UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

NRC STAFF TESTIMONY OF EUGENE J. GALLAGHER WITH RESPECT TO QUALITY ASSURANCE PROGRAM IMPLEMENTATION PRIOR TO DECEMBER 6. 1979

Q. 1. Please state your name and position with the NRC.

A. My name is Eugene J. Gallagher. I am a civil engineer with the U.S. Nuclear Regulatory Commission. Since February, 1981, I have been assigned to the Reactor Engineering Branch, Division of Resident and Regional Reactor Inspection, Office of Inspection and Enforcement. Prior to February, 1981, I was a reactor inspector assigned to the Region III, Reactor Construction and Engineering Support Branch, Office of Inspection and Enforcement. I was assigned to the Midland Plant (among others) from October, 1978 until January, 1981.

Since October of 1978, I have spent approximately one year of effort performing inspections, reviewing quality control records and procedures, observing work activities, reviewing Consumers Power Company (hereafter Consumers) responses to 50.54(f) questions 1 and 23, attending meetings and presentations by Consumers and Bechtel regarding the soil settlement matter at the Midland Plant.

Q. 2. Have you prepared a statement of professional qualifications?

A. Yes, a copy of this statement is attachment No. 17.

Q. 3. Please state the nature of t responsibilities that you had with respect to the Midland Plant, Units 1 & 2, from October, 1978 to December 6, 1979.

A. As a civil engineer inspector for the Region III office of Inspection and Enforcement I conducted five inspections prior to December 6, 1979 in order to (1) ascertain whether adequate quality assurance plans, instructions and procedures had been established for the construction of the foundation of safety related structures, (2) provide an independent evaluation of the performance, work in progress and completed work to ascertain whether activities relative to foundation construction were accomplished in accordance with NRC requirements, and (3) review the quality related records to ascertain whether these records reflected work accomplished consistent with NRC requirements and license commitments. The results of these inspections prior to December 6, 1979 are contained in the following NRC inspection reports:

50-329/78-12; 50-330/78-12, conducted October 24-27, 1978 (Attachment No. 2).

50-329/78-20; 50-330/78-20, conducted December 11, 1978-January 25, 1979 (Attachment No. 7).

50-329/79-06; 50-330/79-06, conducted March 28-29, 1979 (Attachment No. 8).

50-329/79-10; 50-330/79-10, conducted May 14-17, 1979 (Attachment No. 10).

50-329/79-19; 50-330/79-19, conducted September 11-14, 1979 (Attachment No. 12).

Q. 4. Please state the purpose of this testimony.

A. The purpose of this testimony is to identify the quality assurance deficiencies which contributed to the soil settlement problem at the Midland Plant prior to the issuance of the December 6, 1979 Order.

Q. 5. What is "quality assurance" comprised of?

A. "Quality assurance" comprises all those planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service. Quality assurance includes quality control. (10 CFR 50, Appendix B, Introduction).

Q. 6. What is "quality control" comprised of.

A. Quality control comprises those quality assurance actions related to the physical characteristics of a material, structure, component or system which provide a means to control the quality of the material, structure, component or system to predetermined requirements. (10 CFR 50, Appendix B, Introduction).

Q. 7. Are soils work activities subject to 10 CFR 50, Appendix B?

A. General Design Criterion 1 of 10 CFR 50, Appendix A (Quality Standards and Records) requires that "structures systems and components important to safety be designed, fabricated, erected and tested to quality standards commensurate with the importance to safety functions to be performed ... A quality assurance program shall be established and implemented in order to provide adequate assurance that these structures, systems and components will satisfactorily perform their safety function..."

General Design Criterion 2 of 10 CFR 50, Appendix A (Design bases for protection against natural phenomena) requires "structures, systems and components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions...".

10 CFR 100, Appendix A, Seismic and Geologic Siting Criteria for Nuclear Power Plants (I-Purpose) states, "It is the purpose of these criteria to set forth the principal seismic and geologic considerations which guide the Commission in its evaluation of the suitability of proposed sites for nuclear power plants and the suitability of the plant design bases established in consideration of the seismic and geologic characteristics of the proposed sites..." Paragraph IV (Required Investigation) states "the investigations shall include the following: "... "Determination of the static and dynamic engineering properties of the materials underlying the site. Included should be properties needed to determine the behavior of the underlying material during earthquakes and the characteristics of the underlying material in transmitting earth-

quake induced motions to the foundation of the plants, such as seismic wave velocities, density, water content, porosity and strength..."

Midland Plant, Units 1 and 2 FSAR, Section 3.2.2.1, "describes the method of identifying and classifying those plant features designed to withstand the effects of earthquakes, and to which the requirements of Appendix B to 10 CFR 50, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, have been applied... structures, systems, and components which are required to support seismic Category I structures, components, and systems are also designed for Category I seismic loads". Table 3.2-1 provides a listing of structures, components, and systems and identifies those which are seismic Category I. Those structures include the containment building, auxiliary building, deisel generator building, service water pump structure and retaining walls and foundations for borated water storage tanks.

The soil foundation work activities for these Category I structures are subject to 10 CFR 50, Appendix B requirements in order to assure that these structures will satisfactorily perform their safety functions.

Q. 8. When did Consumers first become aware of the apparent excessive settlement of the diesel generator building?

Consumers first reported the excessive settlement of the diesel generator building orally on August 21, 1978 to the Region III, on-site NRC resident inspector. Written notification was made on September 29, 1978 in the form of a 10 CFR 50.55(e) notification of a significant deficiency in construction (attachment 1). This report states that the

diesel generator building and foundations settlement was greater than anticipated at that time (mid August, 1978). In fact, the settlement values at that time (less than 6 months after the start of construction of the diesel generator building) were approaching the total settlement values for the 40-year life.

Q. 9. Under what circumstance is a 10 CFR 50.55(e) report required?

A. By the terms of the regulation, a 50.55(e) report is required for each deficiency found in design and construction which if it were to remain uncorrected could affect adversely the safety of operations of the nuclear power plant at any time throughout the expected lifetime of the plant and which represents:

(1) A significant breakdown in any portion of the quality assurance program conducted in accordance with the requirements of [10 CFR 50], Appendix B; or

(2) A significant deficiency in final design as approved and released for construction such that the design does not conform to the criteria and bases stated in the safety analysis report or construction permit; or

(3) A significant deficiency in construction of or significant damage to a structure, system, or component which will require extensive evaluation, extensive redesign, or extensive repair to meet the criteria and bases stated in the safety analysis report or construction permit or to otherwise establish the adequacy of the structure, system, or component to perform its intended safety function; or

(4) A significant deviation from performance specifications which will require extensive evaluation, extensive redesign or extensive repair to establish the adequacy of a structure, system, or component to meet the criteria and basis stated in the safety analysis report or construction permit or to otherwise establish the adequacy of the structure, system or component to perform its intended safety function.

Consumers submitted a 50.55(e) report with respect to the soil settlement problem by its letter of September 29, 1978 (Attachment 1). Several interim reports were subsequently submitted through November 2, 1979. Consumers' initial 50.55(e) interim report (Attachment 1) states that the event was reportable under 10 CFR 50.55(e)1(iii) which is the equivalent of (3) above - a significant deficiency in construction.

Q. 10. When did you conduct your first inspection at Midland with respect to soils?

A. An inspection was conducted on October 24-27, 1978 the results of which are contained in NRC inspection report 50-329/78-12; 50-330/78-12 (hereafter NRC Report 78-12) dated November 17, 1978 (Attachment 2). The purpose of the inspection was to provide Region III management with a preliminary evaluation of the extent of the soils problem based on initial investigative borings, the type of foundation material, review of construction specifications and license commitments. Items 1(a) through (f) of that report provided a summary of Consumers 50.55(e) report and information Consumers provided while I was onsite. Items 2 through 8 of that report are the results of my review and observations made during the inspection.

I would like to bring to the attention of the board that the third paragraph of the transmittal letter for NRC Report 78-12 and the inspection summary results therein that indicate that no items of noncompliance were identified are erroneous. At the time of the inspection the identified inconsistencies (item 3) and failure to follow

specifications requirements (item 4) did constitute noncompliances. I intended to (and did in fact) conduct further investigations with respect to the soils work activities and these noncompliances. The results of this further investigation of each of these items described in NRC Report 78-12 are further discussed in NRC Report 78-20 and are identified as items of noncompliances.

Q. 11. What actions did the office of Inspection and Enforcement take subsequent to the initial inspection of October 24-27, 1978?

A. We met with Consumers to discuss the October 24-27, 1978 inspection and NRC Report 78-12 on December 4, 1978 (See Attachment 3). Members of the NRC Office of Nuclear Reactor Regulation (NRR) were also present as a result of a transfer of lead responsbility that had been executed on November 17, 1978. Bechtel initially addressed the items in NRC Report 78-12. The NRC also emphasized that while attention to remedial action is important, determination of the exact cause is also quite important for verifying the adequacy of the remedial action, assessing the extent of the matter relative to other structures, and in precluding repetition of such matters in the future.

The director of the Region III Office of Inspection and Enforcement then initiated an investigation to obtain information concerning the circumstances of the soil settlement occurrence to determine whether (1) a breakdown in the quality assurance program had occurred, (2) whether the occurrence had been reported properly and (3) whether the final

safety analysis report which had been submitted by Consumers was consistent with the design and construction of the Midland project.

Q. 12. Summarize your preliminary investigation findings.

A summary of the preliminary investigation findings were presented to Consumers on February 23, 1979 at the Region III office. These findings are documented in Attachment 4. In summary, the findings related to quality assurance deficiencies, are:

* The FSAR did not correctly state the type of fill material supporting safety related structures. This is a violation of 10 CFR 50 Appendix B quality assurance criterion III. (Design Control)

* The FSAR included conflicting values for the settlement of the diesel generator building founded on spread footings. This is a violation of 10 CFR 50 Appendix B quality assurance criterion III. (Design Control)

* The compaction requirement for clay material was not followed. This is a violation of 10 CFR 50 Appendix B quality assurance criterion V. (Instructions, Procedures and Drawings)

* The compaction requirement for sand was not correctly translated into the construction specifications. This is a violation of 10 CFR 50 Appendix B quality assurance criterion V. (Instructions, Procedures and Drawings)

* Moisture control was not properly implemented. This is a violation of 10 CFR 50 Appendix B quality assurance criterion XVI. (Corrective Action)

* Soil was not protected from frost action nor removed prior to resuming work. This is a violation of 10 CFR 50 Appendix B quality assurance criterion III. (Design Control)

* The root causes of nonconforming conditions were not adequately corrected to preclude repetition. This is a violation of 10 CFR 50 Appendix B quality assurance criterion XVI. (Corrective Action)

* The settlement calculations for the diesel generator building were based on conditions of foundation type, load intensity and

soil compressibility other than the actual conditions. This is a violation of 10 CFR 50 Appendix B quality assurance criterion III. (Design Control)

* Consumers did not adequately investigate the extent of the soil problem after the settlement of the administration building footings. This is a violation of 10 CFR 50 Appendix B quality assurance criterion XVI. (Corrective Action)

* Program changes were not implemented to preclude erroneous selection of the laboratory compaction standards (maximum density and optimum moisture content) after the settlement of the administration building footings. This is a violation of 10 CFR 50 Appendix B quality assurance criterion XVI. (Corrective Action)

[We subsequently determined that the last two items should not have been listed as quality assurance deficiencies because the administration building is not subject to quality assurance requirements.]

* Concrete material was permitted to be used in lieu of fill material without consideration of the effects on structures. This is a violation of 10 CFR 50 Appendix B quality assurance criterion V. (Instructions, Procedures and Drawings)

* Personnel directing the soils operation were not trained in the area of soil work, nor was a geotechnical soils engineer present on-site as required. This is a violation of 10 CFR 50 Appendix B quality assurance criterion II. (Quality Assurance program)

* Inspection procedures were relaxed from original procedural requirements which provided insufficient hold points to ascertain backfill material was installed properly. This is a violation of 10 CFR 50 Appendix B quality assurance criterion X. (Inspection)

* The sampling (surveillance) plan was infrequent and inadequate to verify conformance. This is a violation of 10 CFR 50 Appendix B quality assurance criterion X. (Inspection)

Based on the above findings it was my conclusion and it is my conclusion now that:

(1) There was inadequate control and supervision of the plant fill.

(2) Corrective action regarding nonconformances was inadequate.

(3) Construction specifications and design bases were not followed.

(4) Interface between design organization and construction was inadequate.

(5) The FSAR contained inconsistent, incorrect and unsupported statements.

Q. 13. Did Consumers respond to these findings?

A. Yes. Subsequent to the February 23, 1979, a meeting was held at the Region III office on March 5, 1979 during which Consumers responded to the NRC investigation findings. Consumers response was documented in their submittal which was revised March 9, 1979 (Attachment 5). During this meeting the NRC Staff reiterated it's concern expressed on December 4, 1978 for assessment of the extent of the matter relative to other structures, and stated that its concern was not limited to the narrow scope of the diesel generator building but extended to various buildings, utilities and other structures located in and on the plant fill. In addition, the NRC Staff expressed concern with the implementation of Consumers quality assurance programs.

Consumers March 9, 1979 response (Attachment 5) failed to identify root causes of the quality assurance deficiencies and corrective actions to preclude repetition of these quality assurance deficiencies.

Q. 14. Did the NRC transmit the detailed investigation results to Consumers?

A. The investigation results were sent to Consumers on March 22, 1979; the details of which are contained in NRC investigation report 50-329/78-20; 50-330/78-20. (Attachment 7). This report indicated that the findings of the investigation continued to be under review by the NRC

Staff and that upon the completion of that review Consumers would be advised of the enforcement action to be taken by the NRC. NRC Report 78-20 contains a more detailed discussion of the investigation findings summarized in response to Question 15 of this testimony.

Q. 15. What action was taken to determine whether enforcement action should be taken?

A. On March 21, 1979 the NRC sent Consumers a request pursuant to 10 CFR 50.54(f) to obtain additional information regarding the adequacy of the plant fill and the quality assurance program for the Midland site. (Attachment 6). I provided input into the 50.54(f) request. Question 1 of 22 of the 50.54(f) letter requested information regarding Consumers' implementation of the quality assurance program. On April 24, 1979 Consumers submitted the initial response to Question 1 (Attachment 9). The NRC review concluded that the information provided was not sufficient. During a July 18, 1979 meeting, Consumers presented the results of its investigation into the probable cause of the settlement problem and the NRC expressed several points of disagreement with these results [see meeting summary dated October 16, 1979, Attachment 13]. On September 11, 1979 the NRC issued Question 23 which contained a request for additional quality assurance information. On November 13, 1979 Consumers Power Co. submitted revision 4 to the 50.54(f) submittals which contained their response to Question 23 (Attachment 14) including specific corrective actions and commitments for implementation of its quality assurance program.

In its responses to 50.54(f) Question 23, Consumers identified and discussed the root causes for quality assurance deficiencies. As discussed more fully below, information in the response to Question 23 supports the allegation in NRC's December 6, 1979 Order Modifying Construction Permits (Attachment 15) that there was a breakdown in quality assurance.

Q. 16. What action was taken with respect to enforcement?

A. On December 6, 1979 an Order Modifying Construction Permits was issued jointly by the NRC Office of Nuclear Reactor Regulation and the Office of Inspection and Enforcement as a result of the investigation findings and the conclusions of the NRC Staff after reviewing responses to the 10 CFR 50.54(f) requests of March 21, 1979 and September 11, 1979. One of the bases for the issuance of the December 6, 1979 Order, was the breakdown in quality assurance with respect to soil activities. (See paragraph III of the December 6, 1979 Order).

As more fully discussed in this affidavit, the facts contained in Part II of the December 6, 1979 Order (including Appendix A) insofar as they relate to quality assurance, are true.

Q. 17. Before discussing what actually occurred at Midland with regard to the implementation of the quality assurance program in the soils area, please state the significance of soil compaction and the factors which affect soil compaction.

A. When soil is employed as a structural or construction material, it must have adequate engineering properties to perform it's intended design function without excessive deformation or settlement. Compaction of soils is an effective technique for increasing the soil density and attaining the desired engineering properties of soil materials such as acceptable strength, resistance to deformation and resistance to the flow of water. Specifying the attainment of a maximum soil density is an accepted engineering practice for measuring the effectiveness of the compactive effort.

The density that can be achieved by compaction depends on (1) the soil type, (2) moisture control, (3) type of compaction equipment, (4) placement thickness of the soil layer to be compacted, and (5) the magnitude of the compaction effort (for example the number of passes of the compaction equipment). Satisfactory performance of the soil can be achieved provided these factors are properly specified and controlled during construction under an effective quality control and quality assurance program.

G. P. Tschebotarioff, author of "Foundations, Retaining & Earth Structures", Second Edition, McGraw Hill, states in paragraph 1-8 (Special Need for Construction Quality Control) that "In foundation work this need [for construction quality control] is much greater than in any branch of civil engineering.... Constant attention to every detail of construction procedures is therefore a must in all foundation work. Above all, continuous competent on-the-site inspection is essential..." This illustrates the special character of the geotechnical field, in comparison to other construction activities.

Q. 18. Identify the 13 quality assurance deficiencies discussed by Consumers in its response to 50.54(f) Question 23.

A. (1) Inconsistencies between construction specifications and consultant reports.

(2) Lack of formal revisions of specifications to reflect clarification of specification requirements.

(3) Inconsistency of design basis within the FSAR relating to diesel generator building fill material and settlement values.

(4) Inconsistencies between the settlement calculations and the original design basis of the diesel generator building.

(5) Inadequate design coordination in the design of the duct bank.

(6) Insufficient compactive effort used in backfill operation.

(7) Insufficient technical direction in the field.

(8) Inadequate quality control inspection of placement of fill.

(9) Inadequate soil moisture testing.

(10) Incorrect soil test results.

(11) Inadequate subcontractor test procedure.

(12) Inadequate corrective action for repetitive nonforming conditions.

(13) Inadequate quality assurance auditing and monitoring of the plant fill work activities.

These items are discussed below, seriatim.

Q. 19. Summarize Consumers and NRC discussion of inconsistencies identified between construction specifications and consultant reports. (Item 13(1))

A. Discussion of this quality assurance deficiency is contained in (1) NRC Report 78-20, pages 9,10,16 and 17, (2) Consumers response to 50.54(f) Question 1 at appendix I, page 1 (¶ A.1) and page 3 (¶ B.1) (3) Consumers response to 50.54(f) Question 23 at pages 23-6 and 23-7 (subsection 3.1) and (4) Consumers Answer to Notice of Hearing, appendix 1(e) and (f).

This quality assurance deficiency existed between 1973 through the substantial reduction in construction during 1978-79 without correction.

