

In the case of soil compaction performed by Bechtel, Construction Quality Control was responsible for inspections in accordance with FIP C-211 and QCI C-1.02. Because soil compaction is an activity where inspection of the completed work to verify quality is ineffective, QCI C-1.02 is designed to provide in-process monitoring by surveillance to verify conformance with the documented instructions, i.e. Project Engineering's specifications. This type of inspection program is consistent with the requirement in Criterion X of 10CFR50, Appendix B which states in part:

"If inspection of processed material or products is impossible or disadvantageous, indirect control by monitoring processing methods, equipment and personnel shall be provided."

A brief description of the work performed by Canonie and Bechtel as well as the surveillance inspection and monitoring performed by Construction Quality Control follows:

1) Canonie

1975: Canonie started fill operations south of the Q line on 10/29/75 for the south access ramp and lay down area for the turbine building. Work proceeded through 11/13/75 to elev. 616 ±. Construction Quality Control surveillance inspection was provided by FIP C-2.10-4-53.

1976: Canonie started fill operations adjacent to the south access ramp 7/11/76 and proceeded to elev. 623 ±. Construction Quality Control surveillance inspection was provided by FIP's C-2.10-4-58 and C-2.10-4-62.

1977: Canonie started fill operations at elev. 623 ± on 6/22/77 for the diesel generator building footings, and completed fill to the bottom footing elev. 628 ± on 7/30/77. Construction Quality Control surveillance inspection was provided by QCI S/C 1.10-1, 2, 3, 4, 5 and 6.

2) Bechtel

1975: Structural backfill (Plant Area Fill) started on 10/17/75 in the area south of and adjacent to the Q line wall from elev. 589' to 612'. Construction Quality Control inspection was provided by FIP 2.11-1-12.

1976: Structural backfill started 7/9/76 for a 3 foot wide area adjacent to the Q line wall from elev. 606 to 618 ± Line 1 through 12. Construction Quality Control inspection was provided by FIP C-2.11-1-19.

1977: Structural backfill began 2/15/77. The majority of work consisted of backfill around the circulating water discharge piping, service water piping and electrical conduit encasement (primarily hand work with some motorized equipment used for small sliver fills in D. G. area). The Bechtel work was performed in the same time period as work performed by Canonie to bring the fill material to elev. 628 ±.

Documentary evidence that the Construction Quality Control program for surveillance inspection over Canonie's implementation of their QA program commitments is provided by the completed FIP's, IR's, NCR's, Bechtel QA audit reports and Canonie inspection reports; all of which are on file at the jobsite.

Documentary evidence that the Construction Quality Control program for inspection of soil compaction performed by Bechtel is similarly provided by the completed FIP's, IR's, DR's, NCR's and Bechtel QA audit reports; all of which are on file at the jobsite.

- B. Since there is no variance, the question of generic application is not relevant.
- C. The remedial action taken by Project Engineering in revising the specification requirements for proctor curves, lift thickness, density testing, etc., will be reflected in changes to the inspection criteria contained in the QCI's.
- D. Except for changes in the inspection criteria referenced in the QCI's to reflect Project Engineering changes to the specifications, no other changes in the Construction Quality Control program are needed for corrective action.

2. Variance 6, Items 7 and 8

A. There is no variance to the Bechtel QA program requirements for construction quality control based upon the following evidence.

- 1) Evaluations of motorized compaction equipment did occur and are recorded in the following memoranda:

Buchanan to Jeffers of 9/18/73
Dragicevic to Church of 10/5/73
Jeffers to Valenzano of 11/16/73

The motorized equipment described in the above correspondence was used by both Canonic and Bechtel for compaction work. Evaluation of hand held equipment was accomplished on initial use based upon satisfactory compaction reports. Formal evaluation reports were not required by specification nor provided by Field Engineering. The documented telephone conversation between Grote and Rixford on 9/18/74 should also be noted as it clearly indicates that Project Engineering position was that equipment capacity is not important provided the main objective of obtaining acceptable compaction test results is achieved.

