Figure 3 Rev. 7/26/73

MIDLAND NUCLEAR UNITS 1 & 2
CANONIE CONSTRUCTION COMPANY

P. M. ____________
G. S. ____________
F. S. ____________

FILL PLACEMENT QA-QC DAILY REPORT

Date June 30, 1977
Shift Day
Weather Clouds Rain
Foreman R DeKKer
Elevation 625.0
Station S 5050 To Station S 5150
Offset E 300 — E 400
Moisture Tests

			M	D
S 5168	E 528	El. 630.5	10.4	98.8
S 5030	E 335	El. 625.5	9.3	101.3

ATURE:
) Emergency Cooling Pond Berm
X) Plant Area Fills
) R/R Embankment
) Laydown Area
) Cooling Pond Dike

) 1 ( ) 4
) 1-A ( ) 4-A
) 2 ( ) 5
) 3 ( ) 6

d Count 55 E-10

IPACTION REQUIREMENT:

ipment No.	Type	Frequency	Time	Speed
272	TD 8 Tractor			
165	HD 11 Tractor			
34	Vibra Plus Comp	1580		2mph
186	Hyster Packer	Kneading		2mph

IARKS/SKETCH:

laced Zone 2 S 5050 S 5150 E 300 E 400
cks Only

8405220502 840517
PDR FOIA
RICE84-96 PDR

By: ____________
CANONIE CONSTRUCTION COMPANY

MIDLAND NUCLEAR UNITS 1 & 2
CANONIE CONSTRUCTION COMPANY

P. M. ______
G. S. ______
F. S. ______

LIFT THICKNESS CHECK

servation Number 6

Date June 30, 1977

na ______

Length 100'

ation S 5050 To Station S 5150

Width 100'

fset E 300 E400

vation: Before	623.80	After	624.60	Lift Thickness	.80
Before	624.60	After	625.40	Lift Thickness	.80
Before		After		Lift Thickness	
Before		After		Lift Thickness	

Average Lift Thickness: .80

marks / Sketch:

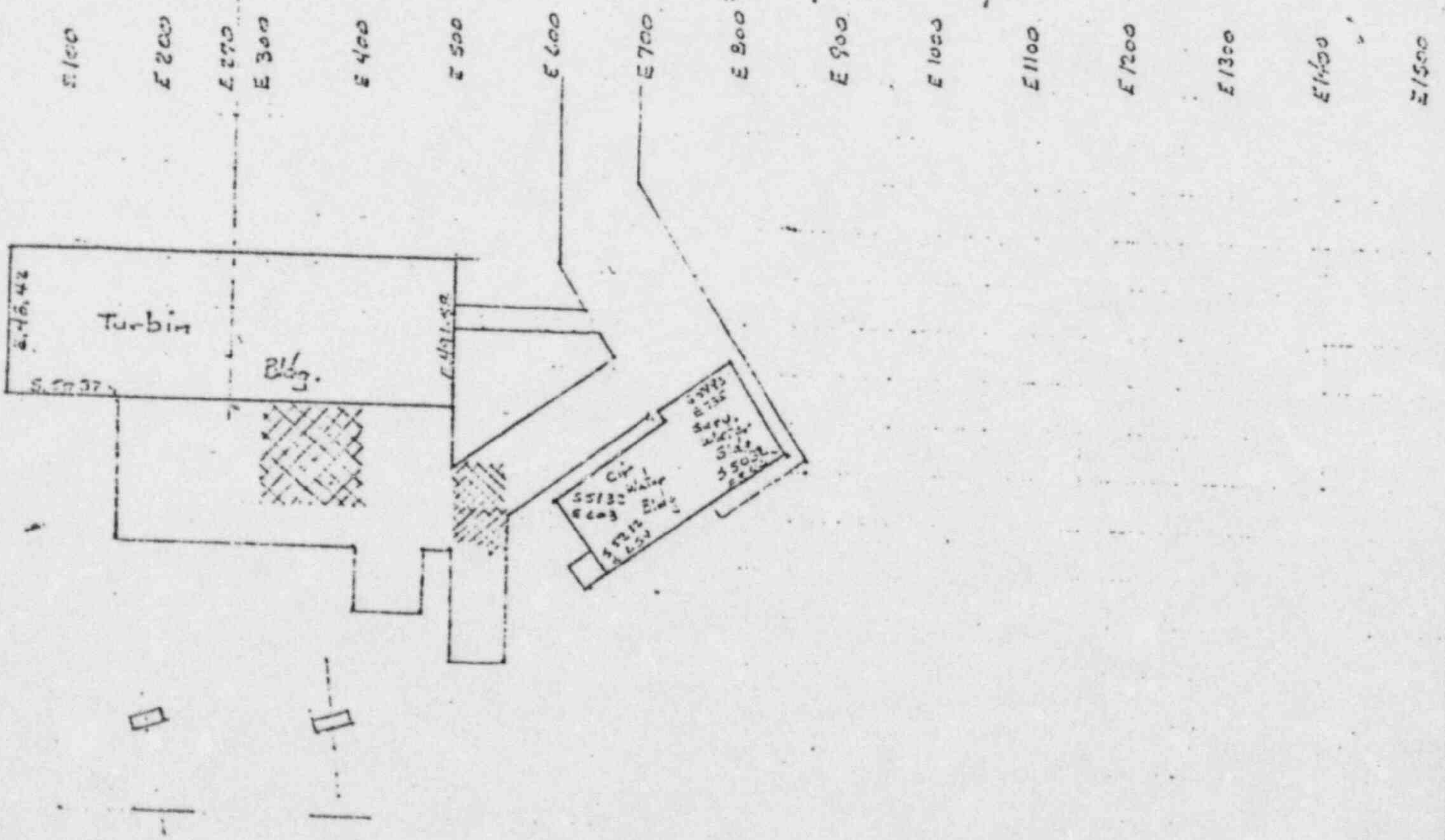


Figure 3 Rev. 7/28/73

MIDLAND NUCLEAR UNITS 1 & 2
CANONIE CONSTRUCTION COMPANY

P. M. ______
G. S. ______
F. S. ______

FILL PLACEMENT QA-QC DAILY REPORT

ATURE:
☐ Emergency Cooling Pond Berm
☒ Plant Area Fills
☐ R/R Embankment
☐ Laydown Area
☐ Cooling Pond Dike

Date July 30, 1977
Shift Day
Weather 70° Wind-Showers
Foreman Dave Dekker
Elevation 626.°±
Station S 5050 To Station S 5150
Offset E 150 S 350

ONE:

☐ 1	☐ 4
☐ 1-A	☐ 4-A
☒ 2	☐ 5
☐ 3	☐ 6

Moisture Tests

			M	D
S 51 35	E 175	Elev. 623.0	10.8	98.6
S 51 22	E 298	Elev. 627.0	9.9	102.9

Retest.
℄ North 20" pipe E 490 Elev. 632.5 11.' 98.0

ad Count 44-~~@~~10

MPACTION REQUIREMENT:

ipment No.	Type	Frequency	Time	Speed
#272	TD 8 Tractor			
#1139	Vibro Plus Comp.	1600		2mph.
#2120	HD21 Tractor			
#2123	HD 21 Tractor			
#644	Disc			
#1184	Hyster Packer	Kneeding.		2mph.

MARKS/SKETCH:

Placed Zone 2 area South of Turbin Bldg. for Diesel Gen. Bldg.

By: ______
CANONIE CONSTRUCTION COMPANY

CANONIE CONSTRUCTION COMPANY

G. S. ____________
F. S. ____________

LIFT THICKNESS CHECK

ation Number 20

Date July 30, 1977

Lot 2

Length 100

Station S 5050 To Station S 5150

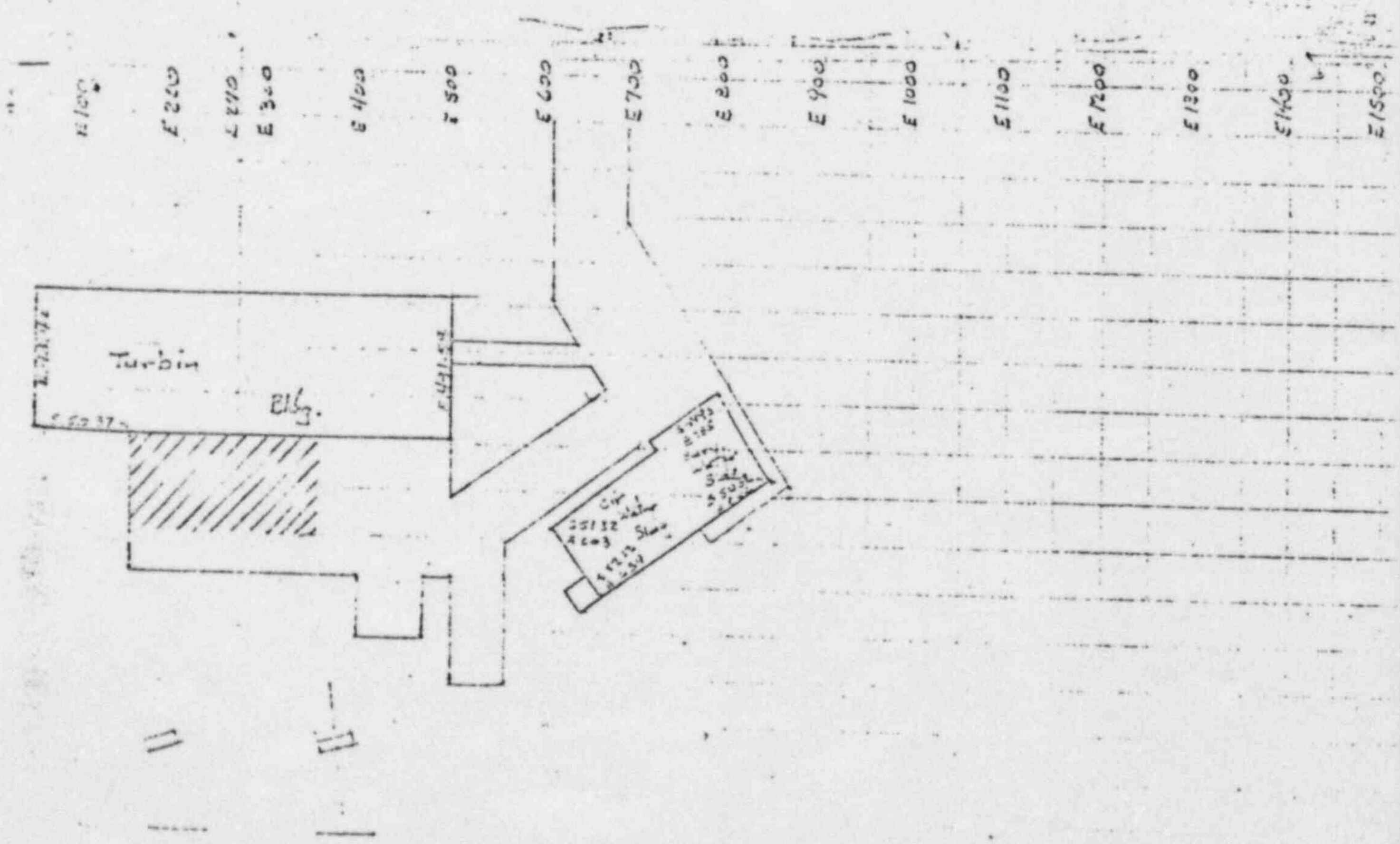
Width 200

Offset E 150 E 350

Elevation: Before 631.2	After 632.0	Lift Thickness .80
Before 622.0	After 623.0	Lift Thickness 1.00
Before 629.0	After 629.7	Lift Thickness .70
Before	After	Lift Thickness

Average Lift Thickness: .83

Remarks / Sketch:



By: Gene DeGeer
CANONIE CONSTRUCTION COMPANY
QA-QC REPRESENTATIVE

Gary,

Please recieve from Proj. Engineering clarificati of Letter BE&C 1998 for the following situations:

7-18
7-22
8-2
8-3
8-4
8-5
thru 8-10

1) Moisture sample taken from borrow area passe (±2%) - Moisture tests taken on same day along with density test fails with passing compaction -
Acceptable or not

2) Moisture sample fails in borrow area - Sup't notified & corrective actions taken to adjust moisture - Passing compaction tests taken but still with failing moistures
Acceptabe or not.

D. Osborn
4/5/78

cc: T. Lieb

BECHTEL

Telephone call

ROUTE G. Cooster GSC
cc. S. Rao
J. Betts
B. Cheek
B. Sigle

BY John Dean / Dayle Osborn OF F.E / QC.
TO S. Rao OF Proj. Eng.
DATE April 7 1978 TIME 2:30 PM
SUBJECT Moisture Content of Soils (Clay) JOB NO. 7220

OSBORN

To clarify BeBC 1998 the following two situations were discussed with S Rao as to the acceptability of the soil:

1) the moisture sample taken from the borrow area at the start of the shift is acceptable (± 2%). The moisture tests taken on same day in conjunction with the density test fails. Proper compaction was obtained.

2) The moisture sample taken from the borrow area at the start of the shift fails. The superintendant in charge of soils is notified and corrective actions taken to adjust moisture (i.e. disking or wetting down). Passing compaction is obtained - but with failing moistures outside of the ± 2% range.

RAO

The above two situations are acceptable as is.

United States Testing Company, Inc.

Testing & Inspection:
concrete
structural steel
soils
asphalt
Quality Control
Construction Supervisor
Investigations

D DENSITY TESTS

DATE: 7/9/77 PROJECT: 7220

TEST NUMBER	MD-1633	MD-1634	DIS-021	MD-1635
CONE NUMBER	192.1	192.1	192.1	192.1
ORIGINAL WT. OF JAR & SAND (gr)	7147.0	7220.0	7262.0	7325.0
FINAL WT. OF JAR & SAND (gr)	2150.0	2508.0	2202.0	2669.0
WT. OF USED SAND (gr)	4997.0	4712.0	5060.0	4656.0
WT. OF SAND IN (gr)	1747.0	1747.0	1747.0	1747.0
WT. OF SAND IN (gr)	3250.0	2965.0	3313.0	2909.0
CALIBRATED WT. OF SAND (gr/cc)	1.524	1.524	1.524	1.524
VOL. OF HOLE (cc)	2132.5	1945.5	2173.9	1908.8
WT. OF SOIL & PAN (gr)	4036.0	3699.0	4926.0	3751.0
WT. OF PAN (gr)	15.0	15.0	15.0	15.0
WT. OF SOIL (gr)	4021.0	3684.0	4911.0	3736.0
WET DENSITY (pcf)	112.7	118.2	141.0	122.1
WT. OF WET SOIL AND CAN (gr)	600.0	600.0	600.0	600.0
WT. DRY SOIL AND CAN (gr)	—	—	—	—
WT. OF CAN (gr)	—	—	—	—
WT. OF WATER LOSS (gr)	43.4	31.0	28.7	42.3
WT. OF DRY SOIL (gr)	556.6	569.0	571.3	557.7
MOISTURE IN PERCENT	7.8	5.4	5.0	7.6
DRY DENSITY IN PCF	109.2	112.1	134.3	113.5
CURVE NUMBER	RD 55	RD 55	BMP 293	RD 55
MAXIMUM DRY DENSITY (pcf)	109.7	109.7	139.6 OMC 6.0	109.7
Compaction Obtained (%)	97.9	109.9	96.2	115.5
Compaction Required (%)	80 RD	80 RD	95% ± 2% OMC	80 RD
Elevation of Test	611.0	625.0	596.0	613.0
Location of Test	75' S. of Q £ of 72" dis. pipes	20' S. of Q 33' E. of 3.0	Sta. 13+12 30" SWI south discharge pipe	85' S. of Q 8' E of east 72" dis. pipe
Soils Description	Yellow Fine Sand	Yellow Fine Sand	Crushed limestone	Yellow Fine Sand
Zone Number	2	2	4A	2
Area of Test	Plant	Plant	30" SWI discharge	Plant
Pass Or Fail / Jar no.	P / 7	P / 7	P / 7	P / 7
Retest:	No	No	Yes	No

Wet Den. = no. 10 / no. 7 X 62.4

Dry Den. = no. 11 / 100 + no. 17

Vol. of Hole = no. 6 / no. 8

% Compaction = no. 13 / no. 20 X 100

REMARKS:

B. Thompson

asphalt

Quality Control
Construction Supervisor
Investigations.

FIELD DENSITY TESTS

DATE: 7/25/77 PROJECT: 7220

(NUMBER	MDR-1019	MD1773	MP 1774	MDR [illegible]
C NUMBER	192.1	192.1	192.1	192.1
ORIGINAL WT. OF JAR & SAND (gr)	7310.0	7294.0	7349.0	7300.0
FINAL WT. OF JAR & SAND (gr)	2764.0	2653.0	2454.0	2301.0
WT. OF USED SAND (gr)	4546.0	4641.0	4895.0	4999.0
WT. OF SAND IN CONE (gr)	1747.0	1747.0	1747.0	1747.0
WT. OF SAND IN HOLE (gr)	2799.0	2894.0	3148.0	3252.0
CALIBRATED WT. OF SAND (gr/cc)	1.524	1.524	1.524	1.524
VOL. OF HOLE (cc)	1836.6	1899.0	2065.6	2133.9
WT. OF SOIL & TARE (gr)	3957.0	3695.0	3908.0	4466.0
WT. OF TARE (gr)	15.0 ~~7.0~~	15.0 ~~7.0~~	15.0 ~~7.0~~	15.0 ~~7.0~~
0 WT. OF SOIL (gr)	3942.0	3680.0	3893.0	4451.0
1 WET DENSITY (pcf)	133.9	120.9	117.6	130.2
2 WT. OF WET SOIL AND CAN (gr)	600.0	600.0	600.0	600.0
3 WT. DRY SOIL AND CAN (gr)	—	—	—	—
4 WT. OF CAN (gr)	—	—	—	—
5 WT. OF WATER LOSS (gr)	23.5	26.4	32.5	35.3
6 WT. OF DRY SOIL (gr)	576.5	573.6	567.5	564.7
7 MOISTURE IN PERCENT	4.1	4.6	5.7	6.3
8 DRY DENSITY IN PCF	128.6	115.6	111.3	122.5
9 CURVE NUMBER	RD61	RD55	RD55	RD61
0 MAXIMUM DRY DENSITY (pcf)	125.3	109.7	109.7	125.3
1 Compaction Obtained (%)	117.5	123.6	106.6	84.4
2 Compaction Required (%)	80RD	80RD	80RD	80RD
3 Elevation of Test	628.0	BF 7/25/77 618.0 ~~620.0~~	622.0	628.0
4 Location of Test	24'E. of 12.0 ℄ 26" pipes North pipes	35'W. of CWI 4'N of north 96" pipe	45'W. of CWI ℄ of 96" pipes	30'E. of 12.0 ℄ of 26" pipes ~~South pipes~~
5 Soils Description	Gr. Sand	FYS	FYS	Gr. Sand
6 Zone Number	~~8~~ 3	2	2	3
7 Area of Test	Structural	Plant	Plant	Structural
8 Pass Or Fail / Jug no.	P / 6	P / 7	P / 7	P / 7
9 Retest:	No	No	No	No

Wet Den.= $\frac{\text{no. 10}}{\text{no. 7}}$ X 62.4

Dry Den.= $\frac{\text{no. 11}}{100\% = \text{no. 17}}$

Vol. of Hole= $\frac{\text{no. 5}}{\text{no. 6}}$

% Compaction= $\frac{\text{no. 13}}{\text{no. 20}}$ X 100

REMARKS:

CHECKED BY: SEC

B. Thompson

Tested By

Approved By

asphalt

Quality Control
Construction Supervis
Investigations

FIELD DENSITY TESTS

DATE: 8-24-77 PROJECT:

NUMBER	MD-1928	MD-1929	MD-1930	MD-1931
NUMBER	193.1	193.1	193.1	193.1
ORIGINAL WT. OF JAR & SAND (gr)	7134	6818	6827	6941
FINAL WT. OF JAR & SAND (gr)	2369	2312	2284	2697
WT. OF USED SAND (gr)	4765	4506	4543	4244
WT. OF SAND IN CONE (gr)	1744	1744	1744	1744
WT. OF SAND IN HOLE (gr)	3021	2762	2799	2500
CALIBRATED WT. OF SAND (gr/cc)	1.514	1.514	1.514	1.514
VOL. OF HOLE (cc)	1995.4	1824.3	1848.7	1651.3
WT. OF SOIL & TARE (gr)	3720	3271	3440	3088
WT. OF TARE (gr)	15 ~~7.0~~	15 ~~7.0~~	15 ~~7.0~~	15 ~~7.~~
WT. OF SOIL (gr)	3705	3256	3425	3073
WET DENSITY (pcf)	115.9	111.4	115.6	116.1
WT. OF WET SOIL AND CAN (gr)	600.0	600.0	600.0	600.0
WT. DRY SOIL AND CAN (gr)	—	—	—	—
WT. OF CAN (gr)	—	—	—	—
WT. OF WATER LOSS (gr)	34.5	34.5	45.4	36.5
WT. OF DRY SOIL (gr)	565.5	565.5	554.6	563.5
MOISTURE IN PERCENT	6.1	6.1	8.2	6.5
DRY DENSITY IN PCF	109.2	105.0	106.8	109.0
CURVE NUMBER	RD55	RD55	RD55	RD55
MAXIMUM DRY DENSITY (pcf)	109.7	109.7	109.7	109.7
Compaction Obtained (%)	97.9	79.3	87.4	97.0
Compaction Required (%)	80 RD	80 RD	80 RD	80 RD
Elevation of Test	632.0	632.0	632.0	622.0
Location of Test	15' S. of N. wall of evaporator bldg 15' N. of block #4	20' S. of N wall of evaporator bldg 2' E. of block #2	26' S. of N wall of evaporator bldg, 5' from west wall block #1	manhole #17
Soils Description	FYS	FYS	FYS	FYS
Zone Number	2	2	2	2
Area of Test	Plant	Plant	Plant	Plant
Pass Or Fail / Jug no.	P / 7	F / 5	P / 6	P / 4
Retest:	No	No	No	No

Wet Den.= $\frac{\text{no. } 10}{\text{no. } 7} \times 62.4$

Dry Den.= $\frac{\text{no. } 11}{100\% = \text{no. } 17}$

Vol. of Hole= $\frac{\text{no. } 5}{\text{no. } 6}$

% Compaction= $\frac{\text{no. } 13}{\text{no. } 20} \times 100$

TEST FAILURE

REMARKS:

Q.C. Rep. Notified Tom Leib

CHECKED BY:

Time & Date of Notification 0800 8-25-77

Reporting Person

#1929

Ken Mauz

Tested By

Approved By

FORM MEI-204 4/18/77

asphalt

Quality Control
Construction Supervisio
Investigations

FIELD DENSITY TESTS

DATE: 8/24/77 PROJECT: 7220

NUMBER	~~MO~~ DIS-049	DIS-050	MO 1933	DIS-051
NUMBER	193.1	193.1	193.1	[illegible]
ORIGINAL WT. OF JAR & SAND (gr)	7755.0	7684.0	7148.0	7445.
FINAL WT. OF JAR & SAND (gr)	2376.0	2462.0	2637.0	2035.
WT. OF USED SAND (gr)	5379.0	5222.0	4511.0	5410.
WT. OF SAND IN CONE (gr)	1744.0	1744.0	1744.0	1744.0
WT. OF SAND IN HOLE (gr)	3635.0	3478.0	2767.0	3666.0
CALIBRATED WT. OF SAND (gr/cc)	1.514	1.514	1.514	1.514
VOL. OF HOLE (cc)	2400.9	2297.2	1827.6	2421.
WT. OF SOIL & TARE (gr)	5381.0	5310.0	3584.0	5390.
WT. OF TARE (gr)	15.0 ~~7.0~~	15.0 ~~7.0~~	15.0 ~~7.0~~	15.0 ~~7.~~
0 WT. OF SOIL (gr)	5366.0	5295.0	3569.0	5375.
1 WET DENSITY (pcf)	139.5	143.8	121.9	138.5
2 WT. OF WET SOIL AND CAN (gr)	600.0	600.0	600.0	600.
3 WT. DRY SOIL AND CAN (gr)	—	—	—	—
4 WT. OF CAN (gr)	—	—	—	—
5 WT. OF WATER LOSS (gr)	25.7	27.1	43.4	25.1
6 WT. OF DRY SOIL (gr)	574.3	572.9	556.6	574.9
7 MOISTURE IN PERCENT	4.5	4.7	7.8	4.4
8 DRY DENSITY IN PCF	133.5	137.3	113.1	132.7
9 CURVE NUMBER	BMP 293	BMP 293	RD-55	BMP-293
0 MAXIMUM DRY DENSITY (pcf)	139.6 omc 6.0	139.6 omc 6.0	109.7	139.6 omc
1 Compaction Obtained (%)	95.6	98.4	113.9	95.1
2 Compaction Required (%)	95% ± 2% OMC	95% ±2% of OMC	80RD	95% ± 2% of o
3 Elevation of Test	591.0	592.0	~~621.0~~ 619.0	596.0
4 Location of Test	02+75 South 30" SWI dis.	25+00 SOUTH 30" SWI DIS	4' E of E. SIDE MANHOLE #17 4' N of S. SIDE	02+48 SOUTH 30 SWI DIS
5 Soils Description	Crushed limestone	CRUSHED LIMESTONE	F/Y/S	CRUSHED LIMESTO
6 Zone Number	4A	4-A	2	4-A
7 Area of Test	South 30" SWI	30" SWI DISCHARGE	PLANT	30" SWI DIS.
8 Pass Or Fail / Jug no.	P / 7	P / 6	P / 5	P / 6
9 Retest:	No	NO	NO	NO

Wet Den.= $\frac{\text{no. } 10}{\text{no. } 7}$ X 62.4

Dry Den.= $\frac{\text{no. } 11}{100\% = \text{no. } 17}$

Vol. of Hole= $\frac{\text{no. } 5}{\text{no. } 6}$

% Compaction= $\frac{\text{no. } 18}{\text{no. } 20}$ X 100

CHECKED BY: SEV

REMARKS:

B. Thompson & R. Smith
Tested By

Approved By

FORM MEI-204 4/18/77

United States Testing Company, Inc.

structural steel
soils
asphalt

Quality Control
Construction Supervisor
Investigations

FIELD DENSITY TESTS - NUCLEAR METHOD

ECT: MIDLAND POWER PLANT 7220 DATE: 6/22/77

NUCLEAR STANDARD COUNT

	DENSITY		MOISTURE
COUNT ONE	424	COUNT ONE	396
COUNT TWO	424	COUNT TWO	392
COUNT THREE	426	COUNT THREE	403
COUNT FOUR	423	COUNT FOUR	401
TOTAL	1697	TOTAL	1592
AVERAGE COUNT	424	AVERAGE COUNT	398

AREA:

SAMPLE IDENTIFICATION					
TEST NUMBER	MD-1551	MD-1552	MD-1553	MD-023	MD-1554
DATE OF TEST	6/22/77				
STATION OR LOCATION	S.5155	S.5335	S.5260	66' W. of River Int. Structure	117' N [illegible]
OFFSET FROM CENTERLINE	E.350	E.230	E.516	16' S. [illegible] retainer wall	41 W. 41
ELEVATION	613.5	618.5	626.0	[illegible]	628.0
DEPTH OF TEST	6"	6"	6"	6"	6"
ZONE NUMBER	1	1	1	1	1
NUCLEAR DENSITY					
DENSITY COUNT	499	483	418	463	491
COUNT RATIO (DENSITY)	1.177	1.139	.986	1.092	1.158
WET DENSITY #/Ft³	133.0	135.0	115.0	138.0	137.0
TOTAL DENSITY DRY #/Ft³	121.2	122.2	124.2	123.0	~~114.0~~
				25 [illegible]	113.5
NUCLEAR MOIST.					
MOISTURE COUNT	214	228	268	260	335
COUNT RATIO (MOISTURE)	.538	.573	.673	.653	.842
MOISTURE FROM MANUAL CHART #/Ft³	11.8	12.5	15.8	15.0	20.5
MOISTURE %	9.7	10.4	12.2	12.2	18.1
ACCEPTANCE DATA					
PROCTOR CURVE NUMBER	BMP-269	BMP-269	BMP-260	BMP-280	BMP-278
MAXIMUM DENSITY #/Ft³	127.3	127.3	129.8	120.8	117.0
OPTIMUM MOISTURE %	~~±2~~ 10.0	10.	10.6	13.6	15.2
% DENSITY REQUIRED	95%	95%	95%	95%	95%
MOISTURE TOLERANCE REQUIRED	±2%	±2%	±2%	±2%	±2
% FIELD DENSITY	95.1	96.0	99.5	101.8	97.0
P= PASS F=FAILURE	P	P	P	P	P F(M)
RETEST	NO	NO	NO	~~N~~ YES	NO
AREA OF TEST	PLANT	PLANT	PLANT	RIVER INT	PLANT

REMARKS: GAUGE NO. 2932

CHECKED BY:

TESTED BY

APPROVED BY

FIELD DENSITY TESTS

Quality Control
Construction Safety
Investigations

DATE: 12-23-77 PROJECT: 722

TEST NUMBER	NDR 1343	ND 2456	NDR 1344	ND 2457
CONE NUMBER	192.1	192.1	192.1	192.
INITIAL WT. OF JAR & SAND (gr)	7217.0	7065.0	7372.0	7253
FINAL WT. OF JAR & SAND (gr)	2786.0	2212.0	2608.0	2600.
WT. OF USED SAND (gr)	4431.0	4853.0	4764.0	4653.
WT. OF SAND IN CONE (gr)	1748.0	1748.0	1748.0	1748.0
WT. OF SAND IN HOLE (gr)	2683.0	3105.0	3016.0	2905.
CALIBRATED WT. OF SAND (gr/cc)	1.517	1.517	1.517	1.517
VOL. OF HOLE (cc)	1768.6	2046.8	1988.1	1915.0
WT. OF SOIL & TARE (gr)	3706.0	3681.0	4107.0	3625.
WT. OF TARE (gr)	15.0	15.0	15.0	15.0
WT. OF SOIL (gr)	3691.0	3666.0	4092.0	3610.0
WET DENSITY (pcf)	130.2	111.8	128.4	117.6
WT. OF WET SOIL AND CAN (gr)	600.0	600.0	600.0	
WT. DRY SOIL AND CAN (gr)	—	—	—	
WT. OF CAN (gr)	—	—	—	
WT. OF WATER LOSS (gr)	24.5	30.0	27.6	43.8
WT. OF DRY SOIL (gr)	565.5	570.0	572.4	556.2
MOISTURE IN PERCENT	6.1	5.3	4.8	7.9
DRY DENSITY IN PCF	122.7	106.2	122.5	109.0
CURVE NUMBER	RD 61	RD55	RD 61	RD 55
MAXIMUM DRY DENSITY (pcf)	125.3	109.7	125.3	109.7
Compaction Obtained (%)	85.5	84.8	84.4	97.0
Compaction Required (%)	80RD	80RD	80RD	80RD
Elevation of Test	627.0	624.0	627.0	629.0
Location of Test	3'W of 10.0 140'S of Q	E of 11.0 190'S of Q	E of 10.0 ~~140'~~ 170'S of Q	3'E of 10.0 145'S of Q
Soils Description	Gr Sand	FYS	Gr Sand	FYS
Zone Number	3	2	3	2
Area of Test	[illegible]	[illegible]	[illegible]	[illegible]
Pass Or Fail / Jug no.	P / 7	P / 4	P / 7	P / 7
Retest:	No	No	No	No

Wet Den.= $\frac{\text{no. 10}}{\text{no. 7}}$ X 62.4

Dry Den.= $\frac{\text{no. 11}}{100\% = \text{no. 17}}$

Vol. of Hole= $\frac{\text{no. 5}}{\text{no. 6}}$

% Compaction= $\frac{\text{no. 18}}{\text{no. 20}}$ X 100

REMARKS:

CHECKED BY: BT

B Thompson
Tested By

Approved By

FORM MEI-204 4/18/77

Bechtel Power Corporation

Inter-office Memorandum

QCFM-5011

To G. L. Richardson

Subject Midland Project, Units 1&2
Moisture Requirements for
Backfill prior to Placement
GLR-02-78-043, QAR SD-40

Copies to
J. F. Newgen w/o
D. R. Johnson w/o

Date July 20, 1978

From W. L. Barclay

Of Quality Control

At Midland, Michigan
Job No. 07220

RECEIVED
JUL 21 1978
BECHTEL POWER CORP.
JOB 7220
PER 204 SE-I-78-282

References: a) BCBE 1802 JNewgen to RCastleberry dated 2/27/78
(with attachments)
b) BEBC 2287 RCastleberry to JNewgen dated 6/1/78

The following is Quality Control's complete response to subject letter GLR-02-78-043 which concerns missing moisture tests, review of US Testing mositure log by Quality Control and a file set-up in the vault.