Consultant reports were submitted by Consumers to the NRC as PSAR attachments. Consumers indicated that consultant reports were subject to being "misconstrued as commitments". The Dames & Moore report, entitled "Foundation Investigation and Preliminary Explorations for Borrow Materials, Proposed Nuclear Power Plant", dated June 28, 1968 was submitted as PSAR amendment 1 and a supplement to this report dated, March 15, 1969 was later submitted as PSAR amendment 3. This report contained criteria relating to compaction and frost protection of the foundation material which were disregarded during actual construction.

In response to an NRC question Consumers also submitted PSAR amendment 9 dated 3/20/70 which states in part, "the design criteria for these Class I structures will be modified to remove all natural sands with a relative density less than 75% and to replace these sands with a controlled backfill compacted in accordance with page 16 to the report titled "Foundation Investigation and Preliminary Explorations for Borrow Material Proposed Nuclear Power Plant, dated March 15, 1969." Since the Dames and Moore report was submitted as part of the application, and was

specifically referenced in Amendment No. 9, NRC considered the designated compaction criteria to be design commitments by applicant.

Page 16 of the Dames and Moore report indicated the compaction criterion for sands supporting structures to be a minimum 85% relative density. Contrary to this, Bechtel construction specification C-210 required compaction of sand to not less than 80% relative density. In addition, the 80% relative density criteria was also not met in numerous cases as will be discussed in Question 20 of this testimony.

Page 15 of the Dames and Moore report indicated "that all frozen soils be removed or recompacted prior to resumption of operations." Construction specification C-210 ("Construct n for Plant Foundation and Cooling Pond Dikes") did not address instructions for removal or recompaction of frozen/thawed material upon resumption of soil work.

In addition to the above inconsistencies Dames & 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 six to eight inches in loose thickness". Contrary to the above, the Bechtel construction specification C-210, section 12.5.3 and C-211 ("Specification for Structural Backfill"), Section 5.2.2 stated, "in no case shall the uncompacted lift thickness exceed 12 inches."

Consumers states the root cause of these inconsistencies as being that "During the preparation and early revisions of the PSAR there were no procedural requirements or methods for documenting the deposition of consultant recommendations in the PSAR". Consumers answer of notice of hearing (appendix, allegation 1(e) and 1(f)) "admits to this allegation".

The above response from Consumers supports the NRC finding that inadequate design control measures were established to assure that license requirements to the NRC were translated into construction specifications. These inconsistencies violate 10 CFR 50, Appendix B Criterion III, Design Control.

Q. 20. Summarize Consumers & NRC discussion regarding lack of formal revisions of specifications to reflect clarifications of specification requirements. (Item 18(2))

A. Discussion of this quality assurance deficiency is contained in (1) NRC Report 78-20, pages 9-14, (2) Consumers response to 50.54(f) Question 1 at appendix I, pages 1 (¶ A.2) and page 3 (¶ B.2) (3) Consumers response to 50.54(f) question 20 at pages 23-8 and 23-9 (subsection 3.2), and (4) Consumers answer to Notice of Hearing, appendix, allegation 2(b)(1).

This quality assurance deficiency existed from as early as June 1974 through the substantial reduction in soils construction during 1978-79 without correction.

Bechtel specification C-210 contained conflicting requirements in sections 13.7 and 12.4 relating to the laboratory compaction standard to be used. Bechtel interoffice memoranda, telexes and telecons were used in an attempt to clarify the intent of specification requirements. Clarifications provided through these methods were taken by the user to modify the specification requirements without a design change or specification change notice to the specification requirement. Conse-

quently, certain activities were not accomplished according to instructions and procedures; specifically, the compaction criteria used for fill material was 20,000 foot-pounds (FT-LBS) of energy rather than a compactive energy of 56,000 FT-LBS as specified in Bechtel construction specification C-210, section 13.7.

Consumers states the root cause of this quality assurance deficiency as being "Engineering Project Instruction 4.49.1 did not address the use of interoffice memoranda, memoranda, telexes, twx's, etc. which might be interpreted by the user as modifying the requirements of the specifications." (Attachment 14).

Consumers Answer to Notice of Hearing (appendix, allegation 2(b)(1), "admits to this allegation".

The above response from Consumers supports the NRC finding that inadequate procedures for design control were established for the control of specification changes affecting the design bases. The lack of formal specification revisions violates 10 CFR 50, Appendix B, Criterion V, Instructions, Procedures and Drawings.

Q. 21. Summarize Consumers and NRC discussion of inconsistencies of design bases within the FSAR relating to diesel generator building fill material and settlement values. (Item 18(3))

A. Discussion of this quality assurance deficiency is contained in (1) NRC Report 78-20, pages 6-8, (2) Consumers response to 50.54(f) Question 1 at Appendix I, page 2 (¶ A.3) and page 4 (¶ B.3), (3) Consumers response to 50.54(f) Question 23 at pages 23-10 and 23-11

(subsection 3.3) and (4) Consumers Answer to Notice of Hearing, Appendix, 1(a).

This quality assurance deficiency existed from late 1977 until FSAR revision 18 dated February 28, 1979.

Consumers response states that 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, [defined in FSAR Table 2.5-21 as any material free of humus, organic, or other deleterious material also referred to as zone 2 material], 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 [which is referenced in FSAR section 2.5.4] indicates a settlement of the diesel generator building of approximately 3 inches."

Consumers response continues:

> "The inconsistency between subsections 2.5.4 and 3.8.5 with respect to the settlement values [½ inch vs. 3 inches] resulted because the two subsections were prepared by separate organizations (Geotechnical Services and Civil Engineering), neither of which were aware of the multiple display of similar information in the opposite subsection. The inconsistency between FSAR Subsection 2.5.4 and the project design drawing (Drawing 7220-C-45) with respect to the fill material resulted because at the time of FSAR preparation the Geotechnical Services personnel preparing the FSAR were unaware, in this case, of the status of the design drawing prepared by Civil Engineering."

Consumers stated the root cause of these inconsistencies as being "the control document did not provide sufficient procedural control for preparation and review of the FSAR." (The control document establishes procedure for preparation and control of Safety Analysis Reports.)

Consumers Answer to Notice of Hearing (Appendix 1(a)), "Admits to this allegation" that "inconsistencies were identified in the license application and in other design basis documents".

The above response from Consumers supports the NRC finding that inadequate design control measures were established.

These inconsistencies of design bases violates 10 CFR 50, Appendix B, Criterion III, Design Control.

Q. 22. Summarize Consumers and NRC discussion of inconsistencies that were identified between the settlement calculations and the original design basis of the diesel generator building. (Item 18(4))

A. Discussion of this quality assurance deficiency is contained in (1) NRC Report 78-20, pp. 20-1, (2) Consumers response to 50.54(f) Question 1 at Appendix I, page 2 (¶ A.4) and page 4 (¶ B.4), (3) Consumers response to 50.54(f) Question 23 at pages 23-12 and 23-13 (subsection 3.4), and (4) Consumers Answer to Notice of Hearing, Appendix, allegations 1(b),(c) and (d).

This quality assurance deficiency existed from March 1977 until it was identified during an NRC investigation in 1978.

Consumers reponse to 50.54(f) states that:

"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.

and that,

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

Consumers states one of the root causes of this quality assurance deficiency is:

"Diesel generator building foundation design changes initiated by Project Engineering were not coordinated with Geotechnical Services, as required by the control documents."

Consumer's Answer to Notice of Hearing (appendix, allegations 1(b), (c) and (d)) admits to this allegation for the diesel generator building.

The above response from Consumers supports the NRC finding that inadequate design control measures were established to assure proper design control interfaces for the diesel generator building. These inconsistencies violate 10 CFR 50, Appendix B, Criterion III, Design Control.

Q. 23. Summarize Consumers and NRC discussion of the inadequate design coordination in the design of the electrical duct banks of the diesel generator building. (Item 18(5))

A. Discussion of this quality assurance deficiency is contained in (1) NRC Report 78-20, pages 23-24, (2) Consumers response to 50.54(f) question 1 at appendix I, page 3 (¶ A.5) and page 5 (¶ B.5), (3) Con-

sumers response to 50.54(f) question 23, pages 14-16 (subsection 3.5), and (4) Consumers Answer to Notice of Hearing (appendix, 2(a)).

NRC determined that lean concrete material was permitted to be used in lieu of soil materials without qualification as to location. Consequently, lean concrete material was used around the electrical duct banks which were to pass through the foundation of the diesel generator building. This resulted in restricting the free movement of the foundation which contributed to the differential settlement of the building.

Consumers response states that,

> "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."

and that,

> "Neither electrical nor civil drawings show how or where to accomplish the transition from the stub-up size to the underground duct size, nor do they show firm definition of duct size."

Consumers identified the root cause of this quality assurance deficiency as being,

> "Failure of the drawings to provide Construction with the information necessary to prevent interference."

Consumers Answer to Notice of Hearing (appendix, 2(a)), however, denies that instructions provided to field construction for substituting lean concrete for zone 2 material caused differential settlement.

Based on the NRC review if lean concrete material had not been used around the electrical duct banks, free movement could be achieved between the diesel generator building foundation and duct banks. This lack of free movement did contribute to the lack of uniform settlement. This was demonstrated by the immediate vertical movement of the structure once it was freed from the duct bank.

This failure to provide adequate procedure and instructions to assure activities have been satisfactorily accomplished violates 10 CFR 50, Appendix B, Criterion V, Instruction, Procedures and Drawings.

Q. 24. Summarize Consumers and NRC discussion of insufficient compactive effort used in backfill operation. (Item 18(6))

A. Discussion of this quality assurance deficiency is contained in (1) NRC Report 78-20 pages 9-14, (2) Consumers response 50.54(f) question 1 at appendix I, page 10 (¶ A.1, B.1) and (3) Consumers response to 50.54(f) question 23, pages 23-17 and 23-18 (subsection 3.6)

This quality assurance deficiency existed from the inception of the plant fill operation in 1974 through the substantial reduction in soils construction in 1978-79.

Effective compactive effort depends on the size and type of compaction equipment, the number of passes of the equipment and the thickness of the soil layer being compacted. Soil specifications and field procedures should have required a "test fill" to demonstrate that a specific piece of compaction equipment with a specific method (i.e., number of passes and soil layer thickness) could achieve the required in-place density. The in-process density tests would then serve as a continuous verification that the equipment selected and established method could consistently satisfy the requirements. The practice of qualifying compaction equipment to a specified method is an acceptable industry practice. The practice of qualifying equipment was not employed at the Midland site prior to placement of plant area fill activities.

Consumers response stated that,

> "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,"

and that,

> "There were no field control documents or procedures to define requirements for the qualification of soils compaction equipment. There were no control documents to govern the requirements for control measures pertaining to soils placement and compaction."

Consumers stated that the root causes of insufficient compactive effort used in backfill operations are,

> (1) "The Quality Assurance Program requirement to establish responsibility for measures to control the placement and compaction of soils and the qualification of construction equipment was not adequately implemented, and
>
> (2) "Reliance was placed on in-place test results, or on the evaluation of the test results, for evaluating compaction equipment. Satisfactory soil test results, or evaluations of test results, implied that adequate compactive effort was obtained and equipment capability and fill placement methods were not questioned."

Consumers also admitted that,

> "These [in-place] soil test results or their evaluations were in error in numerous cases."

Incorrect soil test results will be discussed below in Question 31.

The above response from Consumers supports the NRC finding that inadequate procedures were developed for the construction of the plant area fill in order to assure that equipment and methods used were capable of obtaining the required compaction.

The failure to establish adequate procedures to assure use of appropriate compaction equipment violates 10 CFR 50, Appendix B, Criterion V, Instructions, Procedures and Drawings.

Q. 25. Summarize Consumers and NRC discussion of insufficient technical direction in the field. (Item 18(7))

A. Discussion of this quality assurance deficiency is contained in (1) NRC Report 78-20, pages 24-26, (2) Consumers response to 50.54(f), question 1 at appendix I, page 10 (¶ A.2 and B.2), (3) Consumers response to 50.54(f) question 23, pages 23-19 and 23-20 (subsection 3.7) and (4) Consumers Answer to Notice of Hearing, appendix, allegation 2(b)(2).

This quality assurance deficiency existed from 1974 through the substantial reduction in construction in 1978-79.

Consumers response to 50.54(f) stated:

> "The Dames & Moore Report [pg. 16] 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."

and that,

> "The technical direction and supervision provided were not properly deployed to overcome the lack of documented instructions and procedural controls."

Consumers states the root cause of this quality assurance deficiency as,

> "Reliance on test results, or the evaluations of test results, and surveillance by quality control instead of providing sufficient technical direction though documented instructions and procedural controls."

Consumers Answer to Notice of Hearing (appendix, 2(b)(2)), "Admits to this allegation" that soil activities were not accomplished under the

technical supervision of a qualified soils engineer who would verify that all materials would be placed and compacted in accordance with specifications criteria.

The above response from Consumers supports the NRC finding that technical supervision by a qualified soils engineer was not provided as required by procedures and instructions. The failure to implement procedures to assure sufficient technical direction in the field violates 10 CFR 50, Appendix B, Criterion V, Instructions, Procedures and Drawings.

Q. 25. Summarize Consumers and NRC discussion of inadequate quality control inspection of placement of fill. (Item 13(3))

Discussion of this quality assurance deficiency is contained in (1) NRC Report 78-20, pages 25-29, (2) Consumers response to 50.54(f) question 1 at appendix I, page 13 (¶ A.1) and page 14 (¶ B.1), (3) Consumers response to 50.54(f) question 23, pages 23-21 and page 23-22 (subsection 3.3) and (3) Consumers Answer to Notice of Hearing (Appendix 3).

This quality assurance deficiency existed from 1974 through the substantial reduction in construction in 1978-79.

Consumers response stated that,

> "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."

and that,

"The inspection of soils was accomplished by "surveillance," and did not require verification of the controls specified in Specifications 7220-C-210 and 7220-C-211. Soil test results, or the evaluations of soil test results, were used as the basis for quality verification."

Consequently, adequate quality control verification of the soils work was not accomplished and resulted in the work not being performed in accordance with requirements to achieve the required compaction.

Consumers states two of the root causes as being,

(1) "Too much reliance was placed on the Quality Control Inspector's ability, without sufficiently specific inspection instructions," and

(2) "Reliance was place on soil test results, or on the evaluation of soil test results, which were in error in numerous cases."

Consumers Answer to Notice of Hearing (appendix,3) admits "the degree of inspection or witnessing was reduced by going to a surveillance (sampling plan)" and that "the sampling (surveillance) plan was inadequate in that it did not specify conditions or criteria under which there would be increased sampling or a return to 100% inspection."

The above responses from Consumers supports the NRC finding that adequate quality control inspection was not provided for the verification of soil work activities.

The inadequate quality control inspection of placement of fill violates 10 CFR 50, Appendix B, Criterion X, Inspection.

Q. 27. Summarize Consumers and NRC discussion of inadequate soil moisture testing. (Item 18(9))

Consumers identifies three of the root causes of inadequate moisture testing as being,

(1) "Reliance was placed on the informal incorrect interpretations of the specification relative to moisture testing.

(2) Reliance was placed on Quality Control surveillances of moisture testing.

(3) Reliance was placed on the incorrect results of the density tests, or on the incorrect evaluation of the results, to the exclusion of the moisture test results."

Incorrect soil test results are discussed in response to Question 28.

Consumers Answer to Notice of Hearing, (appendix, 4(a)) "denies this allegation to the extent that it is inconsistent with" a prior response submitted by Consumers. That prior response is preliminary finding 6 of Attachment 5. My reading of that prior response leads me to conclude that the requirements for moisture conditioning prior to compaction (as set forth in the second paragraph of this answer) was not verified in that "prior to August 1, 1977 there were no moisture measurements made at the borrow area or when the loose fill was placed prior to or during compaction" and after August 1, 1977 "moisture measurements were made at the borrow area but were not compared to the laboratory standards".

This failure to take adequate corrective action to assure appropriate soil moisture testing violates 10 CFR 50, Appendix B, Criterion XVI, Corrective Action.

Q. 28. Summarize Consumers and NRC discussion of incorrect soil test results. (Item 18(10))

A. Discussion of this quality assurance deficiency is contained in (1) Consumers response to 50.54(f) Question 1 at appendix I, page 13 (¶ A.3) and page 15 (¶ 13.3) and (2) Consumers response to 50.54(f) Question 23, pages 23-26, 23-27 and 23-28 (subsection 3.10).

This quality assurance deficiency existed from 1975 through the substantial reduction in construction in 1978-79.

A review of the soil test reports indicated fill density tests contain the following types of errors: (1) incorrect soil identification, (2) incorrect selection of laboratory standard (maximum density and optimum moisture content) to be used for field control of in-place field density tests, (3) erroneous field density test data for those tests which indicate the soil to be in excess of 100% saturated, a physical impossibility, (4) calculation errors, and (5) improper clearing of failed test results. (See Bechtel July 1979 report referenced below.)

Based on a Bechtel report to Consumers entitled, "Review Of U.S. Testing Field & Laboratory Tests On Soils", dated July 1979 (Attachment 11), "Since more than one half of the test results for relative density and percent compaction fall outside the possible theoretical comparison limits, it must be concluded that these results are suspect and should not be used alone for acceptance of the plant area fill". The Bechtel report also concludes that as a result of incorrect soil identification, incorrect selection of the laboratory standard, and erroneous field density test data, "there is no rational means of determining which test results are valid and which are not."

Consumers response to 50.54(f) requests identified the root cause of incorrect soil test results as,

"Technical procedures available to control the testing were inadequate, and the technical direction of the testing operations did not avoid or detect the incorrect soil test results."

This failure to provide adequate procedure to assure correct soil test results violates 10 CFR 50, Appendix B, Criterion V, Instructions, Procedures and Drawings.

Q. 29. Summarize Consumers and NRC discussion of inadequate subcontractor test procedures. (Item 10(11))

A. Discussion of this quality assurance deficiency is contained in (1) Consumers response to 50.54(f) Question 1, at appendix I, page 13 (¶ A.4) and page 16 (¶ B.4) and (2) Consumers response to 50.54(f) Question 23, pages 23-29, 23-30 and 23-31 (subsection 3.11).

This quality assurance deficiency existed from 1974 through the substantial reduction in construction in 1978-79.

Consumers response to 50.54(f) states that,

"The procedures used for soils testing did not cover the following activities:

1. Developing and updating the family of proctor curves;

2. Visually selecting the proper proctor curves;

3. Developing additional proctor curves for changing materials occurring between normal frequency curves; and

4. Using alternative methods of determining the proper laboratory maximum density where visual comparison is not adequate."

Consumers identifies the root cause of this quality assurance deficiency as being,

"Adequate technical procedures for control of the testing were not prepared."

This failure to provide adequate procedural controls for the soil testing activities violates 10 CFR 50, Appendix B, Criterion V, Instructions, Procedures and Drawings.

