivery and subcontractor activities affected by halted or suspended construction activities	$5,945,000	Escalated 8% per year
4) Cost estimate contingencies for the above three items at 20%	$5,405,000	Escalated 8% per year
5) Manual labor assistance of preoperational testing and startup activities which would be delayed by halted or suspended construction activities. Estimated at 321,000 manual manhours	$6,800,000	Escalated 8% per year
6) Field costs associated with the maintenance of completed structures, systems, and utilities in a clean and safe condition until such a time that the suspended structures, systems, and utilities are completed to allow the continuation of the preoperational testing and startup activities	None	Relative to the length of schedule delay. Varies from 25,000 to 50,000 manhours per month

Delay Cost Category	Current Schedule To-Go Cost as of 5-1-79 for Halted Activities	Delay Cost Basis
Bechtel Costs (continued)		
7) Field costs associated with remobilization of manual personnel to the levels required to continue the halted or suspended construction activities	None	Relative to the length of schedule delay. Varies from 0 to 20% of delayed manual labor manhours
8) Field costs associated with maintaining nonmanual staffing beyond and current project plan as necessitated by the delay in project completion	None	Assumes an average of 40,000 manhours per month of suspension period
9) Engineering and home office costs associated with maintaining project staffing beyond the current project plan as necessitated by the delay in project completion	None	Assumes an average of 32,000 engineering manhours and 10,000 home office manhours per month of suspension period
CPCo Costs		
10) Nuclear steam systems supplier cost for continuation of contract service (i.e, site construction and operating services, project management, etc)	None	$35,000/month based on past contract delay cost increases
11) CPCo directs - continuation of project mangement, project services groups, testing and operating personnel beyond current project plan	None	Assumes either a continuation of existing level throughout the suspended period, or, if in a buildup mode, the level is held constant during the suspension period and resumes at the planned buildup at the end of the suspension

Delay Cost Category	Current Schedule To-Go Cost as of 5-1-79 for Halted Activities	Delay Cost Basis
CPCo Costs (continued)		
12) General and administrative (G&A) indirect cost for continuation of support beyond existing project plan	None	Estimated at 1.3% of total Bechtel and CPCo direct costs of delay
13) Property taxes - continuation of taxes beyond existing project completion plan	None	Assumes continuation of taxes at 1980 tax rate level plus taxes on additional delay cost
14) Insurance - continuation of insurance beyond existing project completion plan	None	Assumes continuation of 1981 rate at $40,000 per month
15) Allowance for funds used during construction (AFUDC) - continuation of AFUDC beyond existing project completion plan	None	AFUDC continues at a rate of 8.5% per year on the current plant sunk cost for the duration of delay plus AFUDC on the delay cost incurred
16) Land	None	AFUDC on land cost for the duration of delay at 8.5% per year
17) Licensing	None	AFUDC on licensing cost for the duration of delay at 8.5% per year

The order-of-magnitude estimated capital delay cost for the above 17 categories, assuming suspension of affected construction activities for periods of 3, 6, 9, 12, 18, and 24 months, is shown in Table 22b-1.

Response (to Question 22, Part c)

Other delay costs which are in addition to the capital delay costs identified in the response to Part 22b are net replacement power costs and nuclear fuel costs. These estimates are order-of-magnitude costs and are considered conservative for the period in which the current commercial operation dates are delayed.

Net replacement power costs are estimates beginning in 1981 dollars and nuclear fuel costs are based on leasing charges beginning in 1980 at 8% per year on the initial core, plus leasing charges on reloads D, E, and F currently under contract. In addition, a storage cost of $3.50 per bundle per day is assumed for the initial core and reloads D, E, and F beginning 1 year after the existing contract ship date. Listed below are the delay costs for net replacement power and nuclear fuel.