Reference a) BCBE 1802 revealed subject soil tests were not performed prior to placement on August 9, 1977, September 30, 1977, October 3, 1977, October 4, 1977 and October 5, 1977. Project Engineering was requested to evaluate the acceptability of the material placed on above mentioned dates. Reference b) BEBC 2287, Project Engineering concluded that all soil placed and tested on August 9, 1977, September 30, 1977, October 3, 1977, October 4, 1977 and October 5, 1977 acceptable as placed.

In response to subject QAR which identifies problems with moisture tests on soils placement, mositure tests are being taken in borrow areas at the start of the day and as needed to maintain the proper control of materials being placed. A review of the moisture test is being made by the responsible QC Engineer and filed in the QC Vault.

If additional information is required concerning the above, please contact this office.

QA ROUTE	INFO.	ACT.
LOAE	/	
CIVIL (1)		
ARCH		
PIPING		
ELECT.		
INST.		
D		
SECY		
FILE NO.	032	070

WLBarclay
W. L. BARCLAY
PROJECT FIELD QUALITY CONTROL ENGINEER

WLB/HDF/ENE/RKS/jmw

Attachments

Bechtel Associates Professional Corporation

Inter-office Memorandum

BEBC- 2287

To J. F. Newgen

Date June 1, 1978

Subject Midland Plant Units 1 & 2
Job 7220
Moisture Requirements for
Backfill Prior to Placement

From R. L. Castleberry

Of Engineering

At Ann Arbor

Copies to File: 0274

C-210 F. E. Meyer
Jim Wanzeck
J. Hurley

RECEIVED
JUN 5 1978
BECHTEL POWER CORP.
JOB 7220
PER

Reference: 1) BCBE-1802 (2/27/78) with attachments

This is a complete response to Reference 1.

We have learned through a telephone conversation with Daryl Osborn of quality control that the "Compacted Fill Density Test Reports" attached to Reference 1 represent soil which was hauled from storage piles or borrow areas and placed and compacted, all on the same day that the tests were performed, e.g., soil tested on 8/9/77 was hauled from storage the same day.

Reference 1 indicates that soil placed on 8/9/77, 9/30/77, 10/3/77, 10/4/77, and 10/5/77 was not tested for moisture content prior to placement. We have reviewed the "Compacted Fill Density Test Reports" attached to Reference 1 and make the following comments:

1. The tests show that material placed on the above dates satisfy the specified requirements for density and moisture content with the exception of MD-2176 (10/5/77).

2. Test MD-2176 (10/5/77) represents clay which has 94.8% compaction and 17.7% moisture content compared to 95% compaction and 13.4% ±2% moisture content specified.

3. For MD-2176 the dry density is within 0.2% of the minimum required and the moisture content is on the wet side of optimum. However, because the location of this soil is adjacent to the steam tunnel, the wet condition of the soil is preferred. Therefore, we consider this material acceptable.

In conclusion, we find all soil placed and tested on 8/9/77, 9/30/77, 10/3/77, 10/4/77 and 10/5/77, in accordance with Reference 1, acceptable as placed.

R. L. Castleberry

JJD/jp
5/17/7

Bechtel Associates Professional Corporation

Inter-office Memorandum

BEBC- 2286

To J.F. Newgen

Date June 1, 1978

Subject Midland Plant Units 1 & 2
Job 7220
Moisture Control
File: 0224

From R. L. Castleberry

Of Engineering

At Ann Arbor

RECEIVED
[illegible] POWER CORP.
JOB 7220
Sw

Copies to
C-210
J. Wanzeck F. E. Meyer
J. Hurley
G.L. Richardson

[illegible] Richardson to R.L. Castleberry dated 5/16/78

The purpose of this letter is to clarify the intent of controlling moisture content in the borrow areas as requested in Reference 1.

Subparagraph 12.6.1 of Specification C-210 requires ("Insofar as practicable,...") qualitative control of moisture conditioning in the borrow areas so that the soil is not "too wet" or "too dry" to be compacted with the least amount of effort after being placed on the plant fill. The only quantitative control of moisture content is specified for soil during compaction.

Insufficient moisture control may lead to considerable increase in work effort and is therefore to be avoided. But moisture content is not necessarily a measure of a soil's adequacy to act as a foundation or as backfill material. If the density of a soil meets the requirements of the specification, in accordance with the correct standard, then the soil is acceptable.

The intent of this letter is to point out that a soil with the specified density following compaction should not be rejected on the basis that its moisture content was not controlled in the borrow area. On the other hand, we do not intend to eliminate moisture control in the borrow areas because this procedure minimizes the work effort required to attain the desired plant fill density.

QA ROUTE	INFO	ACT.
LQAE	✓	[illegible]

RL Castleberry

Bechtel Power Corporation

Inter-office Memorandum

QA ROUTE	INFO.	ACT
LQAE		339
CIVIL (I)		
MECH		
PIPING		
ELECT		
INST		
[illegible]		
SEC'Y		
FILE NO. [illegible]		

To R. L. Castleberry

Subject Job 7220 Midland Project
Moisture Content of Soils
GLR-249

Copies to J. Newgen
J. Hurley
J. Klacking
W. Barclay
S. Rao

Date May 16, 1978

From G. L. Richardson

Of Quality Assurance

At Midland, MI

QAR SD-40 was issued on 7/22/77 to request testing of soils for proper moisture content prior to compaction. Several IOMs and telecons were written to resolve this QAR cumulated by the attached IOM BEBC-1993 and J. Hook's telephone call record of 10/13/77. These documents indicate that moisture content for "Q" listed material must be controlled to assure that it is within +2% of optimum prior to compaction as required by Specification 7220-C-208. Moisture content after compaction not within the required range is not to be considered a problem.

Subsequent to this a telephone call record (attached) dated 4/7/78 was made to record a call to S. Rao requesting further clarification. Part II of this telecon appears to be in conflict with the foregoing. The current interpretation by Quality Control is to allow compaction to take place where the initial test indicates out of tolerance moisture content concurrent with corrective actions to correct the moisture.

Concerns in this area have been raised by D. Horn of CPCo QA who has requested that this area be clarified prior to resumption of work upon settlement of the laborers work stoppage.

It is requested that you take action to resolve this situation and to provide clear direction for the control of moisture content.

One possible solution would be to delete the requirement to control the moisture content and rely on the compaction requirement only for the [illegible] of soils [illegible] the only "Q" listed [illegible]

Telephone call

CC:
XXXXX S. Rao
W. Barclay
G. Richardson
A. Boos
F. Teague
T. Lieb
J. Speltz - UST
File

BY J. G. Hook OF Site - QA

TO S. Rao OF AAO

DATE October 13, 77 TIME 11:35

SUBJECT Moisture Requirements for Backfill Ref: QAR SD-40

JOB NO. 7220

Returned S. Rao's call about the telecon dated October 10, 1977 on the same subject.

RAO: What I said on moisture requirements for backfill is not what you wrote on the telecon. The moisture requirement (± 2% of optimum) is mandatory and must be implemented at the time of placement and testing.

HOOK; OK. I will write a new telecon stating this and make distribution to the same people previously copied.

Jon G. Hook

QA ROUTE	INFO.	ACT.
LQAE		
CIVIL (C)		
CIVIL (G)		
MECH		
PIPING		
ELECT.		
INST.		
SECY		
FILE NO.		

TELECOPY

Inter-office Memorandum

BEBC- 1998

To J. F. Newgen

Date December 15, 1977

Subject Midland Plant Units 1 & 2
Job 7220
Moisture Requirements for
Backfill

From R. L. Castleberry

Of Engineering

At Ann Arbor

Copies to File: 0274, C-210, C-208

S. Afifi

RECEIVED
DEC 16 1977
BECHTEL POWER CORP.
JOB 7220
PER ________________

Reference: 1. BCBE-1669 dated 11/18/77

This is a complete response to Reference 1.

The moisture content of the soil should be within 2% of optimum <u>during</u> placement and compaction. However, this property of the soil is not necessarily a measure of its adequacy <u>after</u> compaction.

The primary goal is to obtain the specified dry density. In order to achieve this end, certain means are prescribed; e.g., maximum lift thickness, specified compactive effort and controlled moisture content.

Soil which has been tested a few days following compaction and found to have suitable dry density should not be rejected solely on the basis that its moisture content is not within 2% of optimum.

for J C Hink
R. L. Castleberry

GAT/sg
12/15/5

BECHTEL

Telephone call

G. Coaste
ROUTE Cc S. Rao
J. Betts
B. Cheek
B. Sigle

BY John Dean / Doyle Osborn OF F.E / QC.
TO S. Rao OF Proj. Eng.
DATE April 7 ..78 TIME 2:30 PM
SUBJECT Moisture Content of Soils (Clay) JOB NO. 7220

OSBORN

To clarify BCBC 1998 the following two situations were discussed with S Rao as to the acceptability of the soil:

1) the moisture sample taken from the borrow area at the start of the shift is acceptable (± 2%). The moisture tests taken on same day in conjunction wi the density test fails. Proper compaction was obtained

2) The moisture sample taken from the borrow area at the start of the shift fails. the superintendant in charge of soils is notified and corrective actions taken to adjust moisture (i.e. disking or wetting down) Passing compaction is obtained - but with failing moistures outside of the ± 2% range.

RAO

The above two situations are acceptable as is.

BECHTEL

Telephone call

ROUTE cc G. Coaster GSC
S. Rao
J. Betts
B. Cheek
B. Sigle KV

BY John Dean / Dayle Osborn OF F.E / Q.C.

TO S. Rao OF Proj. Eng.

DATE April 7 19 78 TIME 2:30 PM

SUBJECT Moisture Content of Soils (Clay) JOB NO 7220

OSBORN

To clarify BeBC 1998 the following two situations were discussed with S Rao as to the acceptability of the soil:

1) the moisture sample taken from the borrow area at the start of the shift is acceptable (± 2%). The moisture tests taken on same day in conjunction with the density test fails. Proper compaction was obtained.

2) The moisture sample taken from the borrow area at the start of the shift fails. the superintendent in charge of soils is notified and corrective actions taken to adjust moisture (i.e. disking or wetting down). Passing compaction is obtained - but with failing moistures outside of the ± 2% range.

RAO

The above two situations are acceptable as is.

COMPACTED FILL DENSITY TEST REPORT

3. N-Hale 12/6/77
QC ACCEPTANCE / DATE
CONTROL NO. 30
FILE NO. C-213.3

1. PROJECT NO. 7220
2. DATE 10/25/77
PAGE 3 of 5

4. SPEC. NO. 7220-C-208
5. ~~DRAWING NO.~~ PLANT AREA
6. TESTED WEEK OF 10/2/77 To 10/8/77

DATE TAKEN	8. TEST NO. MD.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
0/5/77	2176	RS	W.41 156' N. OF AA W. OF STEAM TUNNEL	617	—	135.0	17.7	114.7	277	13.4	1	121.0	94.8	FAILED
"	2177	"	W.41 116' N. OF AA W. OF STEAM TUNNEL	625	—	145.0	12.7	128.7	277	13.4	1	121.0	106.4	PASS
"	2178	"	W.41 94' N. OF AA W. OF STEAM TUNNEL	629	—	144.0	13.4	127.0	277	13.4	1	121.0	105.0	PASS
—	2179 THRU 2181	SEE	PAGE 2											
0/5/77	2182	BT	S. 5087 E. 562	633.5	—	143.0	13.5	126.0	277	13.4	1	121.0	104.1	PASS
"	2183	"	S. 5150 E. 400	629	—	143.0	12.9	126.7	277	13.4	1	121.0	104.7	PASS
"	2184	"	S. 5165 E. 420	630.5	—	145.0	13.1	128.2	277	13.4	1	121.0	106.0	PASS
"	2185	"	10' N. OF G. LINE 25' N. OF N.W. COR. STEAM TUNNEL	619	—	144.5	12.7	128.2	277	13.4	1	121.0	106.0	PASS
"	2186	"	12' N. OF G LINE 20' E. OF N.W. COR STEAM TUNNEL	621	—	139.5	13.4	123.0	277	13.4	1	121.0	101.7	PASS
"	2187	"	7' N. OF G. LINE 20' E. OF N.W. COR. STEAM TUNNEL	623	—	142.0	13.4	125.2	277	13.4	1	121.0	103.5	PASS

TEST FAILURE

Q.C. Rep. Notified

Time & Date of Notification

Reporting Person NOTIFIED DATE OF TEST

MD.- 2176

0. PREPARED B...(e) B. Johnson DATE 10/25/77

...ONSIBLE ENGINEER DATE

17

302 (3-73)

11-2-77

BECHTEL

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE 11/[illegible]/77 DATE

CONTROL NO.

FILE NO. C-210.3

1. PROJECT NO. 7220

2. DATE 10/25/77

PAGE 2 OF 5

SPEC. NO. 7220-C-208

5. ~~DRAWING NO.~~ PLANT AREA

6. TESTED WEEK OF 10/2/77 To 10/8/77

7. DATE TAKEN	8. TEST NO. MD.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION			17. MAX. / MIN ~~MAX.~~ LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION AS% RD	19. REMARKS
									RD	OMC	ZONE			
3/77	2157	RS PR	42'S. OF Q LINE ℄ OF 8" SEWER N. OF MANHOLE	625	—	125.4	11.9	112.1	55	N/A	2	109.7/90.2	109.8	PASS
3/	2158	BJ	7'E OF 15.0 LINE 6'S. OF H LINE STEAM TUNNEL	633	—	115.6	7.5	107.5	55	N/A	2	109.7/90.2	90.5	PASS
	2159	"	8'N. OF N. WALL 15'E. OF NW. COR. STEAM TUNNEL	615	—	122.9	5.7	116.3	55	N/A	2	109.7/90.2	126.2	PASS
—	2160 THRU 2165	SEE	PAGE 1											
4/77	2166	RS	17'S. OF MANHOLE #16 4'E. OF DUCT.	624	-	121.7	8.3	112.4	55	N/A	2	109.7/90.2	111.1	PASS
"	2167	"	50' CONT. #2 4' E. OF ELECT. DUCT. APROX. 100'E. OF 12.0	625.5	-	125.7	6.2	118.4	55	N/A	2	109.7/90.2	134.0	PASS
—	2168 THRU 2170	SEE	PAGE 1											
4/77	2171	BT	MANHOLE #16	624	—	122.2	8.1	113.0	55	N/A	2	109.7/90.2	113.5	PASS
"	2172	"	MANHOLE #7	628	—	130.2	11.1	117.2	55	N/A	2	109.7/90.2	129.6	PASS
"	2173	"	TRANSFORMER PIT 100'E. OF UNIT 2	625	—	128.5	7.4	119.6	55	N/A	2	109.7/90.2	138.3	PASS
"	2174	"	MANHOLE #16	626	—	125.9	10.3	114.1	55	N/A	2	109.7/90.2	117.8	PASS
"	2175	"	TRANSFORMER PIT 100' E. OF UNIT 2	627	—	118.4	7.4	110.0	55	N/A	2	109.7/90.2	101.3	PASS
—	2176 THRU 2178	SEE	PAGE 3											
5/77	2179	RS	W. 25 5'N. OF N. STEAM TUNNEL	613	—	122.4	8.8	112.5	55	N/A	2	109.7/90.2	111.5	PASS
"	2180	"	4'S. OF ELECT RISER 140'E. OF 12 LINE 70' CONT. 2	627	—	124.0	11.2	111.5	55	N/A	2	109.7/90.2	107.1	PASS
"	2181	"	40'S. OF Q 4'W. OF 10.C	624.5	—	128.9	11.4	115.7	55	N/A	2	109.7/90.2	124.0	PASS

PREPARED BY B. Johnson DATE 10/25/77

RESPONSIBLE ENGINEER DATE

Typed 11-2-77

12.13.131

QC-C1

BECHTEL

COMPACTED FILL DENSITY TEST REPORT

3. D F Cole 12/9/77
QC ACCEPTANCE DATE

CONTROL NO. C.210.B FILE NO.

1. PROJECT NO. 7220
2. DATE 10/24/77
PAGE 1 OF 5

SPEC. NO. 7220-C-208
5. ~~DRAWING NO.~~ PLANT AREA
6. TESTED WEEK OF 10/2/77 To 10/8/77

DATE TAKEN	8. TEST NO. MD.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMP	ZONE	17. MAX./MIN. ~~MAX.~~ LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
/3/77	2151	R.S. P.R.	S. 5282 E. 282	633.5	—	143.0	13.9	125.5	277	13.4	1	121.0	103.7	PASS
	2152	"	S. 5308 E. 205	633.5	-	142.0	13.0	125.7	277	13.4	1	121.0	103.9	PASS
"	2153	"	S. 5333 E. 365	630.5	—	144.5	13.3	127.5	277	13.4	1	121.0	105.4	PASS
"	2154	"	S. 5360 E. 435	628	-	140.5	14.0	123.2	277	13.4	1	121.0	101.8	PASS
/3/77	2155	P.R. R.S.	S. 5350 E. 160	630.5	-	140.0	13.4	123.5	277	13.4	1	121.0	102.1	PASS
/3/77	2156	R.S.	S. 5074 E. 552	632.5	-	140.5	12.4	125.0	277	13.4	1	121.0	103.3	PASS
—	2157 THRU 2159	SEE	PAGE 2											
/4/77	2160	R.S.	S. 5122 E. 295	629.5	-	142.0	11.8	127.0	277	13.4	1	121.0	105.0	PASS
"	2161	"	S. 5062 E. 567	632.5	-	135.5	13.2	119.7	277	13.4	1	121.0	98.9	PASS
"	2162	"	S. 5335 E. 387	633.5	-	142.5	12.9	126.2	277	13.4	1	121.0	104.3	PASS
"	2163	"	S. 5324 E. 240	633.5	-	145.0	15.4	125.7	277	13.4	1	121.0	103.9	PASS
"	2164	"	S. 4960 E. 830	629	-	141.5	13.6	124.6	277	13.4	1	121.0	103.0	PASS
"	2165	"	S. 5355 E. 421	633	-	145.0	12.8	128.5	270	11.1	1	124.6	103.1	PASS
—	2166 THRU 2167	SEE	PAGE 2											
/4/77	2168	BT	S. 5030 E. 612	633	-	142.0	13.1	125.5	277	13.4	1	121.0	103.7	PASS
"	2169	"	S. 5368 E. 220	633	-	142.5	13.8	125.2	277	13.4	1	121.0	103.5	PASS
"	2170		S. 5000 E. 657	633.5	-	142.5	12.5	12[illegible]7	277	13.4	1	121.0	104.7	PASS

PREPARED BY (Signature) B. Johnson DATE 10/24/77

ONSIBLE ENGINEER DATE

11·2·77

QC C1

Bechtel Power Corporation

Interoffice Memorandum

To R. L. Castleberry

File No.

Subject Midland Project Job 7220
Moisture Requirements for
Backfill Prior to Placement
Spec. C-210, Rev. 5
BCBE-1802

Date February 27, 1978

From J. F. Newgen

Of Construction

At Midland, MI Ext.

Copies to W. L. Barclay w/a
B. Rixford w/a
D. L. Osborn wo/a
T. R. Lieb wo/a

References:
1) QAR SD40 dated 7-22-77 (Attached)
2) Moisture Control Log (Attached)
3) Canonie Q.A. - QC Daily Reports (Attached)
4) Inplace density and moisture reports (Attached)

Reference 2 was initiated in response to reference 1 on August 1, 1977. A Q.C. review of reference 2 revealed subject soil tests were not performed prior to placement on August 9, 1977, August 30, 1977, October 3, 1977, October 4, 1977 and October 5, 1977 when Canonie Inc. worked in "Q" list areas. Note: Moisture and compaction tests were performed after placement.

Please evaluate the acceptability of the material placed on the aforementioned dates. To assist in your evaluation references 3 and 4 are attached.

If additional information is required do not hesitate to contact me.

J. F. Newgen

JFN/WLB/LLL/AF/TRL/jae

Attachments

8024 (1-74)

QUALITY ACTION REQUEST

From: ①
G. L. Richardson Site QA Job 7220

To: J. F. Newgen/ ~~G.~~ P. Connolly ②

Control Document ref.: 7220-C-210 ③

QAR Ident. No.: SD-40 ④

Action Requested: ⑤

Section 13.0 of specification 7220-C-210, Rev. 4 provides the requirements for Q-listed backfill in the plant area. Section 13.6 states that the moisture control in this area shall be in accordance with Section 12.6 of the same specification. Section 12.6 states in part: "The water content during compaction shall not be more than 2 percentage points below optimum moisture content and shall not be more than 2 percentage points above optimum moisture content" . . ."

"Tests done in accordance with para. 12.5 will indicate the degree of moistening of aerating necessary to comply with para. 12.6.1. After placement of loose material on the embankment fill, the moisture content shall be further adjusted as necessary to bring such material within the moisture content limits required) OVER

Signature: Gary L. Richardson ⑥

Date: 7/22/77 ⑦

Reply Requested by: 1&3) 7/25/77 2) 8/19/77 ⑧

Reply: ⑨

ROUTE QC 07220 INIT.
PFQCE
A. PFQCE
CIVIL
ELECT.
PIPING
MECH.
WELDING
DOC.
RECEIVING
[illegible] ASST
OPEN ITEM
☐ YES ☑ NO
DATE.......

RECEIVED
JUL 22 1977
QUALITY CONTROL
BECHTEL JOB 7220
dp

Signature: ⑩

Date: ⑪

Action Verified: ⑫

Date: ⑬

8/2/71

WHITE — Return to sender CANARY — Addressee's file PINK — Sender's file

BPC 20877
G1001649-05

for compaction."

"Rolling of any section of embankment containing material too wet or too dry to obtain the required compaction shall be delayed until the moisture content of the material is brought to within the required limits or the material shall be removed and replaced with suitable material. . ."

Contrary to the above: 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.

Recommended Corrective Action

1) A system for testing the soil for moisture content prior to compaction should be developed and implemented by Bechtel and the subcontractor. QC should make any necessary revisions to the QCI.

2) Recognizing that the soil has been tested for moisture content after compaction and meets the requirements of the specification it is not necessary to identify these materials as nonconforming. However Project Engineering should be apprized of the past testing methods. In addition it is recommended that engineering concur with the interpretation that moisture contents taken after compaction are for determining dry densities and should not be used for specified moisture control.

3) Assure responsible personnel are aware of the testing system.

Midland Units 1 & 2

Bechtel Job 7220

7220-C-210 "Q" Test Soil Moisture Control Log

"Q" Soils Placements By Canonie	Control Moistures (%)	Comments
8- 1-77	10.3	
8- 2-77	8.7	
8- 3-77	11.2	
8- 4-77	8.9	
8- 9-77		
8-11-77	9.8/9.9	
8-12-77	9.6	
9-30-77		
10- 3-77		
10- 4-77		
10- 5-77		
10- 6-77	10.1	
10- 7-77	13.[illegible]	
10-13-77	8.6	
10-16-77	10.[illegible]	

Figure 3 Rev. 7/26/73

MIDLAND NUCLEAR UNITS 1 & 2
CANONIE CONSTRUCTION COMPANY

P. M. ________
G. S. ________
F. S. ________

FILL PLACEMENT QA-QC DAILY REPORT

FEATURE:
- ( ) Emergency Cooling Pond Berm
- (X) Plant Area Fills
- ( ) R/R Embankment
- ( ) Laydown Area
- ( ) Cooling Pond Dike

Date Aug. 9, 1977
Shift Day
Weather Clouds Rain
Foreman Dave Dekker
Elevation 630.0
Station S 5000 To Station S 5100
Offset E 500 — E700

Moisture Tests

			M.	D.
S 5122	E600	Elev. 626.0	11.9	97.6
S5107	E 520	Elev 632.5	11.5	100.7

ZONE:
- ( ) 1
- ( ) 1-A
- (X) 2
- ( ) 3
- ( ) 4
- ( ) 4-A
- ( ) 5
- ( ) 6

Load Count 4-4-6-10

COMPACTION REQUIREMENT:

Equipment No.	Type	Frequency	Time	Speed
#272	TD 8 Tractor			
#1139	Vibra Plus Comp.	1600		2 mph
#2123	HD-21 Tractor			
#644	Disc.			
#2165	HD-11 Tractor			
#1184	Hyster Packer	Kneading		2 mph

REMARKS/SKETCH:

Placing Zone 2 small areas East Turbin Bldg.
Material going together well.

By:
CANONIE CONSTRUCTION COMPANY

MIDLAND NUCLEAR UNITS 1 &
CANONIE CONSTRUCTION COMPANY

P. M. ______
G. S. ______
F. S. ______

FILL PLACEMENT QA-QC DAILY REPORT

( ) Emergency Cooling Pond Berm
(X) Plant Area Fills
( ) #?? Embankment
( ) Laydown Area
( ) Cooling Pond Dike

Date Sept 30 1977
Shift Day
Weather Cloudy Late Showers
Foreman D. Dakker
Elevation 631.0±
Station S 5250 To Station S 5150
Offset E 500 — E 650
Moisture Tests

			M	D
S5047	E614	Elev. 632.0	10.0	99.3
S5082	E569	Elev. 632.0	11.6	100.9
S5060	E ~~590~~	~~Elev. 629.5~~	~~10.6~~	~~99.1~~

ZONE:

( ) 1
( ) 1-A
(X) 2
( ) 3
( ) 4
( ) 4-A
( ) 5
( ) 6

Load Count 40 ~~??~~ 10 cy

COMPACTION REQUIREMENT:

Equipment No.	Type	Frequency	Time	Speed
#1136	Hyster	Kneeding		2mph
#277	Tractor TD8			
#1139 ~~[illegible]~~	VibroPlus Comp.	1775		2mph.

REMARKS/SKETCH:

Placed Zone 2 as back fill over 26" pipe after Bechtel sand.

By: Gene Dakker
CANONIE CONSTRUCTION COMPANY

Figure 3 Rev. 7/26/73

MIDLAND NUCLEAR UNITS 1 & 2
CANONIE CONSTRUCTION COMPANY

P. M. ____________
G. S. ____________
F. S. ____________

FILL PLACEMENT QA-QC DAILY REPORT

FEATURE:
( ) Emergency Cooling Pond Berm
(X) Plant Area Fills
( ) R/R Embankment
( ) Laydown Area
( ) Cooling Pond Dike

Date Oct. 3, 1977
Shift Day
Weather Sun Cool Breeze 60°
Foreman D. Dekker
Elevation 632.5
Station S 5050 To Station S 5150
Offset E500 E550
Moisture Tests
S. 5074 E552 Elev. 632.5 M 12.4 D 103.3

ZONE:

( ) 1	( ) 4
( ) 1-A	( ) 4-A
(X) 2	( ) 5
( ) 3	( ) 6

Load Count 35 @ 10

COMPACTION REQUIREMENT:

Equipment No.	Type	Frequancy	Time	Speed
#271	TD 7			
#272	TD 8			
#1139	Vibro Plus Comp.	1775		2mph

REMARKS/SKETCH:

Rain over weekend. stripped Zone 2 ar for placement.
Zone 2 backfill 26" pipe.

By: ____________
CANONIE CONSTRUCTION COMPANY

MIDLAND NUCLEAR UNITS 1 & 2
CANONIE CONSTRUCTION COMPANY

P.M. ____________
G.S. ____________
F.S. ____________

FILL PLACEMENT QA-QC DAILY REPORT

FEATURE:
☐ Emergency Cooling Pond Berm
☒ Plant Area Fills
☐ R/R Embankment
☐ Laydown Area
☐ Cooling Pond Dike

Date Oct 4 1977
Shift Day
Weather Cool 50°-70
Foreman D. Dekker
Elevation —
Station S 5050 To Station S 5150
Offset E 500 — E 650

ZONE:
☐ 1
☐ 1-A
☒ 2
☐ 3
☐ 4
☐ 4-A
☐ 5
☐ 6

Moisture Tests

			M	D
S 5122	E 454	El. 629.5	11.8	105.6
S 5062	E 567	El. 632.5	13.2	96.7
S 5030	E 612	El. 633.0	13.1	103.7
S 5000	E 657	El. 633.5	12.5	104.7

Load Count 160 @ 10

COMPACTION REQUIREMENT:

Equipment No.	Type	Frequancy	Time	Speed
#274	TD7			
#272	TD8			
#1139	Vibro Plus Comp.	1775		2 mph
#1156	Hyster Comp.	Kneading		2 mph

REMARKS/SKETCH:

Placed Zone 2 backfill over 26" pipe South & East Turbine.