Q. 30. Summarize Consumers and NRC discussion of inadequate corrective action for repetitive nonconforming conditions. (Item 18(12))

A. Discussion of this quality assurance deficiency is contained in (1) NRC Report 78-20 pages 17-20, (2) Consumers response to 50.54(f) Question 1 at Appendix I, pages 21 (¶ A.1 and B.1) and (3) Consumers response to 50.54(f) Question 23, pages 23-32 and 23-33 (subsection B.12), and (4) Consumers Answer to Notice of Hearing, Appendix 4(b).

This quality assurance deficiency existed from 1974 through the substantial reduction in construction in 1978-79.

Consumers response states that,

"There were nonconformances reported which are considered to be repetitive. These include, but are not limited to: CPCo [Consumers] Nonconformance Reports QF-29, QF-52, QF-68, QF-120, QF-130, QF-147, QF-172, QF-174, QF-199, and QF-203; CPCo Audit Findings F-77-21 and F-77-32; and Bechtel Nonconformance Reports 421, 686, 698, and 1005."

A full description and supporting details of each of the above nonconformances are discussed in Attachment 5, item 8.

Consumers states that the root causes of inadequate corrective action for these repetitive nonconforming conditions as being,

"1. The conditions under which nonconformances are considered to be repetitive are not adequately defined in the control documents.

2. The trending activity did not provide timely responses to repetitive product nonconforming conditions."

Consumers Answer to Notice of Hearing, appendix 4(b) states that the,

"Licensee admits that corrective action it initially took with regard to nonconformance reports related to plant fill did not prevent nonconformances at a later date in the area of plant fill construction."

Consumers reponse supports the NRC finding that inadequate corrective action was taken to assure that the cause of the condition was determined and corrective action taken to preclude repetition.

This failure to take adequate corrective action to preclude repetitive conditions violates 10 CFR 50, Appendix B, Criterion XVI, Corrective Action.

Q. 31. Summarize Consumers and NRC discussion of inadequate quality assurance auditing and monitoring of plant fill work activities. (Item 18(13))

A. Discussion of this quality assurance deficiency is contained in (1) Consumers response to 50.54(f) Question 1 at appendix I, page 21 (¶ A.2) and page 22 (¶ B.2) and (2) Consumers response to 50.54(f) Question 23, pages 23-34 and 23-35 (Subsection 3.13).

This quality assurance deficiency existed from 1974 through the substantial reduction in construction in 1978-79.

Consumers response states that,

"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."

and that,

"In the case of soils operations, Quality Assurance auditing and monitoring found that quality-related activities were being performed as planned, quality verification activities (primarily soil testing) were being performed, and the soil test results, or their evaluation, provided evidence of compliance with the established standards. The auditing and monitoring did not identify the policy and procedure inadequacies."

Consumers identified the root cause of inadequate quality assurance auditing and monitoring as being,

"Quality Assurance audit and monitoring was oriented more toward evaluating the degree of compliance with established procedures rather than toward the assessment of policy and procedural adequacy or toward the assessment of product quality."

This failure to provide adequate quality assurance auditing and monitoring of the plant area fill violates 10 CFR 50, Appendix B, Criterion XVIII, Audits.

Q. 32. What is the cause of the soil settlement problem at the Midland Plant, Units 1 and 2?

Since the quality assurance program in effect from 1974 through 1979 was ineffective in establishing and implementing sufficient quality assurance/quality controls to assure proper design, inspection and control of soils work under and around safety related structures I conclude that prior to December 6, 1979 there was a breakdown in the quality assurance program.

The foregoing quality assurance deficiencies resulted in the plant area fill being insufficiently compacted. This failure to properly compact the plant area fill was the cause of the soil settlement problem at the Midland Plant, Units 1 and 2.

CONCLUSION

The quality assurance deficiencies related to soil construction activities under and around safety related structures and systems arising from improper implementation of the quality assurance program provide adequate bases to modify the construction permits by suspending those soil construction activities.

LIST OF ATTACHMENTS

1. September 29, 1978: Initial 10 CFR 50.55(e) Report from Consumers Power Co.
2. November 17, 1978: NRC Inspection Report 78-12.
3. January 12, 1979: Summary of December 4, 1978 meeting.
4. February 23, 1979: NRC Presentation of Preliminary Investigation Findings of the Settlement of the Diesel Generator Building.

5. March 9, 1979: Consumers Discussion of NRC Inspection Facts Resulting From NRC Investigation of the diesel generator building.

6. March 21, 1979: NRC 10 CFR 50.54(f) Request Regarding Plant Fill.

7. March 22, 1979: NRC Inspection Report 78-20.

8. April 9, 1979: NRC Inspection Report 79-06.

9. April 24, 1979: Consumers Response to 10 CFR 50.54(f), Question 1.

10. June 6, 1979: NRC Inspection Report 79-10.

11. August 10, 1979: Bechtel Review of U.S. Testing Co. Field & Laboratory Tests on Soils.

12. October 1, 1979: NRC Inspection Report 79-19.

13. October 16, 1979: Summary of July 18, 1979 Meeting.

14. November 13, 1979: Consumers Response to 10 CFR 50.54(f), Question 23.

15. December 6, 1979: Order Modifying Construction Permits.

16. April 16, 1980: Consumers Answer to Notice of Hearing.

17. Professional Qualifications of Eugene J. Gallagher.

ATTACHMENT 1

Stephen H. Howell
Vice President

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

September 29, 1978
Howell-83-78

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.

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
Attn: Mr John G Davis, Acting Director, USNRC (15)

Director, Office of Management
Information and Program Control, USNRC (1)

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ATTACHMENT 2

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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. D. 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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OFFICE ➤
SURNAME ➤
DATE ➤

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/ok	Spessard	Heishman	Vandel	Cook
DATE▶	11/14/78				

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

REGION 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. E. Gallagher 11/14/78

Approved By: 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.

ATTACHMENT 3

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

JAN 12 1979

DOCKET NOS. 50-329
50-330

APPLICANT: Consumers Power Company

FACILITY: Midland Plant, Units 1 & 2

SUBJECT: SUMMARY OF DECEMBER 4, 1978 MEETING ON STRUCTURAL SETTLEMENTS

On December 4, 1978, the NRC staff met in Midland, Michigan with Consumers Power Company (CPCO), Bechtel Associates, and consultants in geotechnical engineering to discuss excessive settlement of the Diesel Generator (DG) Building and pedestals, and settlement of other seismic Category I structures. These technical discussions followed a site tour on December 3, 1978 during which the NRC staff observed each of these structures. Attendees for the tour and technical discussions are listed in Enclosure 1. Enclosure 2 is the agenda used during the technical discussion.

1. Background

Pursuant to 10 CFR 50.55(e), CPCO notified Region III of the Office of Inspection and Enforcement (I&E) on September 7, 1978, that settlement of the Midland DG Building foundation and generator pedestals was greater than expected and that a soils boring program had been started to determine the cause and extent of the problem. An interim status report was provided I&E by CPCO's letter of September 29, 1978. I&E conducted inspections on this matter on October 24-27, 1978 and issued inspection report number 50-329/78-12; 50-330/78-12.

2. History

The Bechtel representative identified the Category I structures and the type of material supporting the structure:

a. Containment - Glacial Till

b. Borated Water Storage Tank - Plant Fill

c. Diesel Generator Building and Pedestal - Plant Fill

d. Auxiliary Building - Part Glacial Till & Part Plant Fill

e. Service Water Intake - Glacial Till (Completed portion only)
- Plant Fill (Small portion yet to be constructed)

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

NOV 14 1978

Docket Nos: 50-329
50-330

MEMORANDUM FOR: Steven A. Varga, Chief, Light Water Reactors Branch No. 4, DPM

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

SUBJECT: FORTHCOMING MEETING AND SITE VISIT ON SETTLEMENT OF MIDLAND STRUCTURES

Date & Time: December 3, 1978 - 1:00 p.m.
December 4, 1978 - 9:00 a.m.

Location: Midland, Michigan
Plant Site

Purpose: To discuss and observe settlement of the Diesel Generator Building and other structures.

Participants:

NRC
L. Heller
D. Gillen
D. Hood
R. Cook (Site)
A. Hafiz
Consumers Power Company
G. Keeley, et. al.

Darl Hood

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

Enclosure:
Agenda

cc: See next page

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ATTACHMENT 4

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

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. Effect of Ground Water on Plant Area Fill

Inspection Facts

- 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.

Conclusion

It has not been fully determined whether the full effects of saturating the fill was taken into account in the design basis.

Finding

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 uniformly 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 inconsistant, incorrect and unsupported statements.

*Note: These are the conclusions of the RIII investigation as of February 23, 1979. Final conclusions of NRC with respect to the technical adequacy of the foundations is under consideration by the NRC staff.

ATTACHMENT 5

PRELIMINARY

Revised March 9, 1979

CONSUMERS POWER COMPANY
DISCUSSION OF NRC INSPECTION FACTS RESULTING FROM THE NRC INVESTIGATION OF THE DIESEL GENERATOR BUILDING

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

NRC PRELIMINARY FINDING 2

2. Identification and Reporting of Diesel Generator Building Settlement

Discussion of NRC Inspection Facts (from the Preliminary NRC Report)

On July 7, 1978, Construction Survey personnel noted difficulty in closing a level circuit when laying out survey control markers for continued construction of the diesel generator building. A survey check was made against existing survey control marks in the building on July 10, 1978 and a degree of settlement was noted. On July 24, 1978 the first formal 60-day settlement reading required by Specification 7220-C-76 for the diesel generator pedestal was taken. Bechtel Surveyors, in processing this data, noticed a larger than anticipated settlement. The processed survey data was transmitted to Project Engineering on July 26, 1978. The combined results of the July 10, 1978 and July 24, 1978 readings prompted Construction Survey personnel to monitor the building settlement in excess of Specification 7220-C-76 frequency requirements. On August 21, 1978 a Construction Survey check of the elevation of the northeast anchor bolt top on the eastern diesel generator pedestal showed a settlement in the range of the estimated ultimate value in FSAR Figure 2.5-43.

A Bechtel nonconformance report was issued (NCR 1482) to document the August 21, 1978 Construction Survey readings on the anchor bolt. As a result of NCR 1482, all construction activities on the diesel generator building, except for reinforcing steel installation, was halted. On August 21, 1978, CPCo advised the NRC Resident Inspector of the settlement condition. This notification was for information only.

An exploratory soil boring program was begun on August 25, 1978. An evaluation by Project Engineering of preliminary boring data made on September 6, 1978, indicated that the settlement condition was reportable under the requirements of 10 CFR 50.55(e).

On September 7, CPCo made an oral 10 CFR 50.55(e) report to the NRC. CPCo submitted written 10 CFR 50.55(e) interim reports to the NRC on September 29, 1978; November 7, 1978; December 21, 1978; January 5, 1979; and February 23, 1979. The next interim report is due to be submitted by April 30, 1979.

A subsequent error has been noted in Revision 18 to the FSAR dated 2/79. The error is that Revision 18 is in conflict with the information given above. Revision 18, derived from the 50.55(e) report dated September 29, 1978, 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. 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.

2. Identification and Reporting of Diesel Generator Building Settlement (Contd)

Conclusion

CPCo complied with the 50.55(e) reportability requirements.

NRC PRELIMINARY FINDING 3

3. Review of PSAR/FSAR Commitments

Discussion of NRC Inspection Facts (from the Preliminary NRC Report)

FSAR Table 2.5-9 provides compaction criteria and zone designation both of which are design bases. Inadvertently omitted from this table was the number "2" in the column used for "Zone Designation" for the "Support of Structures." Also inadvertently omitted were the words "and sand" in the column used to designate the "Soil Type" for the "Support of Structures." FSAR Table 2.5-10 provides a definition of Zone 2 materials. These materials were used consistent with the recommendations contained in the Dames and Moore report included in the PSAR. FSAR Table 2.5-14 summarizes contact stresses, estimated bearing capacity and factors of safety for the supporting soils given in the table for each structural unit. However, some of these supporting soils specified in Table 2.5-14 were intentionally not the same as the design bases soils described (or intended to have been described) in Table 2.5-9. The supporting soils specified in 2.5-14 were those used for the conservative calculations given in that table.

FSAR Table 2.5-9 was revised to correct the inadvertent omissions and Table 2.5-14 was revised to reflect the design bases contained in the PSAR (as translated into the actual design) rather than to reflect the material used for calculational purposes.

The settlement information on spread footing found in Section 3.8.5.5 of the FSAR was a carryover of a preliminary estimate given in the PSAR. The information regarding settlement found in Section 3.8.5.5 of the FSAR 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. The settlement predictions intended for the diesel generator building are found in Figure 2.5-48 of the FSAR.

Conclusions

a. The FSAR accurately states the design bases or type of fill material supporting Class 1 structures except for the inadvertent omission of the number "2" and the words "and sand" in Table 2.5-9. Regardless of the omissions, however, the proper design basis was carried through to the detailed design.

b. The presentation of FSAR Table 2.5-14 was not as clear as it could have been with regard to the use of the entries in the "Supporting Soils" column and has since been revised.

c. The presentation in FSAR Subsections 3.8.5.5 was not as clear as it could have been to distinguish it from the different information presented in FSAR Figure 2.5-48 and has been eliminated.

NRC PRELIMINARY FINDING 4

4. Effect of Groundwater on Plant Area Fill

Discussion of NRC Inspection Facts (from the Preliminary NRC Report)

The increase in the plant area groundwater level allowed by elimination of the planned drainage system was included in the design bases. Dames and Moore's consideration of this design change is presented in their report dated March 15, 1969, which is included in the Midland PSAR. Evaluations by Bechtel involving the increased groundwater level are discussed in FSAR Subsection 2.5.4.10.3, and the supporting settlement calculations are available in the Bechtel Ann Arbor office.

Dr. Peck's discussion on the effects of changes in moisture content on soil refers to his hypothesis that if soils beneath the diesel generator building had been compacted too dry of optimum (5 to 6%), changes in moisture after placement could cause them to settle significantly. Soils placed within ± 2% of optimum moisture, as specified, would not cause this effect.

Conclusion

The saturating of the fill, which was a design basis, was taken into account in calculating settlements and bearing capacities.

NRC PRELIMINARY FINDING 5

5. Compaction Requirements for Plant Area Fill

Discussion of NRC Inspection Facts (from the Preliminary NRC Report)

The density requirements for clay and sand as found in PSAR Amendment 3 and Specification C-210 and as implemented are as shown below:

	Clay	Sand
PSAR	100% of maximum density using a compactive energy of 20,000 ft-lbs	85% relative density
C-210 (after Revision 5)	95% of maximum density using ASTM 1557 Method D (Equivalent to above.)	80% relative density
As Implemented	95% of maximum using Bechtel modified test method using 20,000 ft-lbs	80% relative density

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.

NRC PRELIMINARY FINDING 6

6. Moisture Control Requirements for Plant Area Fill

Discussion of NRC Inspection Facts (from the Preliminary NRC Report)

Specification 7220-C-210, Section 12.6.1, states in part:

> "Insofar as practicable...materials which require moisture control, shall be moisture-conditioned in the borrow areas.... The water content during compaction shall not be more than 2 percentage points below optimum moisture content and shall not be more than 2 percentage points above optimum moisture content....
>
> ...after the placement of loose material on the embankment fill, the moisture content shall be further adjusted as necessary to bring such material within the moisture content limits required for compaction."

On July 22, 1977 Bechtel QA identified in QAR SD-40 that the field did not take moisture control measurements prior to and during placement of the backfill, but rather relied on the moisture results taken from the in-place (after compaction) soil density tests to control moisture.

As shown in Attachment 1, prior to August 1, 1977, there were no moisture measurements made at the borrow area or when the loose fill was placed prior to or during compaction. Moisture measurements were made after compaction, as were density tests, and the results of both served as the acceptance criteria.

From August 1, 1977, to the cessation of fill operation with the onset of the winter 1977-1978 season, there was a change. During this time, moisture measurements were made at the borrow area, but the measurements were not compared to laboratory standards. Again, no moisture measurements were made when the loose fill was placed prior to or during compaction. Moisture measurements were made after compaction and the data were used in conjunction with the density tests, the results of which served as the acceptance criteria. For this period, the data from moisture measurements made after compaction, in conjunction with the corresponding density tests, have been reviewed again and thirteen individual moisture measurements were found to be beyond $\pm$ 2% of optimum.

For 1978, moisture measurements were made either in the borrow area or when the loose fill was placed prior to compaction, or both, but not during compaction. These measurements were compared to laboratory standards. Also during this period, moisture measurements were made after compaction and the data were used in conjunction with the density tests, the results of which served as acceptance criteria. Subsequently, moisture measurements

6. Moisture Control Requirements for Plant Area Fill (Cont'd)

made after compaction were reviewed again for this period and the cases for which the post-compaction moisture data indicate measurements beyond ± 2% of optimum have been identified.

Moisture measurements for the three periods are now considered not to have met the intent of the specification regarding the location and time of the measurements. Prior to commencing fill operations for the 1979 season, this requirement will be redefined.

Conclusions

a. Final acceptance density criteria were clearly specified and were implemented from the inception of the project.

b. Moisture measurements were taken as a necessary part of the final density tests.

c. In-process moisture control criteria were not clearly specified and were not consistently implemented. Clarifications and interpretations of the specification were made without specification changes.

ATTACHMENT

Time Period	Moisture Measurements to Aid Compaction			Control for Final Acceptance	
	As Practical in the Borrow Area	Loose Fill Prior to Compaction (±2%)	During Compaction (±2%)	Moisture	Density
Prior to August 1, 1977	No measurements taken	No measurements taken	No measurements taken	Measurements taken (moisture controlled here)	Test 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	Test taken (density controlled here)
1978	Measurements were taken and controlled in at least one of these areas		No measurements taken	Measurements taken	Tests taken (density controlled here)

NRC PRELIMINARY FINDING 7

7. Subgrade Protection of Plant Area Fill

Discussion of NRC Inspection Facts (from the Preliminary NRC Report)

For frost protection for foundations in natural soils below the original grade, the Dames and Moore report dated March 15, 1969, on Page 14 recommends that if, "...foundation excavation be left open during the winter... at least three and one-half feet of natural soil or similar cover remain in place...." (emphasis added).

These instructions were transmitted in Sketch SK-C-271, "Winter Protection for Foundations," and approved and released by Project Engineering on November 16, 1970, as an official design document. This document was implemented by Project Engineering direction contained in a memo to Construction dated November 16, 1970. The direction was implemented by the use of temporary enclosures and/or straw cover for freeze protection as provided by Bechtel when construction was suspended in 1970.

