PRELIMINARY
3/5/79

CONSUMERS POWER COMPANY

DISCUSSION OF

NRC INSPECTION FACTS

RESULTING FROM THE

NRC INVESTIGATION

OF DIESEL GENERATOR

BUILDING SETTLEMENT

Consumers Power Company
Midland Plant Units 1 and 2

NRC Inspection Facts

2. Identification and Reporting of Diesel Generator Building Settlement
3. Review of PSAR/FSAR Commitments
4. Effect of Groundwater on Plant Area Fill
5. Compaction Requirements for Plant Area Fill
6. Moisture Control Requirements for Plant Area Fill
7. Subgrade Preparation of Plant Area Fill
8. Nonconformance Reports Identified
9. Settlement Calculations for Plant Area Fill
10. Settlement of Administration Building Footings
11. Interface Between Diesel Generator Building and Electrical Duct Banks
12. Soils Placement and Inspection Activities
13. Inspection Procedures for Plant Fill

NRC PRELIMINARY FINDING 2

2. Identification and Reporting of Diesel Generator Building Settlement

Discussion of NRC Inspection Facts

Settlement data for the diesel generator building was first recorded on July 22, 1978. This was the first of the 60-day interval readings taken under the foundation settlement data survey program contained in Bechtel Specification 7220-C-76.

Bechtel surveyors, in processing this data, noticed the larger than expected settlement. The processed survey data was transmitted to project engineering on July 26, 1978, and the survey frequency was increased. On August 21, construction survey data indicated a settlement approaching the maximum value in FSAR Figure 2.5-48. A Bechtel nonconformance report was issued (NCR 1482). About August 21, 1978, CPCo advised the NRC Resident Inspector of the settlement condition.

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.

Will check date reported in response
To question 362.12 — [illegible] exceeded in July 1978.
[illegible] Figure 2.

NRC PRELIMINARY FINDING 3

3. Review of PSAR/FSAR Commitments

Discussion of NRC Inspection Facts

FSAR Tables 2.5-9 and 2.5-14 provide minimum compaction criteria and a summary of contact stresses and ultimate bearing capacities. Table 2.5-14 shows the Dames and Moore calculated ultimate bearing capacities as given in the PSAR. For Zone 2 material the calculation is conservatively based on the principal constituent being cohesive soil, although the random fill is the design basis, thus providing greater conservatism.

The purpose of these tables is not to stipulate the foundation material to be actually used. FSAR Table 2.5-10 identifies the gradation ranges for fill material and stipulates the foundation materials to be used. These materials were used consistent with the recommendations contained in the Dames and Moore report included in the PSAR.

FSAR Tables 2.5-9 and 2.5-14 have been revised to reflect the design basis contained in the PSAR as translated into the actual design.

The structural acceptance criteria presented in FSAR Subsection 3.8.5.5 for a shallow spread footing foundation as discussed in the Dames and Moore report dated March 15, 1969, Pages 20 and 21 (attached to the PSAR), is not applicable for the diesel generator building. The diesel generator building foundation is a spread footing type foundation with walls of the four cells supported by continuous footings. Generator foundations located within the building foundation limits are mat type foundations that cover most of the area within the building not occupied by the spread footings (FSAR Figure 3.8-55).

NRC PRELIMINARY FINDING 4

4. Effect of Groundwater on Plant Area Fill

Discussion of NRC Inspection Facts

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 soils beneath the diesel generator building had been compacted too dry of optimum (5 to 6%), and changes in moisture after placement caused them to settle significantly. Soils placed within ±2% of optimum moisture, as specified, would not cause this effect.

NRC PRELIMINARY FINDING 6

6. Moisture Control Requirements for Plant Area Fill

Discussion of NRC Inspection Facts

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

> "Insofar as practicable...material 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 above or below the optimum moisture content.
>
> ...after placing 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 does (did) not take moisture control tests prior to and during placement of the backfill, but rather rely (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 results were used to facilitate the density tests, the results of which served as the acceptance criteria. For this period, the results of the moisture measurements made after compaction, in conjunction with the corresponding density tests, have been reviewed again and three

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individual moisture measurements were found to be beyond ±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 results were used to facilitate the density tests, the results of which served as acceptance criteria. Subsequently, moisture measurements 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 meet 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.