By: ____________
CANONIE CONSTRUCTION COMPANY

Figure 3 Rev. 7/26/73

MIDLAND NUCLEAR UNITS 1 & 2
CANONIE CONSTRUCTION COMPANY

P. M. ____________
G. S. ____________
F. S. ____________

FILL PLACEMENT QA-QC DAILY REPORT

FEATURE:
( ) Emergency Cooling Pond Berm
(✗) Plant Area Fills
( ) R/R Embankment
( ) Laydown Area
( ) Cooling Pond Dike

Date Oct 5, 1977
Shift Day
Weather Cool Bright 60°
Foreman D. DaWalker
Elevation 629.5
Station S 5050 To Station S 5150
Offset E 500 E650

ZONE:

( ) 1	( ) 4
( ) 1-A	( ) 4-A
(✗) 2	( ) 5
( ) 3	( ) 6

Load Count 135 @ 10

Moisture Tests

			M.	D.
S 5087	E562	El. 633.5	13.5	106.1
~~S 5150~~	~~E 400~~	~~El. 629.2~~	~~12.9~~	~~104.7~~
S5165	E420	El. 630.5	13.1	106.0

COMPACTION REQUIREMENT:

Equipment No.	Type	Frequency	Time	Speed
#271	TD 7			
#272	TD 8			
#1139	Vibro Plus Comp.	1775		2mph
#1186	Hyster Comp.	Kneading		2mph

REMARKS/SKETCH:

Placed Zone 2 area south & East of turbin bldg.

By: ____________
CANONIE CONSTRUCTION COMPANY

COMPACTED FILL DENSITY TEST REPORT

3. 8/29/77
QC ACCEPTANCE — DATE
CONTROL NO. 3 — FILE NO. C-210

1. PROJECT NO. 7220
2. DATE 8/12/77
PAGE 2 OF 3

4. SPEC. NO. 7220-C-208
5. ~~DRAWING NO.~~ PLANT AREA
6. TESTED WEEK OF 8/6/77 To 8/12/77

7. DATE TAKEN	8. TEST NO. MD.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
8/9/77	1837	RS	S. 5025 E. 542	631.5	—	145.0	9.8	132.0	269	10.0	1	127.3	103.7	Pass
	1838	"	S. 5074 E. 532	632	—	141.5	11.7	126.7	269	10.0	1	127.3	99.5	Pass
"	1839	"	S. 5122 E. 600	626	—	139.0	11.9	124.2	269	10.0	1	127.3	97.6	Pass
"	1840	"	S. 5107 E. 520	632.5	—	143.0	11.5	128.2	269	10.0	1	127.3	100.7	Pass
"	1841	"	S. 5090 E. 612	628.5	—	143.0	13.5	126.0	269	10.0	1	127.3	99.0	CLEARED BY Removing Material
—	1842	SEE	Page 1											
8/10/77	1843	BT	25' N.S.W. COR. OF STEAM TUNNEL 15' S. OF Q LINE	630	—	135.5	11.5	121.5	269	10.0	1	127.3	95.4	Pass
"	1844	"	12' S. OF Q 5' E OF S.W. COR. STEAM TUNNEL	632	—	143.5	11.7	128.5	269	10.0	1	127.3	100.9	Pass
8/11/77	1845	KM/RS	W. 54 10' S. OF Q LINE	631	—	139.0	11.3	124.0	269	10.0	1	127.3	97.4	Pass
"	1846	"	S. 5125 E. 578	630.5	—	145.0	12.2	129.2	270	11.1	1	124.6	103.7	Pass
"	1847	"	S. 4996 E. 935	632	—	141.0	11.9	126.0	270	11.1	1	124.6	101.1	Pass
8/11/77	1848	BT	S. 5087 E. 602	632	—	141.5	10.5	128.0	270	11.1	1	124.6	102.7	Pass
"	1849	"	S. 5000 E. 915	633	—	145.5	12.8	129.0	270	11.1	1	124.6	103.5	Pass
"	1850	"	110' W. OF W. WALL OF AUX. BLDG. 3' E. OF 11.0	629	—	141.0	13.5	124.2	270	11.1	1	124.6	99.7	Fail
"	1851	"	110' W. OF W. WALL OF AUX. BLDG. 3' E. OF 11.0	629	—	142.0	11.8	127.0	270	11.1	1	124.6	101.9	CLEARS MD 1850 Pass
8/12/77	1852	RS	S. 5112 E. 359	624	—	139.5	11.8		269	10.0	1	127.3	98.0	Pass
"	1853	"	S. 5019 E. 432	630.5	—	142.0	11.8		269	10.0	1	127.3	99.8	Pa

Q.C. Rep. Notified
Time & Date of Notification
Reporting Person

MD 1841, 1850 Verification time of testing
MD 1841 material removed
MD 1850 cleared by MD 1851

PREPARED BY Bill Johnson DATE
RESPONSIBLE ENGINEER DATE

BECHTEL

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE — DATE 10/21/77
CONTROL NO. 30 — FILE NO. [illegible]

1. PROJECT NO. 7220
2. DATE 10/17/77
PAGE 2 OF 5

4. SPEC. NO. 7220-C-208
5. ~~DRAWING NO.~~ PLANT AREA
6. TESTED WEEK OF 9/25/77 To 10/1/77

7. DATE TAKEN	8. TEST NO. MD.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION RD	OMC	ZONE	17. MAX./MIN ~~MAX.~~ LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION AS% RD	19. REMARKS
/26/77	2101	RS	8'S.OF 7.0 2'E.OF EVAP. Bldg.	633.5	—	129.7	10.4	117.5	55	N/A	2	109.7/90.2	130.7	PASS
/2 7	2102	KM	4'E OF 13 LINE 7'N.OF G LINE	633.5	—	121.3	9.4	110.9	55	N/A	2	109.7/90.2	105.0 ~~105.5~~ BJ 10/17/77	PASS
"	2103	"	5'E.OF 14 LINE 4'S. OF F LINE	633.5	—	117.2	8.3	108.2	55	N/A	2	109.7/90.2	93.6	PASS
—	2104 THRU 2127	SEE	PAGES 1 & 3											
/28/77	2128	KM	100'E.OF 12 LINE 30'N.OF K LINE OVER DUCT LINE	626	—	121.1	7.5	112.7	55	N/A	2	109.7/90.2	112.3	PASS
"	2129	"	100'N.OF END OF CIR. WATER RET. WALL 20'S OF WALL OVER DRAIN	626	—	121.7	~~4.9~~ 8.1 BJ 10/17/77	122.7	55	N/A	2	104.7/90.2	111.9	PASS
"	2130	"	40'S.OF S WALL OF CIR. WATER STRUCT. 45'W.OF CIR. WATER OVER DR	627	—	~~122.9~~ 112.6 BJ 10/17/77	8.7	113.1	55	N/A	2	104.7/90.2	113.9	PASS
/29/77	2131	RS	120'E. OF 12.6 LINE 28'N.OF K LINE NEXT TO DUCT	628	—	119.2	8.3	110.1	55	N/A	2	109.7/90.2	101.7	PASS
—	2132 THRU 2149	SEE	PAGES 5 & 4											
/30/77	2150	KM	20'W.OF 12 LINE 130'S.OF Q LINE CENTER 26" PIPE	~~625~~	~~—~~	~~133.5~~	~~5.9~~	~~126.1~~	N/A B.J. 10/17/77					
/30/77	2150	KM	5'W.OF 11 LINE 115'S.OF Q LINE OVER DUCT	625	—	124.6	9.1	114.2	55	N/A	2	109.7/90.2	118.2	PASS

10. PREPARED BY B. Johnson DATE 10/17/77

RESPONSIBLE ENGINEER — DATE

002 (3-73) [illegible] - 2816 — 10.19.77

COMPACTED FILL DENSITY TEST REPORT

3. [illegible] 10/[illegible]/77
QC ACCEPTANCE / DATE
30 [illegible]
CONTROL NO. / FILE NO.

1. PROJECT NO. 7220

2. DATE 10/17/77

PAGE 4 OF 5

SPEC. NO. 7220-C-208

5. ~~DRAWING NO.~~ PLANT AREA

6. TESTED WEEK OF 9/25/77 To 10/1/77

DATE TAKEN	8. TEST NO. MO.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
28/77	2124	RS	S. 5395 E. 309	621.5	—	138.5	10.8	125.0	270	11.1	1	124.6	100.3	PASS
21	2125	KM	S. 5280 E. 209	631	—	140.0	12.0	125.0	277	13.4	1	121.0	103.3	PASS
"	2126	"	S. 5285 E. 282	631.5	—	138.0	13.1	122.0	277	13.4	1	121.0	100.8	PASS
"	2127	"	15' E. OF S.E. COR. [illegible] 15' N OF S.E. COR. OF MUP.	626.5	—	137.0	14.4	119.8	277	13.4	1	121.0	99.0	PASS
—	2128 THRU 2131	SEE	PAGE 2											
29/77	2132	RS	S. 5270 E. 417	631.5	—	145.0	10.5	131.2	269	10.0	1	127.3	103.1	PASS
"	2133	"	S. 5303 E. 269	631.5	—	144.5	12.0	129.0	270	11.1	1	124.6	103.5	PASS
"	2134	"	12' N. OF S.W. COR. OF MUP. 20' W. OF S.W. CORNER MUPS.	623.5	—	139.0	13.0	123.0	277	13.4	1	121.0	101.7	PASS
"	2135	"	5' W. OF S.W. COR 68' S. OF S.W. COR. MUPS.	632	—	143.0	13.9	125.5	277	13.4	1	121.0	103.7	PASS
"	2136	"	37' S. OF S.W. COR. 2' E. OF S.W. OF M.U.P.S.	633.5	—	140.0	11.8	125.2	270	11.1	1	124.6	100.5	PASS
29/77	2137	KM	S. 5270 E. 320	633	-	138.0	12.4	122.8	270	11.1	1	124.6	98.6	PASS
"	2138	"	S. 5266 E. 249	633	-	143.0	11.5	128.3	270	11.1	1	124.6	103.0	PASS
"	2139	"	S. 5060 E. 590	629.5	-	136.5	12.8	121.0	270	11.1	1	124.6	97.0	PASS
30/77	2140	RS	S. 5353 E. 133	628.5	-	149.0	11.4	133.7	260	10.6		129.8	103.0	PASS
"	2141	"	S. 5376 E. 269	628	-	139.5	11.9	124.7	270	11.1		124.6	100.1	PASS
"	2142	"	W. 41 96' N. OF AA W. OF STEAM TUNNEL	626	-	141.0	14.6	123.0	277	13.4		121.0	[illegible]	PASS
"	2143	"	W. 41 116' N. OF AA W. OF STEAM TUNNEL	622	-	145.0	12.0	129.5	277	13.4		121.0	[illegible]	PASS

PREPARED BY B. [illegible] DATE 10/17/77

RESPONSIBLE ENGINEER [illegible] DATE [illegible]

COMPACTED FILL DENSITY TEST REPORT

3. [illegible] [illegible]
QC ACCEPTANCE DATE
30 C 810.5
CONTROL NO. FILE NO.

1. PROJECT NO. 7220
2. DATE 10/17/77
PAGE 5 OF 5

SPEC. NO. 7220-C-208
5. ~~DRAWING NO.~~ PLANT AREA
6. TESTED WEEK OF 9/25/77 To 10/1/77

ATE AKEN	8. TEST NO.	9. TEST-ED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION			17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
	MD.								BMP	OMC	ZONE			
0/77	2144	RS.	W.41 156'N.OF AA W. OF STEAM TUNNEL	615	–	139.5	14.3	122.0	277	13.4	1	121.0	100.8	PASS
"	2145	"	W.41 54'N.OF AA STEAM TUNNEL	628	–	138.0	12.5	122.7	271	13.4	1	121.0	101.4	PASS
"	2146	"	S. 5282 E. 569	632	–	146.5	11.8	131.0	260	10.6	1	129.8	100.9	PASS
"	2147	"	S. 5282 E. 296	633.5	–	139.5	13.2	123.2	277	13.4	1	121.0	101.8	PASS
"	2148	"	S. 5313 E. 145	632.5	–	141.0 ~~126~~ [illegible]	11.5	126.5	270	11.1	1	124.6	101.5	PASS
"	2149	"	S. 5040 E. 614	632	–	143.0	10.4	129.5	260	10.6	1	129.8	99.8	PASS

PREPARED BY B. Johnson DATE 10/17/77 21

IBLE ENGINEER Tom [illegible] DATE

[illegible] 10-18-77

COMPACTED FILL DENSITY TEST REPORT

3. Dr Oole [illegible] QC ACCEPTANCE 11/8/77 DATE
30 CONTROL NO. C-210.3 FILE NO.

1. PROJECT NO. 7220
2. DATE 10/26/77
PAGE 5 OF 5

SPEC. NO. 7220-C-208
5. ~~DRAWING NO.~~ PLANT AREA
6. TESTED WEEK OF 10/2/77 To 10/8/77

DATE TAKEN	8. TEST NO. MD.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION BMP	OMC	ZONE	17. MAX. LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION	19. REMARKS
/6/77	2190	RS	6' N. OF N. STEAM TUNNEL WALL W. 12	621	–	139.0	11.6	124.5	270	11.1	1	124.6	99.9	PASS
"	2191	"	S. 5163 E. 372	631	–	146.0	12.6	129.7	270	11.1	1	124.6	104.1	PASS
"	2192	"	S. 5148 E. 400	633	–	144.0	12.9	127.5	270	11.1	1	124.6	102.3	PASS
"	2193	"	S. 5166 E. 427	633	–	144.0	13.7	126.7	277	13.4	1	121.0	104.7	PASS
"	2194	"	6' N. OF N. WALL STEAM TUNNEL W. 25	624	–	141.0	12.8	125.0	270	11.1	1	124.6	100.3	PASS
/6/77	2195	KM	S. 5130 E. 442	631	–	145.5	12.4	129.5	270	11.1	1	124.6 ~~126~~ 85 [illegible]	103.9	PASS
"	2196	"	7' N. OF N. WALL OF STEAM TUNNEL WALL W. 10	626	–	135.5	13.4	119.5	277	13.4	1	121.0	98.8	PASS
—	2197 THRU 2200	SEE	PAGE 4											
/7/77	2201	KM RS	S. 2155 E. 425	633.5	–	147.0	9.3	134.5	297	9.0	1	131.6	102.2	PASS
"	2202	"	S. 5151 E. 407	633.5	–	140.5	12.2	125.2	270	11.1	1	124.6	100.5	PASS
"	2203	"	6' N. OF N. WALL OF STEAM TUNNEL	627	–	143.0	10.7	129.2	270	11.1	1	124.6	103.7	PASS

PREPARED BY B. Johnson DATE 10/25/77
[illegible] 11-2-77
NSIBLE ENGINEER DATE 17

Q2 (1-73)
QC-C1

BECHTEL

COMPACTED FILL DENSITY TEST REPORT

3. QC ACCEPTANCE 12/5/77 DATE
CONTROL NO. C-210.3 FILE NO.

1. PROJECT NO. 7220
2. DATE 10/26/77
PAGE 4 OF 5

SPEC. NO. 7220-C-208
5. ~~DRAWING NO.~~ PLANT AREA
6. TESTED WEEK OF 10/2/77 To 10/8/77

DATE TAKEN	8. TEST NO. MD.	9. TESTED BY	10. LOCATION	11. ELEV. OF TEST	12. DEPTH BELOW FINAL GRADE (FT.)	13. IN PLACE WET DENSITY (LB./C.F.)	14. MOISTURE CONTENT (%)	15. IN PLACE DRY DENSITY (LB./C.F.)	16. SOIL CLASSIFICATION			17. MAX./MIN. ~~MAX.~~ LAB. DRY DENSITY (LB./C.F.)	18. PERCENT COMPACTION AS% RD	19. REMARKS
									RD	OMC	ZONE			
10/5/77	2188	BT	10'S. OF MANHOLE #16	628	—	124.1	8.1	114.8	55	N/A	2	109.7/90.2	120.5	PASS
"	2189	"	15'S. OF MANHOLE #16	627	—	117.2	6.7	109.8	55	N/A	2	109.7/90.2	100.4	PASS
—	2190 THRU 2196	SEE	PAGE 5											
10/6/77	2197	RS	42'S. OF ℄ 4'W. OF 10.0	625	—	117.1	6.7	109.7	55	N/A	2	109.7/90.2	100.0	PASS
"	2198	"	60° CONT. #2 4'N. OF W. ELECT DUCT	628	—	117.3	7.1	109.5	55	N/A	2	109.7/90.2	99.2	PASS
"	2199	"	60° CONT. #2 4'S. OF E. ELECT. DUCT.	627	—	119.4	7.6	111.0	55	N/A	2	109.7/90.2	105.4	PASS
"	2200	"	12'N. OF MANHOLE #16	627.5	—	116.3	6.8	108.9	55	N/A	2	109.7/90.2	96.6	PASS
—	2201 THRU 2203	SEE	PAGE 5	BJ 10/26/77 ~~632~~										
10/8/77	2204	BT	8'W. OF 3.0 120'S. OF ℄	632	BJ 10/26/77 ~~17~~ —	123.6	7.2	115.3	55	N/A	2	109.7/90.2	122.5	PASS
"	2205	"	3'E. OF 3.0 125'S. OF ℄	632	—	122.1	9.0	112.0	55	N/A	2	109.7/90.2	109.5	PASS
10/8/77	2206	RS	21' N. OF N SIDE MANHOLE #16	628	—	125.9	12.6	111.8	55	N/A	2	109.7/90.2	108.7	PASS
"	2207	"	℄ BETWEEN WATER METER MANHOLES	632	—	125.0	9.0	114.7	55	N/A	2	109.7/90.2	120.2	PASS
"	2208	"	17'N. OF MANHOLE #16	630	—	119.4	8.1	110.5	55	N/A	2	109.7/90.2	103.5	PASS

0. PREPARED B e) 10/26/77 Bill Johnson DATE 10/26/77 :
NSIBLE ENGINEER DATE 17
11-7-77

QC-C1

for compaction."

> "Rolling of any section of embankment containing material too wet or too dry to obtain the required compaction shall be delayed until the moisture content of the material is brought to within the required limits or the material shall be removed and replaced with suitable material. . ."

Contrary to the above: 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.

Recommended Corrective Action

1) A system for testing the soil for moisture content prior to compaction should be developed and implemented by Bechtel and the subcontractor. QC should make any necessary revisions to the QCI.

2) Recognizing that the soil has been tested for moisture content after compaction and meets the requirements of the specification it is not necessary to identify these materials as nonconforming. However Project Engineering should be apprized of the past testing methods. In addition it is recommended that engineering concur with the interpretation that moisture contents taken after compaction are for determining dry densities and should not be used for specified moisture control.

3) Assure responsible personnel are aware of the testing system.

TELECOPY

BEBC-668

Bechtel Associates Professional Corporation

Inter-office Memorandum

To E. E. Felton

Date December 27, 1974

Subject Midland Plant Units 1 and 2
Job 7220
Q-Listed Fill (Dwg. C-45, Rev. C)
File: 0274, C-210

From R. L. Castleberry

Of Engineering

Copies to

At Ann Arbor

This IOM is to provide clarification of the intent of Dwg. C-45, in response to telephone conversations on 12-11-74 with T. Hudson, J. Serafin and R. Crote.

Dwg. C-45 and this memo give the Quality requirements which are applicable to the backfill work done by Bechtel as opposed to the Quality requirements of Specification C-210 which are applicable only to the C-210 Subcontractor (Canonie).

The cross hatched areas on Dwg. C-45 were located to include all Q-listed structures, pipes and facilities, plus an allowance for possible minor re-alignment and/or shifting. Hence, it is intended that there will be no Q-listed items or structures outside the cross hatched areas and the material used for backfill at trenches and temporary excavations in this non-Q area need not be controlled, with the following exception: any material removed from within the "dike section" must be replaced with material which meets all the requirements of the material originally used except it need not be Q-listed. (Lean concrete backfill is considered acceptable for replacement of zones 1 and 2).

Please advise if you have any further questions on this item.

R. L. Castleberry

RLR/slv

Bechtel Power Corporation

Interoffice Memorandum

To R. L. Castleberry

File No

Subject Midland Project Job 7220
Moisture Requirements for
Backfill Prior to Placement
Spec. C-210, Rev. 5
MCBE-1802

Date February 27, 1978

From J. F. Newgen

Of Construction

Copies to W. L. Barclay w/a
B. Rixford w/a
D. L. Osborn wo/a
T. R. Lieb wo/a

At Midland, MI Ext

References:
1) QAR SP40 dated 7-22-77 (Attached)
2) Moisture Control Log (Attached)
3) Canonie Q.A. - QC Daily Reports (Attached)
4) Inplace density and moisture reports (Attached)

Reference 2 was initiated in response to reference 1 on August 1, 1977. A Q.C. review of reference 2 revealed subject soil tests were not performed prior to placement on August 9, 1977, August 30, 1977, October 3, 1977, October 4, 1977 and October 5, 1977 when Canonie Inc. worked in "Q" list areas. Note: Moisture and compaction tests were performed after placement.

Please evaluate the acceptability of the material placed on the aforementioned dates. To assist in your evaluation references 3 and 4 are attached.

If additional information is required do not hesitate to contact me.

J. F. Newgen

JFN/[illegible]/jac

Attachments

Bechtel Power Corporation

Interoffice Memorandum

To G. Richardson

Subject Job 7220 Midland Project
Moisture Requirements for
Backfill - QAR SD-40
0-1631

Copies to

File No.

Date December 21, 1977

From J. F. Newgen

Of Construction

At Midland, MI Ext.

References: 1) BEBC-1998
2) BEBC-1859

This memo is a complete response to the subject quality action request, which asked that Project Engineering be apprised of past testing methods used for determining moisture content of backfill.

Reference memos numbers 1 and 2 contain the Project Engineering response to our notification of past test methods.

We trust this information closes your action request.

J. F. Newgen

JFN/FGT/jae

QA ROUTE	INFO.	ACT.
LOAE	✓	
CIVIL (1)		
CIVIL (2)		
MECH		
PIPING		
ELECT.	ROH	
INST.		
SEC'Y		
FILE NO	Q2220	

DW I-77-184

Bechtel Associates Professional Corporatio

Inter-office Memorandum

BEBC- 1998

To J. F. Newgen

Date December 15, 1977

Subject Midland Plant Units 1 & 2
Job 7220
Moisture Requirements for
Backfill

From R. L. Castleberry

Of Engineering

Copies to File: 0274, C-210, C-208

At Ann Arbor

S. Afifi

RECEIVED
DEC 15 1977
BECHTEL POWER CORP.
JOB 7220
PER ____

Reference: 1. BCBE-1669-dated 11/18/77

This is a complete response to Reference 1.

The moisture content of the soil should be within 2% of optimum <u>during</u> placement and compaction. However, this property of the soil is not necessarily a measure of its adequacy <u>after</u> compaction.

The primary goal is to obtain the specified dry density. In order to achieve this end, certain means are prescribed; e.g., maximum lift thickness, specified compactive effort and controlled moisture content.

Soil which has been tested a few days following compaction and found to have suitable dry density should not be rejected solely on the basis that its moisture content is not within 2% of optimum.

for J B Hink
R. L. Castleberry

[illegible]
12/15/7

TELECOPY

Bechtel Power Corporation

Interoffice Memorandum

To R. L. Castleberry

File No

Subject Job 7220 Midland Project
Backfill Moisture Requirement
Spec. C-210
BCDE-1669R

Date November 18, 1977

From J. F. Newgen

Of Construction

At Midland, MI Ext.

Copies to G. Richardson
B. Cheek
G. Tuveson
J. Dean

Confirming verbal requests; please provide written clarification of the 2% tolerance on backfill moisture content during compaction. Although moisture tests are taken both <u>during</u> and sometimes <u>after</u> compaction we have been verbally informed that for Zone I material moisture tests taken within a few days after compaction which do not fall within 2% of optimum moisture shall be cause for rejection of the fill, even though proper compaction is achieved. Information moisture tests taken more than a week after Zone I fill has been properly compacted are not so limited. For Zone II materials these limits can also be extended in accordance with previous written direction.

Your response is required by 11/30/77 in order to process documentation of backfill which was not placed in accordance with the verbal information above, if necessary.

J. F. Newgen

JFN/FGT/jae

RECEIVED
NOV [illegible] 1977
BECHTEL POWER CORP.
JOB 7220
BY

QA
RO...
ACT.
SECY

BECHTEL

Telephone call

cc:
XXXXX S. Rao
W. Barclay
G. Richardson
A. Boos
F. Teague
T. Lieb
J. Speltz - UST
File

BY J. G. Hook OF Site - QA

TO S. Rao OF AAO

DATE October 13, 19 77 TIME 11:35

SUBJECT Moisture Requirements for Backfill Ref: QAR SD-40 JOB NO. 7220

Returned S. Rao's call about the telecon dated October 10, 1977 on the same subject.

RAO: What I said on moisture requirements for backfill is not what you wrote on the telecon. The moisture requirement (± 2% of optimum) is mandatory and must be implemented at the time of placement and testing.

HOOK; OK. I will write a new telecon stating this and make distribution to the same people previously copied.

Jon G. Hook

QA ROUTE
INFO.
ACT.
SECY
FILE NO.

Telephone call

CC:
~~XXXXX~~ S. Rao
W. Barclay
G. Richardson
A. Boos
F. Teague
File

BY J. G. Hook OF QA - Site

TO S. Rao OF AAO

DATE October 10, 19 77 TIME 1:40

SUBJECT Moisture Requirements For Backfill

JOB NO.

I called Rao, the originator of letter BEBC-1859, to clear up any misunderstanding I had on the letter.

HOOK:	In the past, we controlled the moisture by taking the test at the same time we took our density tests. Was this acceptable?
RAO:	Yes, it is, as indicated in letter BEBC-1859.
HOOK:	Should we continue in the same manner as we have in the past?
RAO:	No. Moisture should be controlled in the borrow area prior to compaction.
HOOK:	Should a compaction area be rejected because it did not have the proper moisture content (± 2% of optimum) even though the density was acceptable.
RAO:	There is no moisture requirements at the time of density testing, only a density requirement. The moisture requirement is prior to compaction.

QA ROUTE	INFO.	ACT.
[illegible]		
CIVIL (1)	JGH	
CIVIL (2)		
MECH		
PIPING		
ELECT.		
INST.		
SEC'Y		
FILE NO.	w/ CM-50-40	

Barclay

Telephone call

CC:
~~XXXX~~ S. Rao
~~C.B.~~ Richardson
J. Speltz - UST
File

BY J. G. Hook OF QA - Site

TO S. Rao OF AAO

DATE October 6, 1977 TIME 10:40 am

SUBJECT CPCo NCR QF-173

JOB No. 7220

Several questions were raised on the response from Project Engineering on CPCo NCR QF-173. I talked to S. Rao the originator of the evaluation to clear up any misunderstanding.

HOOK:	Is the soil condition represented on QF-173 acceptable?
RAO:	Yes it is, it is a "Use-As-Is"
HOOK:	Can the field continue to test the material the way they have in the past?
RAO:	No. They must indicate what sieve size they are using to obtain their sample, either the #40 or #200 sieve. They must also have atleast 500 GRMS ~~on~~ ABOVE that sieve. If they use the #200 sieve this will insure the minimum of 500 GRMS retained ~~on~~ ABOVE that sieve.

RECEIVED

OCT 11 1977

QUALITY CONTROL
BECHTEL JOB 7220

Bechtel Associates Professional Corporation

Inter-office Memorandum

BEBC-1859

To J. F. Newgen

Subject Midland Plant Units 1 & 2
Job 7220
Quality Action Report
QAR No. SD-40
File: 0274, C-0467.1

Copies to S. Afifi
J. Klacking

Date September 30, 1977

From R. L. Castleberry

Of Engineering

At Ann Arbor

RECEIVED
OCT 06 1977
BECHTEL POWER CORP.
JOB 7220
PER Dw

Reference: 1) BCBE-1533 dated 8/15/77

This is a complete response to Reference 1.

It should be noted that it is ideal to control the moisture of backfill material at the borrow areas by conditioning. It is true that moisture content tests should be conducted at the borrow areas in order to establish the control to meet the specification requirements. However, in the placing of soil in large quantities, it should be noted that after placement and compaction, the moisture is not necessarily the same due to drying and mixing with other loads. This implies that a moisture content check is needed after the compaction is acheived. Therefore, the procedure used to take the moisture content tests after compaction would not have direct impact on the quality of work.

Based on the above, we agree with field and backfill placed prior to modification of the moisture testing methods to be accepted as is.

for J. E. Hink
R. L. Castleberry

SR/bkp
9/30/5

QA ROUTE	INFO.	ACT.
LOAE		
CIVIL (1)		
CIVIL (2)		
MECH		
PIPING		
ELECT.		
INST.		
SEC'Y		
FILE NO.	7220	

? get telecon

Bechtel Power Corporation

Interoffice Memorandum

To R. L. Castleberry

File No.

Subject
Job 7220 Midland Project
Specification 7220-C-210
Quality Action Request
QAR No. SD-40
BCBE-1533R

Date August 15, 1977

From J. F. Newgen

Of Construction

At Midland, MI Ext.

Copies to
G. Tuveson
S. Rao
F. Teague
G. Richardson

Reference: Quality Action Request - QAR No. SD-40

This memo is to bring to your attention item 2 under "Recommended Corrective Action" of the attached "Quality Action Request", wherein we are asked to advise Project Engineering of past moisture testing methods. In the past, it was found that densities meeting the specification requirements could be attained, irrespective of the use of moisture tests, because of the uniformity of materials. Therefore, moisture tests were taken after compaction for determining dry densities and acceptance or rejection was based on compaction tests. Moisture tests were not used to control backfill moisture. This practice has since been changed to making one moisture test each day at the beginning of backfill operations at 500 cubic yards intervals per Spec. C-210, and one after the density of the area compacted has reached 95%.

Based on the above, the Field requests that Project Engineering agree to acceptance of backfill materials installed in the past, along with records thereof, irrespective of the use of the moisture tests.

Please respond by August 26, 1977.