For freeze protection for compacted soils, Dames and Moore report dated March 15, 1969, on Page 15 states, "...If filling or 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." These recommendations are included as follows in Specification 7220-C-210.

a. Section 12.5.1

b. Section 12.10 delineating the requirements for winter protection of embankment

c. Section 11 setting forth the requirements for reconditioning, removing, and recompacting the fills and excavations that were left open during the winter periods of 1970 through 1973

To satisfy these requirements, the top layer of soil was removed until the underlying layer was determined to be acceptable by visual inspection and/or in situ soil tests. The placement of materials was performed on the acceptable foundation soil after reconditioning.

Conclusions

a. Instructions to meet PSAR requirements regarding freeze protection were provided to Construction for natural soils via SK-C-271 and project memorandum, and for compacted fill via Specification 7220-C-210.

b. Where soils were not protected from frost action, specifications did not require complete removal of the soils.

NRC PRELIMINARY FINDING 8

8. Nonconformance Reports Identified

Discussion of NRC Inspection Facts (from the Preliminary NRC Report)

The nonconformances referenced by the NRC included 10 CPCo NCRs and 2 CPCo Audit Finding Reports. Additionally, Bechtel prepared 1 independent NCR (NCR 421) and 3 other NCRs (NCRs 686, 698 and 1005) which duplicated the essence of prior CPCo NCRs.

The 13 different NCRs are summarized in Attachment 1 with regard to the type of activity impacted by the nonconformance, the Engineering disposition, the use-as-is justification, whether or not the problem was included in the Bechtel Quality Trend Program, and the type of nonconformance. During the period from October 1974 through October 1977, the repetitiveness of the activities impacted by the 13 NCRs was as follows:

Moisture control	6 cases
Compaction test	4 cases
Lift thickness	1 case
Soils inspection	1 case
Inspection planning	1 case
Structural backfill inspection	1 case
Gradation requirement	4 cases
Test frequency	1 case
Total	19 cases (6 multiple cases)

During the period from October 1974 through October 1977, the repetitiveness of the types of nonconformances associated with the 13 NCRs was as follows:

Missed inspection	2 cases
Failing moisture	2 cases
Incorrect test data	4 cases
Misinterpretation of specification	1 case
Failing tests not identified	2 cases
Other	2 cases
Total	13 cases

Attachment 2 provides a narrative of each NCR. It provides more explicit information as to the type of activity impacted by the NCR and the type of nonconformance, as well as additional information from which to estimate the total number of individual nonconformances covered by each NCR or

8. Nonconformance Reports Identified (Cont'd)

subsequently determined as a result of further investigation required by the NCR disposition. Finally, Attachment 2 provides a description of the part and process corrective action taken in each case.

Getting back to Attachment 1, it is shown that all but the first of the NCRs were included in the Bechtel Trend Program. In 1977 structural backfill operations were trended and resulted in 3 of the 13 NCRs (QF 147, 172, and 174). The nonconformances were in the areas of testing methods, test criteria, and moisture content. Although the discrepancies had occurred earlier, it was not until review of the turnover packages that the nonconformances were detected. Corrective actions taken included:

Additional surveillance of the testing laboratory by Bechtel QC

Changes in U.S. Testing Laboratory Supervision (new Chief and appointment of Assistant Chief)

Training session on Specification 7220-C-211 on the control of backfill sand

Instructions to Procurement to Q-list the purchase order

A subsequent audit by Bechtel QA of the U.S. Testing's QA Program found it effectively controlled.

Attachment 1 also shows each NCR disposition and its justification. Of the 13 NCRs, 9 were dispositioned use-as-is. Each such disposition was reviewed by Bechtel Project Engineering and professional judgements were based on the following factors:

Degree of variation from established standards

Impact on quality and performance

Location of tests that failed

Analysis with justification of the variation

Each use-as-is disposition was evaluated by CPCo to ensure that the dispositioning was consistent with quality assurance program requirements.

Conclusions

a. The identification of some nonconformances warranting corrective action was missed by Bechtel and was untimely by CPCo.

b. Except for NCR 199, the corrective action process was implemented.

c. Use-as-is dispositions were made with justifications under a disciplined process.

ATTACHMENT 1

MATRIX OF NONCONFORMANCES

NCR	ALSO COVERED BY	DATE OF NCR	ACTIVITY IMPACTED								ENGR DISPO		USE AS IS JUSTIFICATION	INCLUDED IN BECHTEL TREND PROGRAM	TYPE OF NONCONFORMANCE
			MOISTURE CONTROL	EXCAVATION REQUIREMENTS	LIFT THICKNESS	SOILS INSPECTION	INSPECTION PLANNING	SPECIAL INSPECTION	EVALUATION REQUIREMENT	TEST FREQUENCY	USE AS IS	OTHER			
QF-25	NCR 198	10/14/76						•			•		STATISTICAL ANALYSIS OF 18 SEPERATE TESTS REVEALED 136 DISTRIBUTION LIMITS FOR EACH GRADATION. THEREFORE, 95.3% PROBABILITY THAT STOCKPILE UNIFORMITY MEETS SPECIFICATION REQUIREMENTS. MATERIAL AS PLACED AND STOCKPILED WILL BE RANDOMLY SAMPLED AND TESTED 15 TIMES TO SUFFICIENT THOSE TESTS THAT WERE TAKEN AND TO MAKE UP THE MISSING REPORTS.	NO	MISSED INSPECTION
QF-42	NCR 326	8/17/76	•										COMPACTED FIELD DENSITY TEST REPORT REVEALED SATISFACTORY COMPACTION.	YES	FAILING MOISTURE NOT IDENTIFIED
QF-48		10/13/76		•								•		YES	INCORRECT TEST DATA USED
NCR 429		5/5/76	•	•								•	NAME REMOVED, VERIFIED BY QC	YES	N/A
QF-170 NON-C		5/21/76			•							•		YES	NON-C CONSTRUCTION ERROR
QF-130		10/18/76					•					•		YES	MISINTERPRETATION OF SPECIFICATION
QF-147	SOR	2/2/77				•			•		•		SAMPLES TAKEN WERE FOUND ACCEPTABLE. ALL MATERIALS WERE OBTAINED FROM SAME SOURCE.	YES	MISSED INSPECTION
	NCR 808										•		" "	YES	
	NCR 638										•		" "	YES	
QF-132		2/8/77	•	•	PROBLEM FOUND DURING TURNOVER						•		COMPACTION PERFORMED IN AN ACCEPTABLE MANNER AS SUSPECT AREA IS NON SAFETY RELATED.	YES	FAILING MOISTURE NOT IDENTIFIED
QF-134		2/15/77	PROBLEM FOUND DURING TURNOVER						•		•		COMPACTION PERFORMED IN AN ACCEPTABLE MANNER AS SUSPECT AREA IS NON SAFETY RELATED.	YES	FAILING TEST NOT IDENTIFIED
QF-155	NCR 1004	11/4/77	•								•		EVALUATION OF TEST RESULTS OF ADJACENT AREA AND SUBSEQUENT LIFTS WERE ACCEPTABLE. (NCR 1004 BEING PREPARED)	YES	INCORRECT TEST DATA USED
	NCR 1005													YES	
QF-203 NON-C REJECT	NCR 1054	11/22/77							•		•		TEST REPORT 0610 DATED 6/15/77 REVEALS THE MATERIAL MEETS THE REQUIREMENTS OF MOSH 22 B.	YES	FAILING TEST NOT IDENTIFIED
	NCR 1055														
F-27 21	FINDING 1	5/25/77 thru 6/10/77	•								•		RETESTED AND FOUND ACCEPTABLE	YES	FOREMAN UNAWARE OF SPECIFICATION REQUIREMENT
	FINDING 2										•	•	DETERMINED TO BE NO VIOLATION		
F-27 32	NCR 1006	10/3 3/77	•	•					•		•		RECALCULATION WITHIN LIMITS	YES	INCORRECT TEST DATA FAILING RESULT NOT IDENTIFIED
	QF-143 NCR 1006														

ATTACHMENT

NCR NO	NCR DESCRIPTION AND SUPPORTING DETAILS	PART CORRECTIVE ACTION	PROCESS CORRECTIVE ACTION
QF-29	Structural backfill material was delivered on 30 days in August and September 1974. Only 11 days had the material been inspected and tested. Of the 11, only one of the reports was in the QC file.	Bechtel NCR 198 was initiated. Twenty-six additional samples were taken from the stockpile. Bechtel Project Engineering's disposition was to use-as-is based on the results of conditional samples. Ten of the eleven reports were found and placed in the QC file.	A memorandum from EEFelton directing that QC be notified of all incoming shipments of structural backfill material was issued on October 29, 1974.
QF-52	Soil test MD-202 for plant area fill located 14 feet east of 8.7 line and 36 feet north of A line at elevation 594.5 had a moisture content 2.9 below optimum moisture content.	NCR 324 written. Was evaluated and accepted the in-place material with low moisture content based on a satisfactory compaction test result.	U.S. Testing and Bechtel Quality Control had each had training sessions re-emphasizing the acceptance criteria for soil tests.
QF-68	The compaction test MD-142 taken in the west plant dike had been calculated using the wrong maximum laboratory dry density for Bechtel Modified Proctor resulting in a 96% compaction which is passing. Using the correct maximum laboratory dry density results in 92% compaction which is failing.	A complete review of Bechtel Modified Proctors and field work sheets used by U.S. Testing was performed by U.S. Testing. Three additional discrepancies were found during this review. A total of 12 field tests were affected by the discrepancies. Revised reports were submitted for the 12 field tests. Failing test MD-142 had been cleared by passing test MD-160. None of the 12 field tests were found failing after corrections had been made, therefore, a Project Engineering evaluation was not necessary.	U.S. Testing devised a system for checking tests against a master proctor list and a master log book.
QF-120	1. Soil was placed between manhole No 5 and 6 above the sanitary sewer in the west plant dike in an uncompacted lift thickness varying between 9 and 14 inches. 2. In an area not accessible to roller equipment, soil was placed between manhole No 4 and No 5 above the sanitary sewer in the west plant dike in uncompacted lift thicknesses of 6 inches.	The material was removed down to the required lift thicknesses and compacted prior to continued work in this area.	This problem was a result of insufficient monitoring of the placing crews and the work was done in accordance to the Note on Detail 6 of Drawing C-130 Rev 3 which is in conflict with Specification C-210. A training session was given to the Laborer General Foremen and Laborer Foremen and Drawing Change Notice No 5 to Drawing C-130 Rev 3 corrected the conflict between Drawing C-130 Rev 3 and Specification C-210. This should also be noted that this was in a non-Q area.

NCR NO	NCR DESCRIPTION AND SUPPORTING DETAILS	PART CORRECTIVE ACTION	PROCESS CORRECTIVE ACTION
QF-130	Quality Control Engineers have observed the material placed in approximately 12 inch uncompacted lifts where roller equipment was not used to compact material.	All closed C-210-4 Field Inspection Plans were reviewed and similar situations as described in QF-130 existed. Bechtel QC discussed the greater than 4 inch lift thickness with both Field Engineering and Project Engineering. It was felt that since the lift thickness never exceeded 12 inches and that the in-place density tests all met the specified compaction requirements, which is the reason for lowering the lift thickness from 12 inches to 4 inches, that the material in-place is acceptable.	Cause of the nonconformance was misinterpretation of specification requirements. To preclude repetition, QCI C-1.02 will be used to inspect compacted backfill and a training/discussion session was held on 2/22/77.
QF-147 (Repeat of QF-29)	Structural backfill delivered on December 1, 1976, December 14, 1976 and January 11, 1977 was not tested for gradation requirements or inspected.	Shipments of structural backfill delivered in October and November 1976 were reviewed for similar problems. NCR's 686 and 698 were written identifying the lack of testing for the dates above and ones noted in the review of October and November 1976. Project Engineering dispositioned the materials use-as-is. NCR 693 was written against the following dates: October 26, October 29, November 12, of 1976, January 11, and January 12, 1977. Project Engineering's disposition stated, "Tests conducted on samples prior to and after the days missed were found acceptable. In addition, one test was conducted on January 12, 1977 and found satisfactory. Therefore, Project Engineering concurs with the Field Engineer recommended disposition to use-as-is". It should be noted that the test run January 12, 1977 used the wrong sieve sizes. This data was from graphic interpolation. NCR 686 was written against December 1, 1976 and December 14, 1976 for which approximately 495 tons and 55 tons respectively were delivered. Project Engineering's disposition, "The samples were taken on days November 9 through November 30, December 3-13 and December 30 were found acceptable. Furthermore, all the materials were obtained from same source. Therefore, Engineering concurs with Field Engineering's disposition to use-as-is".	Starting February 4, 1977 incoming structural backfill was controlled in accordance with the Quality Control Receipt Inspection Program. In addition, a training session was held on February 10, 1977 on the control of Q-list backfill sand to preclude repetition. In attendance were: FCFeague, Lead Civil Field Engineer BCheek, Lead QC Civil Engineer HBoline, Bechtel QC Engineer DAPerkins, Superintendent, Civil JBean, Field Engineer, Civil Gary Coaster, Field Engineer, Civil FFish, BGrubich, and LAPepion, Superintendent. The following approach to control the structural backfill was discussed and agreed upon by all present. The first truck delivering backfill sand each day will not be allowed in the gate without release from field receiving department. The backfill vendor has been instructed by Procurement to have this first load stopped by U.S. Testing for test samples and Receiving will assure that this requirement is complied with. A Bechtel craftsman working in the sand stockpile area and field receiving will assure that sampled load and

NCR NO	NCR DESCRIPTION AND SUPPORTING DETAILS	PART CORRECTIVE ACTION	PROCESS CORRECTIVE ACTION
QF-147		(Contd) Also, NCR QF-147 stated that this same problem had recurred. It stated in Recommended Corrective Action 3. This same problem of structural backfill material lacking gradation tests was identified in CPCo NCR QF-29 issued October 14, 1974. The corrective action to preclude repetition for this NCR was a memorandum from the Project Superintendent directing that Quality Control be notified of all incoming shipments of structural backfill material was issued. Recently, Bechtel QA identified this same problem in QADR SB-6 issued October 21, 1976. The corrective action to preclude repetition for this QADR was to use the following system: a. Each day's delivery of structural backfill is stockpiled separately. b. On the following day the responsible Field Engineer verifies that the material was tested and is acceptable. c. If the material wasn't tested, a test will be taken at this time or if the material is acceptable, it will be placed in the acceptable pile. It is evident that the corrective action taken for NCR QF-29 and QADR SB-6 is not adequate. Determine the underlying cause/causes and propose further corrective action to preclude repetition.	(Contd) all subsequent loads are dumped in a different hold pile each day. QC will be notified in writing by U.S. Testing of test results for each pile. QC will notify Field Receiving if a hold pile is acceptable. Field Receiving will, in turn, verbally notify supervision and physically remove the hold on the acceptable pile with a release signed. Supervision will instruct the craftsmen working in the stockpile area not to move hold piles until they are marked released. When the hold piles are marked released, the craftsmen will move them into the main stockpile which is appropriately marked. Field Engineering will assure enough material is in the main stockpile to support construction requirements. In addition, EGrubich of Receiving agreed to give Field Engineering written notification that a hold pile has been released by QC including the date of release and description of the release pile.
QF-172	1. Test Report MD-359 taken May 30, 1974 for the northeast dike station 29 + 00 5 feet right centerline zone 2 at elevation 622 had moisture content of 2.6% below optimum moisture content. This test had been marked P for pass	Project Engineering stated, "A review of the failed density test report MD-359 reveals that the soil represented by this test failed to meet the moisture content requirements while meeting the compaction criteria". It is also noticed that test MD-359 substitutes for test	No Process Corrective Action was determined necessary because this problem happened three years hence. Also, these problems were in the dike section and we no longer had dike sections to be completed.

NCR NO	NCR DESCRIPTION AND SUPPORTING DETAILS	PART CORRECTIVE ACTION	PROCESS CORRECTIVE ACTION
QF-172	(Contd) 1. when actually the test failed. 2. Test Reports for the northeast dike MD-342 which was taken May 25, 1974 at station 30 + 00 centerline zone 2 at elevation 622 had 94.5% compaction. MD-354 taken May 28, 1974 at station 31 + 00 100 feet right of centerline sand drain zone 2 at elevation 622 had 93.2% compaction and MD-356 taken May 28, 1974 at station 29 + 00 100 feet right of centerline of sand drain zone 2 at elevation 622 had 92.2% compaction. Test MD-342 had been marked P for pass when actually the test failed. Test MD-354 and 356 had been marked F for fail and accepted by four roller passes. Four roller passes are not the acceptance criteria in this area.	(Contd) MD-351. Test MD-307, MD-286 and MD-308 taken in the vicinity of test MD-359 around station 29 + 00 for the northeast dike have met the density and moisture content requirements. Considering the test results in the neighboring areas and the amount of compaction achieved, a moisture content 2.8% below the optimum in lieu of 2.0% for test MD-359 will have insignificant effect on the material placed. Since test MD-359 is located away from the Q-listed backfill areas and no safety related structures will be located in this area, the test MD-359 be accepted as is. Also, the test report MD-342 was incorrect and has been revised to indicate the correct result. The correct percent compaction is 97.5 instead of 94.5. For MD-354 and MD-356 the following was stated, "If MD-354 and MD-356 are faded west of the dike centerline, these tests will be in the plant fill area No safety related structure or system will be located in this area. Therefore, the four passes of the roller can be accepted as adequate".	
QF-174	Contrary to the requirement that zone 1 impervious fill should have not less than 20% passing the 200 sieve, tests 115 in the north plant dike and MD-359 and MD-358 in the northeast dike had soil classification zone 1 (BMP-114) which has 5.2% passing No 200 sieve. Test MD-830 in the northeast dike had soil classification zone 1 (BMP-139) which has 3.4% passing No 200 sieve. It should be noted test 115 was taken May 28, 1974; test [illegible]8 and MD-359 were taken May 30, 1974 a[illegible]t MD-830 was taken August 8, 1974.	MD-115 is 50 feet left or west of the dike centerline at station 5 + 00. Section T, Drawing C-119 and Section K, Drawing C-117 are identical on the plant side (i.e., west side) of the fill. Therefore, test MD-115 is shown in a zone 2 area based on either Section T, Drawing C-119 or Section K, Drawing C-117. It is agreed that there are discrepancies in the soils test reports, wherein the test location and soil types listed in the reports are not always consistent with the design drawing dike cross-sections (e.g., zone 2 material listed as material used where zone 1 material should have been used). However, we have reviewed reports for adjacent tests in the same vicinity of test MD-358, 359, and 440;	No Process Corrective Action was determined necessary because this problem happened three years hence. Also, these problems were in the dike section and we no longer had dike sections to be completed.