Delay Costs ($1,000s)	Months of Construction Suspension					
	3	6	9	12	18	24
Net replacement power costs	$31,000	$67,000	$126,000	$162,000	$267,000	$351,000
Nuclear fuel costs	$ 7,000	$15,500	$ 28,800	$ 39,000	$ 65,000	$ 82,300

The total delay costs which would be incurred as the result of any delay to the current project schedule is as follows:

Delay Costs ($1,000s)	Months of Construction Suspension 3	6	9	12	18	24
Capital Costs	$44,800	$ 94,300	$160,000	$209,500	$350,800	$456,400
Net replacement power costs	$31,000	$ 67,000	$126,000	$162,000	$267,000	$351,000
Nuclear fuel costs	$ 7,000	$ 15,500	$ 28,800	$ 39,000	$ 65,000	$ 82,300
Total Delay Costs	$82,800	$176,800	$314,900	$410,500	$682,800	$889,700
Round to	$83,000	$177,000	$315,000	$410,000	$683,000	$890,000

Response (Question 22, Part d)

The principal construction activities which are to take place over the next 24 months pursuant to the current project schedule are shown in Table 22d-1. Those activities which are totally or partially affected by the halt or suspension of construction have been specifically identified in this table.

Response (Question 22, Part e)

The construction activities within the various safety-related structures scheduled to be completed during the next 24 months are identified in response to Part 22d. The estimated weight in place and weights to be added during this construction period are compiled in Table 22e-1. The weights to be added to the diesel generator building and to the borated water storage tanks are significant. However, for the other structures, the weight to be added to complete the construction is found to be minimal.

Response (to Question 22, Part f)

The following safety-related structures or systems are founded on plant fill materials:

1) Diesel generator building

2) Service water pump structure (only partially supported on fill)

3) Borated water storage tanks

4) Emergency diesel fuel oil tanks

5) Underground yard piping and utilities

6) Main feedwater isolation valve pits (adjacent to the auxiliary building)

7) Control tower and electrical penetration areas of the auxiliary railroad bay (north of column line A) in the auxiliary building

Although the following evaluation of continued construction activities includes all Seismic Category I structures founded on plant fill, the results of the investigations to date show that corrective measures are not required in all areas (reference the response to Question 12).

With the exception of the aboveground borated water storage tanks, all structural work for the above items is complete. However, there is work remaining in the mechanical and electrical fields. In several areas of the auxiliary building, there is some electrical cable yet to be pulled and miscellaneous piping to be installed. All major pieces of equipment are in place. In the service water pump structure, remaining work includes welding of some piping and electrical installation. The service water pumps have been installed. As noted in Table 22e-1, the estimated weight addition to the structures resulting from continued construction is small (i.e., approximately 5% or less) in all areas except at the diesel generator building.

A review of the alternative solutions which might be foreclosed by continued construction activities include the following:

1) Diesel Generator Building

   This area is currently surcharged, and no construction activities are underway. No construction work in this area will be resumed unitl MCAR 24 is satisfactorily resolved.

2) Service Water Pump Structure (Portion on Fill Material)

   The north and east sides of the service water pump structure are accessible for underpinning from outside of the structure. The continued installation of electrical and mechanical items inside the building would add to the congestion and make repairs from within the structure less desirable. However, it is possible to remove such items, if necessary. Continued construction activity in this structure does not foreclose on any future repair methods.

3) Borated Water Storage Tanks

A full scale load test will be implemented in this area as described in Question 6 above. Upon completion of the construction of the tanks, the tanks will be filled with water.

If the tank areas require corrective measures, the installed tanks will not preclude grouting or similar repair methods. If complete soils replacement is required, the tanks are accessible for removal, although at significant cost and schedule penalties.

4) Emergency Diesel Fuel Oil Tanks

Similar to the above comments for the borated water storage tanks, the emergency diesel fuel oil tank foundation areas may be grouted, or, if soils replacement under the tanks is required, the tanks could be removed.