J. F. Newgen

JFN/JSPD/cb
Attachment

QA ROUTE	INFO.	ACT.
LQAE		
CIVIL (1)	JH	
CIVIL (2)		
MECH		
PIPING		
ELECT.		
INST.		
SEC'Y	logged	
FILE NO	2236	

RECEIVED
AUG 19 1977
BECHTEL POWER CORP.
JOB 7220
BY [illegible]

301A-(2-74)

E

QUALITY ACTION REQUEST

From: ①
G. L. Richardson   Site QA   Job 7220

To: ② J. F. Newgen/ C. P. Connolly

Control Document ref.: ③ 7220-C-210

QAR Ident. No.: ④ SD-40

Action Requested: ⑤

Section 13.0 of specification 7220-C-210, Rev. 4 provides the requirements for Q-listed backfill in the plant area. Section 13.6 states that the moisture control in this area shall be in accordance with Section 12.6 of the same specification. Section 12.6 states in part: "The water content during compaction shall not be more than 2 percentage points below optimum moisture content and shall not be more than 2 percentage points above optimum moisture content . . ."

"Tests done in accordance with para. 12.5 will indicate the degree of moistening of aerating necessary to comply with para. 12.5.1. After placement of loose material on the embankment fill, the moisture content shall be further adjusted as necessary to bring such material within the moisture content limits required)OVER

Signature: ⑥ Gary L Richardson

Date: ⑦ 7/22/77

Reply Requested by: ⑧ 1&3) 7/25/77   2) 8/19/77

Reply: ⑨

RECEIVED
JUL 22 1977
QUALITY CONTROL
BECHTEL JOB 7220
SIGNATURE dp

ROUTE   INIT.
QC 07220
PFQCE
A. PFQCE
CIVIL
ELECT.
PIPING
MECH.
WELDING
DOC.   KEB
RECEIVING
ADM. ASST
OPEN LOOP
☐ YES ☑ NO
DATE______

Signature: ⑩

Date: ⑪

Action Verified: ⑫

Date: ⑬

3/2/74

WHITE — Return to sender   CANARY — Addressee's file   PINK — Sender's file

BPC-20877
G1001549-05

Bechtel Associates Professional Corporation

Inter-office Memorandum

TELECOPY

BEBC- 1998

To J. F. Newgen

Date December 15, 1977

Subject Midland Plant Units 1 & 2
Job 7220
Moisture Requirements for
Backfill

From R. L. Castleberry

Of Engineering

At Ann Arbor

Copies to File: 0274, C-210, C-208

S. Afifi

Reference: 1. BCBE-1669 dated 11/18/77

This is a complete response to Reference 1.

The moisture content of the soil should be within 2% of optimum <u>during</u> placement and compaction. However, this property [illegible] the soil is not necessarily a measure of its adequacy <u>after</u> compa[illegible]n.

The primary goal is to obtain the specified dry density [illegible] order to achieve this end, certain means are prescribed; e.g [illegible]mum lift thickness, specified compactive effort and control[illegible] moisture content.

Soil which has been tested a few days following compaction and found to have suitable dry density should not be rejected solely on the basis that its moisture content is not within 2% of optimum.

for J C Hink
R. L. Castleberry

GAT/sg
12/15/5

PAGE 5 OF 5 NCR-1005

Controlled Copy

gbek 2-27-78
5 VSC 12/9/77

NONCONFORMANCE REPORT

1. PROJECT NAME Midland	JOB NO. 7220	19. NO. 1005	20. PAGE 1 OF ~~2~~ 2

2. UNIT(S) Common	3. DRAWING/PART NO. N/A	REV N/A	4. ITEM DESCRIPTION Soil	5. ITEM LOCATION Plant Area

6. P.O. OR SPEC NO. N/A	7. SERIAL NO. N/A	8. REPLACEMENT PART P/N N/A REV N/A SER NO. N/A	9. SOURCE Construction	10. CONTRACTOR/SUPPLIER N/A

11. INSPECTION CRITERIA ( ) DWG ☒ SPEC ( ) OTHER IR NO. N/A NO. C-210, R.5	12. ASME AUTHORIZED INSPECTION REQ'D ( ) YES ☒ NO	13. SKETCH ATTACHED ( ) YES XX NO	14. Discovered During ( ) Rec'g ☒ Const ( ) Test	15. Equip Furnished By ( ) Client ( ) N/A ( ) FLD

16. NONCONFORMING CONDITION: Specification C-210 Rev. 5, Section 12.6.1 states in part.... "That the moisture content is to be within ±2% of the optimum moisture content." Contrary to the above, the following moisture tests are failing without retests taken:

(CONTINUED ON PAGE 2)

24. DISPOSITION CONCURRENCE

3/10/78 1/18/78

rework reject repair use as is X

10/27/77

F. Strumb 11 SB 10/27/77

PROJECT FIELD ENGINEER DATE

3/10/78

PROJECT ENGINEER DATE

T.E. Barclay 3-10-78

PROJ CONSTR QC ENGINEER DATE

AUTHORIZED INSPECTOR DATE

25. DISPOSITION RESULTS

17. REPORTED BY: N L Oslen DATE: 10/26/77

18. VALIDATED BY: T E Barclay, T.E. Barclay DATE: 11-14-77, 10-26-77

21. ROUTING: ☒ TO FIELD ENGINEERING ( ) TO OTHERS (SPECIFY)

1/19/78

22. ☒ Field Engineering Disposition ☒ Field Engineering Recommended Disposition to Project Engineering

SEE PAGE 3

DISPOSITION REQUIRED BY 2/1/78

10/28/77

~~SPEC. C-210, SEC. 12.8.2 - ADDITIONAL ROLLING - STATES IN PART "... WHERE MOISTURE CONTENT AT TIME OF ROLLING IS IMPROPER, SUCH ROLLING SHALL BE AT THE EXPENSE OF THE SUB-CONTRACTOR." THE FACT THAT PROPER COMPACTION WAS ACHIEVED IS EVIDENCE THAT ADDITIONAL ROLLING WAS PERFORMED (CONT.)~~

23. PROJECT ENGINEERING DISPOSITION Project Engineering has previously responded to the condition in which acceptable dry density test has been obtained with moisture content out of the specified limits. This information is found in BEBC-1859 & 1998; and need not be further addressed. There Fore Project Engineering concurs with Field Engineering's disposition. For the material represented by test No. MD-360, Project Engineering has evaluated adjacent tests results in the same general area and subsequent lifts results, all of which are acceptable. In addition the location of test MD-360 lies in

(Contd. on page 3)

26. QC ACCEPTANCE D.L. Oslen 3/23/78

QC ENGINEER DATE

AUTHORIZED INSPECTOR DATE

BLOCK #16 CONTINUED: NONCONFORM REPORT (CONT'D) PAGE 2 OF 2 1005

AREA	ELEV.	DATE OF TEST	DENSITY TEST NO.	PERCENT COMPACTION	MOISTURE CONTENT	OPTIMUM MOISTURE CONTENT
West Plant Dike						
7 + 00 37' L Center Line	622'	10/6/75	MD-227	99%	10.2	8.1
North Plant Dike						
1 + 00 40' R Center Line	625'	5/30/74	MD-142	95.2%	10.3	8.0
North Plant Dike						
3 + 00 40' R Center Line	625'	5/30/74	MD-143	95.7%	11.4	13.8
Plant Area						
183' S of S. Wall -- SWI						
53' W of "A" Line -- SWI	613.5'	5/10/77	MD-1326	96.3%	18.5	15.2
Plant Area						
183' S of S. Wall -- SWI						
53' W of "A" Line -- SWI	613.5'	5/10/77	MD-1328	103.3%	12.2	15.2
Plant Area						
30' East of 12.0						
90' South of Q	622'	6/7/77	MD-1412	106.4%	10.4	15.2
North Plant Dike						
1 + 25 100' L Center Line	626'	7/16/74	MD-290	96.3%	11.7	9.5
North Plant Dike						
3 + 50 130' L Center Line	630.5	7/16/74	MD-377	95.4%	19.7	15.2
North Plant Dike						
0 + 00 160' L Center Line	629'	7/31/74	MD-360	86.4%	20.6	15.2

Hold for Engineering Disposition. No Hold Tags Applied. "Q"-List #1.002.

~~BLOCK 22 CONT.:~~

~~AS REQUIRED BY SPECIFICATION, OR THAT THE SPECIFIED ROLLING WAS ADEQUATE. TO~~ 10/21/77

10/27/77

10/27/77

NONCONFORM/ REPORT (CONT'D) 20PAGE 3 OF ~~4~~ 5 10 1005

BLOCK 22 CONTINUED:

Spec. (210), Section 12.1 states in part that the water content <u>during</u> compaction shall not be more than 2 percentage points below or above optimum moisture content. The tests listed in this NCR were taken <u>after</u> proper compaction was achieved. This test procedure was accepted for the tests listed in this NCR by Project Engineering in letter #BEBC-1859. (copy attached) The Project Engineering Acceptance clearly addresses the fact that tests taken after compaction may have a different moisture than the moisture during compaction. As there are no specified restrictions on in place soil moisture content, <u>after</u> compaction, this condition is not unacceptable or indeterminate. No NCR is therefore required.

10/28/77

BLOCK 22 CONTINUED

THE ABOVE DISPOSITION APPLIES TO ALL ITEMS WITH MOISTURE CONTENT ABOVE OR BELOW 2% OF OPTIMUM MOISTURE. THE FACT THAT THESE ARE NOT NONCONFORMING CONDITIONS IS FURTHER SUPPORTED BY PROJECT ENGINEER LETTER #BEBC-1998

FOR THE TEST TAKEN AT NORTH PLANT DIKE STATION 0T80 WITH NONCONFORMING COMPACTION, ROUTE TO PROJECT ENG. FOR DISPOSITION.

1/18/78

Block # 23 Project Engineering Disposition (Contd. from page 1): JPBetts 1/18/78

an area away from Q-listed limits per dwg. C-45.

Since adjacent tests to MD-360 indicates acceptable density and there are no safety implications due to the location of test MD-360, Project Engineering concludes that the soil represented by test MD-360 be "used as is" with no additional testing. 2-27-78 2-27-78

2-27-78

Rao 2/27/78

Bechtel Associates Professional Corporation

Inter-office Memorandum

BEBC- 1859

To	J. F. Newgen	Date	September 30, 1977
Subject	Midland Plant Units 1 & 2 Job 7220 Quality Action Report QAR No. SD-40	From	R. L. Castleberry
		Of	Engineering
Copies to	File: 0274, C-0467.1 S. Afifi J. Klacking	At	Ann Arbor

RECEIVED
OCT 0 5 1977
BECHTEL POWER CORP.
JOB 7220
PER

Reference: 1) BCBE-1533 dated 8/15/77

This is a complete response to Reference 1.

It should be noted that it is ideal to control the moisture of backfill material at the borrow areas by conditioning. It is true that moisture content tests should be conducted at the borrow areas in order to establish the control to meet the specification requirements. However, in the placing of soil in large quantities, it should be noted that after placement and compaction, the moisture is not necessarily the same due to drying and mixing with other loads. This implies that a moisture content check is needed after the compaction is acheived. Therefore, the procedure used to take the moisture content tests after compaction would not have direct impact on the quality of work.

Based on the above, we agree with field and backfill placed prior to modification of the moisture testing methods to be accepted as is.

for R. L. Castleberry

SR/bkp
9/30/5

ROUTING
ACT
INIT

J. DEAN

PAGE 4 OF 58 NCR 1005

-98

BECHTEL

REFERENCE COPY

NONCONFORMANCE REPORT

1. Project Name: Midland
Job No. 7220
19. No. 698
20. Page 1 of 1

2. Unit(s): N/A
3. Drawing/Part No.: N/A
Rev: N/A
4. Item Description: Structural Backfill
5. Item Location: Yard

6. P.O. Or Spec No.: C-211
7. Serial No.: N/A
8. Replacement Part P/N N/A REV N/A SER NO. N/A
9. Source: ~~Engineering~~ CONSTRUCTION DLO 2/9/77
10. Contractor/Supplier: N/A

11. Inspection Criteria: ☐ DWG ☒ SPEC ☐ OTHER
IR NO. N/A
NO. C-211, Rev. 3
12. ASME AUTHORIZED INSPECTION REQ'D: ☐ YES ☒ NO
13. SKETCH ATTACHED: ☐ YES ☒ NO
14. Discovered During: ☐ REC'G ☒ CONST ☐ TEST
15. Equip Furnished By: ☐ CLIENT ☐ ENG ☒ FLD

16. Nonconforming Condition: Specification C-211, Rev. 3, Section 5.6.2 states in part ...... "Material delivered to the jobsite....shall be tested....by the contractor's representative once per day when material is being delivered." Contrary to the above, on the following dates (Oct. 26, 1976, Oct. 29, 1976, Nov. 12, 1976, Jan. 11, 1977 and Jan. 12, 1977) structural backfill was delivered without the required acceptance tests taken. "Q"-List No. 1.004. No hold tags applied. Hold for Engineering Disposition.

17. Reported By: DL Oslan Date: 2/9/77
18. Validated By: J Connolly Date: 2-9-77

21. Routing: ☐ TO FIELD ENGINEERING ☐ TO OTHERS (SPECIFY)

22. ☐ Field Engineering Disposition ☒ FIELD ENGINEERING RECOMMENDED DISPOSITION TO PROJECT ENGINEERING

Response requested by 2/16/77

Field recommends use as is. Tests conducted on material received on the days before and after the subject loads revealed that gradation met requirements of the specification. Visual inspection during delivery and installation revealed no substantial changes. The structural backfill material was placed in accordance with specification C-211 and found to be acceptable. JS Castle 2-9-77 2/9/77

23. Project Engineering Disposition

Tests conducted on samples prior to and after the days missed were found acceptable. In addition, one test was conducted on Jan.12, 1977, and found satisfactory. Therefore, Project Engineering concurs with the Field Engineering recommended disposition to "use as is".

RCO 3/3/77 J. arora 3-3-77

24. Disposition Concurrence

REWORK	REJECT	REPAIR	USE AS IS
			X

Soor 3/4/77
PROJECT FIELD ENGINEER DATE

3/3/77
PROJECT ENGINEER DATE

J Connolly 3-7-77
PROJECT CONSTR QC ENGINEER DATE

AUTHORIZED INSPECTOR DATE

25. Disposition Results

26. QC Acceptance
DL Oslan 3/7/77
QC ENGINEER DATE

AUTHORIZED INSPECTOR DATE

REFERENCE COPY

NONCONFORMANCE REPORT

1. Project Name: Midland
Job No.: 7220
19. No. 686
20. Page 1 of 1

2. Unit(s): Yard
3. Drawing/Part No.: N/A
Rev: N/A
4. Item Description: Structural Backfill
5. Item Location: Yard Area

6. P.O. Or Spec No.: C-211
7. Serial No.: N/A
8. Replacement Part P/N N/A REV N/A SER NO. N/A
9. Source: Construction Engineering
10. Contractor/Supplier: N/A

11. Inspection Criteria: ☐ DWG ☒ SPEC ☐ OTHER — IR NO. N/A — NO. C-211, Rev. 3
12. ASME AUTHORIZED INSPECTION REQ'D: ☐ YES ☒ NO
13. SKETCH ATTACHED: ☐ YES ☒ NO
14. Discovered During: ☐ REC'G ☒ CONST ☐ TEST
15. Equip Furnished By: ☐ CLIENT ☐ ENG ☒ FLD

16. Nonconforming Condition:

Specification 7220-C-211, Section 5.6.2 states in part: "Material delivered to the jobsite.:. shall be tested... by the Contractor's representative once per day when material is being delivered." Contrary to the above, on Dec. 1, 1976 and Dec. 14, 1976 approximately 495 tons and 55 tons, respectively, of structural backfill was delivered without the required acceptance tests taken. "Q"-List No. 1.004. 2 Hold Tag Applied. Hold for Engineering Disposition.

17. Reported By: D L Orlan — Date: 2/1/77
18. Validated By: Connolly — Date: 2-1-77

21. Routing: ☒ TO FIELD ENGINEERING ☐ TO OTHERS (SPECIFY)

22. ☐ Field Engineering Disposition ☒ FIELD ENGINEERING RECOMMENDED DISPOSITION TO PROJECT ENGINEERING

Response requested by 2/17/77.

Field recommends use as is. Tests conducted on material received on the days before and after the subject loads revealed that gradation met the requirements of the specification. Visual inspection during delivery and installation revealed no substantial changes. The structural backfill material was placed in accordance with specification C-211 and found acceptable. 2/2/77

23. Project Engineering Disposition

The samples were taken on days Nov. 19 through Dec. 30, Dec. 3 through 13 and Dec. 30 were found acceptable. Furthermore, all the materials were obtained from same source. Therefore, Engineering concurs with Field Engineering disposition to "use as is".

Rao 3/3/77 J. arora 3-3-77

24. Disposition Concurrence

REWORK	REJECT	REPAIR	USE AS IS
			X

Boon — PROJECT FIELD ENGINEER — DATE 3/4/77
PROJECT ENGINEER — DATE 3/4/77
Connolly — PROJECT CONSTR QC ENGINEER — DATE 3-7-77
AUTHORIZED INSPECTOR — DATE

25. Disposition Results

26. QC Acceptance
D L Orlan — QC ENGINEER — DATE 3/7/77
AUTHORIZED INSPECTOR — DATE

ROUTE TO	THIS COPY FOR
	WLBarclay WRBird SHHowell JMKlacking BWMarguglio JFNewgen CLRichardson
	QA SUBJ FILE

Consumers Power Company

QUALITY ASSURANCE PROGRAM

REPORT NO F-77-32

FILE: 18.4.3.4 & 18.4.3.6

DA[illegible] October 3-7, 1977

PLANT: Midland UNIT 1 & 2

SUBJECT OF AUDIT: Soil Placement Records

I. AUDIT SCOPE

The purpose of this record review audit is to verify the documentation associated with the placement of Structural Backfill, North Plant Dike, West Plant Dike, and Plant Area Fill conforms to the specifications and to expedite dike turnover.

II. AUDITORS

***D. A. Blumenthal, CPCo QAE (IE&TV) - Team Member
**D. E. Horn, CPCo QAE Civil Supervisor - Team Leader

III. PERSONNEL CONTACTED

**Ben Cheek, Bechtel Lead Civil Quality Control Engineer
*Keith Berk, Bechtel QCE (QC Vault)
*Pat Guiette, Bechtel QCE (QC Vault)
*Mary Kerridge, Bechtel QC Documentation Clerk
*Jim Miller, Bechtel QC Documentation Lead
*Tom Lieb, Bechtel QCE (Civil)
****Daryl Osborn, Bechtel Assistant Lead Civil QCE
*John Speltz, U.S. Testing Lab Chief

IV. SUMMARY OF AUDIT

A. A Pre-Audit Conference was held on August 31, 1977 in Ben Cheek's office with those in attendance as noted in Sections II and III above. The audit scope was the only item discussed. The audit scope originally was to observe soil placement, however, due to heavy rains and no soil placement in "Q" areas, the audit scope was changed to that given in Section I.

B. 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 using the attached checklist.

C. The findings associated with this audit are noted in Section V.

*Contacted during Audit
**Attended Pre-Audit Conference and Post-Audit Conference
***Attended Post-Audit Conference
****Contacted during Audit and attended Post-Audit Conference

BY Donald E. Horn DATE 11-4-77 SHEET 1 OF 12
Donald A. Blumenthal 11/4/77 Reviewed by [illegible] 1/20/78

IV. SUMMARY OF AUDIT (Contd)

D. Future audits will be run the same, when scheduled.

E. A Post-Audit Conference was held on October 11, 1977 in Ben Cheek's office with those in attendance as noted in Sections II and III above. The audit findings were presented to those in attendance by D. A. Blumenthal and D. E. Horn. Bechtel QC understood and agreed with the findings and recommended corrective action.

V. CLOSED OUT FINDINGS

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 desnity 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.

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.

AUDIT REPORT NO F-77-32

V. CLOSED OUT FINDINGS

Finding 1

North Plant Dike (Contd)

MD-269 (sampled 7-12-74) shows maximum dry lab density 116.2. It should have been 116.3.

MD-290 (sampled 7-16-74) shows maximum dry lab density 125.2. It should have been 128.3.

MD-318 (sampled 7-19-74) shows optimum moisture content 13.0. It should have been 13.3.

MD-336 (sampled 7-20-74) shows optimum moisture content 20.5. It should have been 20.0.

MD-341 (sampled 7-25-74) shows optimum moisture content 17.0. It should have been 15.5.

MD-377 (sampled 8-6-74) shows maximum lab dry density 109. It should have been 112.9.

MD-476 (sampled 8-19-74) shows optimum moisture content 17.0. It should have been 17.1.

MD-512 (sampled 8-28-74) shows maximum lab dry density 109.4. This should have been 109.0.

Structural Backfill Area

MDR-919 (sampled 5-25-77) shows maximum dry lab density of 109.3. It should have been 125.3. It also shows minimum dry lab density as 90.3. It should have been 109.3.

Plant Area Fill

MD-1262 (sampled 4-8-77) gives maximum dry lab density of 117.0. It should have been 117.1.

MD-1300 (sampled 5-2-77) gives optimum moisture content of 11.1. It should have been 10.4.

MD-1385 (sampled 6-2-77) gives optimum moisture content of 13.5. It should have been 13.4.

FILE: .4.3.4 & 18.4.3.6
DATE: October 3-7, 1977
PLANT: Midland UNIT 1 & 2
SUBJECT OF AUDIT: Soil Placement Records

AUDIT REPORT NO F-77-32

V. CLOSED OUT FINDINGS

Finding 1

Plant Area Fill (Contd)

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 127.3. 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.

Corrective Action Requested: Recalculate the test results using the proper values and determine the acceptability of the corrected test results.

Corrective Action Taken: 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.

Corrective action verified October 25-26, 1977.

For further corrective action see Section VI "Open Findings" Finding 1.

Finding 2

Specification C-210, Revision 5 Section 12.6.1 states in part, "The water content during compaction shall not be more than 2 percentage points below optimum moisture content and shall not be more than 2 percentage points above optimum moisture content..."

Specification C-210, Revision 5 Section 13.7.1 states, "All cohesive backfill in the plant area and the berm shall be compacted to not less than 95 percent of maximum density as determined by ASTM D 1557, Method D".

Specification C-210, Revision 5 Section 13.7.2 states in part, "All cohesionless backfill in the plant area and the berm shall be compacted to not less than 80 percent of relative density as determined by ASTM D 2049..."

Contrary to these requirements, the following tests had failing results and did not indicate being cleared by passing tests.

FILE: .4.3.4 & 18.4.3.6
DATE: October 3-7, 1977
PLANT: Midland UNIT 1 & 2
SUBJECT OF AUDIT: Soil Placement
Records

AUDIT REPORT NO F-77-32

V. CLOSED OUT FINDINGS

Finding 2 (Contd)

Plant Area Fill

Test No.	Date Sampled	Compaction	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	74.6% of Relative Density		
1194✓	11-02-76	75.4% of Relative Density		
"Q" { 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%
1388✓	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%	10.0%
1509✓	6-16-77		12.9%	15.2%

North Plant Dike

Test No.	Date Sampled	Compaction	Moisture Actual	Moisture Optimum
MD 418	8-14-74		17.2%	20.0%

Structural Backfill

Test No.	Date Sampled	Compaction
MDR 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	60.0% of Relative Density
682✓	11-24-76	70.6% of Relative Density
688✓	11-24-76	77.1% of Relative Density
700	1-13-77	75.0% of Relative Density
701	1-13-77	68.1% of Relative Density
721✓	3-14-77	60.0% of Relative Density

FILE: .4.3.4 & 18.4.3.6
DATE: October 3-7, 1977
PLANT: Midland UNIT 1 & 2
SUBJECT OF AUDIT: Soil Placement Records

AUDIT REPORT NO F-77-32

V. CLOSED OUT FINDINGS

Finding 2

Structural Backfill (Contd)

Test No.	Date Sampled	Compaction	Moisture Actual	Moisture Optimum
MDR 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		
861	5-10-77	76.3% of Relative Density		
862	5-10-77	74.0% of Relative Density		
889✓	5-13-77	56.5% of Relative Density		
914✓	5-24-77		9.0%	11.8%
922✓	5-26-77	75.7% of Relative Density		
925✓	5-27-77		11.4%	15.2%
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.

Corrective Action Taken: Test reports Plant 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.

Corrective Action Verified October 26, 1977.

V. CLOSED OUT FINDINGS

Finding 2 (Contd)

Corrective Action Taken: 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.

For further corrective action see Section VI "Open Findings" Finding 2.

Finding 3

Relative Density Reports 59 and 61 were missing from the QC Vault.

Corrective Action Requested: Obtain copies of these reports and place them in the QC Vault.

Corrective Action Taken: Copies have been obtained and placed in the QC Document Vault.

Corrective action verified October 26, 1977.

VI. OPEN FINDINGS

Finding 1

Specification C-210, Revision 5 Section 12.6.1 states in part, "The water content during compaction shall not be more than 2 percentage points below optimum moisture content and shall not be more than 2 percentage points above moisture content..."

Specification C-210, Revision 5 Section 13.7.1 states, "All cohesive backfill in the plant area and the berm shall be compacted to not less than 95 percent of maximum density as determined by ASTM D 1557, Method D".

Specification C-210, Revision 5 Section 13.7.2 states in part, "All cohesionless backfill in the plant area and the berm shall be compacted to not less than 80 percent of relative density as determined by ASTM D 2049..."

Contrary to these requirements, the following tests had been passed using incorrect testing data. Using the correct testing data, the tests fail.

FILE: .4.3.4 & 18.4.3.6
DATE: October 3-7, 1977
PLANT: Midland UNIT 1 & 2
SUBJECT OF AUDIT: Soil Placement
Records

AUDIT REPORT NO F-77-32

VI. OPEN FINDINGS

Finding 1 (Contd)

North Plant Dike

MD 290 (sampled 7-16-74) shows optimum moisture content 11.6. It should be 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 be 15.2. This also shows maximum lab dry density as 103.2. It should be 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 be 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 be 112.2. Using the correct minimum dry lab density of 112.2, the correct percent of relative density is 41.5.

Corrective Action Requested:

(1) Determine if there are passing tests in the same area to clear these failing tests.

(2) If these failing tests cannot be cleared by passing tests in the same area, present these findings to Bechtel Project Engineering so Project Engineering can determine what additional tests, reviews, etc. are needed to justify the material these tests represent. Have Project Engineering justify the material these failing tests represent.

(3) Determine the underlying cause(s) and take corrective action to preclude repetition.

Corrective Action Taken:

(1) North Plant Dike MD 290 and MD 377 have been identified on Bechtel NCR 1005. North Plant Dike MD 360 and Structural Backfill MDR 621 density problems have been identified on Bechtel NCR 1004.

Corrective action verified October 26, 1977.

North Plant Dike MD 360 moisture problem has been identified on revised NCR 1005.

Corrective action verified October 28, 1977.

FILE: .4.3.4 & 18.4.3.6
DATE: October 3-7, 1977
PLANT: Midland UNIT 1 & 2
SUBJECT OF AUDIT: Soil Placement Records

AUDIT REPORT NO F-77-32

VI. OPEN FINDINGS

Finding 1 (Contd)

NCR QF-199 has been written to resolve the corrective action still open.

Finding 2

Specification C-210, Revision 5 Section 12.6.1 states in part, "The water content during compaction shall not be more than 2 percentage points below optimum moisture content and shall not be more than 2 percentage points above optimum moisture content..."

Specification C-210, Revision 5 Section 13.7.1 states, "All cohesive backfill in the plant area and the berm shall be compacted to not less than 95 percent of maximum density as determined by ASTM D 1557, Method D".

Specification C-210, Revision 5 Section 13.7.2 states in part, "All cohesionless backfill in the plant area and the berm shall be compacted to not less than 80 percent of relative density as determined by ASTM D 2049".

Contrary to these requirements, the following tests had failing results and did not indicate being cleared by passing tests or had been marked passing.

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%

FILE: .4.3.4 & 18.4.3.6
DATE: October 3-7, 1977
PLANT: Midland UNIT 1 & 2
SUBJECT OF AUDIT: Soil Placement Records

AUDIT REPORT NO F-77-32

VI. OPEN FINDINGS

Finding 2 (Contd)

Structural Backfill

Test No.	Date Sampled	Compaction	Moisture	
			Actual	Optimum
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		

Corrective Action Requested:

(1) Determine if there are passing tests in the same area to clear these failing tests.

(2) If these failing tests cannot be cleared by passing tests in the same area, present these findings to Bechtel Project Engineering so Project Engineering can determine what additional tests, reviews, etc. are needed to justify the material these tests represent. Have Project Engineering justify the material these failing tests represent.

(3) Determine the underlying cause(s) and take corrective action to preclude repetition.

Corrective Action Taken:

(1) Bechtel QC has determined that none of the above have passing tests in the same area to clear the failing tests.

(2) North Plant Dike MD 142 and MD 143, West Plant Dike MD 227 and Plant Area Fill MD 1326, 1328 and 1412 have been identified on Bechtel NCR 1005. Structural Backfill MDR 621, 671, 672, 685, and 686 have been identified on Bechtel NCR 1004.

(3) Corrective action has been taken as of the last of July, 1977 by Bechtel QC and U.S. Testing to more adequately clear failing tests. Therefore, the corrective action to preclude repetition for not clearing failing tests need not be addressed.

Corrective action verified October 26, 1977

Plant Area Fill MD 1311 has been identified on revised NCR 1004.

Corrective action verified November 1, 1977.

NCR QF-199 has been written to resolve the corrective action still open.

VI. OPEN FINDINGS (Contd)

Finding 3

Specification C-211 Revision 3 Section 5.6.2 states in part, "Material delivered to the jobsite for use as structural backfill shall be visually inspected, and tested in accordance with ASTM C-136..."

ASTM C136-71 Section 4.2 states in part, "In no case, however, shall the fraction retained on any sieve at the completion of the sieving operation weigh more than 4g/in.^{2} of sieving surface.

Note 2 - This amounts to 200g for the usual 8 in. (203-mm) diameter sieve".

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.

Project Quality Control Instruction No. SC-1.05 "Material Testing Services and Concrete Production" Rev. 3 Section 2.7.2 Reports, Item A states, "Perform a daily review of the subcontractor's jobsite inspection and test reports for acceptability, completeness, and the laboratory chief's signature for concrete, steel, and soils. Sign and date on the report verifying the acceptable status".

Contrary to these requirements:

Structural Backfill Log Number	Date Sampled	Amount Retained
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 QF-152 was not adequate. Determine the underlying cause(s) and take further corrective action to preclude repetition.

FILE: .4.3.4 & 18.4.3.6
DATE: October 3-7, 1977
PLANT: Midland UNIT 1 & 2
SUBJECT OF AUDIT: Soil Placement Records

AUDIT REPORT NO F-77-32

VI. OPEN FINDINGS

Finding 3 (Contd)

Corrective Action Taken:

(1) These findings have been identified on Bechtel NCR 1006.