- 2) The completed Quality Control Inspection Plans and Inspection Records on file at the jobsite provide documentary evidence that lift thicknesses did not exceed the 12 inch limit. No changes to the maximum lift thickness were made by Field Engineering, and the inspection records show that the specification requirements were met.
 - B. Since there is no variance, the question of generic application is not relevant.
 - C. Same as for 1C above.
 - D. Same as for 1D above. If it is now believed that formal documentation for reporting equipment evaluation is necessary, this requirement should be added to the Project Engineering specification.
3. Variance 7, Items 4 and 5
 - A. There is no variance to the Bechtel QA program requirements for construction quality control based upon the following evidence:
 - 1) Construction Quality Control through their surveillance of U. S. Testing did in fact identify the lack of moisture testing. As illustrated in the following listed documents, it is apparent that not only QC, but Construction, Project Engineering and QA were all aware of the lack of testing:
 - NCR-55 of 2/4/74
 - NCR-324 of 8/6/75
 - NCR-421 of 5/16/76
 - QAR SD-40 of 7/22/77
 - Memo Newgen to Castleberry of 8/15/77
 - Memo Castleberry to Newgen of 9/30/77
 - Telecon Hook to Roa of 10/10/77
 - Telecon Hook to Roa of 10/13/77
 - NCR-1005 of 10/26/77
 - Memo Newgen to Castleberry of 11/18/77
 - Memo Castleberry to Newgen of 12/15/77
 - Memo Newgen to Richardson of 12/21/77
 - Telecon Dean/Osborn to Roa of 4/7/78

- 2) Following the issuance of QAR SD-40, U. S. Testing did perform moisture tests in the borrow area and they maintained an informal moisture log for this activity starting 8/1/77.

A review of this log by CPCO - QA in January 1978 revealed some inconsistency in reporting dates and moisture contents. As a result, Bechtel QC added a formal review of the U. S. Testing Log to the current inspection plan QCI C-1.02 on 2/13/78 - and this log is now being retained in the QC vault.

- B. Same as 1B.
- C. No remedial action is needed.
- D. No corrective action is needed.

4. Variance 8, Item 1

- A. There is no known variance (Geo-Tech has not completed their investigation) to the Bechtel QA program requirements for construction quality control based upon the following evidence:

- 1) Geo-Tech has not prepared their report as of this writing, but from what we have been told it is their belief that testing frequency and material classification (matching laboratory comparison samples with field samples) were performed incorrectly.

- 2) U. S. Testing Procedure

U. S. Testing soils technicians selected the lab standard (Proctor curve) used for comparison with the in-place soil material at the time of in-place density testing. They accomplished this by visual comparison of the in-place samples to jarred laboratory samples brought to the field. An approximation of the active jarred samples to select from ranged from 10 to 25 at any given time. These samples included cohesive and non-cohesive material. The laboratory samples representing soils that were encountered frequently remained in this active collection. When a jar sample was no longer being used, it would be placed in the inactive collection retained at the laboratory. Material such as that represented by BMP 278 was encountered frequently, and that is the reason it remained active for such an extended period. The values for BMP 278 were periodically checked with information from either a one point sample or complete proctors. Documentation of these checks was not required by specification and was not maintained.

When an in-place soils sample could not be readily classified through visual comparison, the U. S. Testing technician would bring the soils sample to the test laboratory and perform a one point proctor to assist in the selection. If classification could still not be made, a complete proctor was prepared, and the sample was added to the laboratory's active proctor collection.

3) Construction Quality Control

The Construction Quality Control Engineer assigned to monitor Bechtel soil compaction also monitored the U. S. Testing technician's visual comparison of laboratory samples with in-place density test samples. If the fill being tested was placed by Canonie, this visual comparison was also observed by the responsible Canonie Inspector. Construction Quality Control also monitored the U. S. Testing technician's technique in performing in-place density tests.

Construction Quality Control, in their role of providing technical direction and surveillance of the laboratory, monitored the procedures used for making Proctor curves and one point proctors when visual classification could not be accomplished in the field.

None of the specified testing methods (ASTM D1556, 1557, 2049, etc.) identify comparison of field moisture and density test results with saturation conditions (zero air voids) as a method of checking the validity of test results.

To establish whether or not a particular group of field tests are in error, it will be necessary to incorporate inherent errors in testing methods (sand cone and nuclear methods). The specified test methods (and geotechnical literature) indicate a standard deviation on density measurement of 3 to 5 lbs./cu.ft., and a standard deviation on moisture content on the order of one half to one percent moisture.

Incorrect calculation of relative density test results was identified in 1975 and the correct method of calculation has been employed ever since.

Material gradation specified in specification C-211 was not intended to match that specified as Zone 3 material in C-210. However, Zone 3 material did meet the gradation requirements of C-211 and was used as structural backfill (cohesionless, free-draining material).