5) Underground Yard Piping/Utilities

With the exception of some small diameter piping, the buried yard piping and utilities are already in place. The evaluation of these services is described in the responses to Questions 7 and 19. Continued construction activities will include filling of the pipes and pulling electrical cable through the ducts. If required, these utility services can be emptied or replaced. Therefore, continued construction does not foreclose on the correction of any deficient buried piping and duct runs.

6,7) Portions of the Auxiliary Building South of Column Line H (i.e., Auxiliary Building Penetration Areas) and the Isolation Valve Pits

Any required corrective measures for these areas can be performed using repair methods installed from outside of the structure (i.e., sinking an access shaft down from plant grade and then tunnelling beneath the existing structural foundations slab). Because the added weight resulting from the remaining construction work to go is minimal (i.e., 5% or less), there is no risk that continued construction activity would foreclose on this option. Corrective repairs with access from within the structure is also feasible. Continued construction activity would add congestion in the repair areas, and make this alternative more difficult to implement. However, much of the congestion already exists because most large items are already in place. Also, if necessary, portions of the installed electrical and mechanical services could be removed later, albeit at at cost and schedule penalty.

8) Railroad Bay in the Auxiliary Building (north of column line A)

Corrective repairs in this area are feasible from both inside or outside of the structure. Because the foundation slab area is used for vehicular traffic, access from within the structure is readily available and access from outside the north and east sides of the railroad bay is also available.

Based on the above considerations, there is no risk in allowing the current construction activities in these safety-related buildings to continue which might later foreclose on any anticipated alternative corrective measures.

In addition to the above comment, Table 22d-1 identifies various activities which are also impacted by plant fill conditions, but which are not safety-related structures or systems (e.g., construction of oily waste building, cooling tower, condensate recovery building, bridges, etc, and associated piping and equipment). Soil conditions in these areas will also be carefully evaluated before proceeding with further construction activities.

TABLE 22a-1

ESTIMATED SCHEDULE IMPACT
OF DELAY OVER A PERIOD OF 24 MONTHS

Months of Construction Stop Work(1)	Unit 2 and Common		Unit 1	
	Months of Schedule Delay(2)	Resultant Fuel Load	Months of Schedule Delay(3)	Resultant Fuel Load
1	2	1/15/81	0	11/15/81
2	3	2/15/81	0	11/15/81
3	4	3/15/81	1	12/15/81
4	5	4/15/81	2	1/15/82
5	6	5/15/81	3	2/15/82
6	7	6/15/81	4	3/15/82
7	8	7/15/81	5	4/15/82
8	10	9/15/81	7	6/15/82
9	12	11/15/81	9	8/15/82
10	13	12/15/81	10	9/15/82
11	14	1/15/82	11	10/15/82
12	15	2/15/82	12	11/15/82
13	16	3/15/82	13	12/15/82
14	18	5/15/82	15	2/15/83
15	19	6/15/82	16	3/15/83
16	21	8/15/82	18	5/15/83
17	23	10/15/82	20	7/15/83
18	24	11/15/82	21	8/15/83
19	25	12/15/82	22	9/15/83
20	26	1/15/83	23	10/15/83
21	27	2/15/83	24	11/15/83
22	28	3/15/83	25	12/15/83
23	29	4/15/83	26	1/15/84
24	30	5/15/83	27	2/15/84

(1) Assumes a halt or suspenstion of all construction program activities within the physical boundaries of the structures and utilities founded of that fill which has a known or suspect settlement problem. All other construction activities would be allowed to continue on present schedule.

(2) Based on the current project schedule fuel load for Unit 2 of November 15, 1980. Any construction delay will cause a fuel load delay because the current project schedule does not include any schedule contingencies.

(3) Based on the current project schedule fuel load for Unit 1 of November 15, 1981. Because of resource restraints, the Unit 1 fuel load is assumed to follow Unit 2 fuel load by no less than 9 months.