Corrective action verified October 26, 1977.

NCR QF-195 has been written to resolve the corrective action still open.

VII. NONCONFORMANCE REPORTS

QF-195
QF-199

ROUTE TO	THIS COPY FOR	Consumers Power Company QUALITY ASSURANCE PROGRAM	FILE: [illegible].8.4.3.4, 18.4.3.6
	MRBird J[illegible]nolly JMKlackin[illegible] JFNewgen GLRichardson HWSlager		D[illegible] May 25, & June 8, 9, 10, 1977 PLANT: Midland UNIT 1 & 2 SUBJECT OF AUDIT: Soils Placement and Inspection
	QA SUBJ FILE	REPORT NO F-77-21	

I. AUDIT SCOPE

The purpose of this audit is to verify that soils placement and inspection are being accomplished in accordance with Bechtel's procedures, specifications and codes.

II. AUDITOR

G. B. Johnson, CPCo Field Quality Assurance Engineer (Civil)

III. PERSONNEL CONTACTED

**Ben Cheek, Bechtel Lead Civil Quality Control Engineer
*Daryle Osborn, Bechtel Quality Control Engineer (Civil)

IV. SUMMARY OF AUDIT

A. A Pre-Audit Conference was held on May 23, 1977 at Daryle Osborn's desk with those in attendance as noted in Sections II and III above. The audit scope was the only item discussed.

B. The audit was performed on the placement and inspection of zone 2 material in the plant area South of the Turbine Building at elevations 620' - 622'. The backfilling operation was centered around plant coordinates S 5070 and E 360. The attached checklist was used.

C. The soils placement and inspection seemed adequate except as described in Section V of this report.

D. Future audits will be run the same, when scheduled.

E. A Post-Audit Conference was held on June 16, 1977 in Ben Cheek's office with those in attendance as noted in Sections II and III above. The Post-Audit Conference consisted of telling Ben Cheek and Daryle Osborn that the results of this audit were adequate except for Findings #1 & #2 in Section V.

CLOSED OUT

V. FINDINGS

Finding #1

Bechtel Specification 7220-C-210, Rev. 4, Section 12.6.1, states in part:

→ The water content during compaction shall not be more than 2 percentage points below optimum moisture content and shall not be more than 2 percentage points above optimum moisture content. . . .

*Attended Pre-Audit Conference and Post-Audit Conference
**Attended Post Audit Conference

BY G B Johnson DATE 5 July 77 SHEET 1 OF 3

Donald E Horn 1-25-78

File: 18.4.3.4, 18.4.3.6
Date: May 25, & June 8, 9, 10, 1977
Plant: Midland 1 & 2
Subject of Audit: Soils Placement and
Inspection

Report No F-77-21

CLOSED OUT

V. FINDINGS

Finding #1 (Contd)

Contrary to These Requirements:

Backfill was placed on a lift which was determined to be greater than 2% below optimum moisture content (Plant Backfill Test #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.

Recommended Corrective Action:

1. The Foreman directing the soils work should be instructed as to the required moisture content limits.

2. Bechtel QC should determine if a re-test had been accomplished on the lift in question. If a re-test had not been accomplished, it will be necessary to obtain one. If the affected material is found to be nonconforming, an evaluation will have to be made as to the acceptability of the in-place material by Project Engineering.

Corrective Action Taken:

1. Bechtel QC informed the foreman directing the soils work of the required moisture content limits and what to do if a failing test occurs.

2. A retest was taken in the area and the retest passed (Plant Backfill Test 1414).

Finding #2

Bechtel Specification C-208, Rev. 10, Table 9-1, states in part:

Field Densities and Moisture Contents will be taken at the frequency of one test per every 500 cubic yards of fill.

Contrary to These Requirements:

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 one test per 1000 cubic yards of fill.

Recommended Corrective Action:

1. The foreman directing the soils work should be instructed as to the correct test frequency requirements.

File: 18.4.3.4, 18.4.3.6
Date: May 25, & June 8, 9, 10, 1977
Plant: [illegible]lland 1 & 2
Subject of Audit: Soils Placement and
Inspection

Report No F-77-21

CLOSED OUT

V. FINDINGS

Finding #2 (Contd)

Recommended Corrective Action: (Contd)

2. Bechtel QC should determine if the 1/500 cy test frequency has been exceeded. If the test frequency has been exceeded, an evaluation will have to be made as to the acceptability of the in-place material by Project Engineering.

Corrective Action Taken:

1. Bechtel QC informed the foreman directing the soils work of the correct test frequency requirements.
2. 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, [illegible],200 cy of random backfill was placed South and East of the Turbine Building. 57 tests were taken on this material which results in an overall test frequency of 320 cy/test. The majority of this 18,200 cy was placed in a NON-Q area.

VI. NONCONFORMANCE REPORTS

None

Bechtel Power Corporation

Interoffice Memorandum

To W. Barclay

File No.

Subject Job 7220 Midland Project
Project QAR SD-40
GLR-02-78-043

Date February 3, 1978

From G. L. Richardson

Of Quality Assurance

Copies to J. Klacking

At Midland, MI Ext 207

In your response to the subject QAR, which identified problems with moisture tests on soils placement, you indicated on Aug. 11, 1977 that moisture tests will be taken in the borrow areas at the start of the day and as needed to maintain the proper testing frequency.

During review of the records in the QC Vault to verify actions taken in response to QAR SD-40 it was noted that there is no evidence of these record tests being taken. Upon further investigation it was discovered that U.S. Testing maintains a log for these tests and they are not being reviewed by Q.C. We feel that these tests should be maintained in the vault and reviewed by Q.C. for adequacy.

Please take appropriate actions to locate the moisture tests, review these tests and file them in the vault. It is requested that these actions be taken by March 1, 1978 so that QAR SD-40 can be closed out.

G. L. Richardson

G. L. Richardson

FEB 06 '78

SKW 2/8/78

GLR/JGH/sw

SB143149

I-78-236

Bechtel Power Corporation

Interoffice Memorandum

To J. Klacking

Subject Structural Backfill
Q-No. 1.004
GLR-2-77-32

Date February 11, 1977

From G. L. Richardson

Of Quality Assurance

At Midland, MI Ext. 207
Job 7220

Copies to

Described below is a series of problems and actions being taken involving procurement, inspection, testing and installation of structural backfill.

1. On 1-31-77 Bechtel QA identified that all structural backfill material purchased to date was purchased as "Non-Q" which is inconsistent with the "Q" list. This resulted in the material not being receipt inspected by Quality Control as is required by the "Bulk Items List" prepared by Project Engineering. (Ref. QAR SD-24)

2. Concurrent with Item 1 CPCo QA identified that structural backfill delivered to the jobsite during 12/76 and 1/77 had not in all cases been tested for gradation on a daily basis as required by Spec. 7220-C-211. (Ref. CPCo NCR QF-147) Lack of testing has been previously identified by Bechtel QA on 10/21/76 (Ref. QADR SD-6) and by CPCo QA on 10/14/74. (Ref. CPCo NCR QF-29)

3. On 2/10/77 CPCo QA, as a result of an audit, identified that in many cases the gradation tests performed on structural backfill were not performed using proper testing procedures. Specifically ASTM C-136-71 states that amounts of material retained on an individual sieves shall not exceed 200 grams. Some tests noted had as much as 360 grams retained on an individual sieve. (Ref. audit report F-77-8).

4. To assure material presently is use was acceptable Bechtel QA reviewed the test results and noted the following:

   a. Tests run on 2/4/77, 2/7/77, 2/8/77 and 2/9/77 all had weights retained in excess of 200 grams.

   b. Bechtel QC had not approved this test and the material was still in the process of receipt inspection.

   c. Bechtel Field Engineering was using this material without release by QC. NOTE: The Asst. PFQCE and PFE stopped use when notified of the discrepancy.

Bechtel Power Corporation

Inter-office Memorandum

MAY 1 9 '78

To R. L. Castleberry

Subject Job 7220 Midland Project
Moisture Content of Soils
GLR-249

Copies to J. Newgen
J. Hurley
~~J. Kracking~~
W. Barclay
S. Rao

Date May 16, 1978

From G. L. Richardson

Of Quality Assurance

At Midland, MI

QAR SD-40 was issued on 7/22/77 to request testing of soils for proper moisture content prior to compaction. Several IOMs and telecons were written to resolve this QAR cumulated by the attached IOM BEBC-1998 and J. Hook's telephone call record of 10/13/77. These documents indicate that moisture content for "Q" listed material must be controlled to assure that it is within ±2% of optimum prior to compaction as required by Specification 7220-C-208. Moisture content after compaction not within the required range is not to be considered a problem.

Subsequent to this a telephone call record (attached) dated 4/7/78 was made to record a call to S. Rao requesting further clarification. Part II of this telecon appears to be in conflict with the foregoing. The current interpretation by Quality Control is to allow compaction to take place where the initial test indicates out of tolerance moisture content concurrent with corrective actions to correct the moisture.

Concerns in this area have been raised by D. Horn of CPCo QA who has requested that this area be clarified prior to resumption of work upon settlement of the laborers work stoppage.

It is requested that you take action to resolve this situation and to provide clear direction for the control of moisture content.

One possible solution would be to delete the requirement to control the moisture content and rely on the compaction requirement only for the completion of soils work realizing that the only "Q" listed work remaining is in the plant fill area.

Please respond by 5/26/78.

G. L. Richardson

G. L. Richardson

I-78-1140

SB143145

GLR/sw

Rec'd by NRC 2/23

Consumers Power Company

NONCONFORMANCE REPORT

PROJECTS, ENGINEERING AND CONSTRUCTION - QUALITY ASSURANCE DEPARTMENT

PAGE 1 OF 5

6. PROJECT NAME: Midland 1 & 2	7. NONCONFORMING PART NO: NA	8. NONCONFORMING PART NAME: Plant Area Soils	1. NCR SERIAL NO: M-01-5-9-012 2. DATE: 2-6-79
9. SERIAL NUMBER: NA	10. ORG. COMMITTING NC: Bechtel Project Engr Bechtel Field Engr Bechtel QC Engr	11. AREA/LOC. OF NC: Plant Area Fill	3. DATE OF REV: NA 4. FILE NO: 16.3.1, 16.3.4, 16.3.6

12. "AS IS" NONCONFORMING CONDITION VERSUS "AS REQUIRED" CONDITION WITH REFS:

Section 13.6 of Specification C-210, Revision 6 states, "Moisture control of the plant area and berm material shall conform to Section 12.6". Section 12.6.1 states in part, "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..." Project Engineering stated in a meeting held at the site February 5, 1979 that the intent of "during compaction" is to be at the time of the density/moisture tests.

(Contd on Page 3)

13. QA RECOMMENDATION FOR PART CA:

a) Review all moisture density test reports from the time of accepting moisture contents at the stockpile instead of at the placements through to date for similar deficiencies.

(Contd on Page 5)

DESIGN/PROJECT ENG. DISPOSITION REQUIRED ☒ NOT REQUIRED ☐

5. DISTRIBUTION

ACTION COPY:

LADreisbach

INFO COPY:

WLBarclay	DBMiller
WRBird	WMoring
TCCooke	JFNewgen
JLCorley	ERumbaugh
RHermeston	RASimanek
SHHowell	DATaggart
DRJohnson	
GSKeeley	
BWMarguglio	
PAMartinez	
JMilandin	

14. HOLD TAGS APPLIED: YES ☐ NO ☒ NUMBER, LOCATION & TYPE OF HOLD TAGS APPLIED: NA

15. IN PROCESS CA REQUIRED: YES ☒ NO ☐ IF NO, ENTER JUSTIFICATION BELOW:

16. DOES NC AFFECT Q-LIST ITEM: YES ☒ NO ☐

17. IS NC REPORTABLE PER 50.55(e): YES ☐ NO ☒

18. IS NC REPORTABLE PER PART 21: YES ☐ NO ☒

19. IF YES, DATE & TIME OF REPORT TO NRC: NA

20. IF YES, WHO MADE REPORT TO NRC: NA

21. IF YES, NAME OF NRC OFFICIAL TO WHOM REPORTED: NA

22. NCR ORIGINATED BY: Donald E. Horn

23. WRITTEN REPLY REQUIRED BY: 2-20-79 TO ESTABLISH CA COMPLETION DATE

24. SUPERVISOR'S SIGNATURE/DATE: Donald E. Horn 2/6/79

25. PART CA DISPOSITION, JUSTIFICATION & COMPLETION DATE:

26. DESIGN/PROJECT SIG. AUTH. DISP.:	27. PMD SIG. AUTH. DISP.:	28. PROCUREMENT SIG. AUTH. DISP.: NA	29. SIG. OF ORG. RESP. FOR C/A:
30. FAB/CONST. SIG. AUTH. IMP. DISP.:	31. SIG. OF TEST GROUP ACKNOW. CONDITION: NA	32. FOR MAJOR MOD - PLT. SUPT. SIG. AUTH. DISP.: NA	33. QA AUTH. SIG. TO IMPLEMENT DISP.:

34. METHOD OF PART CA VERIFICATION:

35. SIG. OF ORG. RESP. FOR PART C/A SIGNIFYING COMPLETION:	36. SIG. VERIFYING PART C/A & HOLD TAG REMOVAL/DATE:	37. NCR CLOSED BY/DATE: (PART & PROCESS CA COMPLETE)

NCR SERIAL NO: M-01-5-9-012
DATE: 2-6-79
DATE OF REV: NA
FILE NO: 16.3.1, 16.3.4, 16.3.6

Consumers Power Company

NONCONFORMANCE REPORT
PROCESS CORRECTIVE ACTION

PROJECTS, ENGINEERING AND CONSTRUCTION - QUALITY ASSURANCE DEPARTMENT

NCR SERIAL NUMBER: M-01-5-9-012

PAGE 2 OF 5

38. QA ASSESSMENT OF ROOT CAUSE(S):

Unknown, to be determined.

39. ACTUAL ROOT CAUSE(S), IF DIFFERENT FROM ABOVE (TO BE COMPLETED BY ORG. RESPONSIBLE FOR PROCESS CA):

40. PROCESS CA REQUIRED FROM:

DESIGN ☒ FABRICATION ☐ CONSTRUCTION ☒ PROCUREMENT ☐ INSPECTION ☒
OTHER

41. QA RECOMMENDATION FOR PROCESS CA:

Unknown, to be determined.

42. PROCESS CA TO BE TAKEN BY ORG(S) CHECKED IN BLOCK 41 & DATE OF COMPLETION:

43. METHOD OF PROCESS CA VERIFICATION:

SIG. OF ORG. RESPONSIBLE FOR PROCESS CA SIGNIFYING COMPLETION:	45. PROCESS CA COMPLETION VERIFIED BY/DATE:

NCR SERIAL NO: M-01-5-9-012
DATE: 2-6-79
DATE OF REV: NA
FILE NO: 16.3.1, 16.3.4, 16.3.6

12. "AS IS" NONCONFORMING CONDITION VERSUS "AS REQUIRED" CONDITION WITH REFS:

(Contd from Page 1)

Contrary to these requirements, the following tests had moisture content in excess of the plus or minus two percentage points of optimum moisture content.

Test No MD	Date Test Taken	Moisture Content (%)	Optimum Moisture Content (%)	Difference MC - OMC Positive
2471	3-29-78	10.8	8.2	+ 2.6
2473	3-29-78	12.3	8.2	+ 4.1
2476	3-31-78	14.2	9.1	+ 5.1
2479	4-01-78	11.6	9.1	+ 2.5
2482	4-01-78	13.5	9.1	+ 4.4
2486	4-08-78	11.8	8.2	+ 3.6
2488	4-08-78	13.8	8.2	+ 5.6
2492	4-08-78	11.5	8.2	+ 3.3
2496	4-10-78	11.0	8.2	+ 2.8
2497	4-11-78	12.7	8.2	+ 4.5
2498	4-11-78	13.5	8.2	+ 5.3
2499	4-11-78	12.1	8.2	+ 3.9
2501	4-12-78	13.2	8.2	+ 5.0
2506	4-17-78	13.5	11.1	+ 2.4
2507	4-17-78	14.1	11.1	+ 3.0
2508	4-17-78	13.3	11.1	+ 2.2
2509	4-17-78	14.5	11.1	+ 3.4
2510	4-17-78	13.2	11.1	+ 2.1
2517	4-19-78	14.2	11.1	+ 3.1
2522	4-19-78	14.6	11.1	+ 3.5
2531	4-27-78	12.9	10.1	+ 2.8
2537	4-28-78	14.0	11.1	+ 3.9
2539	6-20-78	15.6	13.4	+ 2.2
2540	6-21-78	15.5	13.4	+ 2.1
2547	6-23-78	15.9	13.4	+ 2.5
2549	6-29-78	14.1	10.1	+ 4.0
2550	6-29-78	12.9	10.1	+ 2.8
2954	7-01-78	13.6	10.1	+ 3.5
2956	7-03-78	12.8	10.1	+ 2.7
2957	7-03-78	12.4	10.1	+ 2.3
2958	7-03-78	15.0	10.1	+ 4.9
2959	7-03-78	12.7	10.1	+ 2.6
2962	7-05-78	12.5	11.1	+ 2.4
2965	7-06-78	12.9	10.1	+ 2.8
2979	7-11-78	12.9	9.1	+ 3.8
2992	7-17-78	14.3	11.1	+ 3.2
3000	7-18-78	13.1	10.1	+ 3.0
3013	7-21-78	13.1	10.1	+ 3.0
3026	7-25-78	17.2	11.8	+ 5.4
3028	7-25-78	16.9	11.8	+ 5.1

90

NCR SERIAL NO: M-01-5-9-012
DATE: 2-6-79
DATE OF REV: NA
FILE NO: 16.3.1, 16.3.4, 16.3.6

12. "AS IS" NONCONFORMING CONDITION VERSUS "AS REQUIRED" CONDITION WITH REFS:

(Contd)

Test No MD	Date Test Taken	Moisture Content (%)	Optimum Moisture Content (%)	Difference MC - OMC Positive
3030	7-25-78	13.0	10.1	+ 2.9
3034	7-26-78	13.3	11.1	+ 2.2
3035	7-26-78	15.2	11.1	+ 4.1
3037	7-27-78	12.7	10.1	+ 2.6
3042	7-28-78	14.5	11.1	+ 3.4
3043	7-28-78	14.6	11.1	+ 3.5
3045	7-29-78	12.7	10.1	+ 2.6
3059	8-03-78	15.0	10.1	+ 4.9
3060	8-03-78	13.1	10.1	+ 3.0
3068	8-05-78	12.7	10.1	+ 2.6
3070	8-07-78	13.1	10.1	+ 3.0
3071	8-07-78	12.3	10.1	+ 2.2
3074	8-07-78	12.3	10.1	+ 2.2
3075	8-08-78	13.8	10.1	+ 3.7
3076B	8-08-78	14.2	10.1	+ 4.1
3082	8-10-78	14.0	10.1	+ 3.9
3087	8-11-78	14.5	10.1	+ 4.4
3088	8-12-78	13.1	10.1	+ 3.0
3100	8-16-78	14.8	10.1	+ 4.7
3103	8-17-78	14.2	10.1	+ 4.1
3105	8-17-78	12.7	10.1	+ 2.6
3106	8-17-78	12.8	10.1	+ 2.7
3107	8-17-78	14.3	10.1	+ 4.2
3108	8-17-78	13.7	10.1	+ 3.6
3109	8-17-78	14.3	10.1	+ 4.2
3110	8-17-78	13.9	10.1	+ 3.8
3111	8-17-78	17.6	10.1	+ 7.5
3112	8-17-78	12.5	10.1	+ 2.4
3114	8-18-78	13.0	10.1	+ 2.9
3115	8-18-78	12.5	10.1	+ 2.4
3130	8-28-78	13.1	10.1	+ 3.0
3132	8-28-78	13.9	10.1	+ 3.8
3134	8-29-78	13.1	10.1	+ 3.0
3141	9-01-78	12.7	10.1	+ 2.6
3143	9-01-78	14.7	10.1	+ 4.6
3144	9-01-78	12.9	10.1	+ 2.8
3145	9-01-78	15.9	10.1	+ 5.8
3156	9-07-78	12.2	10.1	+ 2.1
3158	9-08-78	13.0	10.1	+ 2.9
3159	9-12-78	16.5	10.1	+ 6.4
2561	9-30-78	13.[illegible]	11.3	+ 2.2
2563	9-30-78	1[illegible]	7.5	+ 2.5

42

TOTAL 82 TEST

NCR SERIAL NO: M-01-5-9-012
DATE: 2-6-79
DATE OF REV: NA
FILE NO: 16.3.1, 16.3.4, 16.3.6

13. QA RECOMMENDATION FOR PART CA:

(Contd from Page 1)

b) Send Project Engineering/Geo Tech all the test reports from the test failures in this NCR and any found in the review a) above.

c) Receive a Project Engineering/Geo Tech evaluation of the acceptability of the material these test failures represent and any found in the review a) above.

Bechtel Associates Professional Corporation

Inter-office Memorandum

BEBC-2694

To J. F. Newgen

Subject Midland Plant Units 1 & 2
Job 7220
Moisture Requirements for
Plant Area Backfill

Copies to File: 0274, C-210PR

Date February 5, 1979

From R. L. Castleberry

Of Project Engineering

At Ann Arbor

RECEIVED
FEB . 197
BECHTEL POWER CORP
JOB 7220
PER ______

This memo is written as a result of a meeting with Consumers Power Company and Construction on February 5, 1979 to discuss the interpretation of the moisture requirement in Section 12.6 of Specification C-210 for plant area backfill.

Moisture conditioning is to be done in the borrow area's as per Specification C-210, however, the moisture content during compaction is the governing control for acceptance. Compaction of any given lift is not considered complete until the testing requirement for moisture content plus density are satisfied. Therefore, during compaction is interpreted as the test result obtained from the inplace tests taken for moisture and density after placements and compaction.

S R Basinski
for/R. L. Castleberry

GAT/km

Attachment A

Route To	This Copy For
	WLBarclay WRBird TCCooke RHermeston SHHowell DBJohnson GSKeeley JFKlacking BWMarguglio PAMartinez JMilandin JFNewgen DATaggart

Consumers Power

Nonconformance
Report No QF-203

File 16.3.4 & 16.3.6
Issue Date November 22, 1977
Project Midland 1 & 2
File Title NCR's on Bechtel Construction and Quality Control

This Nonconformance Report is Issued To:

G. L. Richardson
Bechtel Lead QAE

who is responsible for corrective action.

Prepared By Donald E. Horn Date 11-22-77
Approved By Date 11/22/77
Written Reply Requested By Date 12/16/77
Corrective Action Requested By Date 12/30/77

Nonconformance Description and Supporting Details:

See attachment.

AEC Reportable Yes ☐ No ☒ See Procedure 9 (For Nuclear Projects Only)

Stop Work Necessary Yes ☐ No ☒ See Procedure 16 - Stop Work No _____

No Hold Tags Applied

Recommended Corrective Action:

See attachment.

[1]Corrective Action Taken:

See attachment.

[1]Verification of Corrective Action Required Yes ☒ No ☐

[1]Method of Verification:

Reviewed letters GLR-12-77-517, GLR-1-78-001 and GLR-01-78-040 from G. L. Richardson to J. L. Corley; letters 216FQA77 and 6FQA78 from J. L. Corley to G. L. Richardson; letters 0-1621 and 0-1651 from J. Newgen to G. Richardson; Bechtel QC Training Session QCFM-4250; and NCR's 1055 and 1094.

[1]Nonconformance Closure Confirmed By Donald E. Horn
Date 2-2-78

[1] To be completed at time of closure by Consumers Power QA Services.

F[illegible] 16.3.4 & 16.3.6
Issue Date November 22, 1977
Project Midland 1 & 2
File Title NCR's on Bechtel
Construction and Quality Control

Attachment to NCR No QF-203

Nonconformance Description and Supporting Details:

Project Quality Control Instruction R-1.00, "Material Receiving Instruction" Section 5.2 of Revision 3 and Section 5.1 of Revision 5 states in part, "Requirements for the sampling and testing and the acceptance criteria reference documents shall be noted on the applicable IR" and Section 5.4 of Revision 3 and 5.3 of Revision 5 states, "Review any required user's test data reports to verify that they have been satisfactorily completed".

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.

Attachment to NCR No QF-203

Nonconformance Description and Supporting Details: (Contd)

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:

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.

Recommended Corrective Action:

Part A & B

1. Present these findings to Bechtel Project Engineering so Project Engineering can determine what additional tests, reviews, etc. are needed to justify the material these tests represent. Have Project Engineering determine the acceptability of the material these failing tests represent.
2. Determine the underlying cause(s) for these discrepancies and take corrective action to preclude repetition in other areas.

Part C

1. An evaluation of this material is not needed because the acceptance criteria as given on QCIR No. R-1.00-1836 was 12-20% passing the No. 200 sieve. It should have been 7-20%, therefore, the test result of 11% is passing.
2. Determine the underlying cause(s) for QC not rejecting the Zone 4A Fine Backfill per the QCIR No. R-1.00-1836 acceptance criteria of 12-20% passing the No. 200 sieve. Review the interface between the material receiving QCE's and the test lab QCE's to determine if there is a breakdown in communicating the inspection criteria for materials being received. Take corrective action to preclude repetition.

File 16.3.4 & 16.3.6
Issue Date November 22, 1977
Project Midland 1 & 2
File Title NCR's on Bechtel
Construction and Quality Control

Attachment to NCR No QF-203

[1] Corrective Action Taken:

Part A & B

1. 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.

2. 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

1. 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.

2. 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.

CONSUMERS POWER COMPANY
RECEIVED
FEB 1 1978
FIELD QUALITY ASSURANCE
MIDLAND, MICHIGAN

Bechtel Power Corporation

Post Office Box 2167
Midland, Michigan 48640

January 31, 1978

JLC	✓
DBK ✓	
RGW	
FMK	
	✓
GE	
FILE	

Consumers Power Company
P. O. Box 1963
Midland, MI 48640

Attention: J. L. Corley

Job 7220 Midland Project
CPCo NCR QF-203 Final
GLR-01-78-040

Dear Mr. Corley:

Ref: 1) Letter J. Corley to G. Richardson, 216FQA77, dated 12/23/77

The following is in response to the above subject nonconformance report which identified problems on user tests for backfill material.

For the material identified in Part A of the subject finding, NCR-1094 was written. This NCR has been dispositioned by Project Engineering as Use-As-Is, and is now closed.

For the material identified in Part B of the subject finding, NCR-1055 was written. This NCR is closed as previously addressed in letter GLR-01-78-001.

For the material identified in Part C of the subject finding the field has provided justification as to why FMRs had stricter requirements than those given by Project Engineering. In letter ~~0-1621~~ 0-1651 [illegible] 2/2/78, dated 1/17/78, Field Engineering stated in part:

> The reason for specifying a 12-20% range of aggregate passing through a #200 sieve, when Specification C-210, Rev. 5 and Dwg. C-130, Rev. 6 allowed 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 and drawing.

This concludes our action on the subject nonconformance report. Should you desire additional information, do not hesitate to bring it to my attention.

Very truly yours,

G. L. Richard

G. L. Richardson
LEAD QUALITY ASSURANCE ENGINEER

GLR/JGH/sw

Bechtel Power Corporation

Interoffice Memorandum

To G. L. Richardson

File No.

Subject Job 7220 Midland Project
FMR Preparation
0-1651

Date January 17, 1978

From J. F. Newgen

Construction

Of

Midland, MI

At

Ext.

References: 1) Ltr. Richardson to Newgen, GLR-12-77-532, dated 12-23-77 (I 8840)
2) Ltr. Corley to Richardson, 216FQA77, dated 12-23-77

This memo is in response to reference 1 and is numbered similarly.

1. Our reason for specifying a 12-20% range of aggregate passing through a number 200 sieve, when Specification C-210, Rev. 5 allowed 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 dispositioning NCR QF-203 by revising the FMR, rather than noting to "use as is".

2. The intent of our previous response to blank signature blocks on FMR's CY-3171, Rev's 1 & 2, was to point out the following:

   a. Revisions to FMR's for commercial purposes do not fall under the QA program.

   b. Paragraph 3.10.2 of the IJI-1, Rev. 1 limits the necessity of the approval process of FMR revisions to those which address specification changes.

   c. Commercial changes to FMR's are not governed by FPG-3.000.

3. We disagree that a generic problem currently exists in the approval completeness of FMR's. The PFE and APFE's have indicated the frequency of signature omission is neglegible on "Q" FMR's. Those which have lacked signatures were returned when discovered.

4. The PFE and APFE's have intensified their surveillance of "Q" FMR's to assure the requirements of FPG-8.000 are implemented.

J. F. Newgen

JFN/LFS/re

Attachment A

Route To	This Copy For
RBird (last)	WLBarclay
BWMarguglio (first)	TCCooke
DATaggart (second)	RHermeston
	SHHowell
	DRJohnson
	GSKeeley
	JMKlacking
	PAMartinez
	JWilandin

Consumers Power

Nonconformance
Report No OF-199

File 16.3.4 & 16.3.6
Issue Date November 4, 1977
Project Midland 1 & 2

File Title NCR's on Bechtel Construction and Quality Control

This Nonconformance Report is Issued To:

G. L. Richardson
Bechtel Lead QAE

who is responsible for corrective action.

Prepared By Donald E. Horn Date 11-4-77
Approved By Date 11/9/77
Written Reply Requested By Date 11-23-77
Corrective Action Requested By Date 12-15-77

Nonconformance Description and Supporting Details:

See attachment.

AEC Reportable Yes ☐ No ☒ See Procedure 9 (For Nuclear Projects Only)

Stop Work Necessary Yes ☐ No ☒ See Procedure 16 - Stop Work No _____
No Hold Tags Applied

Recommended Corrective Action:

See attachment.

[1]Corrective Action Taken:

See attachment.

[1]Verification of Corrective Action Required Yes ☐ No ☐

[1]Method of Verification:

[1]Nonconformance Closure Confirmed By __________
Date __________

[1] To be completed at time of closure by Consumers Power QA Services.

File 16.3.4 & 16.3.6
Issue Date November 4, 1977
Project Midland 1 & 2
File Title NCR's on Bechtel
Construction and Quality Control

Attachment to NCR QF-199

Nonconformance Description and Supporting Details:

Specification C-210, Revision 5 Section 12.6.1 states in part, "The water content during compaction shall not be more than 2 percentage points below optimum moisture content and shall not be more than 2 percentage points above moisture content..."