NCR NO	NCR DESCRIPTION AND SUPPORTING DETAILS	PART CORRECTIVE ACTION	PROCESS CORRECTIVE ACTION
QP-174		(Contd) again we conclude that the zone 2 material in a zone 1 area should be considered an anomaly. While it is unlikely that the dikes would be acceptable if there were conclusive evidence that zone 2 material had been widely used in lieu of the specified impervious material, the test reports in total do not support this position. The reports from adjacent test in the vicinity of MD-358, 359, and 440 do not support the theorem that a zone 2 material is at the locations as described in the test report Therefore, the request for a Project Engineering evaluation to "determine the acceptability of the dike...." based on speculation about errors in recorded data is not appropriate, nor do we believe warranted in this case. Any Project Engineering evaluation would be based on the same test report information which already has been questioned as anomalous by Consumers; the conclusions would only be as good as the facts used as the basis of the evaluation. Although recognizing that documentation errors will infrequently occur, it is not recommended that each document discrepancy be evaluated as though it were fact. Our office is satisfied that appropriate quality control programs, including Geotech surveillance, should provide adequate confidence in the dike construction and its acceptability. To reiterate our earlier evaluation, we recommend acceptance of test reports MD-359 and 440, based on the soil classification as a zone 2 material, albeit in a location other than as described in the test report.	

NCR NO	NCR DESCRIPTION AND SUPPORTING DETAILS	PART CORRECTIVE ACTION	PROCESS CORRECTIVE ACTION
QF-199	Part 1 Contrary to these requirements, the following tests had been passed using incorrect testing data. Using the correct testing data, the tests fail. Earth Plant Bike MD-290 (sampled 7-16-74) shows optimum moisture content 11.6. It should have been 9.5. Using the correct optimum moisture content of 9.5%, the actual moisture content is 2.2% above optimum moisture content. MD-360 (sampled 7-31-74) shows optimum moisture content as 21.4. It should have been 15.2. This also shows maximum lab dry density as 103.2. It should have been 115.1. Using the correct optimum moisture content of 15.2%, the actual moisture content is 5.4% above optimum moisture content. Also using the correct maximum lab dry density of 115.1, the correct percent of maximum density is 86.4%. MD-377 (sampled 8-6-74) shows optimum moisture content as 18.0. It should have been 15.2. Using the correct optimum moisture content of 15.2%, the actual moisture content is 4.5% above optimum moisture content. Structural Backfill MDR 671 (sampled 10-14-76) shows minimum dry lab density as 94.2. It should have been 112.2. Using the correct minimum dry lab density of 112.2, the correct percent of relative density is 41.5. Part 2 Also contrary to these requirements, the following tests had failing results and did not indicate being cleared by passing tests or had been marked passing.	Bechtel NCR 1004 was written on the density problems and Bechtel NCR 1005 was written on the moisture content problems. NCR 1005 was dispositioned use-as-is; 1004 remains open.	Part 1 A training session was held on 12-14-77 for U.S. Testing personnel. In conjunction with this training session, a list of all applicable proctors were developed to aid the inspector in obtaining correct values for density and moisture. It was felt that no additional corrective actions be taken in the problem with density tests MD-142 and MD-143 in which failing tests were marked passing since it occurred only in May of 1974 and has not been a recurring problem. Corrective action had been taken at the last part of July 1977 by Bechtel QC and U.S. Testing to more adequately clear failing tests. Therefore, the corrective action to preclude repetition for not clearing failing tests need not be addressed. Part 2 Corrective action had been taken as of the last of July 1977 by Bechtel QC and U.S. Testing to more adequately clear failing tests. Therefore, the corrective action to preclude repetition for not clearing failing tests need not be addressed.

NCR NO	NCR DESCRIPTION AND SUPPORTING DETAILS	PART CORRECTIVE ACTION	PROCESS CORRECTIVE ACTION

QF-199

(Contd)

North Plant Dike

MD-142 (sampled 5-30-74) shows optimum moisture content 8.0, moisture content 10.3. This test failed but it is shown as passing.

MD-143 (sampled 5-30-74) shows optimum moisture content 13.8, moisture content 11.4. This failed but it is shown as passing.

West Plant Dike

MD-227 (sampled 10-6-75) failed moisture but has not been cleared.

Plant Area Fill

Test No	Date Sampled	Compaction	Moisture Actual	Moisture Optimum
MD 1311	5-03-77	61.6% of Relative Density		
1326	5-10-77		18.5%	1[illegible].2%
1328	5-10-77		12.2%	1[illegible].2%
1412	6-07-77		10.4%	1[illegible].2%

Structural Backfill

MDR 621	10-14-76	78.0% of Relative Density		
671	11-12-76	74.8% of Relative Density		
672	11-13-76	75.4% of Relative Density		
685	11-24-76	56.2% of Relative Density		
686	11-24-76	70.9% of Relative Density		
691	11-24-76	62.0% of Relative Density		

NCR NO	NCR DESCRIPTION AND SUPPORTING DETAILS	PART CORRECTIVE ACTION	PROCESS CORRECTIVE ACTION
QF-203	Part A QCIR No. R-1.00-1560 for Zone 4A Fine Backfill references User's Test Report No. 0630 and the acceptance criteria as: Sieve Size — % Passing 1" — 100 3/4" — 90-100 1/2" — 75-90 3/8" — 60-85 #200 — 7-15 Contrary to the above, User's Test Report No. 0630 references 75-100% passing as the acceptance criteria for the 1/2" sieve, consequently 94% passed the 1/2" sieve and it was accepted when actually it failed. Part B QCIR No. R-1.00-2105 for Zone 4A Fine Backfill references User's Test Report No. 1036 and the acceptance criteria as: Sieve Size — % Passing 1" — 100 3/4" — 90-100 1/2" — 75-90 3/8" — 60-85 #200 — 7-15 Contrary to the above, User's Test Report No. 1036 indicated 81% passing the 1/2" sieve and accepted, this should have indicated 91% passing the 1/2" sieve and failed. Part C QCIR No. R-1.00-1836 for Zone 4A Fine Backfill references User's Test Report No. 0836 and the acceptance criteria as:	Part A & B NCR 1094 was written to identify the nonconforming material in Part A. Project Engineering dispositioned this material "Use-As-Is". NCR 1055 was written to identify the nonconforming material in Part B. Field Engineering has dispositioned this material "Reject For Q-Use". This material was only used in Non-Q areas. Part C Based on response given in Part A of letter 0-1621 from J. Meegen to C. Richardson, it was necessary for Field Engineering to justify the more stringent requirements and the use of this material when it did not meet these requirements. The justification was given by Field Engineering as for specifying a 12-20% range of aggregate passing through a #200 sieve when specification C-210 Rev 5 allows a range of 7-20 was strictly for commercial reasons. The vendor said he had a supply of 12-20% material. When this material actually turned out to be 11% it was still acceptable for use in accordance with our specification. The only error was in the dispositioning NCR QF-203 by revising the FMR rather than noting to use-as-is.	Part A & B The underlying cause of these conditions was improper review of the test reports by Quality Control. To prevent this condition from recurring, a training session was held with cognizant individuals in attendance. Part C The underlying cause of this condition was that the Civil QC Engineer identified the different gradation requirements on the QCIR and failed to bring it to the attention of the QC Receiving Engineer. To preclude repetition, the cognizant QC engineers in both disciplines were reminded that close interfacing is a necessity.

NCR NO	NCR DESCRIPTION AND SUPPORTING DETAILS	PART CORRECTIVE ACTION	PROCESS CORRECTIVE ACTION
QF-203	(Contd) Sieve Size — % Passing 1" — 100 3/4" — 90-100 1/2" — 75-90 3/8" — 65-85 #200 — 12-20 Contrary to the above, User's Test Report No. 0836 had 11% passing the #200 sieve and it was accepted.		
Closed Out Finding No 1 to Audit Report F-77-21	Backfill was placed on a lift which was determined to be greater than 2% below optimum moisture content (plant backfill test No 1352 optimum 23.2%, actual 12.8%). When questioned, the Foreman directing the soils work stated that he would continue backfilling since satisfactory compaction had been obtained.	A retest was taken in the area and the retest passed (plant backfill test 1414).	Bechtel QC informed the Foreman directing the soils work of the required moisture content limits and what to do if a failing test occurs.
Closed Out Finding No 2 to Audit Report F-77-21	During the audit, it was discovered that the Foreman directing the soils work believed that the required frequency for testing of field, density, and moisture content was 1 test per 1000 cubic yards of fill.	Bechtel QC made an evaluation concerning the frequency of testing in the affected area. It was determined that between 5-13-77 and 6-17-77, 18,200 cubic yards of random backfill was placed south and east of the Turbine Building. Fifty-seven tests were taken on this material which results in an overall test frequency of 320 cubic yards per test. The majority of this 18,200 cubic yards was placed in a non-Q area.	Bechtel QC informed the Foreman directing the soils work of the correct test frequency requirements.

NCR NO	NCR DESCRIPTION AND SUPPORTING DETAILS	PART CORRECTIVE ACTION	PROCESS CORRECTIVE ACTION
Closed Out Finding No 1 to Audit Report F-77-32	The audit was performed on soil reports North Plant Dike MD 72 (5-23-74) through MD 514 (9-21-74), West Plant Dike MD 75 (9-12-74) through MD 307 (9-27-74), Structural Backfill MDR 611 (10-7-76) through MDR 1121 (8-11-77), Plant Area Fill MD 1122 (10-7-76) through MD 1854 (8-12-77) and gradation reports for structural backfill material received February 4, 1977 through August 31, 1977 to assure fail-ing tests have been cleared by passing tests; correct optimum moisture contents, maximum and minimum dry lab densities have been used; the test results were properly evaluated for acceptance; and test reports could be located in the Quality Control Documentation Vault. Finding 1 West Plant Dike MD-276 and 277 (sampled 9-15-76), 278 (sampled 9-16-76), and 285 (sampled 9-17-76) have NA in the optimum moisture content column. North Plant Dike MD-92 (sampled 5-25-74) shows maximum dry lab density 110.6. It should have been 101.4. MD-93 (sampled 5-25-74) shows maximum dry lab density 110.6. It should have been 101.4. MD-109 (sampled 5-28-74) shows maximum dry lab density 103.4. It should have been 115.1. MD-119 (sampled 5-28-74) shows maximum dry lab density 127.2. It should have been 128.0. MD-155 (sampled 6-4-74) shows optimum moisture content 18.8. It should have been 18.4. MD-195 (sampled 6-24-74) shows optimum moisture content 11.0. It should have been 11.6. MD-223 (sampled 6-25-74) shows optimum moisture content 10.3. It should have been 11.6.	The test results were recalculated and corrections made. The errors did not change the acceptance of these tests even though they did change the test results.	Refer to NCR QF-199 for Finding No 1.

NCR NO	NCR DESCRIPTION AND SUPPORTING DETAILS	PART CORRECTIVE ACTION	PROCESS CORRECTIVE ACTION
Finding No 1 to Audit Report F-77-32	(Contd) MD-224 (sampled 6-25-74) shows optimum moisture content 13.5. It should have been 13.0. MD-257 (sampled 7-11-74) shows optimum moisture content 9.8. It should have been 10.4. This also shows maximum dry lab density 126.8. It should have been 127.4. MD-269 (sampled 7-12-74) shows maximum dry lab density 116.2. It should have been 116.3. MD-290 (sampled 7-16-74) shows maximum dry lab density 125.2. It should have been 128.3. MD-318 (sampled 7-19-74) shows optimum moisture content 13.0. It should have been 13.3. MD-336 (sampled 7-20-74) shows optimum moisture content 20.5. It should have been 20.0. MD-341 (sampled 7-25-74) shows optimum moisture content 17.0. It should have been 15.5. MD-377 (sampled 8-6-74) shows maximum lab dry density 109. It should have been 112.9. MD-476 (sampled 8-19-74) shows optimum moisture content 17.0. It should have been 17.1. MD-512 (sampled 8-28-74) shows maximum lab dry density 109.4. This should have been 109.0. Structural Backfill Area MDR-919 (sampled 5-25-77) shows maximum dry lab density of 109.3. It should have been 125.3. It also shows minimum dry lab density as 90.3. It should have been 109.3. Plant Area Fill MD-1262 (sampled 4-8-77) gives maximum dry lab density of 117.0. It should have been 117.3. MD-1300 (sampled 5-2-77) gives optimum moisture content of 11.1. It should have been 10.4.		

NCR NO	NCR DESCRIPTION AND SUPPORTING DETAILS	PART CORRECTIVE ACTION	PROCESS CORRECTIVE ACTION
Finding No 1 to Audit Report F-77-32	(Contd) MD-1385 (sampled 6-2-77) gives optimum moisture content of 13.5. It should have been 13.4. MD-1420 (sampled 6-8-77) gives optimum moisture content of 9.8. It should have been 8.6. It also gives maximum dry lab density of 127.1. It should have been 132.9. MD-1521 (sampled 6-17-77) gives maximum dry lab density of 117.8. It should have been 117.1.		
Closed Out Finding No 2 to Audit Report F-77-32	The following [illegible] ad failing results and did not indicat[illegible] ag cleared by passing tests.	Test reports Plan Area Fill MD 1317-1320; North Plant Dike MD 418; and Structural Backfill MDR 620, 629, 632, 637, 673, 679, 700, 701, 757, 767, 769 and 770 have been cleared by passing tests and Structural Backfill represented by MDR 854, 861 and 862 was removed.	Refer to NCR QF-199 for Finding No 2.

Plant Area Fill

Test No	Date Sampled	Compaction	Moisture Actual	Moisture Optimum	
MD 1153	10-21-76	61.6% a[illegible]ve Density			
1155	10-21-76	73.5% [illegible]ve Density			
1191	11-[illegible]3-76	76.6% [illegible]ve Density			
1194	11-22-76	75.4% [illegible]e Density			
1317	5-09-77		18.0%	15.2%	Test reports Plan Area Fill MD 1153, 1155, 1191, 1194, 1321, 1337, 1388, 1393, 1398, 1404, 1415, 1498, 1509 and Structural Backfill MDR 625, 663, 664, 667, 680, 682, 688, 721, 734, 736-741, 744, 746, 757, 768, 770, 785, 799, 826, 843, 845, 889, 914, 922, 925, 938, 940, 993 and 998 are in a "Non-Q" area and have been given to CPCo Project Management Organization (Field) for resolution in letter 186FQA77.
1318	5-09-77		11.5%	15.2%	
1319	5-09-77		11.7%	15.2%	
1320	5-09-77		12.2%	15.2%	
1321	5-09-77	94.0% of Maximum Density			
1337	5-17-77		12.4%	15.2%	
1388	6-02-77		9.8%	15.2%	
1393	6-01-77		11.1%	11.4%	
1398	6-01-77		11.2%	11.4%	
1404	6-03-77		10.2%	11.4%	
1415	6-07-77		9.9%	11.4%	
1498	6-15-77	88.2% of Maximum Density	14.5%	10.0%	
1509	6-16-77		12.9%	11.2%	

North Plant Dike

MD 418	8-24-74	17.2%	20.0%	

NCR NO	NCR DESCRIPTION AND SUPPORTING DETAILS	PART CORRECTIVE ACTION	PROCESS CORRECTIVE ACTION

Finding No 2 to Audit Report F-77-32

(Contd)

Structural Backfill

Test No	Date Sampled	Compaction	Moisture Actual	Moisture Optimum
NDR 620	10-13-76	72.3% of Relative Density		
625	10-12-76	51.5% of Relative Density		
629	10-20-76	79.2% of Relative Density		
632	10-20-76	73.5% of Relative Density		
637	10-21-76	76.3% of Relative Density		
663	11-31-76	53.0% of Relative Density		
664	11-31-76	72.3% of Relative Density		
667	11-31-76	67.5% of Relative Density		
673	11-23-76	33.9% of Relative Density		
679	11-23-76	71.8% of Relative Density		
680	11-24-76	60.0% of Relative Density		
682	11-24-76	70.6% of Relative Density		
688	11-24-76	77.1% of Relative Density		
700	1-31-77	75.0% of Relative Density		
701	1-31-77	68.1% of Relative Density		
721	3-14-77	60.0% of Relative Density		
734	3-17-77	34.0% of Relative Density ← 200 ± T		
736	3-18-77	79.0% of Relative Density		
737	3-18-77	41.9% of Relative Density		
738	3-18-77	72.4% of Relative Density		
739	3-18-77	70.6% of Relative Density		
740	3-18-77	69.1% of Relative Density		
741	3-21-77	73.8% of Relative Density		
744	3-21-77	56.2% of Relative Density		
746	3-21-77	54.9% of Relative Density		
757	3-23-77	68.7% of Relative Density		
767	3-29-77	54.3% of Relative Density		
768	3-30-77	66.9% of Relative Density		
770	3-30-77	65.0% of Relative Density		
785	4-01-77	69.3% of Relative Density		
799	4-12-77	79.8% of Relative Density		
826	4-19-77	70.4% of Relative Density		
843	4-28-77	66.8% of Relative Density		
845	4-29-77	70.4% of Relative Density		
854	5-09-77	67.4% of Relative Density		

NCR NO	NCR DESCRIPTION AND SUPPORTING DETAILS	PART CORRECTIVE ACTION	PROCESS CORRECTIVE ACTION
Finding No 2 to Audit Report F-77-32	(Contd) Structural Backfill (Contd) Test No / Date Sampled / Compaction / Moisture Actual / Moisture Optimum SBR 861 5-20-77 76.3% of Relative Density 862 5-20-77 74.0% of Relative Density 889 5-23-77 65.5% of Relative Density 914 5-24-77 9.0% 11.8% 922 5-26-77 75.7% of Relative Density 925 5-27-77 11.4% 15.2% 933 6-08-77 56.5% of Relative Density 940 6-08-77 78.6% of Relative Density 993 6-15-77 60.2% of Relative Density 998 6-15-77 77.4% of Relative Density Corrective Action Requested: Determine if there are passing tests in the same area to clear these failing tests.		
Finding No 3 to Audit Report F-77-32	Relative Density Reports 59 and 61 were missing from the QC Vault.	Copies have been obtained and placed in the QC Document Vault.	No Process Corrective Action.
Open Findings 1 & 2 to Audit Report F-77-32	Refer to NCR QF-199.	Refer to NCR QF-199.	Refer to NCR QF-199.
Open Finding 3 to Audit Report F-77-32 (Repeat of QF-152)	To preclude repetition to NCR QF-152 (the same deficiency as this), U.S. Testing developed a new gradation form that has check points that include documenting that the 200 gram material limit on any individual 8 inch sieve has not been exceeded. In addition, a training session was held on February 21, 1977.	These findings have been identified on Bechtel NCR 1006. Dispositioned "Use-As-Is." NCR QF-195 has been written to resolve the corrective action still open. Closed based on "Use-As-Is" disposition.	The corrective actions to preclude recurrence was taken in the form of training for Bechtel Quality Control personnel and training for U.S. Testing personnel.