TABLE 22a-2

ESTIMATED SCHEDULE IMPACT
OF INDIVIDUAL SUSPENSIONS

Structure, System, or Utility	Suspension Period (months)					
	3	6	9	12	18	24
1) Diesel generator building	2	3	5	9	16	23
2) Service water pumphouse	4	7	10	13	19	25
3) Borated water storage tanks	1	4	7	9	15	21
4) Emergency diesel oil storage tanks	0	0	3	6	12	18
5) Underground safety-related utilities	3	6	9	13	20	27
6) Main feedwater isolation valve pits	0	0	3	6	12	18
7) Auxiliary building control tower and electrical penetration (Unit 1)	3	7	10	13	20	27
8) Auxiliary building railroad	4	7	9	12	18	24

NOTES:

1. These estimated schedule impacts would be to the current project schedule Unit 2 fuel load of November 15, 1980.

2. These estimated schedule impacts assume a halt or suspension only within the physical boundaries of each individual structure, system, or utility. However, they are not additive, and a halt or suspension in more than one area may cause schedule impacts greater than these individual estimates.

TABLE 22b-1

ESTIMATED CAPITAL DELAYS COSTS ($1,000s)

Delay Cost Category	Months of Construction Suspension 3	6	9	12	18	24
1) Manual labor for halted activities	300	700	1,000	1,300	2,100	2,800
2) Nonmanual labor for halted activities	100	200	300	200	500	700
3) Material and subcontract costs for halted activites	100	200	400	500	700	1,000
4) Contingency for the above categories	100	200	400	500	700	900
5) Delayed preoperation assistance	100	300	400	500	800	1,100
6) Plant layup and maintenance costs	1,700	4,100	7,300	11,400	22,100	30,700
7) Manual labor remobilization costs	-	1,400	2,800	2,900	5,900	6,200
8) Nonmanual staffing costs	1,700	3,500	5,400	7,300	11,400	15,800
9) Engineering and home office staffing costs	3,400	6,900	10,500	14,300	22,300	30,800
Total Bechtel Costs	$7,500	$17,500	$28,500	$39,000	$66,500	$90,000
10) NSS supplier costs	140	245	420	525	840	1,050
11) CPCo direct costs	8,700	15,200	15,000	20,000	30,000	40,000
12) CPCo general and administrative costs	212	428	571	774	1,265	1,704
13) Property taxes	3,600	6,500	11,200	14,100	23,400	29,700
14) Insurance costs	160	280	480	600	960	1,200
15) AFUDC	24,193	53,612	102,940	133,252	225,908	290,258
16) Land costs	90	158	270	338	540	675
17) Licensing costs	238	417	714	893	1,428	1,785
Total CPCo Costs	$37,333	$76,840	$131,595	$170,482	$284,341	$366,372
Total Project Capital Delay Costs	$44,833	$94,340	$160,095	$209,482	$350,841	$456,372
Round to	$44,800	$94,300	$160,100	$209,500	$350,800	$456,400

TABLE 22d-1

PRINCIPAL ACTIVITIES SCHEDULED FOR THE NEXT 24 MONTHS

Activities identified with an asterisk are either totally or partially located on the plant area fill in question.

Civil/Structural/Architectural	Forecasted Completion Date
Install new and spent fuel racks	12/1/79
Install and post-tension reactor building Unit 2 tendons	1/1/80
Install and post-tension reactor building Unit 1 tendons	2/1/81
Close construction opening in reactor building Unit 1	1/15/80
Install the equipment hatch in reactor building Unit 1	5/1/79
Construct cooling pond blowdown valve pit and discharge structure	11/1/79
Construct oily waste building	1/1/80
Construct service water cooling tower	8/1/79
Construct condensate recovery building and bridges to Dow	10/1/80
Mechanical/Piping	
*Install main steam and process steam lines, missle protection, and supports	10/1/80
Install NSSS system components and piping in reactor building Unit 2	2/15/80
Install NSSS system components and piping in reactor building Unit 1	1/1/81