Specification C-210, Revision 5 Section 13.7.1 states, "All cohesive backfill in the plant area and the berm shall be compacted to not less than 95 percent of maximum density as determined by ASTM D 1557, Method D".

Specification C-210, Revision 5 Section 13.7.2 states in part, "All cohesionless backfill in the plant area and the berm shall be compacted to not less than 80 percent of relative density as determined by ASTM D 2049..."

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.

Attachment to NCR QF-199
(Contd)

[1]Corrective Action Taken:

Part 1

(1) Bechtel QC has determined that none of the above failing tests have passing tests in the same area to clear them.

(2) North Plant Dike MD 290 and MD 377 have been identified on Bechtel NCR 1005. North Plant Dike MD 360 and Structural Backfill MDR 621 density problems have been identified on Bechtel NCR 1004. North Plant Dike MD 360 moisture problem has been identified on revised NCR 1005.

Part 2

(1) Bechtel QC has determined that none of the above failing tests have passing tests in the same area to clear them.

(2) North Plant Dike MD 142 and MD 143, West Plant Dike MD 227 and Plant Area Fill MD 1326, 1328 and 1412 have been identified on Bechtel NCR 1005. Structural Backfill MDR 621, 671, 672, 685, and 686 have been identified on Bechtel NCR 1004. Plant Area Fill MD 1311 has been identified on revised NCR 1004.

(3) Corrective action has been taken as of the last of July 1977 by Bechtel QC and U.S. Testing to more adequately clear failing tests. Therefore, the corrective action to preclude repetition for not clearing failing tests need not be addressed.

Attachment to NCR QF-199

Nonconformance Description and Supporting Details:

Part 2 (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	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

Recommended Corrective Action:

(1) Determine if there are passing tests in the same area to clear these failing tests.

(2) If these failing tests cannot be cleared by passing tests in the same area, present these findings to Bechtel Project Engineering so Project Engineering can determine what additional tests, reviews, etc. are needed to justify the material these tests represent. Have Project Engineering justify the material these failing tests represent.

(3) Determine the underlying cause(s) and take corrective action to preclude repetition.

BECHTEL

MEMORANDUM

004477

TO TC Cooke LOCATION

FROM RL Rixford DATE 1-8-80 19

SUBJECT 7-18 Presentation to NRC JOB NO. 7220

re: DGB Settlement FILE

Attached is the list of questions raised by the NRC at the 7-18-79 presentation. The list has been supplemented by, in most cases, a reference to where the subject has been discussed, ~~but~~ in some cases a brief notation has been made in the response, and in a few cases the question was deemed irrelevant to the MCAR and the response so indicates.

If anything more detailed, more complete, or more formal is required please let myself or Karl Weidner know.

cc: K. Weidner w/a
C. McConnel w/a
J.O. Wanzeck w/a
RL Rixford w/orig.

RESPONSE TO QUESTIONS ASKED BY THE NRC DURING THE 7/18/79 PRESENTATION

References to: "Question" are the NRC 50.54(f) Questions
"Item" are the items in this list

:em 1 Agenda Item 2 - Is it possible that the condensate line or other utilities are still providing support to the Diesel Generator Building? (Lyman Heller, Darl Hood)

001177

Response: No, the settlement data and drawing clearly show the building has settled in all areas. However, the differential settlement of the building does seem to have been exaggerated by the presence of either the condensate line and the concrete encasement around the condensate line or the concrete back fill in the area.

Item 2 Agenda Item 3 - Have provisions been made for the train bay tracks loading effect on the borated storage tank lines? (Darl Hood)

Response: Considered irrelevant to MCAR scope, but it was addressed in BLC-8370, 10/29/79, which transmitted Interim Report #8 to Consumers Power Company

Item 3 How does dewatering tie into the load test of the borated water storage tanks (time frame)? (Lyman Heller)

Response: Adequate settlement data can be acquired by the load test whether it is done prior to or after dewatering. Therefore, the dewatering and load test are considered to be independent items.

Item 4 How much settlement of the borated water storage tanks is acceptable? (Lyman Heller)

Response: Original plans outlined in BLC-8370, 10/29/79, were suspended upon receipt of Question 31 from NRC.

Item 5 Has any concrete pipe been profiled? (Ron Lipinski)

It was noted at this time that there is no Class I concrete pipe in the fill.

Response: No, the response during meeting is correct.

Item 6a What is the limiting factor in the design of the concrete duct banks? (Lyman Heller)

Response: The design of buried utilities was described in the response to Question 13 with additional specifics for the Aux. to DGB duct in the response to Question 30.

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Item 6b What is the basis for the assumption that no further remedial action is required for the duct banks? (Ron Lipinski)

Bechtel responded that settlement monitoring would continue probably through cable pulling.

Ron Lipinski noted that duct banks are a Category I structure the same as any other structure on the site.

Response: Basis is that the ducts are not pressure boundaries, and have been evaluated for Category I seismic effects. The integrity of the ducts due to plant area fill settlement will be determined by techniques described in the response to Question 12, Table 12-1, Note 2. Additional discussion is in the response to Questions 7 and 30.

Item 6c Did we analyze the load associated with a large crane parked over the duct bank which may have a void below it? (Lyman Heller)

Carl Wiedner discussed the flexibility of the electrical duct bank and the structural analysis.

Response: Irrelevant to the MCAR. It was not a design load combination and was not analyzed. Additional discussion is in the response to Question 34.

Item 7 Is there any corrosion protection for stainless steel Class I pipes? (Darl Hood)

Response: Irrelevant to the MCAR.

Item 8 Chuck Goulds Presentation - Question concerning the valve pit caissons going through construction pads and reinforcement of caissons for transfer of horizontal loads. (Ron Lipinski)

Item 8 Cont. It was noted that various tools would be used for demolition which would deliver about 1,000 foot pounds per blow and that this would not damage any of the other structures. It was also noted that the valve pit crane pad was about 2½ feet thick.

Response: Response made in meeting addresses caissons going through the construction pads. Caissons will not provide for transfer of horizontal loads. (refer to MCAR 24, Interim Report 7, page 5)

Item 9a Sherif Afifi's Presentation - With ½" to 1" as the upper limit for seismic settlement, would there be no effects on other structures due to dewatering? (Lyman Heller)

It was noted to be a small general settlement to be evaluated by Sherif.

Response: Refer to the response to Question 27.

Item 9b Why do we feel that a 1.5 factor of safety is adequate? (Darl Hood)

It was noted that primarily this was due to the fact that 7.5 earthquake value was too large.

Response: Answer during meeting considered adequate assuming the factor of safety against liquefaction was the one being questioned.

Item 10 Where exactly are the liquefaction potential problem areas? (Lyman Heller)

Sherif responded that the small zone in the railroad bay was not a problem.

The borated water storage tank line was not a problem.

We have not analyzed all areas yet; however, this is in reality a hypothetical question since dewatering will answer the potential liquefaction questions in any area in the power block.

Response: Permanent site dewatering will handle all potential liquefaction problem areas.

Item 11a Dick Loughney's Presentation - Would the Service Water Building be outside the perimeter of the dewatering system? (Lyman Heller)

esponse: Yes. MCAR 24 Interim Report #6 addresses soil conditions and corrective actions for this structure.

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Item 11b When would the clay dike cutoff in front of power block be in place? (Lyman Heller)

Response: Design of dewatering system does not assume any cutoff system.

Item 11c Will this comply with the new Reg. Guides? (Ron Lipinski)

Response: Yes. Refer to the response to Question 24.

Item 11d What will be the systems discharge rate? (Gene Gallagher) It was noted that it would be less than 400 GPM.

Response: Refer to the response to Question 24.

Item 12 General Question on electrical blackout. It was noted that it would be low since the horsepower requirements for the pumps are small. (D. Hayes)

Response: Irrelevant to the MCAR, no discussion of diesel backup.

Item 13 Expressed a general interest on getting test pit information. (Gillan)

Response: MCAR 24, Interim Report 8 addressed test pit information.

Item 14 Ted Johnson's Presentation. Please comment on ACI 349 which includes settlement with dead load and wind, earthquake, etc. (Gene Callagher) Bechtel noted that they had done a similar consideration. They also noted thay they would probably seal all cracks greater than 15 mils because of potential corrosion problems and that they were still pursuing an analysis in this area.

Response: The response to Question 15 addresses this, as will the study in response to Question 28.

Item 15 Exactly what all will the caissons support? (Henderson)

It was noted that Bechtel had not completed the horizontal support analysis in this area.

Response: Assuming the reference is to the Auxiliary Building caissons, refer to MCAR 24, Interim Report 7 (page 4).

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Item 16a Sherif Afifi's Presentation - Will the Diesel Generator sand surcharge be removed prior to dewatering? (Lyman Heller)

Response: Yes, Surcharge removal discussed in MCAR 24, Interim Report 8 (page 2).

Item 16b How much lower than the construction water would dewatering operation go? (Lyman Heller)

It was noted that it would be a minimum elevation of 600 feet (existing till), and that it was still under evaluation.

Response: Refer to the response to Question 24.

Item 17 Are we confident that the material below the borated water storage tank is acceptable? (Lyman Heller)

It was noted that it is mainly clay and with minimal amounts of sand.

Response: Refer to MCAR 24, Interim Report 7 (page 11) and response to Question 31.

Item 18 Considering the settlement to the southeast side of the Diesel Generator Building, what accounts for this impact?

There also appears to be some concerns on conduit supporting the building.

It was noted that there is more sand on the north side of the building. (Lyman Heller)

Response: Refer to response to Item 1 above.

Item 19 Interim Report #6 to the MCAR 24 (50/553 Report) stated that we would be removing the top 3-4 ft. of soil. Why? (Gene Gallagher)

It was noted that this was to take care of weathering that the soil ahd experienced and also possible the bubbling of air through that portion of the soil.

Response: Refer to response to Item 17 above.

Item 20 The PLOCAP location (?) shown on the drawings as a dotted line is no longer part of the design. (Darl Hood)

The control room pressurizer is in the location proposed, but how will it be determined that the soil will be acceptable for any new Class I structures? (Darl Hood)

Response: Borings have been done (MCAR 24, Figure 67)

Item 21 Since we have eliminated chemical grout what about the control tower area void? (Gillan)

Sherif responded that this was an insignificant area and would still probably be pressure grouted.

Response: Refer to the response to Question 12, Table 12-1, Item A.1

Item 22 Dr. Peck Presentation - How would the Diesel Generator surcharge improve the bearing capacity of the fill? (Lyman Heller)

It was noted that long term bearing capacity was based on the friction of the material, and the load has increased the settlement capacity.

Response: Refer to the response to Questions 27 and 35.

Item 23 Why are we testing the caissons at 1.5 times the working load? (Lyman Heller)

It was noted that this was to avoid any unanticipated settlement in the adjacent areas.

Response: Response during meeting considered adequate (MCAR 24, Interim Report 7, pg. 5)

Item 24 TCCooke Presentation on Schedule - When will the cutoff wall be established? It was noted that there would be not cutoff wall the south end of the power block area, since the rate of flow of water to the sands and/or clays was expected to be minimal. However, if necessary, a slurry trench or chemical grout could be utilized in this area.

Response: Refer to the response to Question 24

Item 25 Phil Martinez's Presentation - If there is too much reliance on testing during the plant area fill what did the dike people rely on? (Ron Lipinski)

Response: Refer to the response to Question 23

Item 26 Why do you say re-excavation was not a cause? (Lyman Heller)

Response: Refer to the response to Question 23

Item 27 How can you possibly say there was not a problem with people qualifications?

esponse: Refer to the response to Question 23

Item 28 Can you say that there was a bona fide soils engineers on site? (Gene Gallagher)

Response: Refer to the response to Question 23

Item 29 How can you possibly say that you have achieved correction action with no "yes" on personnel as a cause?

How can you say there are bad test procedures when personnel was not involved as a cause?

The NRC disagrees with qualifications of eprsonnel as not being a cause. (Gene Gallagher)

Response: Refer to the response to Question 23

tem 30 How can you say the procedures were not bad?

Response: Refer to the response to Question 23

Item 31 Why was the Spec not included as a cause? (Gene Gallagher)

Response: Refer to the response to Question 23

Item 32 D. Hayes also disagrees with the QC people not being a cause. If the people were qualified, many of the five most probable causes would have been eliminated. (Gene Gallagher)

Response: Refer to the response to Question 23.

Item 33 How come in some areas QC identified problems, but nothing happened? (D. Hayes)

Response: Refer to the response to Question 23

Item 34 He commented that there were also problems with moisture density relationship Phil said that moisture did not cause the problem.

Response: Refer to the response to Question 23

Item 35 Does the applicant endorse the most probable causes? (Darl Hood) Yes - Per GSKeeley after checking with Don Horn.

Response: Refer to the response to Question 23.

Item 36 How then do people enter into the analysis? (Darl Hood) It was noted that Don Horn's presentation would cover this.

Response: Refer to the response to Question 23.

Item 37 Don Horn's Presentation - Why are we no longer using the Nuclear Denseometer? (Gene Gallagher) It was noted that because of moisture problems found in the sand and clay.

Response: Response during meeting considered adequate.

Item 38 What does generic mean? (D. Hayes)

It was noted that this means U. S. Testing in some cases.

Response: Irrelevant to MCAR

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Item 39 What was the source of the air bubbles at the tank farm at elevation 611' and bubbles at 627'? (Lyman Heller)

Response: Refer to MCAR 24, Interim Report 7 (page 11)

Item 40 Has the tank farm test pit (inspection pit 20 X 20) confirmed boring information? (Lyman Heller)

It was noted that it has not been compared yet, but the material appeared good below the top four feet.

Was there clay in both pits or was there sand? (Lyman Heller)

Response: Refer to MCAR 24, Interim Report 7 (page 11)

Item 41 What other plant improvements will be made as a result of the soils experience?

Will there be a topical report? (Lyman Heller)

Response: Refer to the response to Question 23

Item 42 Who pays the on-site GEOTECH Man? (Lyman Heller)

Response: Irrelevant to MCAR

Item 43 Is QC separate and does it have authority to stop work? (Lyman Heller)

Response: Yes, per SF/PSP G-1.1, Section 3.5

Item 44 What is the criteria for acceptability of the borated storage tank ring foundation?

Response: See Item 4 above.

Item 45a Lyman Heller was concerned with the flexure of the ring beam.

It was noted that the tank bottom transfers load to the soil.

Response: Irrelevant to MCAR

Item 45b Lyman also seemed concerned about the fact that the borated storage tank had no baffles. He was really looking for a measurement on membrane stretching.

Darl Hood noted that this was the basis for 50.54(f) questions.

Response: Irrelevant to MCAR

Item 46a Since air bubbles may have travelled horizontally, how can borings confirm that there are not problems?

Dr. Peck noted that in all likelihood the air passages were already there and that the only evidence of air leaking was the bubbling at the surface.

Response: MCAR 24, Interim Report 7 (page 11)

Item 46b Will the fact that the air line condition existed two months be part of the decision on what to do with the tank farm soil? (Gene Gallagher)

Dr. Peck noted that you could expect some surface disturbance, but he believes there would be little damage to the underlying soil.

TCCooke then noted that the piezometers could have provided paths for the air bubbles leaking to the surface.

Response: MCAR 24, Interim Report 7 (page 11)

Item 47 Has Consumers Power Company applied lessons to other sites? (D. Hayes)

Response: (Consumers Power Company)

Item 48 How are the procedures now reviewed? (D. Hayes)

Response: (Consumers Power Company)

Item 49 Question on structural mat vs. spread footing - It was noted that it would have to be rechecked to see that the design would have to be satisfactory. The 50.54(f) response was confusing to Ron Lipinski.

It was noted that this was a settlement calculation only. 004477

Response: Refer to the response to Question 27

Item 50a What load or elevation will the underpinning be made to? (Lyman Heller)

Response: Elevation for underpinning of valve pit will be determined by the use of dutch cone penetration tests. (no longer applicable for Aux. Bldg.)

Item 50b How will we decide what load has to be applied to each pile during jacking? It was noted that we would calculate the theoretical reactions.

Response: Exact techniques will be developed by underpinning subcontractor. But it will be based on a combination of structure weight and movement during jacking.

Item 50c How will we transfer load from the jacks to the structure? (Ron Lipinski)

Response: This is a subcontractor design and will be included in procedures he will develop.

Item 51 What about earthquake vibration? (Ron Lipinski)

Response: Seismic laods will be carried by the fill under the Main Feedwater Valve pit. Refer to MCAR 24, Interim Report 7, (page 4).

Item 52 Who runs the show on underpinning? (Lyman Heller)

It was noted that Bechtel would do the design with Chuck Gould acting as a consultant.

Consumers Power would then review it.

esponse: Subcontractor after Bechtel, Gould, and Consumers Power review of procedures.

Item 53 GSKeeley's Presentation - Darl Hood noted that the staff was aware of the confusion they may have created by attacking the soil problem from several directions, and were trying to compensate for same.

Response: (NRC) Irrelevant to the MCAR

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Item 54 Darl Hood wanted Keeley statement on his confidence that the deficiencies were sufficiently understood and the corrective actions taken to preclude repetitions in this area.

Response: (Consumers Power Company - See response to Question 23)

Item 55 Darl Hood also wanted to know whether all problems have been understood prior to remedial action. That is, the problems should not again show up during the remedial activities. For example, flooding was noted to have been removed from the specification by Rev. 7.

Response: The remedial actions for each structure do have a sound basis.

Item 56 Will all remedial action be accomplished by the Consumers Power Quality Assurance Program? (Gene Gallagher)

Response: All remedial action performed upon the Q-listed portions of the backfill will be accomplished under the QA program.

Item 57 Will dewatering be part of the Qualtiy System? This has to be responded in accordance with criteria 2. (Gene Gallagher)
The NRC is reviewing the standard review plan and we will look for compliance. (Darl Hood)

Response: Refer to the response to Question 24.

Item 58 Documentation is needed. (Jim Knight)

It was noted that there is more information in existing reports and that the narrative of today's discussions will take approximately two weeks to prepare for Mr. Knight.

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He also noted that there appeared to be much positive progress in the Diesel Generator and he would appreciate having the documentation very quickly. (Jim Knight)

Response: Documentation of presentation provided to NRC via HOWE-218-79, dated August 10, 1979.

Attachment A

**Reissued July 15, 1977 to indicate time nonconformances occurred.

Route To	This Copy For
Bird (Third) Skaggs (Second) BWMarguglio (First)	WLBarclay TCCooke RHermeston SHHowell DRJohnson GSKeeley JMKlacking PAMartinez JMilandin JFNewgen

Consumers Power

Nonconformance Report No OF-174

File 16.3.4, 16.3.6
Issue Date July 15, 1977
Project Midland 1 & 2

File Title NCR's on Bechtel Construction & Quality Control

This Nonconformance Report is Issued To:

G. L. Richardson
Bechtel Project Field Quality
Assurance Engineer

who is responsible for corrective action.

Prepared By Date 7-15-77
Approved By Date 7-15-77
Written Reply Requested By Date 8-19-77
Corrective Action Requested By Date 9-2-77

Nonconformance Description and Supporting Details:

See Attachment.

AEC Reportable Yes ☐ No ☒ **See Procedure 9 (For Nuclear Projects Only)**

Stop Work Necessary Yes ☐ No ☒ **See Procedure 16 - Stop Work No** ____
No hold tags applied

Recommended Corrective Action:

Have Project Engineering evaluate the acceptability of these materials and determine what action is needed to correct these problems if the material is unacceptable.

[1] **Corrective Action Taken:**

Project Engineering evaluated the nonconforming conditions and determined these materials acceptable.

[1] **Verification of Corrective Action Required** Yes ☒ No ☐

[1] **Method of Verification:**

Reviewed IOM R. L. Castleberry to G. L. Richardson dated 8/31/77, Bechtel QA Letter GLR-9-77-317, CPCo Letter 151FQA77, IOM R. L. Castleberry to G. L. Richardson dated 10/4/77 and Bechtel QA Letter GLR-10-77-390.

[1] **Nonconformance Closure Confirmed By**
Date [illegible]-77

[1] To be completed at time of closure by Consumers Power QA Services.

File: 16.3.[illegible] 16.3.6
Date: July [illegible], 1977 ** July 19, 1977
Project: Midland 1 & 2
Title: NCR's on Bechtel Construction and
Quality Control

Attachment to Report No QF-174

<u>Nonconformance Description and Supporting Details</u>

During a review of test reports for partial cooling ponds and dikes turnover, the following was found:

Specification C-210, Revision 2, Section 12.5.2 states in part:

> "Zone 1 and Zone 1A material shall be placed in the embankment fill as shown on the Drawings or as required..."

Table 12-1 in this specification states in part:

> "Zone 1 Impervious Fill - Not less than 20% passing No. 200 sieve..."

Contrary to these requirements, tests 115 in North Plant Dike and MD 359 and MD 358 in North East Dike had soil classification Zone 1 (BMP 114) which has 5.2% passing No. 200 sieve. Test MD 830 in North East Dike had soil classification Zone 1 (BMP 139) which has 3.4% passing No. 200 sieve.

** Test 115 was taken May 28, 1974, Tests MD 358 and MD 359 were taken May 30, 1974 and Test MD 830 was taken August 8, 1974.

Attachment A

** Reissued July 19, 1977 to indicate time nonconformances occurred.

Route To	This Copy For
RBird (Third) OESkaggs (Second) BWMarguglio (First)	GLBarclay JLCooke BHermeston GWHowell DRJohnson RSKeeley JNKlacking PAMartinez DMiTandin JP [illegible]

Consumers Power

Nonconformance Report No QF-172

File 16.3.4, 16.3.6
Issue Date July 8, 1977
Project Midland 1 & 2
File Title NCR's on Bechtel Construction & Quality Control

This Nonconformance Report is Issued To:

G. L. Richardson
Bechtel Project Field Quality Assurance Engineer

who is responsible for corrective action.

Prepared By **Date** 7-8-77
Approved By **Date** 7/8/77
Written Reply Requested By Date 7-25-77
Corrective Action Requested By Date 8-26-77

Nonconformance Description and Supporting Details:

SEE ATTACHMENT

AEC Reportable Yes ☐ No ☒ **See Procedure 9 (For Nuclear Projects Only)**

Stop Work Necessary Yes ☐ No ☒ **See Procedure 16 - Stop Work No** ____
"No hold tags applied"

Recommended Corrective Action:

Have Project Engineering evaluate the acceptability of these materials and determine what action is needed to correct these problems if the material is unacceptable.

[1]**Corrective Action Taken:**

Project Engineering evaluated the nonconforming conditions and determined these materials acceptable.
Percent compaction for MD 342 in North East Dike was incorrect and has been revised identifying the correct (passing) result.

[1]**Verification of Corrective Action Required** Yes ☒ No ☐

[1]**Method of Verification:**

Reviewed the revised North East Dike test MD 342, IOM R. L. Castleberry to G. L. Richardson dated 8/31/77, Bechtel QA Letter GLR-9-77-317, CPCo Letter 151FQA77, IOM R. L. Castleberry to G. L. Richardson dated 10/4/77 and Bechtel QA Letter GLR-10-77-390.

[1]**Nonconformance Closure Confirmed By**
Date 10-11-77

[1] To be completed at time of closure by Consumers Power QA Services.

File: 16.3.4, 16.3.6
Date: July 8, [illegible]77 ** July 19, 1977
Project: Midland 1 & 2
Title: NCR's on Bechtel Construction &
Quality Control

Attachment to Report No QF-172

During a review of test reports for partial cooling ponds and dikes turnover, the following were found:

Specification C-210, Revision 4, Section 13.6 states:

> "Moisture control of the plant area and berm material shall conform to Section 12.6.

Section 12.6.1 states in part:

> "The water content during compaction shall not be more than 2 percentage points below optimum moisture content ..."

Contrary to this requirement, test report MD 359 for the North East Dike Station 29+00 5'R ℄ Zone 2 @ elevation 622 had moisture content of 2.8 percent below optimum moisture content. This test had been marked P - for pass, when actually the test failed.

Specification C-210, Revision 4, Section 13.7 states in part:

> "All backfill in the plant area and berm shall be compacted to not less than 95 per cent of maximum density as determined by modified Proctor method (ASTM 1557, Method D)..."

Contrary to this requirement, test reports for the North East Dike MD 342 Station 30+00, ℄ Zone 2 @ elevation 622 had 94.5 percent compaction; MD 354 Station 31+00, 100'R of ℄ sand drain Zone 2 @ elevation 622 had 93.7 percent compaction; and MD 356 Station 29+00, 100'R of ℄ of sand drain Zone 2 @ elevation 622 had 92.2 percent compaction. Test MD 342 had been marked P - for pass, when actually the test failed. Tests MD 354 and MD 356 had been marked F - for fail and accepted by 4 roller passes. The 4 roller passes are not the acceptance criteria in this area.

** Test MD 342 was taken May 25, 1974, Tests MD 354 and MD 356 were taken May 28, 1974, and Test MD 359 was taken May 30, 1974.

Attachment A

Route To	This Copy For
BWMarguglio HWSlager JHMaclaren WRBird	SHHowell GSKeeley TCCooke JMilandin JMKlacking GLRichardson Subject File

Consumers Power

Nonconformance
Report No QF-147

File 16.3.4 & 16.3.6
Issue Date February 2, 1977
Project Midland 1 & 2

File Title NCR's on Bechtel Construction and Bechtel Quality Control

This Nonconformance Report is Issued To:
Mr. J. F. Newgen
Bechtel Project Superintendent

Mr. J. P. Connolly
Bechtel Project Field Quality Control Engineer
who is responsible for corrective action.

Prepared By Donald E. Horn Date 2-2-77
Approved By Date 2/3/77
Written Reply Requested By Date 2-14-77
Corrective Action Requested By Date 3-15-77

repeat
see
QF-29
Oct 14, 1974

Nonconformance Description and Supporting Details: (1) Specification C-211 Revision 3 section 5.6.2 states "Material delivered to the jobsite for use as structural backfill shall be visually inspected, and tested in accordance with ASTM C-136 (and C-117 when required by the Field Engineer) by the Contractor's representative once per day when material is being delivered". (2) Project QC Instruction No. 7220/C-1.02 Compacted Backfill Revision 0 section 2.3 D states in part "The following tests shall be taken at the specified frequencies: 4. During each day's delivery of structural backfill material, a minimum of one representative sample tested in accordance with ASTM C-136 (and ASTM C-117 as determined by Field Engineering) to the gradation requirements specified, prior to placement". (Contd)

AEC Reportable Yes ☐ No ☒ See Procedure 9 (For Nuclear Projects Only)

Stop Work Necessary Yes ☐ No ☒ See Procedure 16 - Stop Work No ______
Bechtel applied hold tags to the structural backfill stockpile.

Recommended Corrective Action:

See attachment.

[1] Corrective Action Taken:

See attachment.

[1] Verification of Corrective Action Required Yes ☒ No ☐

[1] Method of Verification:
Verified review of structural backfill deliveries for October and November, 1976 for lack of testing on February 9, 1977. Reviewed letters FQCL-140 and BCCC-2373, Training File BT-117 and NCR's 686 and 698.

[1] Nonconformance Closure Confirmed By Donald E. Horn
Date 6-10-77

---

[1] To be completed at time of closure by Consumers Power QA Services.

Attachment to Report No QF-147

Nonconformance Description and Supporting Details: (Contd)

Contrary to (1) and (2) above, structural backfill delivered on December 1, 1976, December 14, 1976 and January 11, 1977 was not tested for gradation requirements.

Recommended Corrective Action:

(1) Review October and November structural backfill delivered in 1976 for similar lack of testing.

(2) Receive a Project Engineering evaluation on the material lacking gradation tests including any found in the review in (1) above.

(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(s) and propose further corrective action to preclude repetition.

Corrective Action Taken:

(1) Shipments of structural backfill delivered in October and November, 1976 have been reviewed. NCR's 686 and 698 have been written identifying the lack of testing in this NCR and in the review of October and November, 1976 delivery tickets.

(2) Project Engineering has evaluated the materials lacking gradation tests in NCR's 686 and 698 and has dispositioned it "use as is".

File 16.3.4 & 16.3.6
Issue Date February 2, 1977
Project Midland 1 & 2
File Title NCR's on Bechtel
Construction and Bechtel Quality
Control

Attachment to Report No QF-147

[1] Corrective Action Taken: (Contd)

(3) Starting Friday, 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.

Attachment A

Route To	This Copy For
BWMarguglio HWSlager JHMaclaren	SHHowell GSKeeley TCCooke JMilandin JMKlacking GLRichardson Subject File

Consumers Power

Nonconformance Report No QF-130

File 16.3.6
Issue Date October 18, 1976
Project Midland 1 & 2
File Title NCR's on Bechtel Quality Control

This Nonconformance Report is Issued To:

J. P. Connolly
Bechtel Project Field Quality
Control Engineer

who is responsible for corrective action.

Prepared By Donald E. Horn Date 10-18-76
Approved By Date 10/18/76
Written Reply Requested By Date 11-1-76
Corrective Action Requested By Date 11-8-76

Nonconformance Description and Supporting Details:
Field Inspection Plan C-210-4-55 Rev. 0 for Placing Plant Area Backfill, North of "A" line, "4.55" to "8.7" line, elevation 610' ± to 634.5, under section 2.20 Activity/Task for "Placement" item 1 states "Zone 1, 1A, 2 and 3 material placed in uncompacted lifts not exceeding 12 inches. Areas not accessible to roller equipment, the material placed in uncompacted lifts not exceeding 4 inches".

Contrary to this Activity/Task, Quality Control Engineers have observed material placed in approximate 12 inch uncompacted lifts where roller equipment was not used to compact the material.

AEC Reportable Yes ☐ No ☒ See Procedure 9 (For Nuclear Projects Only)

Stop Work Necessary Yes ☐ No ☒ See Procedure 16 - Stop Work No ______
No Hold Tags Applied

Recommended Corrective Action:
(1) Review other C-210-4 Field Inspection Plans for similar problems.
(2) Determine the cause of the nonconformance above and similar problems in (1) above, if any found.
(3) Take corrective action to preclude repetition.

[1]Corrective Action Taken:
(1) All closed C-210-4 Field Inspection Plans have been reviewed and similar situations as described in QF-130 existed (i.e., that 12 inch lifts were placed in areas where roller equipment was not used).
(2) Cause of nonconformance was misinterpretation of specification requirements.
(3) 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.

[1]Verification of Corrective Action Required Yes ☒ No ☐

[1]Method of Verification:

Reviewed letter FQCL-142.

[1]Nonconformance Closure Confirmed By Donald E. Horn
Date 3-3-77

[1] To be completed at time of closure by Consumers Power QA Services.