ATTACHMENT 1

CONTROL OF MOISTURE MEASUREMENT

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 tests taken	No tests taken	No tests taken	Tests taken (moisture controlled here)	Tests taken (density controlled here)
August 1, 1977 to winter of 1977-1978	Tests taken but No comparison to laboratory standard	No tests taken	No tests taken	Tests taken	Tests taken (density controlled here)
1978	Tests were taken and controlled in at least one of these areas		No tests taken	Tests taken	Tests taken (density controlled here)

NRC PRELIMINARY FINDING 7

7. Subgrade Protection of Plant Area Fill

Discussion of NRC Inspection Facts

For frost protection for foundations in natural soils below the original grade, the Dames and Moore report dated March 15, 1969, at Page 14 recommends that, "...for foundations 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, at Page 15 states, "...If filling and backfilling operations are discontinued during periods of cold weather, it is recommended that all frozen soils be removed or recompacted prior the 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 10.1 regarding removal of soil and reconditioning after each spring thaw

d. 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 by visual inspection and/or in situ soil tests to be acceptable. The placement of materials was performed on the acceptable foundation soil after reconditioning.

NRC PRELIMINARY FINDING 8

8. Nonconformance Reports Identified

Discussion of NRC Inspection Facts

The nonconformances identified by the NRC represent 10 CPCo NCRs and 2 audit finding reports. Additionally, Bechtel identified one independent NCR (NCR 421) and three other NCRs that were also identified by CPCo (NCRs 686, 698, and 1005).

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

When relating the type of problems to the problem causes over the same period, the repetitiveness is 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

There were 9 use-as-is dispositions of the 13 nonconformances. The duplicated NCRs (686, 698, and 1005) were also dispositioned use-as-is. Each nonconformance condition is reviewed by Project Engineering and researched for facts before Engineering professional judgment dispositioning is given to:

- Degree of variation from established standards
- Impact on quality and performance
- Location of tests that failed
- Analysis with justification of the variation

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

Attachment 1 provides examples of use-as-is justification for the referenced nonconformances. Corrective actions taken for the nonconformances referenced are described in Attachment 2.

In 1977 the structural backfill subcontractor's performance was trended and resulted in 3 of the 13 nonconformances (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
- Replacement of the U.S. Testing Laboratory 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 subcontractor's QA program found it effectively controlled.