Table 22d-1 (continued)

Mechanical/Piping (continued)	Forecasted Completion Date
Install T/G system components and piping in turbine building Unit 2	3/1/80
Install T/G system components and piping in turbine building Unit 1	3/1/81
Install underground utilities and piping to:	7/1/80
Cooling pond blowdown valve chamber	
*Borated water storage tanks	
Service water cooling towers	
*Emergency diesel generator fuel oil tanks	
*Install large pipe and supports	1/1/81
*Install small pipe and supports	5/1/81
Install major equipment	
CO_2 storage tank	9/1/79
Pumps at el 568 in the auxiliary building	10/1/79
Pumps at el 634 in the auxiliary building	4/8/80
Auxiliary building trolley upgrade	5/1/80
Fuel transfer tube	6/15/79
Solid radwaste system	9/1/79
Hypochlorination system	9/1/79
*Diesel generator building	11/1/79
Install HVAC equipment, duct, and supports	7/1/80
Electrical/Instrumentation	
*Install exposed conduit and tray	3/1/80
*Pull wire and cable and terminate	5/1/81
*Install Unit 2 main transformer and complete isophase bus	11/1/79
Complete Unit 1 isophase bus	9/1/79
Install underground duct banks and pull cable to:	7/1/80
Cooling pond blowdown valve chamber	

Table 22d-1 (continued)

Electrical/Instrumentation (continued)	Forecasted Completion Date
*Borated water storage tanks	
Service water cooling towers	
*Emergency diesel generator fuel oil tanks	
Install major equipment	
*Control panels at el 645 to 568 in the auxiliary building	10/1/79
*Control room panels	7/1/80
*Control panels at el 659 in the auxiliary building	8/1/80
Process steam radiation monitoring panels	10/1/80

System Turnovers

*Electrical distribution system for energization	8/1/79
*Service water system	8/13/79
Chemical addition to service water and circulating water, Unit 2	9/3/79
Service air and instrument air, Unit 2	9/16/79
*Makeup demineralizer	9/24/79
*Demineralizer storage and transfer	10/7/79
Component cooling water, Unit 2	11/10/79
Condensate storage and transfer	11/4/79
Decay heat removal, Unit 2	12/24/79
Condensor air removal, Unit 2	2/25/80
Reactor coolant pumps, Unit 2	12/31/79
Reactor vessel and primary loop, Unit 2	3/29/80
Integrity leak rate test, Unit 2	9/80
Hot functional testing, Unit 2	7/80

TABLE 22e-1

Structure/Component	Estimated Total Weight In Place (kips)	Estimated Total Weight To Be Added (kips)	Percent Weight To Be Added
1. Diesel generator building	19,000[(3)]	5,400	28
a. Ground floor slab	0	1,200	-
b. Diesel generator pedestal	3,000[(3)]	1,000	33
2. Service water pump structure (part on fill only)	4,770	200	4
3. Borated water storage tanks			
a. BWST 1T-60	860	4,340[(2)]	500
b. BWST 2T-60	760	4,340[(2)]	570
4. Emergency diesel oil storage tanks[(1)]	3,770	490	13
5. Underground safety-related utilities (in fill)	N/A	N/A	N/A
6. Main feedwater isolation valve pits (Units 1 and 2)	650	6	1
7. Auxiliary building electrical penetration areas			
a. Unit 1	7,700	350	5
b. Unit 2	7,700	300	5
8. Auxiliary building railroad bay between columns A and AA	9,500	180	2

[(1)] The tanks are currently filled with water.
[(2)] Includes the weight of the water to be contained in the tank.
[(3)] Does not include surcharge weight.

Note: The above weight estimates are as of April 1, 1979.