Attachment A

Route To	This Copy For
FMSouthworth	SHHowell
HWSlager	GSKeeley
CQHills	TCCooke
	JMilandin
	JMKlacking
	GLRichardson
	Subject File

Consumers Power

Nonconformance Report No QF-120

File 16.3.4 & 16.3.6
Issue Date September 21, 1976
Project Midland 1 & 2

File Title NCR's on Bechtel Construction & Quality Control

This Nonconformance Report is Issued To:
J. P. Connolly
Bechtel Project Field Quality Control Engineer
J. F. Newgen
Bechtel Project Superintendent
who is responsible for corrective action.

Prepared By Donald E. Horn Date 9-21-76
Approved By DRKeating Date 9-21-76
Written Reply Requested By Date 10-8-76
Corrective Action Requested By Date 10-8-76

Nonconformance Description and Supporting Details: Specification C-210, Revision 4 sections 12.5.2, 12.5.3 and 12.5.4 state in part that (1) The uncompacted lift thickness of soil placement shall be not more than 12 inches. (2) In areas not accessible to roller equipment, the material shall be placed in lifts not to exceed 4 inches in uncompacted thickness. Contrary to these requirements, (1) soil was placed between manhole #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 #4 and #5 above the Sanitary Sewer in the West Plant Dike in uncompacted lift thickness of 6 inches. The material was removed down to the required lift thicknesses and compacted, prior to continued work in this area.

AEC Reportable Yes ☐ No ☒ See Procedure 9 (For Nuclear Projects Only)

Stop Work Necessary Yes ☐ No ☒ See Procedure 16 - Stop Work No ______
No Hold Tags Applied.

Recommended Corrective Action:

(1) Determine why the original uncompacted lift thicknesses exceeded the maximum lift thicknesses.

(2) Take corrective action to preclude repetition.

[1]Corrective Action Taken:

(1) This was the 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.

(2) A Training Session was given to the Laborer General Foreman and Laborer Foreman 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.

[1]Verification of Corrective Action Required Yes ☒ No ☐

[1]Method of Verification:

Reviewed Training Session BT94, letters BCCC-2068 and FQCL-114, and DCN No. 5 on Drawing C-130, Rev. 3.

[1]Nonconformance Closure Confirmed By Donald E. Horn
Date 11-9-76

[1] To be completed at time of closure by Consumers Power QA Services.

Attachment A

Route To	This Copy For
FMSouthworth HWSlager CQHills	SHHowell GSKeeley TCCooke JMilandin WFHolub GLRichardson Subject File

Consumers Power

Nonconformance Report No QF-68

File 16.3.6
Issue Date October 17, 1975
Project Midland 1 & 2

File Title NCR's on Bechtel Quality Control

This Nonconformance Report is Issued To:

J. P. Connolly
Bechtel Project Field Quality Control
Engineer

who is responsible for corrective action.

Prepared By Donald E. Horn Date 10-17-75
Approved By Date 10/17/75
Written Reply Requested By Date 11-17-75
Corrective Action Requested By Date 11-17-75

Nonconformance Description and Supporting Details: Specification C-210 Revision 4, section 13.7 states in part "All backfill in the plant area and the berm shall be compacted to not less than 95 percent of maximum density as determined by modified Proctor method..." Contrary to this requirement, the compaction test MD142 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.

AEC Reportable Yes ☐ No ☒ See Procedure 9 (For Nuclear Projects Only)

Stop Work Necessary Yes ☐ No ☒ See Procedure 16 - Stop Work No ______

Recommended Corrective Action:

See Attachment A.

[1]Corrective Action Taken:

See Attachment A.

[1]Verification of Corrective Action Required Yes ☒ No ☐

[1]Method of Verification: (1) Compared 17 Bechtel Modified Proctors to Field Work Sheets. (2) Reviewed revised reports for correctness. (3) Reviewed U.S. Testing's system for checking tests against a Master Proctor List and a Master Log Book.

[1]Nonconformance Closure Confirmed By Donald E. Horn
Date 11-21-75

[1] To be completed at time of closure by Consumers Power QA Services.

oute To
G. S. Keeley
H. W. Slager
C. Q. Hills

This Copy For
S. H. Howell
W. E. Kessler(2)
W. F. Holub
File

Nonconformance No QF29

File 16.3.6
Issue Date October 14, 1974
Project Midland 1 & 2
File Title NCR's on Bechtel Quality Control

This Nonconformance Report is Issued to:

Mr. J. P. Connolly
Bechtel Project Field Quality Control Engineer

who is responsible for correction action.

Prepared By Date 10-14-74
Reviewed By Date [illegible]
Written Reply Required By Date 10-24-74
Action Required By Date 11-14-74

Nonconformance Description and Supporting Details: Specification C-211 Rev. 0 and SCN No. C-211-4001, 5.6.2 states "Material delivered to the jobsite for use as structural backfill shall be visually inspected, and tested in accordance with ASTM C-117 and C-136 by the contractors representative once per day when material is being delivered." Structural backfill material was delivered on thirty (30) days in August and September, but the QC File only has test reports for one (1) of the thirty (30) days. U.S. Testing File only has test reports for eleven (11) of the thirty (30) days.

AEC Reportable Yes ☐ No ☒ See Procedure 9 - Reporting of Deficiencies to AEC
AEC Notified on ____________ By ____________ Method ____________

Recommended Corrective Action (If Appropriate): (1) Evaluate the structural backfill material in place and in the stockpile with additional tests. (2) Locate the missing test reports. (3) Correct the problem of U.S. Testing not being notified of in coming structural backfill material.

[1]Corrective Action To Be Taken: (1) Evaluate the structural backfill material in the stockpile with additional tests. (2) Locate the missing test reports. (3) Correct the problem of U.S. Testing not being notified of incoming structural backfill material.

[1]Underlying Cause of Nonconformance: The underlying cause of this nonconformance is Bechtel Quality Control was not being fully informed of material deliveries, therefore U.S. Testing was not being informed by Bechtel Quality Control.

(Corrective Action Implemented and Nonconformance Closed) Confirmed By
Date February 12, 1975

(1) Bechtel NCR 198 was initiated. 26 additional samples were taken from the stockpile. Bechtel Project Engineering's Disposition is to "use as is" based on the results of the additional samples. (2) The ten missing reports were found and placed in the QC File (3) A memorandum from E. E. Felton directing that Quality Control be notified of all incoming shipments of structural backfill material was issued on October 29, 1974.

---

[1] To Be Provided by Addressee.

3/15/74

CONSUMER ER COMPANY
PROJECT QUALITY ASSURANCE SERVICES
Daily Log Sheet

Prepared By: Donald E. Horn
Date: March 9, 19
Page 1 of 3

ACTIVITY	FINDING	EVALUATION	CORRECTIVE ACTION	RESOLUTION & DATE
Talked with Don Stock, Jay Finlayson, Jim Connelly & Tony Thompson about NCR 508 & the lack of a response to letter B-203-41 dated 9-7-76 requesting U.S.T. give a training session on stacking tolerances & loc. of the training back to Bechtel by 9-15-76.	N.A.	Bechtel QC has since trained on Bechtel plant & vendor's sites.	Same as "Evaluation"	Closed 7-3-78 DE Horn
Gary Slagle called & had comments on NCR 421 & 640.	N A.	NCR 421 needs letter attached to NCR stating the ramp was taken out.	The NCR 421 block #23 states "The Nonconforming material was removed." as of 3-18-77.	The change was made 3-18-77. Closed 3-18-77 DEH
	N A.	NCR 640 states the temp. could have affected the conc. cylinders, but does not give rationale.	Minor point, I do not feel a change is necessary.	Closed 7-3-78 DE Horn
Revised section 3(b) & 8 of the EA&P Position Description Questionnaire.	N.A.	N.A.	N.A.	N.A.

Copy sent to PQAA on 3-16-77

RYDEN

NONCONFORMANCE REPORT

2. Spec. 7220-C-210
REV. 4
3. ITEM DESCRIPTION: Plant Area Backfill
4. SERIAL NUMBER: N/A
5. PURCHASE ORDER NO.: N/A
6. CONTRACTOR/LOCATION: Canonie Construction Co., South Haven, MI
7. PROJECT NO.: 7220
8. ITEM LOCATION: Ramp North of Aux. Bldg
9. STARTUP SYSTEM NO.: N/A
10. QC FIELD INSPECTION PLAN NO.: N/A
11. ASME CODE ITEM ☐ YES ☒ NO
12. REPORTED BY: C. H. Nelson DATE 5/5/76
13. VALIDATED BY: J. F. Connolly DATE 5-10-76
15. REPLACEMENT PART NO.: N/A REV.
16. REPLACEMENT SERIAL NO.: N/A
17. SOURCE: Subcontractor
1. PAGE 1 OF 4 ~~2~~
14. NCR NO. 421
25. DISPOSITION CONCURRENCE N/A

REWORK	REJECT	REPAIR	USE AS IS	DOC.

J.A. Boos for T.C. Valenzano 6/22/76
SITE FIELD ENGINEER DATE
J.L. Kurley for RLC 6/18/76
PROJECT ENGINEER DATE
J.F. Connolly 6-22-76
PROJECT FIELD QC ENGINEER DATE
AUTHORIZE INSPECTOR DATE

18. ROUTING INSTRUCTIONS: ☒ ROUTE TO FIELD ENGINEERING ☐ ROUTE TO MATERIAL SUPERVISOR

19. NONCONFORMING CONDITION:

Specification 7220-C-210, Rev. 4, Para. 12.6.1 states in part, "The water content during compaction . . . shall not be more than 2 percentage points above optimum moisture content . . .". Contrary to the above, during the fall of 1975 a construction access ramp was constructed from material which exceeded the moisture content requirements of Specification C-210. The field forces, including Bechtel Quality Control, were aware that the material exceeded moisture when placed. When the material was placed it was

Q-LIST NO. 1.002 NO HOLD TAGS APPLIED CHN 5/14/76

Continued on Page 2

20. ☐ FIELD DISPOSITION ☒ FIELD RECOMMENDATION/ROUTE TO PROJECT ENGINEERING

Recommend "accept as is," subject to Project Engineering review and evaluation. Backfill material has been compacted to not less than 95% of maximum density in accordance with Specification C-210.

C.H. Nelson 5/14/76 F.G. Jeagne

21. FIELD DISPOSITION RESULTS:

22. ENGINEERING DISPOSITION

Discussion of the background to this condition with Field personnel indicated (1) that the ramp was installed as a temporary means for access into adjacent work areas and not as permanent backfill; and (2) that the Field now wishes to use the ramp as part of the permanent backfill. We understand that should the ramp not be suitable as

23. ENGINEERING DISPOSITION RESULTS:

The Nonconforming material was removed
3/18/77

24. IS DESIGN CHANGE REQUIRED ☒ NO ☐ YES, SEE ATTACHED:
DRAWING ______ REV. ______ DCN ______
SPEC. ______ REV. ______ ADD. ______

26. REJECTED MATERIAL DISPOSITION ☐ RETURN TO SUPPLIER ☐ SCRAP
REMARKS

27. QC ACCEPTANCE
3/10/77
QC ENGINEER 6/23/76 DATE
AUTHORIZED INSPECTOR DATE

10098-1

White Copy — Originator
Canary Copy — Field Engineer
Pink Copy — PQAE
Goldenrod Copy — QC

QC-G3-2

BECHTEL

NONCONFORMANCE REPORT (CONT'D) PAGE 2 OF 4 14. NCR NO. 421

Block 19 Continued -

considered temporary fill for construction access. The field now wishes to leave this material in place. With the exception of the moisture content requirement, the material meets all requirements of Specification C-210. The testing frequency was maintained and the compaction test results are as shown on the following list:

Block 22 Continued:

permanent backfill it can readily be removed. Hence Engineering submits that a non-conforming condition does not exist since the ramp is still a temporary facility.

Engineering suggests that if the Field wishes to use the ramp as part of permanent backfill, they request Engineering approval via an FCR.

6-18-76

White Copy – Originator
Canary Copy – Field Engineer
Pink Copy – PQAE
Goldenrod Copy – QC

Block 19 Continued -

Test No	Date	Location	Elev.	Moisture Content(%)	Optimum Moisture	% Above Optimum	Percent Compaction
MD-490*	10-31-75	356° Cont #1, 76' off wall	631'	14.8	10.6	4.2	95
MD-492*	10-31-75	356° Cont #1, 79' off wall	631'	12.9	10.6	2.3	96
MD-512	11-13-75	45° Cont #2, 95' off wall	610'	14.2	9.8	4.4	98
MD-513	11-13-75	28° Cont #2, 100' off wall	615'	13.5	9.8	3.7	98
MD-514**	11-13-75	356° Cont #1, 76' off wall	631'	12.6	10.6	2.0	100
MD-524	11-17-75	25' E. 4.55 line, 90' N. "A"line	630'	14.4	9.8	4.6	97
MD-525	11-17-75	75' N. "A" line @ 6.6 line	627'	15.2	9.8	5.4	98
MD-526***	11-17-75	85' N. "A" line @ 8.7 line	624'	16.4	9.8	6.6	93
MD-527	11-17-75	28° Cont #2, 110' off wall	619'	14.7	9.8	4.9	97
MD-530	11-18-75	365° Cont #1, 115' off wall	633'	13.9	9.8	4.1	96
MD-531	11-18-75	31' E. 4.55 line, 88' N. "A" line	632'	14.3	9.8	4.5	98
MD-532	11-18-75	108' N. "A" line @ 7.8 line	628'	16.6	13.7	2.9	96
MD-533	11-18-75	87' N. "A" line @ 8.7 line	624'	14.5	9.8	4.7	96
MD-534	11-18-75	68' N. "A" line @ 8.7 line	624'	16.9	13.7	3.2	99
MD-535	11-18-75	25° Cont #2, 90' off wall	620'	14.8	9.8	5.0	98
MD-536****	11-18-75	45° Cont #2, 95' off wall	615'	15.1	9.8	5.3	94
MD-537	11-18-75	90° Cont #2, 85' off wall	610'	14.9	9.8	5.1	95
MD-539	11-19-75	45° Cont #2, 97' off wall	615'	11.9	9.8	2.1	97

Notes:

* This area reworked and retested: See test No. MD-514

** Moisture and Compaction pass; clears MD-490 and MD-492

*** This area reworked and retested: See test No. MD-533 for passing compaction

**** This area reworked and retested: See test No. MD-539 for passing compaction

See page 3 for location sketch.

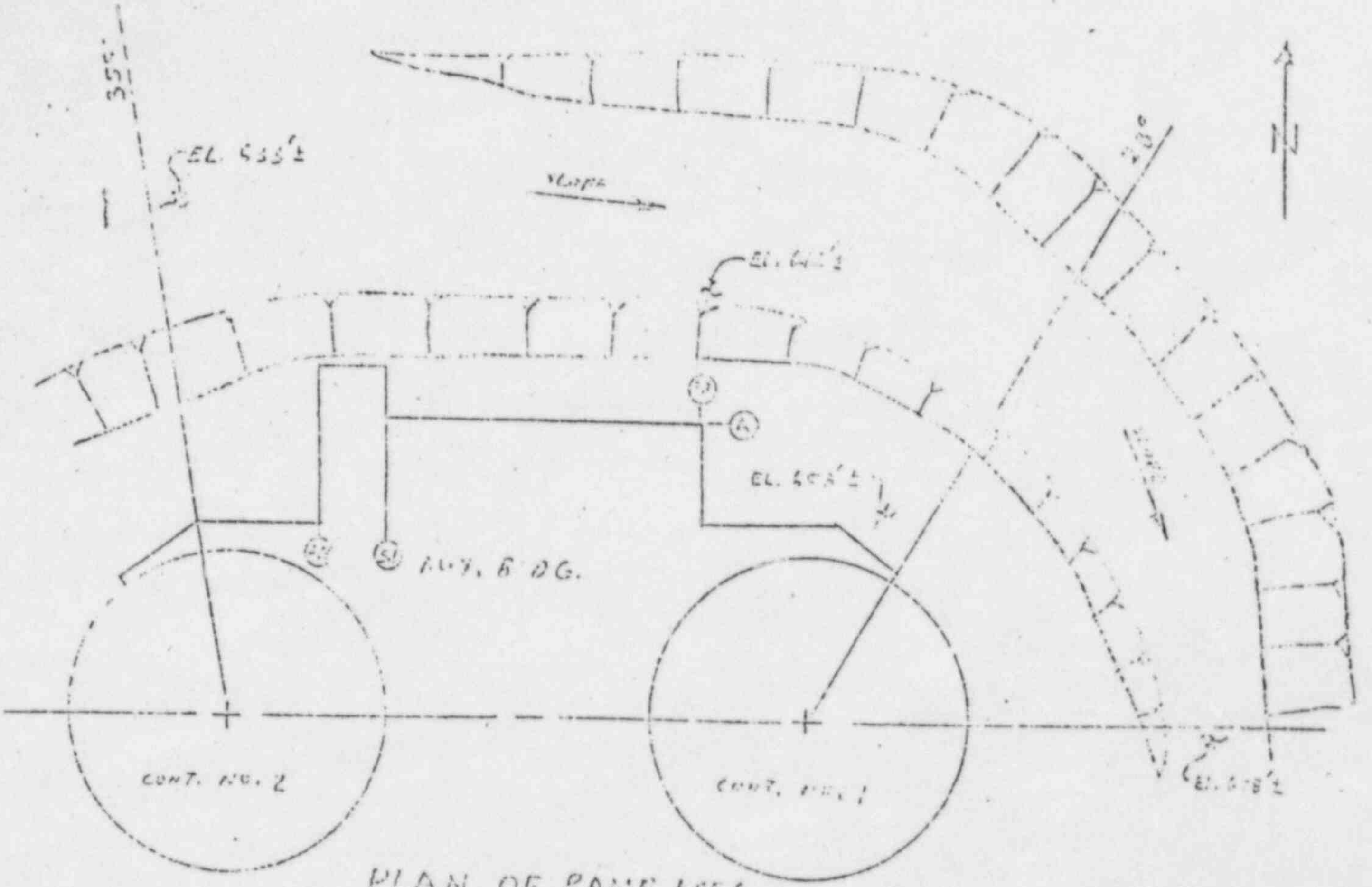
White Copy – Originator
Canary Copy – Field Engineer
Pink Copy – PQAE
Goldenrod Copy – QC

DATE [illegible]

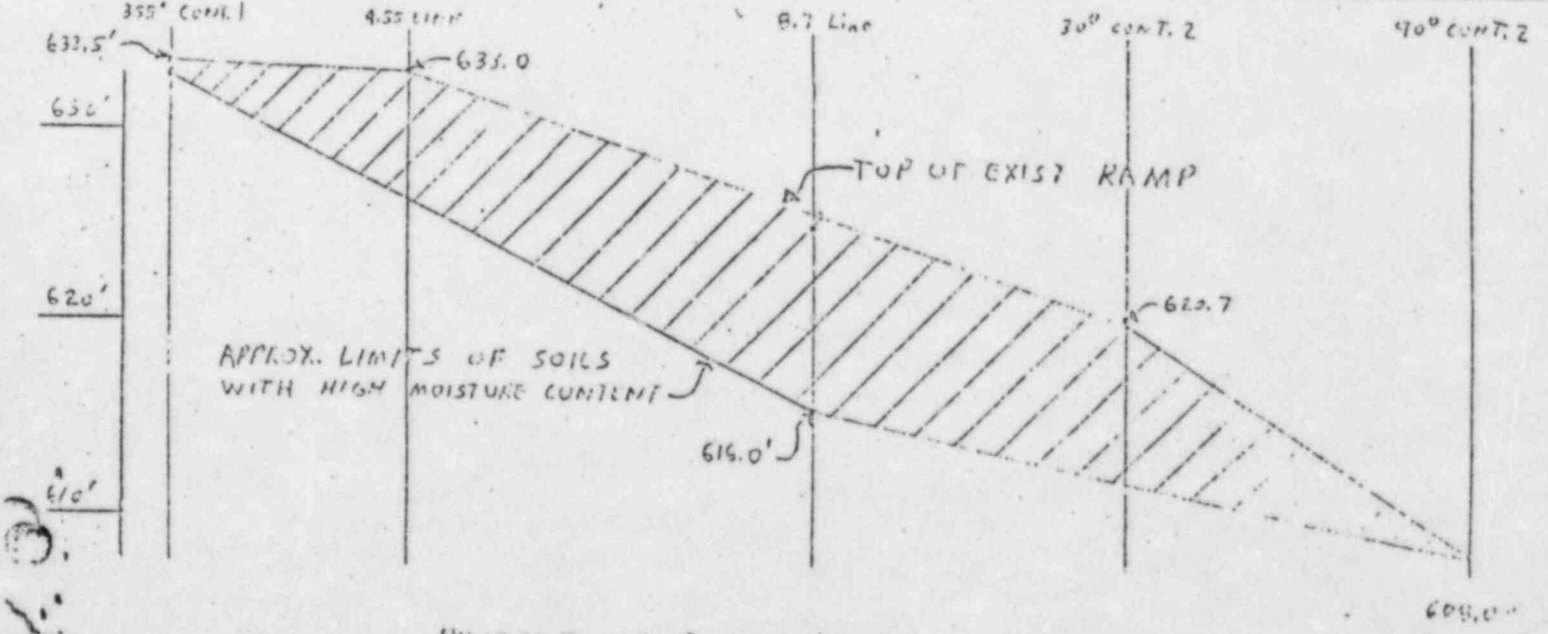
DESIGN BY [illegible] DATE CHECKED BY SHEET NO [illegible]

PROJECT Midland NCR # 421 Page ~~3~~ 4 of 4 JOB NO [illegible]

SUBJECT Ramp North of Auxiliary Building - Soils Plan/Profile FILE NO



PLAN OF RAMP AREA
N.T.S.



PROFILE OF RAMP AREA
N.T.S.

4 of 4

Attachment M-9A

Review of Nonconformance #421

See (6) Comments

	Issuance	Disposition	Cl
1. Endorsement			
a. Has the nonconformance been prepared by an authorized person?	N.A.		
b. Has the preparer dated the nonconformance?	↑		
c. For NCR's only, has the PFQCE validated the NCR?			
2. Nonconformance Description			
Are descriptive data and supporting details clear?			
3. 50.55(e) Reportable			
a. Has an evaluation been made to determine whether the nonconformance is reportable per 10CFR50.55(e)?			
1) Where documented?			
2) Who evaluated?			
3) Was this the proper organization?			
b. If a safety evaluation was required, is it adequate and was it performed by Project Engineering?	↓	N.A	
c. If the item is determined by Bechtel to be non-reportable, is the nonconformance significant?	N.A.	↑	
4. Recommended Corrective Action			
a. Has appropriate and adequate corrective action been recommended?			
b. Does disposition agree with definition?			
c. Was corrective action approved by the proper organization?		↓	
d. Has Project Engineering provided adequate rational for "use-as-is" dispositions?		N.A.	
5. Corrective Action Taken			
a. Was corrective action taken?			N.A.
b. Does the corrective action taken agree with the recommended corrective action?			N.A.

	Issuance	Disposition	Closure
5. Corrective Action Taken (Contd)			
c. Was the corrective action accomplished promptly?			N.A
d. If yes to 3.c., have the following been done: If no to 3.c, enter N.A.			
1) Has the cause been determined?			
2) Has corrective action been taken to preclude repetition?			
3) If so, has this been documented in procedures or instructions?			
4) Have the condition, its cause, and corrective action taken been documented and reported to management?			N.A.

6. Comments:

Project Engineering submitted that a non-conforming condition did not exist since the ramp was a temporary facili Engineering suggested that if the Field wished to use the ramp as part of permanent backfill, Field request Engineering approval via an FCR. I concur with Project Engineering. This temporary ramp had been removed prior to permanent backfill being placed in this area.

Prepared By Donald E. Horn Date 11-12-76

RYDEN

BECHTEL

NONCONFORMANCE REPORT

2. ~~DRAWING/PART NO.~~ Spec. 7220-C-210 REV. 4

7. PROJECT NO. 7220

3. ITEM DESCRIPTION Plant Area Backfill

8. ITEM LOCATION Ramp North of Aux. Bldg

4. SERIAL NUMBER N/A

9. STARTUP SYSTEM NO. N/A

5. PURCHASE ORDER NO. N/A

10. QC FIELD INSPECTION PLAN NO. N/A

6. CONTRACTOR/LOCATION Canonie Construction Co., South Haven, MI

11. ASME CODE ITEM ☐ YES ☒ NO

12. REPORTED BY C. H. Nelson DATE 5/5/76

13. VALIDATED BY J. Connolly DATE 5-10-76

15. REPLACEMENT PART NO. N/A REV.

16. REPLACEMENT SERIAL NO. N/A

17. SOURCE Subcontractor

1. PAGE 1 OF 4

14. NCR NO. 421

25. DISPOSITION CONCURRENCE N/A

REWORK	REJECT	REPAIR	USE AS IS	DOC.

F. A. Boos for T. C. Valenzano 6/22/76
PROJECT FIELD ENGINEER DATE

J. Hurley for RLC 6/18/76
PROJECT ENGINEER DATE

J. Connolly 6-22-76
PROJECT FIELD QC ENGINEER DATE

AUTHORIZE INSPECTOR DATE

18. ROUTING INSTRUCTIONS: ☒ ROUTE TO FIELD ENGINEERING ☐ ROUTE TO MATERIAL SUPERVISOR

19. NONCONFORMING CONDITION:

Specification 7220-C-210, Rev. 4, Para. 12.6.1 states in part, "The water content during compaction . . . shall not be more than 2 percentage points above optimum moisture content . . .". Contrary to the above, during the fall of 1975 a construction access ramp was constructed from material which exceeded the moisture content requirements of Specification C-210. The field forces, including Bechtel Quality Control, were aware that the material exceeded moisture when placed. When the material was placed it was

Q-LIST NO. 1.002 NO HOLD TAGS APPLIED CRC 5/11/76

Continued on Page 2

20. ☐ FIELD DISPOSITION ☒ FIELD RECOMMENDATION/ROUTE TO PROJECT ENGINEERING

Recommend "accept as is," subject to Project Engineering review and evaluation. Backfill material has been compacted to not less than 95% of maximum density in accordance with Specification C-210.

C. H. Nelson 5/14/76 F. G. Fenzel

21. FIELD DISPOSITION RESULTS:

22. ENGINEERING DISPOSITION

Discussion of the background to this condition with Field personnel indicated (1) that the ramp was installed as a temporary means for access into adjacent work areas and not as permanent backfill; and (2) that the Field now wishes to use the ramp as part of the permanent backfill. We understand that should the ramp not be suitable as

23. ENGINEERING DISPOSITION RESULTS:

24. IS DESIGN CHANGE REQUIRED ☒ NO ☐ YES, SEE ATTACHED:

DRAWING ______ REV. ______ DCN ______

SPEC. ______ REV. ______ ADD. ______

26. REJECTED MATERIAL DISPOSITION ☐ RETURN TO SUPPLIER ☐ SCRAP

REMARKS

27. QC ACCEPTANCE

E. R. Albert 6/23/76
QC ENGINEER DATE

AUTHORIZED INSPECTOR DATE

10098-1

White Copy – Originator
Canary Copy – Field Engineer
Pink Copy – PQAE
Goldenrod Copy – QC

QC-G3-2

NONCONFORMANCE REPORT (CONT'D)

1. PAGE 2 OF 4

14. NCR NO. 421

Block 19 Continued -

considered temporary fill for construction access. The field now wishes to leave this material in place. With the exception of the moisture content requirement, the material meets all requirements of Specification C-210. The testing frequency was maintained and the compaction test results are as shown on the following list:

Block 22 Continued:

permanent backfill it can readily be removed. Hence Engineering submits that a non-conforming condition does not exist since the ramp is still a temporary facility.

Engineering suggests that if the Field wishes to use the ramp as part of permanent backfill, they request Engineering approval via an FCR.

6-18-76

White Copy — Originator
Canary Copy — Field Engineer
Pink Copy — PQAE
Goldenrod Copy — QC

NONCONFORMANCE REPORT (CONT'D) 1. PAGE ~~2~~ 3 OF 4 14. NCR NO. 421

Block 19 Continued -

Test No	Date	Location	Elev.	Moisture Content(%)	Optimum Moisture	% Above Optimum	Percent Compaction
MD-490*	10-31-75	356° Cont #1, 76' off wall	631'	14.8	10.6	4.2	95
MD-492*	10-31-75	356° Cont #1, 79' off wall	631'	12.9	10.6	2.3	96
MD-512	11-13-75	45° Cont #2, 95' off wall	610'	14.2	9.8	4.4	98
MD-513	11-13-75	28° Cont #2, 100' off wall	615'	13.5	9.8	3.7	98
MD-514**	11-13-75	356° Cont #1, 76' off wall	631'	12.6	10.6	2.0	100
MD-524	11-17-75	25' E. 4.55 line, 90' N. "A"line	630'	14.4	9.8	4.6	97
MD-525	11-17-75	75' N. "A" line @ 6.6 line	627'	15.2	9.8	5.4	98
MD-526***	11-17-75	85' N. "A" line @ 8.7 line	624'	16.4	9.8	6.6	93
MD-527	11-17-75	28° Cont #2, 110' off wall	619'	14.7	9.8	4.9	97
MD-530	11-18-75	365° Cont #1, 115' off wall	633'	13.9	9.8	4.1	96
MD-531	11-18-75	31' E. 4.55 line, 88' N. "A" line	632'	14.3	9.8	4.5	98
MD-532	11-18-75	108' N. "A" line @ 7.8 line	628'	16.6	13.7	2.9	96
MD-533	11-18-75	87' N. "A" line @ 8.7 line	624'	14.5	9.8	4.7	96
MD-534	11-18-75	68' N. "A" line @ 8.7 line	624'	16.9	13.7	3.2	99
MD-535**	11-18-75	25° Cont #2, 90' off wall	620'	14.8	9.8	5.0	98
MD-536**	11-18-75	45° Cont #2, 95' off wall	615'	15.1	9.8	5.3	94
MD-537	11-18-75	90° Cont #2, 85' off wall	610'	14.9	9.8	5.1	95
MD-539	11-19-75	45° Cont #2, 97' off wall	615'	11.9	9.8	2.1	97

Notes:

* This area reworked and retested: See test No. MD-514

** Moisture and Compaction pass: clears MD-490 and MD-492

*** This area reworked and retested: See test No. MD-533 for passing compaction

**** This area reworked and retested: See test No. MD-539 for passing compaction

See page 3 for location sketch.