ATTACHMENT 1

MATRIX OF NONCONFORMANCES

NCR	ALSO I.D. ON	DATE	TYPE OF PROBLEM IDENTIFIED								ENGR DISPOS		USE AS-IS JUSTIFICATION	BECHTEL TREND PROGRAM IN LOGS	PROBLEM CAUSES
			MOISTURE CONTROL	COMPACTION TEST	LIFT THICKNESS	SOILS INSPECTION	INSPECTION PLANNING	STR BACKFILL INSPECTION	GRADATION REQUIREMENT	TEST FREQUENCY	USE AS IS	OTHER			
QF-25	NCR 198	10/14/74						•			•		STATISTICAL ANALYSIS OF 16 SEPERATE TESTS REVEALED 136 DISTRIBUTION LIMITS FOR EACH GRADATION. THEREFORE, 99.7% PROBABILITY THAT STOCKPILE UNIFORMITY MEETS SPECIFICATION REQUIREMENTS. MATERIAL AS PLACED AND STOCKPILED WILL BE RANDOMLY SAMPLED AND TESTED 19 TIMES TO SUPPLEMENT THOSE TESTS THAT WERE TAKEN AND TO MAKE UP THE MISSING REPORTS.	NO	MISSED INSPECTION
QF-62	NCR 324	8/7/75	•								•		COMPACTED FILL DENSITY TEST REPORT REVEALED SATISFACTORY COMPACTION.	YES	FAILING MOISTURE NOT IDENTIFIED
QF-68		10/17/75		•								•		YES	INCORRECT TEST DATA USED
NCR 421		5/5/76	•	•								•	RAMP REMOVED, VERIFIED BY QC	YES	N/A
QF-120 NON-Q		9/21/76			•							•		YES	NON-Q CONSTRUCTION ERROR
QF-130		10/18/76					•					•		YES	MISINTERPRETATION OF SPECIFICATION
QF-147	SD-6	2/2/77				•			•		•		SAMPLES TAKEN WERE FOUND ACCEPTABLE. ALL MATERIALS WERE OBTAINED FROM SAME SOURCE.	YES	MISSED INSPECTION
	NCR 686										•		" "	YES	
	NCR 698										•		" "	YES	
QF-172		7/8/77	•	•	PROBLEM FOUND DURING TURNOVER						•		COMPACTION PERFORMED IN AN ACCEPTABLE MANNER AS SUSPECT AREA IS NON-SAFETY RELATED.	YES	FAILING MOISTURE NOT IDENTIFIED
QF-174		7/15/77	PROBLEM FOUND DURING TURNOVER						•		•		COMPACTION PERFORMED IN AN ACCEPTABLE MANNER AS SUSPECT AREA IS NON-SAFETY RELATED.	YES	FAILING TEST NOT IDENTIFIED
QF-199	NCR 1004	11/4/77	•										EVALUATION OF TEST RESULTS OF ADJACENT AREA AND SUBSEQUENT LIFTS WERE ACCEPTABLE.	YES	INCORRECT TEST DATA USED
	NCR 1005										•			YES	
QF-203 NON-Q REJECT	NCR 1054	11/22/77							•		•		TEST REPORT 0630 DATED 6/29/77 REVEALS THE MATERIAL MEETS THE REQUIREMENTS OF MOSH 22 B.	YES	FAILING TEST NOT IDENTIFIED
	NCR 1055														
F-77-21	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-77-32	NCR 1006	10/3-7/77	•	•					•		•		RECALCULATION WITHIN LIMITS	YES	INCORRECT TEST DATA FAILING RESULT NOT IDENTIFIED

G-0495-01

ATTACHMENT 2

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	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 698 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: FGTeague, Lead Civil Field Engineer BCheek, Lead QC Civil Engineer HBoline, Bechtel QC Engineer DAPerkins, Superintendent, Civil JDean, Field Engineer, Civil Gary Coaster, Field Engineer, Civil RFish, 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 SD-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 SD-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, BGrubich 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 2.8% 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 93.7% 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 indeed 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 MD-358 and MD-359 were taken May 30, 1974 and test 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
QF-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. North Plant Dike 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 621 (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.	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.

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%	15.2%
1328	5-10-77		12.2%	15.2%
1412	6-07-77		10.4%	15.2%

Structural Backfill

MDR 621	10-14-76	78.0% of Relative Density
671	11-12-76	74.8% of Relative Density
672	11-23-76	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. Newgen to G. 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" — 60-85 #200 — 12-20 Contrary to the above, User's Test Report No. 0836 had 11% passing the #200 sieve and it was accepted.		
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 15.2%, 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.
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
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 25 (9-12-74) through MD 307 (9-27-76), 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 failing 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 103.4. MD-93 (sampled 5-25-74) shows maximum dry lab density 110.6. It should have been 103.4. 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 above errors did not change the acceptance of these tests even though they did change the test results.	

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 17.5 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 117.1. 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 117.0. It should have been 117.1.		
Finding No 2 to Audit Report F-77-32	The folloiwng tests had failing results and did not indicate being 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, 768 and 770 have been cleared by passing tests and Structural Backfill represented by MDR 854, 861 and 862 was removed. Test reports Plant 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.	