NCR NO	NCR DESCRIPTION AND SUPPORTING DETAILS	PART CORRECTIVE ACTION	PROCESS CORRECTIVE ACTION
Open Finding 3 to Audit Report F-77-32	(Contd) Project Quality Control Instruction No. SC-1.05 "Material Testing Services and Concrete Production" Rev. 3 Section 2.7.2 Reports, Item A states, "Perform a daily review of the subcontractor's jobsite inspection and test reports for acceptability, completeness, and the laboratory chief's signature for concrete, steel, and soils. Sign and date on the report verifying the acceptable status". Contrary to these requirements: Structural Backfill Log Number / Date Sampled / Amount Retained C-220 — 1-13-77 — #40 Sieve - 225.2g 0364 — 4-27-77 — #10 Sieve - 217.1g 0417 — 5-11-77 — #10 Sieve - 221.4g 0431 — 5-16-77 — #10 Sieve - 260.1g 0451 — 5-13-77 — #10 Sieve - 211.7g 0505 — 6-02-77 — #200 Sieve - 228.0g 0704 — 7-18-77 — #10 Sieve - 249.5g Corrective Action Requested: (1) Present these findings to Bechtel Project Engineering and obtain engineering rationale from Bechtel Project Engineering as to the acceptability of the material these tests represent. (2) Evidently the corrective action taken in NCR-152 was not adequate. Determine the underlying cause(s) and take further corrective action to preclude repetition.		

NRC PRELIMINARY FINDING 9

9. Settlement Calculations for Plant Area Fill

Discussion of NRC Inspection Facts (from the Preliminary NRC Report)

Bechtel settlement calculations for the diesel generator building were based on designs involving a mat foundation having an applied soil pressure of 3,000 psf. The foundation design was subsequently changed to spread footings with four independent generator pedestals having applied soil pressures of 4,000 and 1,750 psf, respectively (FSAR Subsection 3.8.4.1). Settlement calculations were not made for the final design conditions. Recent comparisons show the settlement estimated for the spread footing foundation condition was a maximum of 8% larger than that for the mat foundation. FSAR Figure 2.5-48 displays the calculated settlements, not the design basis. The design basis provided in FSAR Subsection 3.8.4.1.2 and 3.8.5.1.3 was translated in detail design drawings and implemented in the actual construction.*

The borated water storage tanks are supported in part by a ring type spread footing, but most of the load is applied across the tank bottom, which is supported on fill (FSAR Figure 3.8-60). Settlement calculations discussed in FSAR Subsection 2.5.4.10.3 for the borated water storage tanks, conservatively used a uniform equivalent circular mat foundation having an applied soil pressure of 2,500 psf (FSAR Figure 2.5-47). The ring type spread footing pressure is 2,500 psf and the tank-applied pressure within the ring-foundation is 2,000 psf. Because the actual pressure is 2,000 psf over most of the foundation area, this settlement estimate is conservative.

Settlement calculations assumed a compressibility parameter of 0.001 whereas FSAR Table 2.5-16 gives a compressibility parameter of 0.003. In this calculation the difference in parameters would result in a maximum increased settlement of 0.3 inch for the diesel generator building. For the borated water storage tanks the difference would be less. Differences in estimated settlements resulting from foundation and soil conditions cited are small and within the accuracy limits of the analyses.

*It has been discovered that some manual holders had not received pages 52a and 52b which contain FSAR Subsection 3.8.4.1.2. These pages will be transmitted to all manual holders.

9. Settlement Calculations for Plant Area Fill (Cont'd)

Conclusions

a. The diesel generator building spread footing foundation, which constitutes the design basis, was translated into the detail design. However, a design change to the foundation was not recognized to affect a previous settlement calculation, but this did not significantly affect settlement estimates.

b. The assumptions used for the borated tank settlement calculations are appropriate for the type of design utilized.

c. The wrong compressibility factor was used for settlement calculations, but it had a minor impact on the resultant values.

NRC PRELIMINARY FINDING 10

10. Settlement of Administration Building Footings

Discussion of NRC Inspection Facts (from the Preliminary NRC Report)

The investigation of failure under the administration building was initiated in September 1977. The results of the investigation in the failure area are summarized below:

Type of Investigation	Results
Unconfined compression test (11 samples)	Very soft to medium stiff clays
Two borings	One boring showed soft to medium stiff clay directly under the footing and stiff to hard clay at lower elevations. The other boring was satisfactory.
Five tests on percent compaction. Proctor curve run on sample representing these tests	Percent compaction below acceptable limits for four tests

The results of the investigation initiated in September 1977 in areas outside the failure area are summarized below:

Area	Type of Investigation	Results
Power block structures	Observations and construction survey data	No evidence of settlement
Strip footings in administration building east of failure area	Load tests	Settlements within acceptable ranges
Sixty feet south of diesel generator building	Soil boring	Soils acceptable - very stiff to hard
Footing for the evaporator building	Soil boring	Soils acceptable - very stiff to hard

10. Settlement of Administration Building Footings (Cont'd)

Based on the above investigations, the administration building grade beam failure was concluded to be a local soil failure. A meeting was held in September 1977 between the Chief Soil Lab Representative, Bechtel Lead Civil Field Engineer, and Lead Civil QC Engineer to discuss the requirements of the proper proctor selection for fill placement tests. U.S. Testing was notified by letter of the requirement to select the proper proctor.

CPCo site personnel acknowledged awareness of the administration building soil failure on August 25, 1977. The CPCo Project Manager learned of the administration building grade beam problem shortly after its occurrence (August 1977). The CPCo Project Engineer did not recall hearing of the administration building grade beam problem prior to diesel generator building settlement discussions. This was not unusual because the field normally would resolve their own problems and request assistance only when necessary.

Conclusions

a. Bechtel investigated the nature of the failure and, on the basis of the information available at the ti determined that the failure was localized.

b. Because none were thought to be necessary at the time, there were no program changes implemented to preclude the possibility of repeated erroneous selection of the laboratory compaction standards. However, Bechtel advised U.S. Testing as to the need to improve the selection of standards.

NRC PRELIMINARY FINDING 11

11. Interface Between Diesel Generator Building and Electrical Duct Banks

Discussion of NRC Inspection Facts (from the Preliminary NRC Report)

Four vertical electrical duct banks restricted settlement of the diesel generator building. This condition was caused by two items. First, the ducts banks passing through the building footings were stepped (enlarged cross-sectional area) below the openings provided in the footing. In some cases the mudmat filled the area between the footing and the larger duct bank, thereby providing support for the building at that location. Second, the duct banks passed through the backfill layer and were bedded in a stiff natural soil layer below.

A 1-inch separation gap was provided between the duct bank and the diesel generator building footings to allow for differential settlement between the duct bank and building foundation. The detail was shown in Drawings C-1001 and C-1002. It was not anticipated in the design that the duct bank would be constructed larger below the footing than at the point of penetration of the footing.

The design requirements of the duct banks where they penetrate the foundation and make the vertical turn are shown in Electrical Drawing E-502. These details were modified to facilitate construction without recognition of the impact on the civil design requirements providing clearance for free movement of the building foundation. Moreover, the mudmat filled the space between the larger section and the footing.

Drawings and specifications permit the use of Zone 2 random fill material in plant area fill. Structural backfill was placed in local excavations in accordance with Specification 7220-C-211. Lean concrete was used to replace structural backfill in confined areas as permitted by Specification 7220-C-211, Section 5.1.3 which states, "In absence of structural backfill materials described above...lean concrete, as specified in Specification 7220-C-230 may be used." Use of lean concrete in restricted areas is a normal construction practice and was controlled by the field engineer's approval after inspection of subgrade. Correspondence (BMBC-668 dated December 27, 1974) addresses the use of lean concrete as an acceptable replacement for Zone 1 and 2 materials only in areas of the dike disturbed due to trenches or temporary excavations.

Conslusions

a. The diesel generator building settlement was restricted by the enlargement of the electrical duct banks or by the specified allowable use of lean concrete to replace structural backfill in confined areas. Concrete backfill was not used indiscriminately.

b. There was a lack of design interface between the electrical and civil drawings in that the electrical drawing did not recognize the effect of the enlargement of the duct banks upon the civil drawing design which attempted to provide free relative movement.

NRC PRELIMINARY FINDING 12

12. Soils Placement and Inspection Activities

Discussion of NRC Inspection Facts (from the Preliminary NRC Report)

The Bechtel Geotechnical Group has provided technical support for soils placement on the Midland Project. Placement of soils by Canonie represents the major portion of soils placed on the jobsite. For Q-listed work, inspection has been performed by a Canonie Quality Control Engineer with soils engineering placement experience in excess of 10 years. Additional overview of Canonie's work has been provided by Bechtel Civil Field Engineers and Quality Control Engineers.

For the Bechtel scope of work, soils have been placed under the direction of Civil Field Engineering personnel. These individuals are either Graduate Civil Engineers or persons with related on-the-job training. The Civil Field Engineers discussed work plans, problems and solutions with craft personnel and witnessed sensitive operations as the work situation required, although they were not physically present at all places and times while work was being performed. They were on call at all times as the situation required.

Bechtel Civil Quality Control Engineers (QCEs) have inspected, witnessed, or surveilled Bechtel placement of Q-listed soils. These QCEs were certified in accordance with ANSI N-5.2.6 and trained in the requirements of QC inspection plans.

QCEs were in soils placement areas as evidenced by quality documentation including Inspection, Nonconformance, and Discrepancy Reports. The following tabulation provides approximate numbers of each type of report prepared by QCEs.

Field Soil Inspection Plans and Record Designation	Active Time Period	Inspection Reports	Nonconformance Reports	Discrepancy Reports
C-210	8/73-11/76	65	8	NA
C-211	8/74-10/76	21	3	NA
C-1.02	10/76-Present	109	8	31
S/C-1.10	6/77-Present	13	-	-
S/C-1.05	7/76-Present	93	2	-
	Total	301	21	31

The requirements for field densities and moisture content are found in Specification 7220-C-208, Table 9-1, "One per every 500 cubic yards of fill." The test must be taken within the frequency envelope, but there is no additional requirement as to the accuracy of the test location. In the event of a test failure, nonconforming material was reworked.

12. Soils Placement and Inspection Activities (Cont'd)

One case was reported in which moisture was added to clay in a non-Q area without reworking. Review indicates this was an isolated case. When moisture was added to the soil for purpose of compaction, the soil was reconditioned in accordance with Specification 7220-C-210.

Conclusions

a. There is insufficient data from which to draw a conclusion as to whether or not qualified personnel were directing the fill placement activity.

b. The measurements associated with the density tests were made by qualified U.S. Testing personnel.

c. Soils engineers were not on site full-time after 1974 to verify placement and compaction as indicated in Specification C-501.

NRC PRELIMINARY FINDING 13

13. Inspection Procedures For Plant Fill

Discussion of NRC Inspection Facts (from the Preliminary NRC Reports)

During the summer 1976 the Bechtel QC Program underwent a format change from Field Inspection Plans (FIPs) to Quality Control Instructions (QCIs) and Inspection Records (IRs). At that time an analysis of FIPs C-210 and C-211 and QCI C-1.02 indicated that no adverse trends were apparent in the soils work. This indicated that a change was justified to a surveillance mode from the initial inspect and witness mode which had been used from the beginning of construction. The modes are defined in Section 3.3.3 of 7220 SF/PSP 6.1, as follows:

> Inspect (I) - Visual examination or measurement to verify the conformance of an item or construction work operation to predetermined quality requirements.
>
> Witness (W) - To watch over, observe or visually examine a specific work operation, examination or test which is performed by others.
>
> Surveillance (S) - To progressively monitor by randomly witnessing and inspection, items and work operations before, during or after in-process construction. This inspection activity requires that the QCE physically verify the work operations described in the Quality Control Instructions to assure they are performed in accordance with inspection criteria requirements. These verifications shall be performed as often and for as long a time period as is necessary to effectively monitor the designated Activity/Task.

The design document characteristics subject to QC, whether by the I, W, or S mode, remained the same for all plans. They included:

a. Material free of organics
b. Material moisture conditioned
c. Material not frozen
d. Material compacted to density
e. Lift thickness required
f. Work area clear of trash, debris, and unsuitable material
g. Backfill material not placed upon frozen surfaces
h. Backfill material conformance to drawing requirements

Inspections, witnesses and surveillances required by these plans were performed as evidenced by inspection, nonconformance, and discrepancy reports.

13. Inspection Procedures For Plant Fill (Cont'd)

Conclusions

a. Neither the characteristics subject to inspection or witnessing nor the type of inspection or witnessing were changed; the degree of inspection or witnessing was reduced by going to a surveillance (sampling) plan.

b. The decision to change to sampling inspection is questionable, in retrospect, recognizing that the bulk of the prior successful experience related to Canonie's activity and that a change was being made to have the activity performed by Bechtel.

c. The sampling (surveillance) plan was inadequate in that it did not specify conditions or criteria under which there would be increased sampling or a return to 100% inspection.

NRC FINAL CONCLUSIONS

14. Discussion of the NRC Final Conclusions (from the Preliminary NRC Report)

It is our position that final conclusions of a general nature are inappropriate because their all encompassing nature renders them subject to interpretation beyond that which is supported by the inspection facts. Specific conclusions are appropriate and we have included our specific conclusions in the preceding pages.

ATTACHMENT 6

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

MAR 21 1979

Docket Nos: 50-329
50-330

Mr. S. H. Howell
Vice President
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Dear Mr. Howell:

SUBJECT: 10 CFR 50.54 REQUEST REGARDING PLANT FILL

At the meetings on February 23, 1979, and March 5, 1979 at the NRC Region III Office in Glen Ellyn, Illinois, the circumstances associated with settlement of the diesel generator building at the Midland facility were discussed. This discussion was part of the investigation being conducted by Region III. Representatives of the staff from headquarters attended the meeting on March 5, 1979. The staff stated that its concern is not limited to the narrow scope of the settlement of the diesel generator building but extends to the various buildings, utilities and other structures located in and on the plant area fill. In addition, the staff expressed concern with your quality assurance program.

Under the authority of Section 182 of the Atomic Energy Act of 1954, as amended, and Section 50.54(f) of 10 CFR Part 50, additional information is requested regarding the adequacy of the fill and your quality assurance program for the Midland site in order for the Commission to determine whether enforcement action such as license modification, suspension or revocation should be taken. Accordingly, please submit complete and adequate responses to the enclosed requests within thirty days after receipt of this letter. Your responses should be submitted by cover letter signed under oath or affirmation. In those cases in which a complete response must await the results of future activities, an interim reply should be given within thirty days addressing the adequacy of that activity to provide the basis for a suitable reply, and the associated schedules for that activity and reply.

DUPE OF 7904160134

Should you desire clarifications or other discussions of the enclosed requests, please contact our Division of Project Management.

Sincerely,

Harold R. Denton, Director
Office of Nuclear Reactor Regulation

Enclosure:
Requests for Additional Information

cc: See next page

Consumers Power Company

MAR 21 1979

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ENCLOSURE

Requests for Additional Information

Regarding Plant Backfill Settlement

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 in item (c) above, describe your position as to the overall effectiveness of your QA program for the design and construction of the Midland plant.

2. Discuss the consideration given to, and estimate the cost of, grouting any natural lacustrine deposits (sands) upon which safety related structures are founded.

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.

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 can not 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.

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?

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?

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.

8. What tolerance is placed upon the alignment of the diesel generators 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 NCAR 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 startup 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?

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 boring meets the control compaction requirements.

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?

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?

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.

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?

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.

15. For all seismic Category I 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 occuring prior to or during a seismic event, should be considered over the life of the plant.

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?

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?

18. For seismic Category I 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.

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?

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.

21. Your letter of December 21, 1978, on the settlement of the diesel generator foundations and building advised us that the use of a preload to densify the existing fill material in place had been selected as the major corrective action plan. Bechtel's Interim Report 3 to NCAR 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.

        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 areas will 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?

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 effect 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 additions 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.

ATTACHMENT 7

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.

OFFICE ▶
SURNAME ▶
DATE ▶

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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

OFFICE▶	RIII	RIII	RIII	RIII	RIII	RIII
SURNAME▶	Phillips/bk	Maxwell	Hayes	Fiorelli	Novelius	Keppler
DATE▶	3/19/79	3/19/79	3/19/79		3/19/79	3/19/79

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 unusual 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. (339/78-20-01; 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 compacti . 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 12.4.3, 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-436, 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. (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 BCRE-1333R (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. (339/78-20-04; 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 (3/5/76)	Material placed and 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 1003 (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. (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. (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. (329/78-20-08; 330/78-20-08)

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. (329/78-20-09; 330/78-20-09)

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.

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 29, 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 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. (329/78-20-10; 330/78-20-10)

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.

ATTACHMENT 8

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.

DUPE OF 7905240724

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

Sincerely,

Gaston Fiorelli, Chief
Reactor Construction and
Engineering Support Branch

Enclosure: IE I[illegible]
Reports No. 50-[illegible]/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

RIII	RIII	RIII	RIII	RIII
Gallagher/blk	Hayes	Fiorelli	Cook	Hansen
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

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

Approved By: D. W. Hayes, Chief F. J. Jablonski for 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.

DUPE OF 7905240734

DETAILS

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 Building 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-654LA
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 Connole 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 Buildng 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.

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 January 1, 1980.

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 January 1, 1980. 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 for the following areas: 1

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 of Specification G-22 requires that this program provide instructions, procedures, and drawings, although it does not specifically call out the requirements of Subparagraphs a through d listed above. 1

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 +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 June 29, 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.

