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

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REASON FOR INVESTIGATION

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

SCOPE

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

SUMMARY OF FACTS

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

Information obtained during this investigation indicates: (1) A lack of control and supervision of plant fill activities contributed to the inadequate compaction of foundation material; (2) corrective action regarding nonconformances related to plant fill was insufficient or

inadequate as evidenced by the repeated deviations from specification requirements; (3) certain design bases and construction specifications related to foundation type, material properties and compaction requirements were not followed; (4) there was a lack of clear direction and support between the contractors engineering office and construction site as well as within the contractors engineering office; and, (5) the FSAR contains inconsistent, incorrect and unsupported statements with respect to foundation type, soil properties and settlement values.

DETAILS

Persons Contacted

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

Introduction

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

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

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

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

Identification and Reporting of Diesel Generator Building Settlement

Surveys to establish a baseline elevation for the DGB were completed by Bechtel on May 9, 1978. As a result of these surveys, the Chief of Survey Parties noted what he considered to be unusual settlement. He

indicated that from his experience he would have expected about 1/8" settlement. The July 22 data showed a differential settlement between various locations ranging from 1/4" to a maximum of 1 5/8". He promptly instructed his survey personnel to resurvey to determine whether the data was accurate. The resurvey confirmed the accuracy of the survey data. The Chief of Survey Parties reported the survey results to the Bechtel lead civil field engineer.

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

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

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

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

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

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

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

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

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

Review of PSAR/FSAR Commitments on Compacted Fill Material

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

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

:o cuality assurance issued a nonconformance report QF-66, dated
:ober 10, 1975, which stated that contrary to the PSAR statement
:cted above) Specification C-211 being implemented at the site
:uired cohesionless (sand) material to be used within 3 feet of the
lls of the plant area structures. The corrective action taken was
r Bechtel to issue SAR Change Notice No. 0097 which stated, "The FSAR
ll clarify the use of cohesive and cohesionless soils for support of
ss 1 structures." As noted above, the FSAR tables 2.5-14 and 2.5-9
e again stated that cohesive (clay) material was used for support of
ructures while the construction drawing continued to permit the use
random fill material.

is investigation included efforts to ascertain whether procedures
re established and implemented for the preparation, control and review
the technical criteria set forth in the safety analysis report (SAR).
is included the role of both Bechtel and CPCo in the review of the
R. Bechtel had established control of the SAR in procedure MED
22 (Preparation and Control of Safety Analysis Report Revision 1,
ed June 20, 1974). The SAR preparation and review flow chart requires
Engineering Group Supervisor (EGS) to review the originator's draft
r technical accuracy and compliance with the standard format guide.
cords indicated that Section 2.5.4 was originated by the Bechtel Geotech
up on January 3, 1977. It was reviewed and approved for technical
curacy by an engineer in the civil project group on April 29, 1977.
technical inaccuracies were noted in the documentation. The Civil
advised that he did not personally review Section 2.5.4.

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

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

ction 3.8 was prepared by Project Engineering. Geotech, who prepared
ction 2.5, said they were unaware of the presence of the statement
garding 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 PSAR. He said there was no other basis to support this statement.

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

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

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

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

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

Effect of Ground Water in Plant Area Fill

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

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

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

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

Review of Compaction Requirements for Plant Area Fill

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

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

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

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

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

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

The compaction requirements actually implemented were as follows:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Review of Moisture Control Requirements for Plant Area Fill

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

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

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

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

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

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

4. Telecon October 13, 1977, (Bechtel Engineering to Bechtel QA Site) changed what was indicated in the telecon on October 10, 1977, (Item 3 above). Engineering then stated, "The moisture requirement (± 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 during placement and compaction. However, this property of the soil is not necessarily a measure of its adequacy after 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 BESC-2286 (June 1, 1978) was Project Engineering's response to GLR-249 (Item 9 above). It states, "moisture content is not necessarily a measure of a soil's adequacy to act as a foundation or backfill material," and that "soil with the specified density following compaction would not be rejected on the basis that its moisture content was not controlled in the borrow area."

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

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

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

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

Review of Subgrade Preparation for Plant Area Fill

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

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

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

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

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

Review of Nonconformance Reports Identified for Plant Area Fill

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

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

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

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

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

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

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

This failure to assure that the cause of conditions adverse to quality are identified and that adequate corrective action be taken to preclude

repetition is considered an item of noncompliance with 10 CFR 50, Appendix B, Criterion XVI as identified in Appendix A. (329/78-20-06; 330/78-20-06)

Review of Calculations of Settlement for Plant Area

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

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

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

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

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

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

type assumed in the settlement calculations and therefore the values in the FSAR figure appear to represent the settlements estimated for the as-constructed spread footing foundation.

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

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

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

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

Review of Settlement of Administration Building Footings

During the investigation, it was disclosed that the Administration Building at the Midland Site had experienced excessive settlement of the foundation footings. Although the Administration Building is a non-safety-related structure, it is supported by plant area fill material compacted and tested to the same requirements as material

supporting safety-related structures and therefore pertinent to the current settlements being experienced by the Diesel Generator Building. The following are the events relating to the settlement of the Administration Building footings.

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

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

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

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

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

The licensee indicated that reports from Bechtel concluded that the primary cause of the settlement in the Administration Building area was insufficient compaction of the fill. Bechtel also concluded that "deviations from specific compaction requirements was the result of

repeated erroneous selection of compaction standard," i.e. the incorrect optimum moisture-density curve was used for the soil material being compacted. In effect, the moisture-density curve was erroneously assumed to represent the soil being used and therefore soil was compacted to less than maximum density.

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

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

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

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

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

Review of Soils Placement and Inspection Activities for Plant Area Fill

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

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

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

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

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

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

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

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

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

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

U. S. Testing personnel advised that they were requested to take tests of clay fill while it was raining and in order to do so, plastic was held over them to protect their equipment while the test was made. Even though it was raining, the fill placement work was not stopped on

some occasions. A Bechtel foreman confirmed that density tests were on occasion taken while it was raining. While this is not contrary to the specification instructions, it is contrary to standard practice.

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

The field engineer who was assigned responsibility for plant fill work stated he did not spend full time on soils work since he also had responsibility for two structures, the steam tunnel and general yard work. He said he tried to get out to the area where fill work was being done once a day. Some times he did and sometimes he did not. He indicated it was his impression that the QC Inspector responsible for the soils work on the day shift visited those work areas once or twice a week. He confirmed that only oral instructions were furnished to the foremen whom he felt were 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 28, 1977.

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

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

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

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

Compaction Requirements

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

Material Testing

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

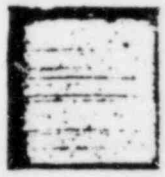
I - Inspection point
H - Hold point
W - Witness point
S - Surveillance (V) - visual
R - Review records

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

It is considered that the relaxation of actions relating to the confirmation that soils placement activities were conducted according to

ecifi ions contributed to inadequate compaction of foundation and fill terial and the increase incidence of deviations from specifications egarding lift thickness, moisture control and frequency of testing.

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



Exit Meetings

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