Plant Area Fill

Test No	Date Sampled	Compaccion	Moisture Actual	Moisture Optimum
MD 1153	10-21-76	61.6% of Relative Density		
1155	10-21-76	73.5% of Relative Density		
1191	11-03-76	76.6% of Relative Density		
1194	11-02-76	75.4% of Relative Density		
1317	5-09-77		18.0%	15.2%
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%
1338	6-02-77		9.8%	15.2%
1393	6-03-77		11.1%	13.4%
1398	6-03-77		11.2%	13.4%
1404	6-03-77		10.2%	13.4%
1415	6-07-77		9.9%	13.4%
1498	6-15-77	88.2% of Maximum Density	14.5%	16.0%
1509	6-16-77		12.9%	15.2%
		North Plant Dike		
MD 418	8-14-74		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 Optimum		
MBR 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	11-11-76	53.0% of Relative Density			
664	11-11-76	72.3% of Relative Density			
667	11-11-76	67.5% of Relative Density			
673	11-23-76	33.9% of Relative Density			
679	11-23-76	71.8% of Relative Density			
680	11-23-76	50.0% of Relative Density			
682	11-24-76	70.6% of Relative Density			
688	11-24-76	77.1% of Relative Density			
700	1-13-77	75.0% of Relative Density			
701	1-13-77	68.1% of Relative Density			
721	3-14-77	60.0% of Relative Density			
734	3-17-77	34.0% of Relative Density			
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	69.3% of Relative Density			
741	3-21-77	77.8% 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	4-07-77	69.3% of Relative Density			
799	4-12-77	78.8% 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 MDR 861 — 5-10-77 — 76.3% of Relative Density 862 — 5-10-77 — 74.0% of Relative Density 889 — 5-13-77 — 65.5% of Relative Density 914 — 5-24-77 — Moisture Actual 9.0% — Moisture Optimum 11.8% 922 — 5-26-77 — 75.7% of Relative Density 925 — 5-27-77 — Moisture Actual 11.4% — Moisture Optimum 15.2% 938 — 6-08-77 — 56.5% of Relative Density 940 — 6-08-77 — 78.6% of Relative Density 993 — 6-25-77 — 60.2% of Relative Density 998 — 6-25-77 — 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.	
Open Findings 1 & 2 to Audit Report F-77-32	Refer to NCR QF-199.		
Open Finding 3 to Audit Report F-77-32	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. NCR QF-195 has been written to resolve the corrective action still open.	

NCR NO	NCR DESCRIPTION AND SUPPORTING DETAILS	PART CORRECTIVE ACTION	PROCESS CORRECTIVE ACTION
Open Finding 3 to Audit Report F-77-32	(Contd) "roject 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 G- 270 — 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 — 5-18-77 — #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

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 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.

NRC PRELIMINARY FINDING 10

10. Settlement of Administration Building Footings

Discussion of NRC Inspection Facts

The investigation of localized failure under the administration building was initiated in September 1977. The results of the testing 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

Based on the above investigations, the administration grade beam failure was felt to be a local soil failure. A followup meeting was held in September 1977 between the Chief Soil Lab Representative, Bechtel Lead Civil Field Engineer, and lead Civil QC Engineer to reiterate 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.

NRC PRELIMINARY FINDING 11

11. Interface Between Diesel Generator Building and Electrical Duct Banks

Discussion of NRC Inspection Facts

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 specification 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 (BEBC-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.

NRC PRELIMINARY FINDING 12

12. Soils Placement and Inspection Activities

Discussion of NRC Inspection Facts

The Bechtel Geotechnical Group has provided ~~overall~~ 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 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 appropriate and extensive 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 (QCE) have inspected, witnessed, or surveilled Bechtel placement of Q-listed soils. These QCEs were certified in accordance with ANSI N45.2.6 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 Inspecting Plans and Record Designation	Active Time Period	Inspection Reports	Nonconformance Reports	Discrepancy Reports
C-210	8/73-11/76	65	6	[illegible]
C-211	8/74-10/76	21	3	[illegible]
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	19	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." This is the complete requirement. 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, the envelope volume was reworked.

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

NRC PRELIMINARY FINDING 13

13. Inspection Procedures For Plant Fill

Discussion of NRC Inspection Facts:

During the summer 1976 the Bechtel QC program underwent a format change from Field Inspection Plans (FIP) to Quality Control Instruction (QCI) and Inspection Records (IR). 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 Instruction 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 required by these plans were performed as evidenced by inspection, nonconformance, and discrepancy reports.