Revision 1
5/79

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 FLITZ	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/COMMITMENT 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	
3.5.6	1.8-3	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 BAS actuating HPI lube oil pumps (QAR 211.124)	04/79F	Bechtel	CS	
2.5.6.13.1	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 2.5-13	Idealized soil profile and parameters	Provide average values for layers A and B	07/79	Bechtel	CV	
3.5	FIG 3.5-10 through 3.5-16	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 3.5-16	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 1-3

PSAR COMMITMENT LIST

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	-M----------	Incorporated	FSAR Section 4.4.2.5 Rev 0
3.2.3.2.11 3.11	The reactor trip point is 107.5% rated power, and the maximum overpower which is 114%, will not be exceeded under any condition.	3-35	0	-MC----------	Incorporated	FSAR Ch 15 Rev 0, Section 3A, A.O. 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.	3-44	4	-M----------	Incorporated	FSAR Sections 1.3.4, 6.2.1.3.2, Rev 0 (Supp 2 to S.E.R. of Midland Plant Units 1 & 2: NRC, July 1973)
3.2.4.1	The reactor internal components are designed to meet the requirements specified in section 3.2.4.1 of the PSAR.	3-45	4	-M----------I	Incorporated	FSAR Section 3.9.3 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.	3-46	4	BW-A-----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 (±2%)	Moisture Measurements to Aid Compaction: During Compaction (±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	536	-
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 2061

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 8059

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	3
80-85	4.6	3
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

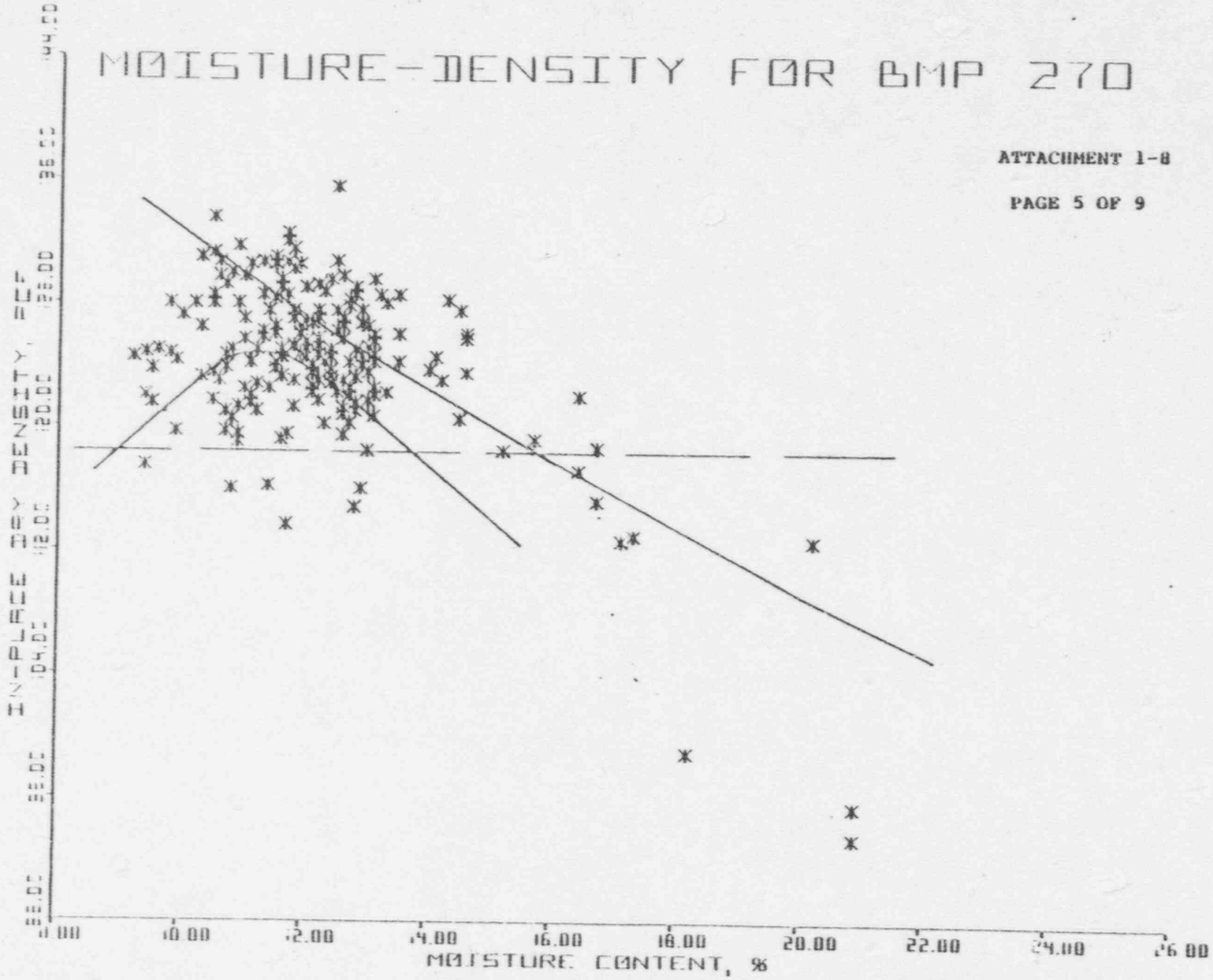
HISTOGRAM OF COMPACTION FOR CLASSIFICATION BOSS

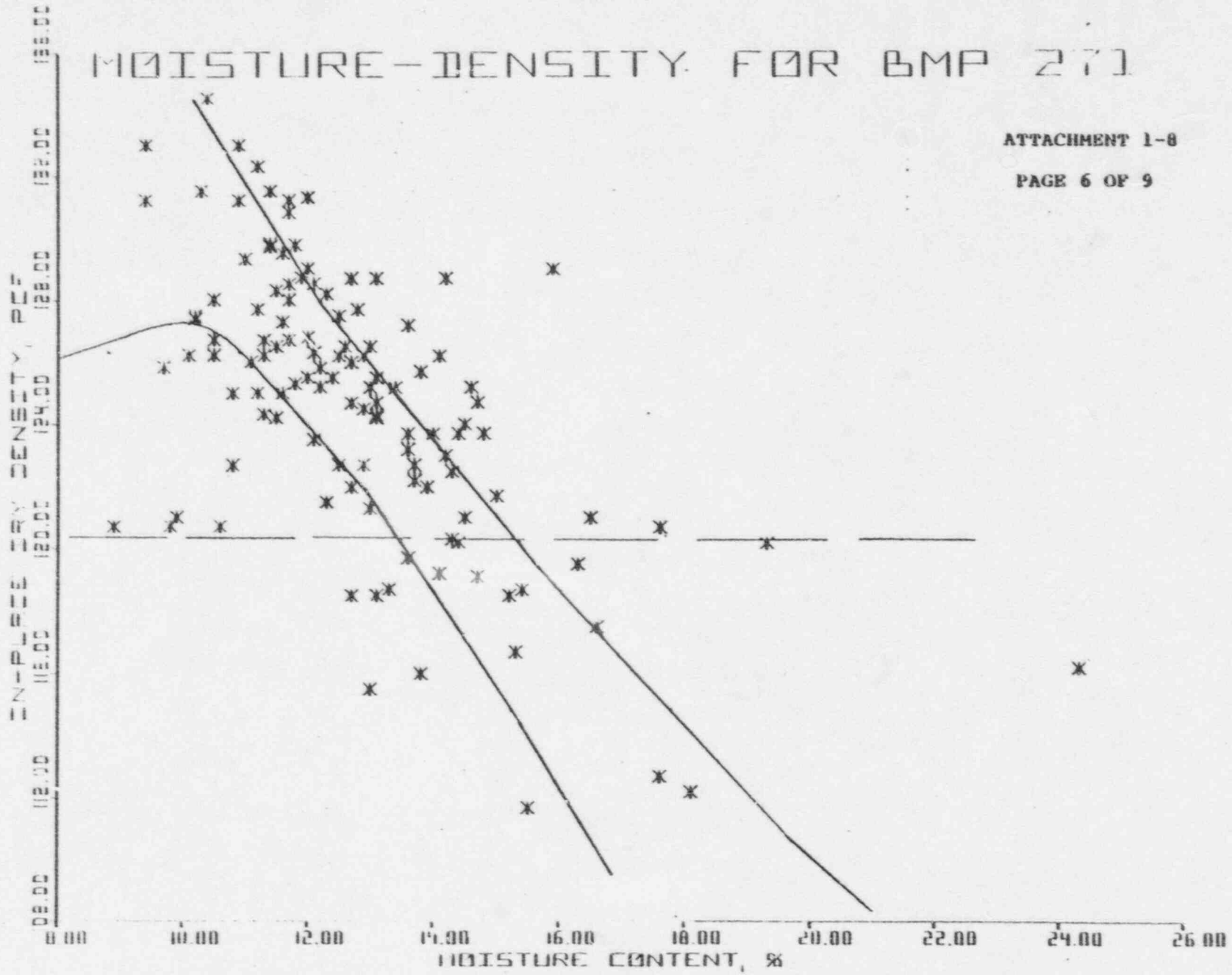
FOR THIS CLASSIFICATION, MAX LAB DRY DENSITY = 109.7

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

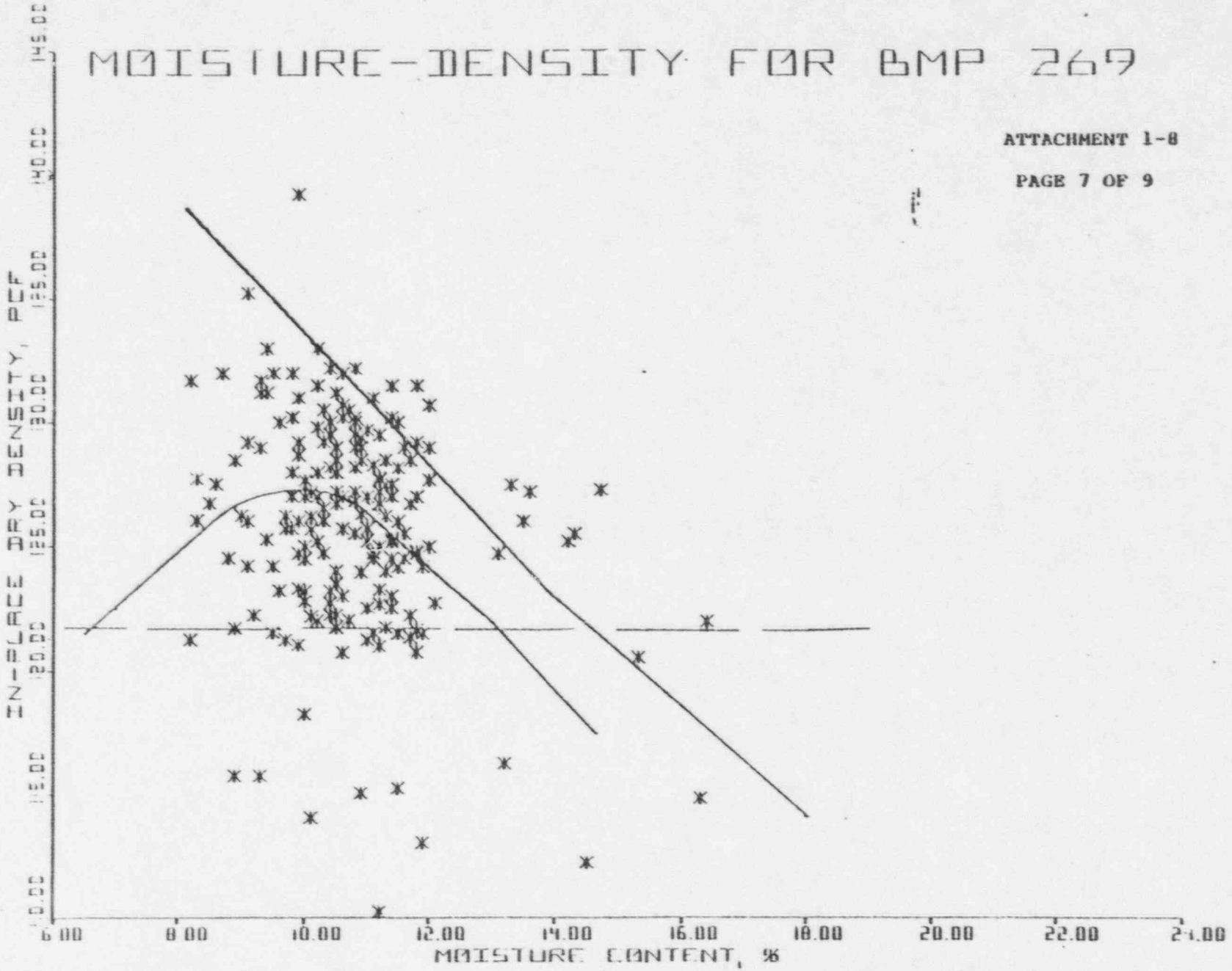
TOTAL COUNT OF TESTS = 555

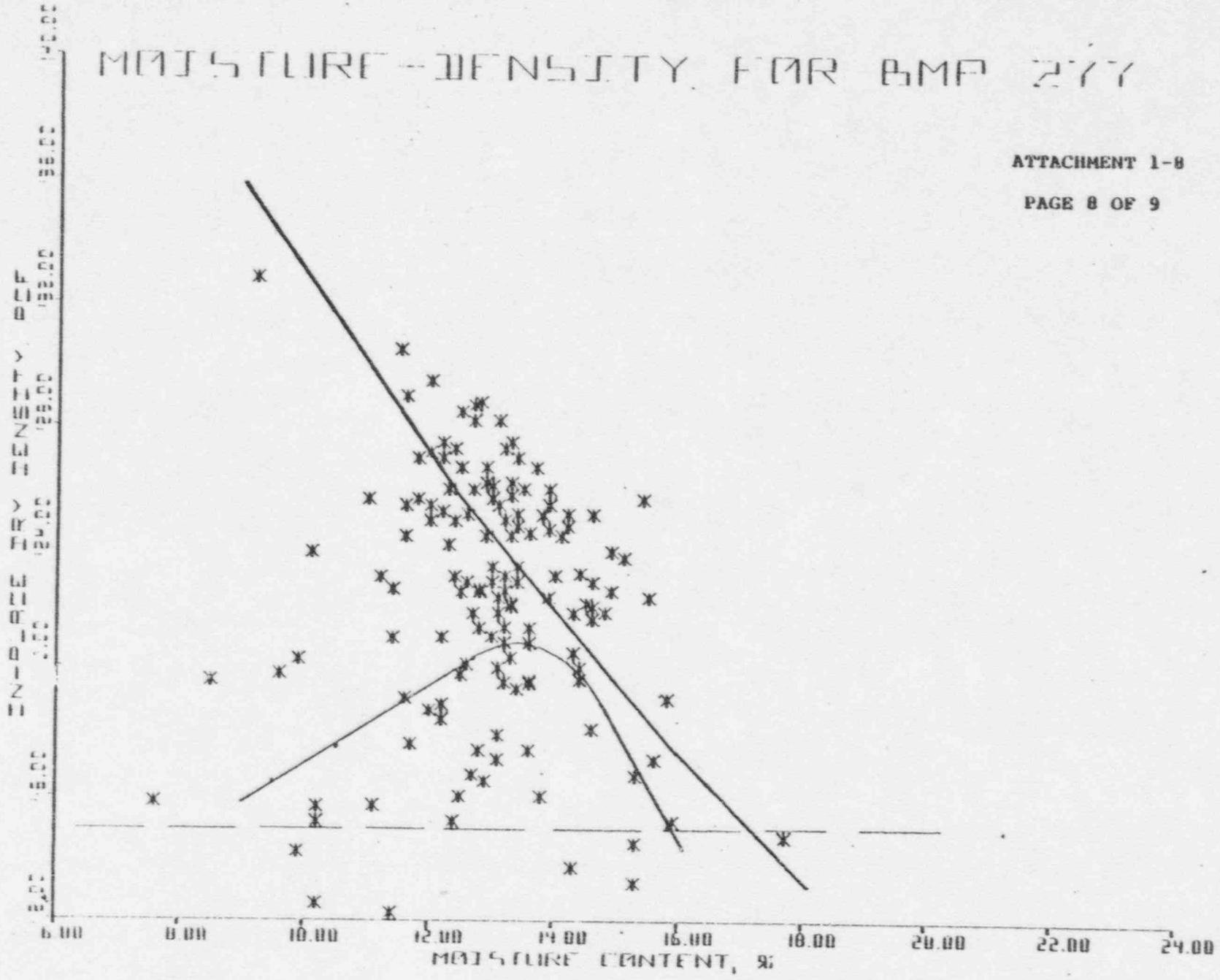
MOISTURE-DENSITY FOR BMP 270

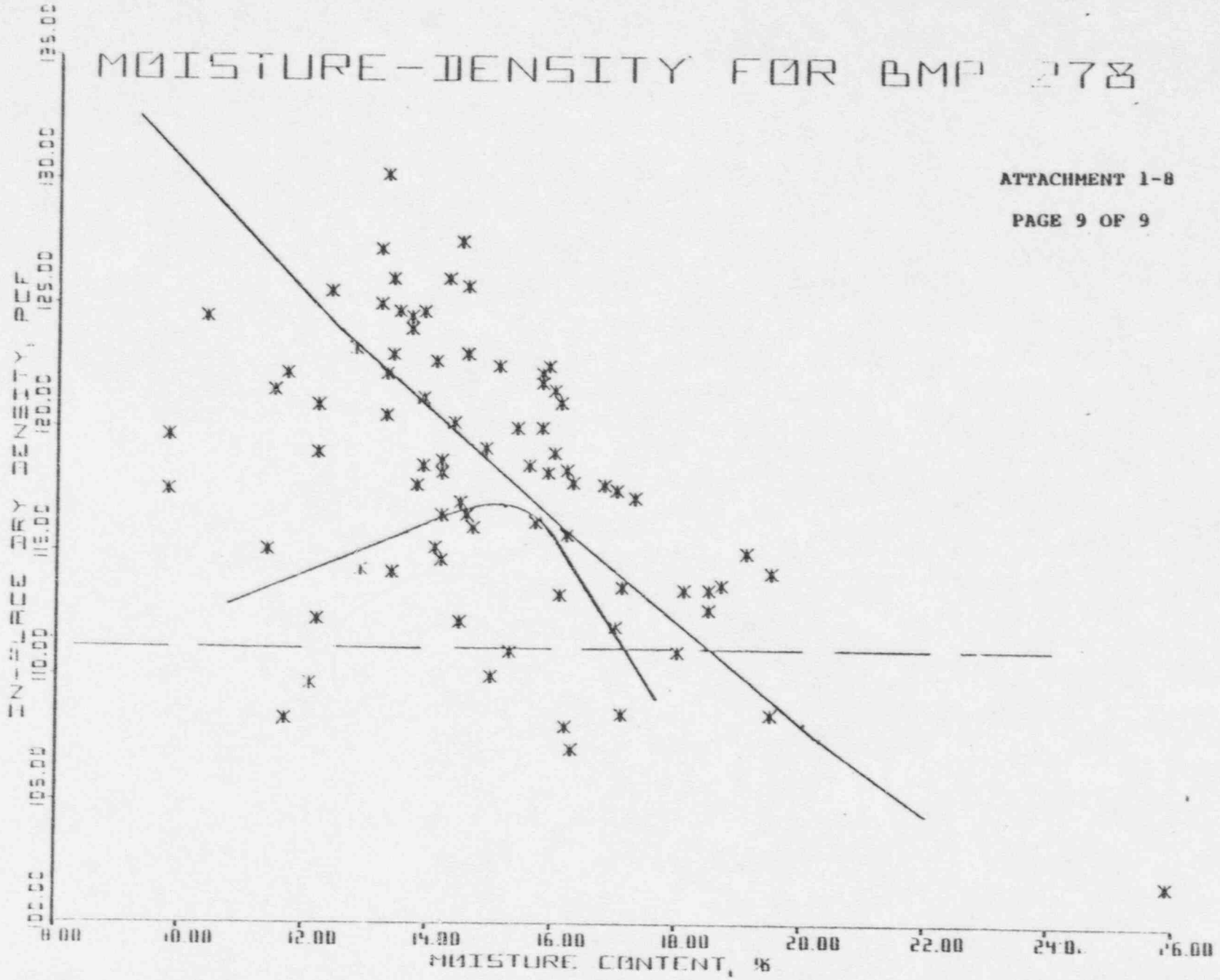



MOISTURE-DENSITY FOR BMP 27
DRY DENSITY, PCF
MOISTURE CONTENT, %
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
26.00

MOISTURE-DENSITY FOR BMP 269




MOISTURE-DENSITY FOR BMP 277
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
MOISTURE CONTENT, %


MOISTURE-DENSITY FOR BMP 278
DRY DENSITY, PCF
105.00
110.00
115.00
120.00
125.00
130.00
135.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
26.00
MOISTURE CONTENT, %

ATTACHMENT 10

JUN 6 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 Messrs. E. J. Gallagher and E. W. K. Lee of this office on May 14-17, 1979, of activities at the Midland Nuclear Power Plant construction site authorized by NRC Construction Permits No. CPPR-81 and No. CPPR-82 and to the discussion of our findings with Messrs. T. Cooke and D. Miller, others of your staff, and others of the Midland site 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.