D. Gillen

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

REGION III

PRESENTATION OF INVESTIGATION FINDINGS OF THE SETTLEMENT OF THE DIESEL GENERATOR BUILDING AND PLANT AREA FILL

CONSUMERS POWER COMPANY

MIDLAND NUCLEAR POWER PLANT
UNITS 1 AND 2

FEBRUARY 23, 1979

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CONTENTS

1. Scope of Investigation

The NRC Region III office performed an investigation to obtain information relating to design and construction activities affecting the Diesel Generator Building foundation and plant area fill and the activities involved in the identification and reporting of the settlement of the building.

The investigation consisted of 240 onsite hours by three NRC inspectors and included examination of pertinent records and procedures and interviews with personnel at the Midland Site, the Consumers Power Company offices in Jackson, Michigan, and the Bechtel Power Corporation offices in Ann Arbor, Michigan.

2. Identification and Reporting of Diesel Generator Building Settlement

Inspection Facts

- Bechtel surveyors first noticed unusual settlement on July 22, 1978, while performing routine survey measurements.
- The result of the survey with unusual settlement was routinely transmitted to Bechtel Engineering.
- Field Project Engineer instructed surveyors to recheck survey and perform survey more frequently. The building was monitored for about one month.
- Apparent settlement continued and when it exceeded the values presented in the FSAR, a nonconformance report was prepared on August 18, 1978.
- On or about August 21, 1978, the NRC Resident Inspector was informed of the settlement.
- After an exploratory boring program began on August 25, 1978, and preliminary data indicated deficient material, CPCo reported the incident under 10 CFR 50.55(e).
- Formal notification was made on September 29, 1978.

Conclusion

CPCo, after preliminary evaluation of the safety implications, notified the NRC in accordance with 10 CFR 50.55(e).

Finding

Compliance of 10 CFR 50.55(e), reportability requirements.

3. Review of PSAR/FSAR Commitments

Inspection Facts

- FSAR Tables 2.5-9 and 2.5-14 identified the type of foundation material to be controlled compacted cohesive (clay) fill.

- Bechtel Design Drawing C-45 (class 1 fill material areas) specify Zone 2 random fill as any material free of organics with no restrictions on gradation.

- FSAR Figure 2.5-48 (estimated ultimates settlements) indicates the Diesel Generator Building to be approximately 3 inches.

- FSAR Section 3.8.5.5 (structural acceptance criteria) indicates shallow spread footing foundation settlements to be 1/2 inch or less on compacted fill. The Diesel Generator Building had a shallow spread footing foundation.

Conclusions

a. The FSAR did not accurately state the design basis or type of fill material supporting class 1 structures.

b. The FSAR included conflicting values for the settlement of the Diesel Generating Building founded on spread footing.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion III (design control); failure to translate design basis as specified in the license application into instructions, procedures or drawings.

4. <u>Effect of Ground Water on Plant Area Fill</u>

<u>Inspection Facts</u>

- PSAR Amendment No. 1 and Dames and Moore report on foundation investigation indicates a planned drainage system to maintain the ground water level in the plant fill at elevation 603.
- PSAR Amendment No. 3 indicates this underdrainage system has been eliminated and the ground water is assumed to rise concurrently with the cooling pond to elevation 625.
- Bechtel consultant (Dr. Peck) has indicated that small changes in moisture content of the soil will probably result in increased compressibility.

<u>Conclusion</u>

It has not been fully determined whether the full effects of saturating the fill was taken into account in the design basis.

<u>Finding</u>

Unresolved matter pending licensee evaluation on the effects of permitting the ground water to rise in the plant area fill.

5. Compaction Requirements for Plant Area Fill

Inspection Facts

- PSAR Amendment No. 3 required the following compaction:

  Clay - 100% of maximum density using a compactive energy of 20,000 ft-lbs (equivalent to 95% of maximum density using ASTM 1557 Method D with 56,000 ft-lb energy).

  Sand - 85% relative density.