Using different laboratory curves to clear failing tests was recognition that the material had been incorrectly identified initially.

In summary, the methods employed at the time were believed to be correct methods. In particular, careful evaluation of the soil encountered in the field when determining the proper curve or laboratory maximum density to use is believed to be consistent with the specification and superior to using one laboratory maximum density test for every 20 field tests without consideration of soil type.

- B. Since, at this point in time, no variance has been identified, the question of generic application is not relevant.
 - C. No remedial action required.
 - D. No corrective action necessary.
5. Variance 8, Items 2, 3 and 4
- A } Refer to 4A, B, C and D above
 - B }
 - C }
 - D }
6. Variance 8, Item 4, 5 and 6
- A. There is no variance to the Bechtel QA program requirements for construction quality control based upon the following evidence:
 - 1) The jobsite records indicate that the minimum testing frequency requirements were exceeded. These records show that one test was performed for approximately every 300 cu. yds. of fill under the diesel generator building rather than the required one test per 500 cu. yds.
 - 2) There was no QA program nor QC program requirement to generate a supplementary record listing actual test frequencies. By program, the Quality Control Engineer was instructed to monitor field in-place density testing by surveillance as defined in PSP G-6.1 and verify that he did so by initialing and dating the IR. The Construction Quality Control Engineer did this. The approved program was implemented.
 - B. Since there is no variance, the questions of generic application is not relevant.
 - C. No remedial action required.
 - D. No corrective action necessary.

7. Variance 8, Item 4

- A. QCI C-1.02, Rev. 2 dated 8/77 and Rev. 3, dated 2/78 do not reference the test frequency requirement found in paragraph 5.6 of specification 7220-C-211 as the appropriate inspection criteria. However, under activity number 3-1.b of QCI C-1.02 Rev. 2 and 3, a review of the testing frequency was and is required. Paragraphs 5.1 and 5.5 of specification C-211 are referenced as the inspection criteria for proper test method and technical adequacy. Thus, Rev. 2 and 3 of QCI C-1.02 was written and approved for use with the additional requirements of paragraph 5.6.3 being omitted.

It should be noted that for the time period during fill placement up to the footing level for the diesel generator buildings Rev. 1 of QCI C-1.02 was in effect which called out the proper specification paragraph reference for testing frequency.

- B. No, this variance is not of a generic nature for the frequency paragraph reference omission was due to a format revision of C-1.02 from Rev. 1 to Rev. 2. A review of C-1.20 Rev. 2 and 3 indicates that all other references were carried through.
- C. QCI C-1.02 will be revised to include paragraph 5.6 of specification 7220-C-211 Rev. 5 as the appropriate inspection criteria for testing frequency.
- D. No corrective action is required to preclude repetition.

8. Variance 12, Items 1 and 2

- A. There is no variance to the Bechtel QA program requirements for construction quality control based upon the following evidence:

Bechtel Quality Control did implement the information feedback and corrective action requirements addressed in SF/PSP G-3.2.

- 1) The following listing represents particular actions taken within QC to correct and improve the Quality Control soils program operations:

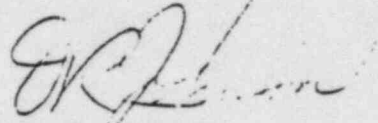
<u>QC Corrective Action Report</u>	<u>Based On</u>
QC-19 - 9/14/76	NCR-510
QC-36 - 2/16/77	CPCO QF-142
QC-37 - 2/24/77	CPCO QF-150
QC-63 - 11/1/77	NCR-1006
QC-64 - 11/21/77	CPCO QF-199

2) Quality Control also routes copies of NCRs to the group responsible for the control of the activity apparently caused the nonconformance. This was accomplished for the following identified NCRs.

	<u>Opened</u>	<u>Closed</u>	<u>Sent To</u>	<u>On</u>
NCR-421	5/5/76	6/23/76	Proj. Super.	6/23/76
NCR-686	2/11/77	3/7/77	Proj. Super.	3/7/77
NCR-698	2/9/77	3/7/77	Proj. Super.	3/7/77
NCR-1005	10/26/77	3/24/78	Proj. Super.	3/24/78

- B. Since there is no variance, the question of generic application is not relevant.
- C. No remedial action required.
- D. No corrective action necessary.

In summary, except for Item 7 above, none of the evidence presented to date is indicative of a variance from the established QA program requirements by Construction Quality Control.


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