During this inspection, certain of your activities appeared to be in noncompliance with NRC requirements, as described in the enclosed Appendix A.

This notice is sent to you pursuant to the provisions of Section 2.201 of the NRC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations. Section 2.201 requires you to submit to this office within thirty days of your receipt of this notice a written statement or explanation in reply, including for each item of noncompliance: (1) corrective action taken and the results achieved; (2) corrective action to be taken to avoid further noncompliance; and (3) the date when full compliance will be achieved.

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, the enclosures, and your response to this letter will be placed in the NRC's Public Document Room, except as follows. If the enclosures

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YELLOW FILE COPY

contain 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.

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

Sincerely,

G. Fiorelli, Chief
Reactor Construction and
Engineering Support Branch

Enclosures:
1. Appendix A, Notice of Violation
2. IE Inspection Reports No. 50-329/79-10 and No. 50-330/79-10

cc w/encls:
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

RIII	RIII	RIII	RIII	RIII	RIII
Gallagher/sr	Hayes	Danielson	Fiorelli	Cook	Vandel
Lee	5/31/79	6/1/79			

Appendix A

NOTICE OF VIOLATION

Consumers Power Company

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

Based on the results of an NRC inspection conducted on May 14-17, 1979, it appears that certain of your activities were not conducted in full compliance with NRC requirements as noted below. This item is an infraction.

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, two inconsistencies were identified in the license application and in other design basis documents. Specific examples are set forth below.

   a. Construction specification C-2, Rev. 11, dated November 16, 1978, Section 11.1 specifies material for prestressing system sheathing to conform to ASTM A-366-66 or 68, 22 gauge cold rolled carbon steel while FSAR Section 3.8.1.6.3

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indicate the sheathing material to be material meeting the requirements of ASTM A-513, Type 1, Grade 1010-1020 or ASTM A-53, Type E or S, Grade B.

b. Construction specification C-49, Rev. 2, Section 6.2.2 specifies the chemical limitation on the corrossive protective filler material for the prestressing system to be 5ppm for chlorides, nitrates and sulfides while FSAR Table 3.8-25 indicates the maximum allowable to be 2ppm (chlorides), 4ppm (nitrates) and 2ppm (sulfides). In addition, the Inryco Quality Control manual requires the material chemical properties to be the same as FSAR Table 3.8-25.

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

REGION III

Report No. 50-329/79-10; 50-330/79-10

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: May 14-17, 1979

Inspectors: E. J. Gallagher E J Gallagher 6/1/79

for E. W. K. Lee 6/1/79

Approved By: D. W. Hayes, Chief 6/1/79
Engineering Support Section 1

Inspection Summary

Inspection on May 14-17, 1979 (Reports No. 50-329/79-10; 50-330/79-10)
Areas Inspected: Reactor coolant pressure boundary and safety related piping; pipe welding work activities; containment prestressing work procedure, work activities and quality records (Units 1 and 2); status of soils work activities; concrete expansion anchor installation procedure (Units 1 and 2). The inspection involved a total of 44 inspector-hours by two NRC inspectors.
Results: Four areas were inspected. One item of noncompliance was identified in the areas inspected. (Infraction - failure to properly translate FSAR design requirements into specifications and procedures.)

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DETAILS

Persons Contacted

Principal Licensee Employees (CPCo)

*D. B. Miller, Site Project Manager
*T. C. Cooke, Project Superintendent
*D. R. Keating, QA Group Supervisor
*D. E. Horn, QA Engineer
*R. G. Wollney, QA Group Supervisor
*B. H. Peck, Construction Supervisor
R. Ostrowski, QA Engineer

Bechtel Power Corporation

*W. L. Barclay, Project Field QC Engineer
*E. Smith, Quality Assurance
*O. H. Holman, Field Superintendent
*R. W. Shope, QC Supervisor
*A. Ozeroff, QA Engineer
*A. J. Boos, Field Engineer

NRC Resident Inspector

*R. J. Cook

*Denotes those present at the exit meeting.

Functional or Program Areas Inspected

Details of functional and program areas inspected are documented in Sections I and II of this report.

Section I

Prepared by E. J. Gallagher

Reviewed by D. W. Hayes, Chief
Engineering Support
Section 1

1. Review of FSAR Containment Prestressing System Commitments (Units 1 and 2)

The inspector reviewed FSAR Section 3.8.1.6.3 (Prestressing System) in order to verify consistency with the site implementing procedures. The following apparent conflicts exist between the FSAR commitments to the NRC and site procedures and specifications for the prestressing system:

a. The FSAR states, "Tendon sheating is galvanized, spiral wrapped, semi-rigid, corrugated tubing conforming to the material requirements of ASTM A-513, Type 1, Grade 1010-1020 or ASTM A-53, Type E or S, Grade B.

Contrary to the FSAR statement, Bechtel specification C-2, Rev. 11, dated November 16, 1978, Section 11.1 requires "material of sheaths shall conform to ASTM A366-66 or 68, 22 gauge cold rolled carbon steel." In addition, the Inryco Quality Control Manual C2-146 requires sheathing to be of ASTM A366 material as well.

b. FSAR Table 3.8-25 indicates the maximum allowable chemical limits for the tendon corrosion protective grease to be 2ppm for chlorides, 4ppm for nitrates and 2ppm for sulfides.

Contrary to the above, FSAR Section 3.8.1.6.3.1 permits the maximum allowable limits for chlorides, nitrates and sulfides to be 5ppm. In addition, Bechtel specification C-49, Rev. 2, Section 6.2.2 specifies the chemical limitations for protective grease to be 5ppm for the above chemicals. However, contrary to the Bechtel specification, Inryco Quality Control Manual C2-146 requires the protective grease to have chemical limits the same as FSAR Table 3.8-25, i.e. 2, 4 and 2ppm for chlorides, nitrates and sulfides, respectively.

Based on the above, measures did not assure the design basis included in design specifications were translated into the license application which resulted in inconsistencies between design documents and the FSAR. This is considred an item of noncompliance with 10 CFR 50, Appendix B, Criterion III. (329/79-10-01; 330/79-10-01)

2. Review of QC Inspector Qualifications for Containment Prestressing System Work Activities (Units 1 and 2)

The inspection requests to review the personnel qualifications of the Bechtel QC inspectors who would be inspecting the prestressing system work activities. The following was determined after reviewing six personnel qualifications:

a. It was apparent from the personnel work experience records that none of the six inspectors had any prior experience with prestressing systems.

b. Training of the six inspectors was given by an individual that likewise had no prior experience on prestressing systems.

The above deficiency in personnel training and qualifications was also identified by the licensee quality assurance group as an item to be resolved prior to performing any further work activities on the prestressing system. This area will continue to be reviewed in followup inspections of the prestressing system.

3. Review of Quality Records for Containment Prestressing System (Unit 2)

The inspector reviewed the following quality records relative to the containment prestressing system.

a. Material Certification

(1) Tendon Wire - a review of the physical and chemical test results was performed on tendon wire heat Nos. 9399, 9582, 9521, 9578, 9507 and 9476. The results meet the requirements of ASTM A421, "Uncoated Stress-Relieved Wire for Prestressed Concrete."

(2) Tendon Bearing Plates - heat codes GB, GS, GM, GR and GN were found to meet the requirements of ASTM A-36, "Specification for Structural Steel."

(3) Tendon Sheathing - the tendon sheathing records were acceptable according to the requirements of ASTM A366-66, 22 gauge, cold rolled sheathing.

(4) Tendon Shop Head Anchorage - heat No. 53315 meet the requirements of ASTM A-322-64, "Hot Rolled Alloy Steel Bars."

(5) Tendon Bushings - heat Nos. 55984, 7836 and 15008 were reviewed and found acceptable to the requirements of ASTM A-322 using material AISI 4142.

b. Performance Tests

Construction specification C-2, Rev. 11, required the following quality tests to be performed and submitted prior to fabrication of the prestressing system. The test results were not available onsite at this time. The licensee indicated that these quality records would be made available during the next NRC inspection.

(1) Section 10.1 requires certified testing at low temperatures to substantiate that the anchorage assembly including bearing plate is capable of transmitting the ultimate load of the tendon to the structure without brittle failure. The lowest service temperature for the anchorage is -20°F.

(2) Section 10.3 requires the sheathing filler retaining caps to be tested to substantiate that the cap will not fail or leak when test to 150% of required pumping pressure.

(3) Section 14.6 requires button head rupture tests from each reel of wire to be submitted a quality control record.

Since the above three items were not available for review, this item is considered unresolved pending submittal of the records. (329/79-10-02; 330/79-10-02)

4. Observation of Containment Prestressing System (Unit 2)

During the course of the NRC inspection CPCo and Bechtel issued a "Stop Work Order" on any further prestressing system work activities. The reason for the stop work according to QA stop

work report No. 5 was that the "status of Inryco furnished Field Installation Manual which forms the basis for Bechtel Field Procedure of Installation and Quality Control (PQCI) is questionable." In order for work to resume, it was stipulated that it would be necessary to resolve questions regarding Project Engineering (Bechtel) level of approval for Inryco furnished Field Installation Manual and establish approved instructions for installation and inspection including revising Bechtel Field Procedure and Quality control instruction.

Due to the above work stoppage, observation of the prestressing work activities could not be performed. This matter will continue to be inspected to verify an adequate procedure and inspection program is in effect for the containment prestressing system work activities.

5. Status of Safety Related Soils Work Activities

Safety related soils work is not preceeding until certain corrective actions are taken in order to resolve a number of previously identified deficiencies. Some of the licensee's corrective actions include:

a. Identifying all conflicts within the PSAR or between PSAR and FSAR.

b. Identify all conflicts between PSAR/FSAR and site procedures.

c. Re-evaluate the use of Zone 2 random fill material as a backfill material.

d. Assure that interpretations to the specifications are resolved.

e. Establish a single soils engineer responsible for the soils work activities.

f. Re-evaluate the capability of the equipment being used to meet compaction requirements.

g. Assure proper tests are performed to document acceptability of in-place soils.

h. Assure each nonconformance report is properly dispositioned.

During this inspection, the NRC inspector observed air bubbles percolating from the ground in the safety related tank farm area. A closer inspection indicated that air and water was

being moved through the previously compacted soil materials in this area. It was observed that soil materials were being moved by this condition and leaving voids beneath concrete foundations for the tank structures.

This condition was brought to the attention of CPCo project manager on May 16, 1979. On May 17, 1979, the project manager and superintendent responded by visually observing this condition. They concurred with the NRC inspector that the condition was serious and that damage to the compacted soils may have occurred. The extent of the movement of materials was not known.

The NRC inspector indicated to the licensee that in order to substantiate that the materials and compaction of the soils had not been disturbed, additional soil borings and test pits would need to be performed. The NRC took photos to document the soil condition and movement of soil materials.

It was also brought to the NRC's attention that CPCo QA department had brought this condition to Bechtel QC months earlier, however, no corrective action had been taken to correct these adverse conditions.

During the exit meeting the CPCo site superintendent gave a copy of a letter to the NRC requiring the contractor to relocate the air line embedded in the fill and turn off the air to the existing line. This letter also indicated to map the location of all air seepage areas so that additional soil borings could be taken in these areas.

6. Review of Procedure and Observation of Testing Concrete Expansion Anchors

The inspector reviewed specification C-305, Rev. 8, "Installation and Testing of Expansion Type Concrete Anchors" and Quality Control Instruction (QCI) -1.50, Rev. 4. In addition, Field Change Notices C-1835 and C-1846 to specification C-305 were also reviewed. The following specific observations were made:

a. As of this inspection, the specification did not require a means of inspecting or identifying the embeddment length of the bolt. CPCo had identified this item in QA request for evaluation on July 28, 1978. Bechtel then issued SCN C-305-9002 to require a permanent length identifier to be stamped on the bolt. CPCo required Bechtel to develop a procedure for ultrasonic testing to reinspect the length of the bolts installed prior to this time.

b. Specification C-305, Table 4.1, lists certain test torques for acceptance of concrete expansion anchor installation. The inspector requested to review the test data which demonstrates that the torque values specified develop a tensile capacity equal to or greater than the design load as required by IE Bulletin 79-02. This data was not readily available and will be followed up on subsequent inspection as per the requirements of IE Bulletin 79-02.

c. Specification C-305, Table 3.2, indicates the allowable design loads for the Hilti HDI Drop-in anchors (shell type anchors) and the required tensile test load. The test load specified is only approximately two times the design load. For example, 3/4" anchor in 4000psi concrete the allowable design load is 3.2 kips while the tensile test load is 6.0 kips.

IE Bulletin 79-02 states that the licensee should verify that the ultimate load for shell type anchors is five times the design load. This was indicated to Mr. W. Bird via telecon. This will continue to be reviewed as per IE Bulletin instructions.

During this inspection, the NRC inspector had a telecon with the CPCo QA supervisor relative to the requirements of IE Bulletin 79-02. The following is a summary of that discussion:

(1) The licensee is required to identify base plates that are considered flexible according to the criteria set forth, i.e. if the unstiffened distance from the attachment to the edge of the plate is greater than two times the thickness of the plate it is considered flexible and requires evaluation for adequacy.

(2) The licensee must verify that the ultimate load for wedge type anchors is four times the allowable design load and the ultimate load for shell type anchors is five times the design load.

(3) The design requirements for the anchor bolts should be described for cyclic loading conditions.

(4) Verify that design requirements have been met through existing QC documentation that (a) cyclic loads were considered and (b) bolts installed are the specified design size and type.

The following is the NRC's understanding of testing requirements: The essential requirement is that the licensee justify the adequacy of proposed testing program. IE Bulletin 79-02 suggests an acceptable sampling program to test one anchor bolt in each base plate. Other approaches including a statistical sample to provide a 95% confidence level that fewer than 5% defective anchors are installed are equally acceptable. It is suggested that any test sampling program chosen should be on an individual system basis when a significant failure rate is found, an increased sample size must be taken or 100% testing may be required to assure systems capability.

Section II

Prepared by E. W. K. Lee

Reviewed by D. H. Danielson, Chief
Engineering Support
Section 2

1. Reactor Coolant Pressure Boundary Piping - Observation of Work and Work Activities (Unit 2)

The inspector observed the two installed hot legs and the installed Reactor Coolant Pump No. 2P51B section. It was determined that the pipe runs were installed in accordance with the drawings.

No items of noncompliance or deviations were identified.

2. Safety Related Piping - Observation of Work and Work Activities (Unit 2)

The inspector observed weld end preparation of weld No. 83 on sketch No. 2FCB36-S611-4-4. It was determined that work activities were performed in accordance with the applicable procedures and good construction practices were adhered to.

No items of noncompliance or deviations were identified.

3. Safety Related Piping - Observation of Welding Activities (Units 1 and 2)

The inspector observed the following welding activities:

a. Unit 1 Main Steam System Weld No. 15 on drawing no. M631, sheet 1;

b. Unit 1 Decay Heat Removal Discharge System 'B' Weld No. 110 on drawing No. M610, sheet 6;

c. Unit 1 Reactor Building Heating Ventilating and Air Conditioning System Weld No. 25 on drawing no. M512, sheet 3;

d. Unit 2 Decay Heat Removal Discharge System 'A' Weld No. 18 on drawing no. M611, sheet 4.

It was determined that (1) work was conducted in accordance with traveler; (2) proper welding materials were used; (3) welding procedure requirements were met; (4) work area was free of weld rod-stubs and (5) physical appearance was acceptable.

No items of noncompliance or deviations were identified.

4. Reactor Coolant Pressure Boundary Piping - Special Welding Applications (Unit 2)

The inspector observed the following repair work activities:

a. Grinding and etching of cladding repair on weld no. WJI-1.

b. Weld repair of classing on weld no. WJ4-4.

It was determined that (1) work was conducted in accordance with traveler; (2) proper materials were used and (3) procedure requirements were met.

No items of noncompliance or deviations were identified.

5. Safety Related Piping - Weld Heat Treatment (Units 1 and 2)

While observing welding activities for items stated in Paragraph 3 of this report, the inspector determined that preheat met the welding procedure requirements.

No items of noncompliance or deviations were identified.

6. Reactor Coolant Pressure Boundary and Safety Related Piping - Welder Qualification (Units 1 and 2)

The inspector reviewed qualifications records of welders who performed welds identified in Paragraphs 3 and 4 of this report. It was determined that ASME B&PV Code Section IX requirements were met.

No items of noncompliance or deviations were identified.

Exit Interview

The inspectors met with licensee representatives (denoted under Persons Contacted) on May 17, 1979. The inspectors summarized the scope and findings of the inspection. The licensee acknowledged the findings as reported.

D Horn
Please address mail as follows

Bechtel Power Corporation
777 East Eisenhower Parkway
Ann Arbor, Michigan
Mail Address: P.O. Box 1000, Ann Arbor, Michigan 48106

August 10, 1979

BLC-7993

Consumers Power Company
Mr. G. S. Keeley
Project Manager
1945 West Parnall Road
Jackson, Michigan 49201

Midland Units 1 and 2
Consumers Power Company
Bechtel Job 7220
REVIEW of U. S. TESTING FIELD AND LABORATORY TESTS ON SOILS
Files 0614/2801

Dear Mr. Keeley:

Attached for your records is the completed report dated July 1979, entitled "Review of U. S. Testing Field and Laboratory Construction Test Data on Soils Used As Fill."

This report includes resolutions to the questions raised by Consumers Power personnel on the earlier draft report.

The report will now be sent to the subcontractor, United States Testing Company, Inc., for their response to the findings.

Very truly yours,

P. A. Martinez
Project Manager

PAM/pp