- Bechtel Specification C-210 requirements:

  Clay - 95% of maximum density using ASTM 1557 Method D (same as PSAR)

  Sand - 80% relative density (less than PSAR)

- Bechtel implemented requirements:

  Clay - 95% of maximum using Bechtel Modified Test Method using 20,000 ft-lbs (less than that required by the PSAR and Specification).

  Sand - 80% relative density (less than PSAR required but met Specification requirement).

Conclusions

a. Bechtel translated PSAR compaction requirement for clay in construction specification, however, failed to follow requirement.

b. Bechtel did not translate PSAR compaction requirement for sand to construction specification.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion V (procedures); failure to implement construction specification requirements.

6. Moisture Control Requirements for Plant Area Fill

Inspection Facts

- Bechtel Specification C-210 required moisture conditioning in the borrow areas such that the moisture prior to compaction was within plus or minus 2% of optimum moisture content.

- CPCo and Bechtel QA identified that the moisture control was not being implemented prior to compaction on July 22, 1977.

- No association was made with a laboratory compaction standard (i.e., optimum moisture-maximum density curve) prior to compaction.

- From July 22, 1977, until June 1, 1978, Bechtel project engineering failed to provide adequate direction for control of moisture content.

Conclusion

For all practical purposes, moisture control was not implemented prior to the settlement failure of the Diesel Generator Building.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion XVI (corrective action); failure to take corrective action in a timely manner.

7. Subgrade Preparation of Plant Area Fill

Inspection Facts

- PSAR Amendment No. 3 and Dames and Moore foundation investigation report indicated that if the construction schedule required foundation excavation to be left open during the winter that at least 3 1/2 feet of material be excavated before resumption of soils work or that same amount of cover material remain in place to prevent softening of subgrade soils due to frost action.

- Bechtel Specification C-210 only prohibited placement of soils frozen surfaces but did not include provision for frost protection or, removal of material prior to resumption of work.

- Correspondence indicates that approximately only 2 inches of frozen/thawed soil was removed prior to resumption of soils work.

Conclusions

a. PSAR requirement was not translated into the specification for soils work to preclude placement of soil over subgrade effected by frost action.

b. Soil was not protected from frost action nor removed prior to resuming work.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion III (design control); failure to translate requirements into instructions or procedures.

8. Nonconformance Reports Identified

Inspection Facts

- CPCo and Bechtel QA identified repeated nonconforming conditions in the following areas of soils work:

  Failing compaction tests due to using incorrect maximum lab density.

  Moisture control tolerance.

  Inadequate inspection.

  Violation of lift thickness.

  Gradation tests not taken.

  Gradation requirements not met.

  Inadequate test frequency.

  Foremen directing soils not familiar with specification requirements.

- The most frequently used engineering disposition was to accept "use as is" with or without sound engineering basis.

Conclusion

The root of the deficiencies was not adequately corrected to preclude continued degradation of the quality of a safety related activity.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion XVI (corrective action); failure to take adequate corrective action to preclude repetition.

9. Settlement Calculations for Plant Area Fill

Inspection Facts

- Bechtel settlement calculations for the Diesel Generator Building were based on a uniform mat foundation with a uniformily distributed load intensity of 3000 psf.

- FSAR Section 3.8.4.1.2 (Diesel Generator Building) indicates the foundation to be a spread footing type with a load intensity of 4000 psf with independent diesel generator pedestal.

- Borated water storage tanks are supported by a circular spread footing. The settlement calculations were based on a uniform circular mat foundation.

- FSAR Table 2.5-16 indicates the soil compressibility parameter to be 0.003 for the soil between elevation 603 and 634. Settlement calculations assumed an index of compressibility of 0.001.

Conclusion

The estimated settlement values for the Diesel Generator Building and borated water tanks shown in FSAR Figure 2.5-48 were based on conditions that are at variance to existing conditions such as foundation type, load intensity and soil compressibility.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion III (design control); failure to translate design basis as specified in the license application into instructions, procedures or drawings

10. Settlement of Administration Building Footings

Inspection Facts

- Administration Building was originally supported by Zone 2 random fill material.

- Administration building foundation material was tested to the same compaction requirements as class 1 fill.

- Administration Building foundation material was placed similar to class 1 fill; by hand held and motorized equipment.

- Bechtel report identified basic cause of administration failure as being due to the result of repeated erroneous selection of laboratory compaction standard (i.e., incorrect selection of moisture-density standard for soil material being compacted).

- Only two borings were authorized to investigate the extent of the deficient soil outside the Administration Building area. Adminstration failure was then considered to be local condition.

- CPCo management (Corporate Project Engineer and Manager) were not properly informed of the Administration Building settlement.

Conclusions

a. CPCo did not adequately investigate the extent of the soil deficiency in the rest of the class 1 fill.

b. No program changes were implemented to preclude the continued erroneous selection of the laboratory compaction standard.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion XVI (corrective action); failure to take adequate corrective action to identify the extent of the deficiency nor preclude repetition.

11. Interface Between Diesel Generator Building and Electrical Duct Banks

Inspection Facts

- Bechtel Electrical Design Drawing E-502 includes a detail to provide separation between the duct banks and diesel generator footing (i.e., styrofoam bond breaker to permit settlement of the Diesel Generator independent of the duct banks).
- Bechtel Construction Drawing C-45 permits the use of random fill Zone 2.
- Correspondence from Bechtel engineerng to field (December 27, 1974) permits the use of lean concrete as replacement for Zone 1 and 2 material.
- Bechtel field used concrete around electrical duct banks under the diesel generator footings.

Conclusion

Due to permitting the use of concrete indiscriminately as random fill the uniform settlement of the Diesel Generator Building was restricted in the areas of the duct banks.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion V (procedures); failure to provide adequate instructions to preclude the use of a material that would cause differential settlement.

12. Soils Placement and Inspection Activities

Inspection Facts

- Bechtel Design Criteria C-501 requires soils operations to be performed under technical supervision of a qualified soils engineer to verify all materials are placed and compacted in accordance with criteria.
- Labor foreman were directing soil operations relative to test locations, test frequency, compaction and moisture.
- Bechtel field and QC inspectors were rarely in the areas where soil operations took place.
- Accuracy of test locations were a chronic problem.
- Moisture was added to the soil after compaction if moisture test failed.

Conclusion

Personnel directing the soils operation were not trained in the area of soils work nor were they considered to be qualified soils engineers.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion II (Quality Assurance); failure to provide training to personnel performing safety related activities.

13. Inspection Procedures for Plant Fill

Inspection Facts

- Bechtel Procedure C-1.02 (compacted backfill) was written as a replacement for Procedures C-210-4 and C-211-1.

- Procedure C-1.02 relaxed certain inspection point to surveillance only. For example:

Activity	Inspection Procedure C-210-4	C-211-1	C-1.02
Material Free of Organics	-	I	S(V)
Material Moisture Conditioned	S	I	S(V)
Material Not Frozen	-	I	S(V)
Compacted to Density	W	S	S(V)
Lift Thickness Required	W	I	S(V)

Conclusions

a. Inspection procedures for soils work were relaxed from original procedural requirements to leaving insufficient mandatory hold points to ascertain backfill materials were installed to requirements.

b. It was ascertained that surveillance was infrequent and inadequate to verify conformance.

Finding

Item of noncompliance with 10 CFR 50, Appendix B, Criterion X (inspection); failure to provide adequate inspection plans.

14. Final Conclusions

- There was inadequate control and supervision of plant fill material placement.
- Corrective action regarding noncomformance related to plant fill was either not taken or was inadequate.
- Certain design bases and construction specifications were not followed.
- Weaknesses exist in the interface between various components within the construction contractor's organization.
- The FSAR contains inconsistent, incorrect and unsupported statements.