10098-2

White Copy – Originator
Canary Copy – Field Engineer
Pink Copy – PQAE
Goldenrod Copy – QC

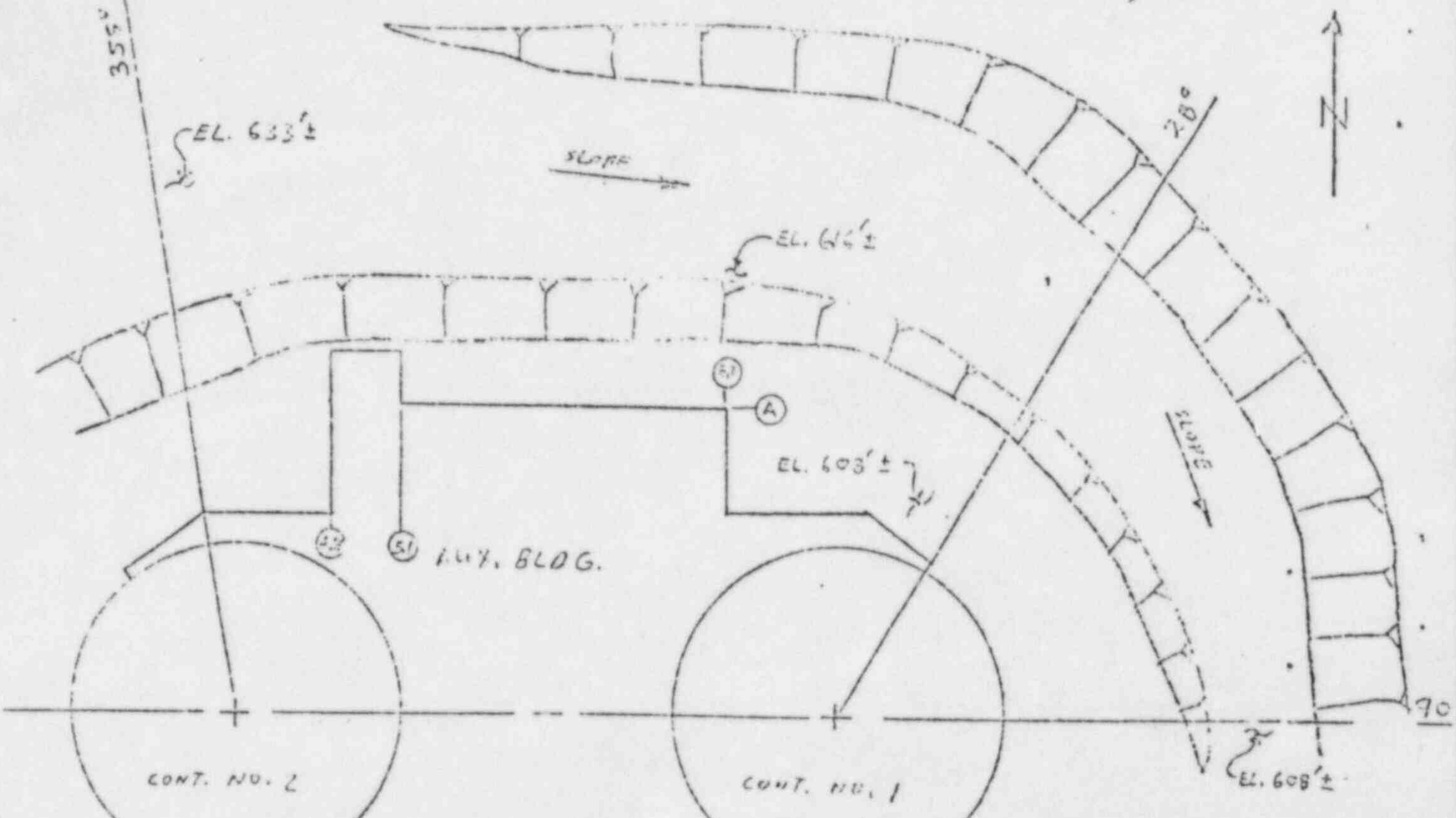
QC-G3-3

DATE 4/28/76

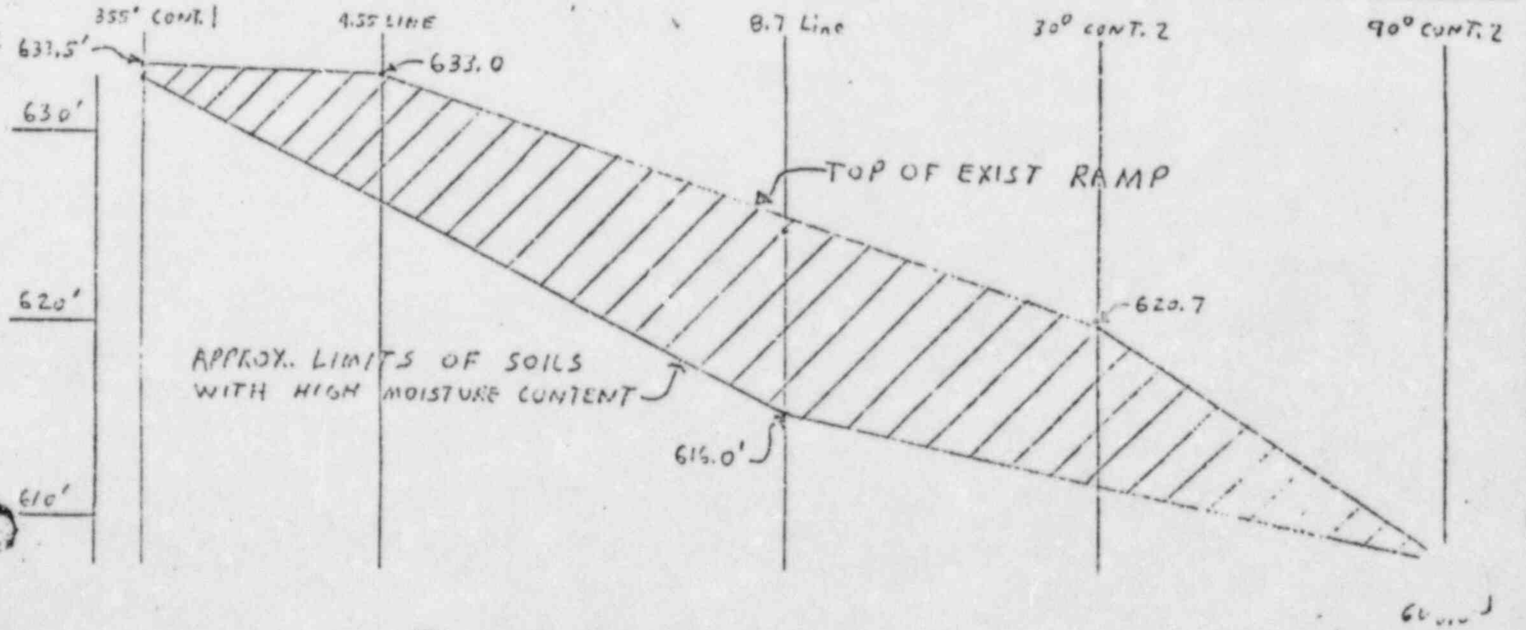
DESIGN BY C. H. Nelson DATE ______ CHECKED BY ______ SHEET NO 1 of 1

PROJECT Midland NCR # 421 Page ~~3~~ 4 of 4 JOB NO 7220

SUBJECT Ramp North of Auxiliary Building -- Soils Plan/Profile FILE NO ______



PLAN OF RAMP AREA
N.T.S.



PROFILE OF RAMP AREA
N.T.S.

4 OF 4.

CONSUMERS POWER COMPANY
RECEIVED
MAR 10 1977
FIELD QUALITY ASSURANCE
MIDLAND, MICHIGAN

To: ~~[illegible]~~ / D.E.H.

From: H.W. Slager

Date: 3/9/77

Subject: ~~[illegible]~~ Comments
NCR

Please resolve the following comment on NCR 421. This comment is based on my review of ~~[illegible]~~ the closed out NCR

Comment:

Some place in the Bechtel records associated with this NCR an indication should be included to document that the material in question was removed

To: Harvey Slager

From: Donald E. Horn

Date: 3-18-77

Following is the resolution of your comment as noted above:

Quality Control Engineer Daryle Osborn added to block #23 "Engineering Disposition Results" ~~that~~ "The Nonconforming material was removed".

Upon resolution of comment, this memo will be filed with in File #

BECHTEL

RYDEN

CPC

NONCONFORMANCE REPORT

1. PAGE 1 OF ~~4~~ 2

14. NCR NO. 421

2. Spec. 7220-C-210 REV. 4

7. PROJECT NO. 7220

12. REPORTED BY G.H. Leben DATE 5/5/76

3. ITEM DESCRIPTION Plant Area Backfill

8. ITEM LOCATION Ramp North of Aux. Bldg

13. VALIDATED BY DATE 5-10-76

4. SERIAL NUMBER N/A

9. STARTUP SYSTEM NO. N/A

15. REPLACEMENT PART NO. N/A REV.

5. PURCHASE ORDER NO. N/A

10. QC FIELD INSPECTION PLAN NO. N/A

16. REPLACEMENT SERIAL NO. N/A

6. CONTRACTOR/LOCATION Canonie Construction Co., South Haven, MI

11. ASME CODE ITEM ☐ YES ☒ NO

17. SOURCE Subcontractor

25. DISPOSITION CONCURRENCE N/A

REWORK	REJECT	REPAIR	USE AS IS	DOC.

A.J. Boos for T.C. Valenzano 6/22/76
PROJECT FIELD ENGINEER DATE

J.F. Hurley for RLC 6/18/76
PROJECT ENGINEER DATE

6-22-76
PROJECT FIELD QC ENGINEER DATE

AUTHORIZE INSPECTOR DATE

18. ROUTING INSTRUCTIONS: ☒ ROUTE TO FIELD ENGINEERING ☐ ROUTE TO MATERIAL SUPERVISOR

19. NONCONFORMING CONDITION:

Specification 7220-C-210, Rev. 4, Para. 12.6.1 states in part, "The water content during compaction . . . shall not be more than 2 percentage points above optimum moisture content . . .". Contrary to the above, during the fall of 1975 a construction access ramp was constructed from material which exceeded the moisture content requirements of Specification C-210. The field forces, including Bechtel Quality Control, were aware that the material exceeded moisture when placed. When the material was placed it was

Q-LIST NO. 1.002 No Hold Tags Applied

Continued on Page 2

20. ☐ FIELD DISPOSITION ☒ FIELD RECOMMENDATION/ROUTE TO PROJECT ENGINEERING

Recommend "accept as is," subject to Project Engineering review and evaluation. Backfill material has been compacted to not less than 95% of maximum density in accordance with Specification C-210.

G.H. Leben 5/14/76

21. FIELD DISPOSITION RESULTS:

CONSUMERS POWER COMPANY
RECEIVED
JUN 23 1976
FIELD QUALITY ASSURANCE
MIDLAND, MICHIGAN

22. ENGINEERING DISPOSITION

Discussion of the background to this condition with Field personnel indicated (1) that the ramp was installed as a temporary means for access into adjacent work areas and not as permanent backfill; and (2) that the Field now wishes to use the ramp as part of the permanent backfill. We understand that should the ramp not be suitable as

23. ENGINEERING DISPOSITION RESULTS:

JLC
REW
DRK
DEH
WHB
RGW
FILE
KEY

24. IS DESIGN CHANGE REQUIRED ☒ NO ☐ YES, SEE ATTACHED:

DRAWING ______ REV. ______ DCN ______

SPEC ______ REV. ______ ADD. ______

26. REJECTED MATERIAL DISPOSITION ☐ RETURN TO SUPPLIER ☐ SCRAP

REMARKS

27. QC ACCEPTANCE

QC ENGINEER DATE

AUTHORIZED INSPECTOR

10098-1

White Copy – Originator
Canary Copy – Field Engineer
Pink Copy – PQAE
Goldenrod Copy – QC

QC-G3-2

JLC

CONSUMERS POWER COMPANY
RECEIVED
MAR 10 1977
FIELD QUALITY ASSURANCE
MIDLAND, MICHIGAN

To: ~~JLC~~ /D.E.H.

From: H.W. Slager

Date: 3/9/77

Subject: ~~NCE~~ Comments
NCR

Please resolve the following comment on NCR 421. This comment is based on my review of the closed out NCR

Comment:

Some place in the Bechtel records associated with this NCR an indication should be included to document that the material in question was removed.

CONSUMERS POWER COMPANY
RECEIVED
MAR 22 1977
FIELD QUALITY ASSURANCE
MIDLAND, MICHIGAN

To: Harvey Slager

From: Donald E. Horn

Date: 3-18-77

Following is the resolution of your comment as noted above:

Quality Control Engineer Daryle Osborn added to block #23 "Engineering Disposition Results" that "The Nonconforming material was removed."

OK File
HWS

Upon resolution of comment, this memo will be filed with in File #

F

G

COPY

NONCONFORMANCE REPORT

1. PROJECT NAME: Midland Units 1 & 2
JOB NO.: 7220
19. NO. 1482
20. PAGE 1 OF 2

2. UNIT(S): Common
3. DRAWING/PART NO.: N/A
REV: N/A
4. ITEM DESCRIPTION: Building Settlement
5. ITEM LOCATION: Diesel Gen. Bldg.

6. P.O. OR SPEC NO.: N/A
7. SERIAL NO.: N/A
8. REPLACEMENT PART P/N N/A REV N/A SER NO. N/A
9. SOURCE: Construction
10. CONTRACTOR/SUPPLIER: N/A

11. INSPECTION CRITERIA ☐ DWG ☐ SPEC ☒ OTHER
IR NO. N/A
NO. Survey
12. ASME AUTHORIZED INSPECTION REQ'D ☐ YES ☒ NO
13. SKETCH ATTACHED ☒ YES ☐ NO
14. Discovered During ☐ Rec'g ☒ Const ☐ Test
15. Equip Furnished By ☐ Client ☐ Eng ☒ FLD

16. NONCONFORMING CONDITION: The attached sketch identifies settlement of the Diesel Generator Foundations and Structure. In addition the mud mat between the E/Wall and Generator has spalled and has been displaced. "Q"-List #1.40. Hold for Engineering Disposition. 4 Hold Tags Applied.

17. REPORTED BY: Clark
DATE: 8-21-78

18. VALIDATED BY: for W.L.B.
DATE: 8-21-78

21. ROUTING: ☒ TO FIELD ENGINEERING ☐ TO OTHERS (SPECIFY)

22. ☐ Field Engineering Disposition ☒ Field Engineering Recommended Disposition to Project Engineering

PROJECT ENGINEERING TO EVALUATE AND SPECIFY ALL TESTING AND OTHER INVESTIGATION REQUIREMENTS TO RESOLVE THIS NONCONFORMANCE.
JBetts

23. PROJECT ENGINEERING DISPOSITION

CONSUMERS POWER COMPANY
RECEIVED
AUG 23 1978
FIELD QUALITY ASSURANCE
MIDLAND, MICHIGAN

24. DISPOSITION CONCURRENCE

rework	reject	repair	use as is

PROJECT FIELD ENGINEER DATE
PROJECT ENGINEER DATE
PROJ CONSTR QC ENGINEER DATE
AUTHORIZED INSPECTOR DATE

25. DISPOSITION RESULTS

JLC	
DRK	
RGW	✓
PRK	
QE	
FILE	

26. QC ACCEPTANCE
QC ENGINEER DATE
AUTHORIZED INSPECTOR DATE

NONCONFORMANCE ORT (CONT'D) 20PAGE 2 OF 3 19NCR 82

Request Conditional Release to allow continuation of construction up to but excluding the placement of concrete. Corrections or removal can be accomplished without causing damage or contamination to the associated plant equipment or structure.

AJBoos 8-22-78
PFE Date

for WLB 8-22-78
PFQCE Date

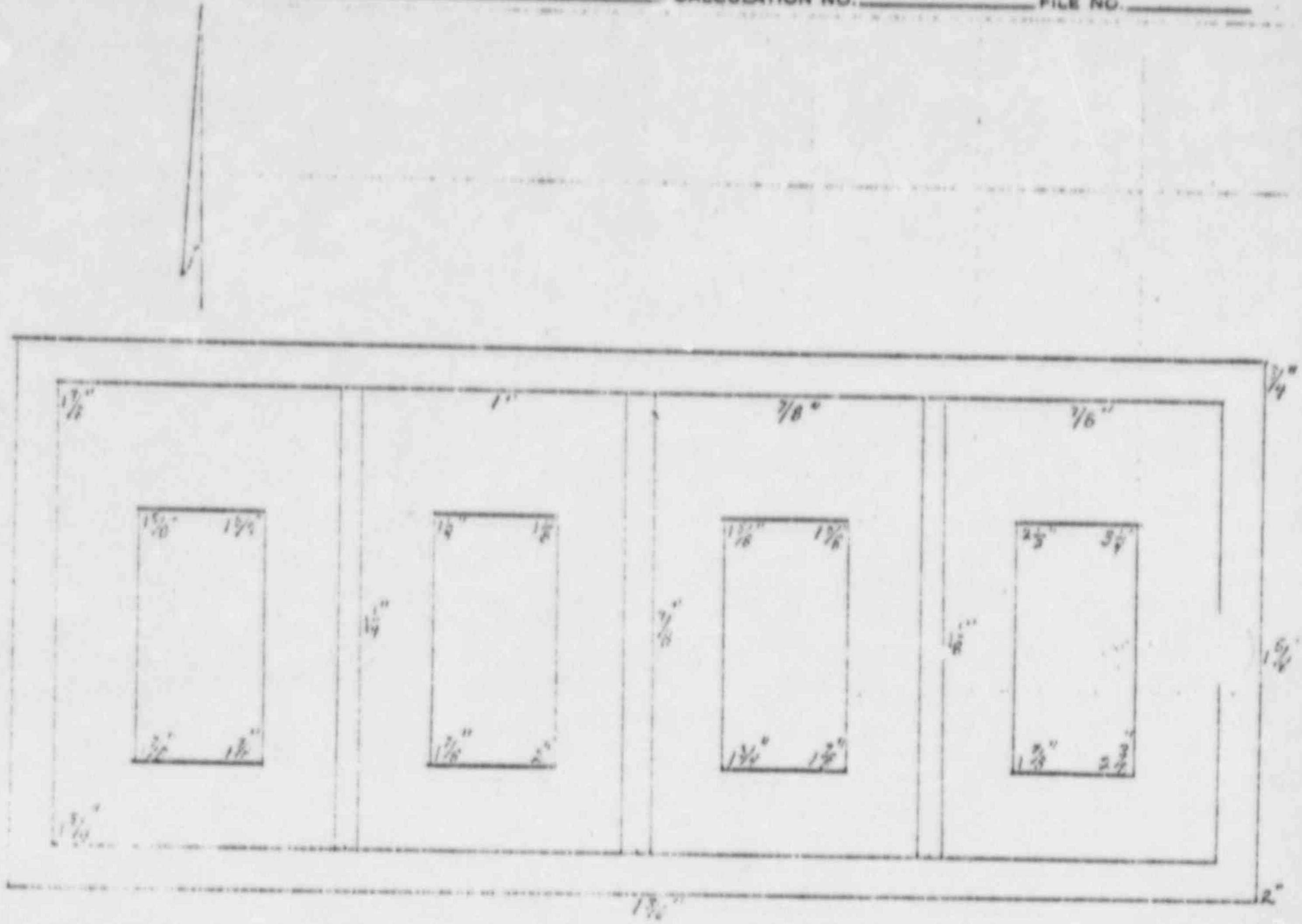
WADreisbach 8-22-78
LQAE Date

DESIGN BY C.E.W. DATE 8-21-78 CHECKED BY ____ SHEET NO. ____

DATE ____

PROJECT ____ JOB NO. ____

SUBJECT ____ CALCULATION NO. ____ FILE NO. ____



note: figures shown are total settlement:
[illegible] theoretical plant elevation.

Page 3 of 3 8-21-78
NCR 14

H

Copy

TELECOPY
BERC-2480

Bechtel Associates Professional Corpora

Inter-office Memorandum

To J.F. Newgen

Subject Midland Plant Units 1 & 2
Job 7220
Instructions for Obtaining
Soil Samples

Copies to File: 0274, C-79-PR
G. Swanberg
S. Afifi
L. Basinski
J. Betts
A. Marshall
W.B. Barclay
L. Dreisbach
Com Log

Date October 4, 1978

From R.L. Castleberry

Of Engineering

At Ann Arbor

RECEIVED
OCT 6 1978
BECHTEL POWER CORP
JOB 7220
PER

The following instructions are to be used to assist in obtaining soil samples from the diesel generator building area and other areas of soil investigations associated with TSA 7220-C-79(Q).

This program is being implemented by the Geotech soils engineering representative at the site.

Standard penetration tests, test pits, auger borings, Dutch Cone tests, undisturbed sample borings, and bag samples are performed as required. The location, depth, and selection of the type borings, tests, and samples are determined by the Geotech engineer at the jobsite with project engineering input as necessary.

The borings should be maintained at all times to prevent hole cave-in. The use of casing or drilling mud is permitted. Where drilling mud is to be used, Bentonite, Attapulgite, Revert, approved equal, or any combination thereof should be used to advance soil borings below the groundwater level. When rotary drilling methods are used, the fluid in the borings should be maintained at all times above the groundwater table.

Penetration tests and split-barrel sampling shall be taken in accordance with ASTM D 1586. The samples obtained should be placed in glass jars and sealed with vapor-seal screw lids. Each jar should be clearly identified using a waterproof marker or label that is firmly attached to the jar showing the job designation, date, boring number, sample number and depth, length of recovery, and standard penetration resistance. The samples should be protected from freezing and direct sunlight.

Undisturbed, thin-walled (Shelby) tube sampling shall be taken in accordance with ASTM D 1587. The minimum outside diameter of thin-walled (Shelby) tubes should be 3 inches. When obtaining undisturbed samples, Denison, Osterberg, or Pitcher samplers may be used as directed. The minimum outside diameter of Denison, Osterberg, or Pitcher samples should be 3 inches. The undisturbed sample should not be removed from the tube, but should be trimmed back from the ends of the tube, the space filled with hot microcrysta-line (nonshrinking) wax, and the tube capped and sealed with hot wax and tape. The thin-walled tube should be clearly identified, using a water proof marker or label that is firmly attached to the tube showing the job designation, date, boring number, sample number, depth, length (in inches), and inches recovered.

Observation wells may be installed as directed by the Geotech representative for subsurface water level monitoring. The borings for observation wells where advanced by the rotary drilling method should use a biodegradable drilling mud such as Revert. After installation, the observation wells should be flushed and a response test should be conducted to make certain the wells are operative. The minimum outside diameter of riser pipes should be 2 inches.

Test pits for supplemental information should be made as directed by the Geotech soils engineer at the site. Density test and block samples may be taken, as directed.

To assist in the above soil investigation program, the following additional ASTM standards are recommended for use.

ASTM D 2488-69	Description of Soils (Visual) Manual Procedure)
ASTM D 653-67	Terms and Symbols Relating to Soil and Rock Mechanics
ASTM D 2113-70	Diamond Core Drilling for Site Investigation
ASTM D 1452	Soil Investigation and Sampling by Auger Borings
ASTM D 3441-75T	Deep, Quasi-Static, Cone and Friction Cone Penetration Tests of Soil

R.L. Castleberry

JH/cap
10/4/2

Bechtel Associates Professional Corporation

Inter-office Memorandum

To L. H. Curtis

Date 26 November 1979

Subject Midland Units 1/2-Job 7220-001
Plant Area Fill - Notes for Meeting
25 October 1979

From S. S. Afifi

Of Geotechnical Services

Copies to 1320, 3310
Attendees
S. L. Blue
H. H. Burke/W. R. Ferris
J. O. Wanzeck

At Ann Arbor 10 D 5
7220-79-261

Attached are the meeting notes for the meeting held in Ann Arbor on 25 October 1979.

S. S. Afifi

JEG/nm
Attachments

CONSUMERS POWER COMPANY
RECEIVED
NOV 30 1979
MIDLAND PLANT PROJECT
MIDLAND, MICHIGAN

Midland Units 1/2
Job 7220-001

MEETING NOTES

DATE: October 25, 1979

LOCATION: Ann Arbor Office 10 D 5

SUBJECT: Problems associated with the plant area fill at the Midland Site.

ATTENDEES:

Bechtel

S. S. Afifi
J. Davie
P. K. Chen
W. R. Ferris
A. Mohan
J. B. Givens
B. C. McConnel
W. C. Paris, Jr. *
S. L. Lo *
J. Hook *
C. Farrell *
M. Rothwell *
B. Dhar *

Consultants

A. J. Hendron
C. Gould *

CPCo

D. Sibbald
D. Horn
T. Cooke

*Part-time

DISCUSSION:

The meeting was led by P. K. Chen and centered around the following topics:

1. Diesel Generator Building

A. Mohan provided background information. The predicted future settlements were discussed. The fill is between foundation el. 628 and el. 600-605 with grade at el. 634. In addition to building and pedestal markers, borros anchors and settlement platforms have been installed for settlement monitoring and sondex for rebound monitoring. Maximum observed settlement is at the southeast corner and the minimum is at the northwest corner. Estimated settlements were given for various "zero-time" dates. The maximum ratio between settlements was about 2 for these dates. The date at which the final surcharge of 20' was completed was assumed to be realistic (Case 4). It was pointed out that the predicted settlements are conservative because of the inherent assumption that the surcharge will continue although it cannot be shown at this time how conservative they are. Based on building settlement markers, the predicted settlement for 40 years would be about 0.5 inch at the northwest corner and 1 inch at the southeast corner. Settlement platforms and building and pedestal markers show higher observed settlements than Borros anchors. Concern was expressed by A. Hendron about the somewhat higher settlement rate which is occurring after rebound for reference (deep) borros anchor No. 62. Hendron requested to look at the recent data immediately to see if this trend is continuing. (During the meeting, the data was updated and it was demonstrated to Hendron that this high settlement rate had leveled off). Hendron stated that we should not have any lag time between the data reading date at the field and submittal to Geotech. Hendron said that it would be prudent to use settlements of 0.5 inch in the northwest corner and 1.5 inches in the southeast corner and it was agreed that the project should proceed in their evaluation of utilities and structures with 1.5 additional inches of total settlement and 0.75 additional inches of differential settlement. Based on the data the differential settlement can be considered rigid body rotation from north to south.

2.0 Settlement of Plant Structures

Background was provided by P. K. Chen. It is necessary to confirm the settlement predictions presented in FSAR Figure 2.5-48 in light of the data obtained from the diesel generator building surcharge loading. Settlement parameters were back-calculated from the diesel generator building settlements measured during the preload program. Concern was expressed by K. Wiedner about the high settlement parameter back-calculated for el. 584-603 but Hendron said that this stratum has never been questioned before and is not of concern. P. K. Chen added that the layer is thin and the parameter will therefore have a negligible effect on the settlement. The settlement predictions were verified by (1) comparing soil parameters which were used previously to those which have been back-calculated and (2) by comparing the measured settlement for the reactor with the settlements calculated using the back-calculated parameters.

3.0 Piping and Duct Banks

It is necessary to predict the long term settlements of the safety-related piping and duct-banks in the plant area fill. The absolute movements from the GZD profiling are in question because the reference elevations used were questionable. The pipe stress group has not determined whether or not the existing stresses in the pipes generally exceed the allowable. B. Dhar said that, in general, the pipe stresses for straight pipes don't exceed the allowable, but the stresses at elbows and bends do. K. Wiedner said that he had already suggested that the project request the field to cut the pipes at certain points to check stresses. The hypothesis was presented that the pond rise is causing "structural breakdown" of the soil and is therefore causing settlement. Discussion centered around the settlement of the fill and till due to dewatering. It was estimated that the fill settlement will be 0.5 inch to 1 inch due to dewatering and the till settlement will be 1.8 inches and will be uniform. Hendron said that the number for the till sounds high. (After the meeting, Hendron said to calculate only the settlement due to compression of the till above the building foundation elevation because this is what contributes to the differential settlement).

4. Temporary Dewatering and Underpinning of Auxiliary Building

W. C. Paris provided background information for dewatering. Wells have been installed on the east side of the Unit 2 containment and west side of the Unit 1 containment for the purpose of dewatering during underpinning of the auxiliary building. It was intended to start dewatering as soon as possible to see if piezometers to the north of the turbine building will react and if in fact more wells will be necessary in this area. C. Gould said that he is concerned about the seepage path between the utility tunnels (between reactors) into the work area. S. Afifi and B. Dhar discussed having a meeting with Loughney to discuss temporary dewatering before underpinning is to proceed. S. Lo provided background information for underpinning. The plan is to place caissons under the turbine building first and continue into the auxiliary building. C. Gould said that all subcontractors involved in underpinning should be able to describe the procedure on paper before construction begins to ensure that the job runs smoothly. Gould said that he would like to meet with the underpinning contractor to make sure that they are aware of the risks in the procedures and to review the procedures he proposes. Gould indicated that the structural goal is to provide caissons uner the wing wall, and the turbine building is of secondary importance. Gould suggested that the subcontractor should be required to assume at least partial liability by cash settlement, insurance, or other means. S. Lo said that because of overstressing near the wing wall and control tower juncture he wants to know what support the soil offers. Hendron said to assume none. B. Dhar said that engineering should (1) refine calculations to consider 100 ft.^{2} ground loss and (2) increase tension capacity by using cables or some other means.

5. Permanent Dewatering

W. C. Paris provided background information. Permanent dewatering has been proposed as a solution to the problem of possible liquefaction of backfill sands. Paris said that some borings drilled along a line perpendicular to the discharge lines near the reservoir showed 5 to 10 feet of sand which was not discharge line backfill. Paris proposed consideration of a cutoff wall near the pond running parallel to the south edge of the diesel generator building and following the pond to the service water pump (SWP) structure. Pump tests will be run at the location of the east discharge line and the SWP structure. W. R. Ferris stated that the consultants and the NRC are aware of permanent dewatering and not the cutoff wall. This should be considered. Discussion centered around the sudden change in plan to the cutoff wall. Ferris said that all consultants including Peck and Loughney should be notified. Chen asked Hendron what the drawdown level is to prevent liquefaction. Hendron suggested that the same procedures that have been used already be used to calculate the safety factors against liquefaction for different drawdown levels. B. Dhar said that the seismic criteria is 0.12 g but this may raised to 0.20 g. Chen asked Hendron if he thinks we can prove that the site is safe against liquefaction if shown based on the borings we have drilled (which are a limited number). Hendron said that if 90% of the points are safe then it is probably all right, but you have to convince the NRC of that. Hendron said that one of the reasons for permanent dewatering was to prevent liquefaction if the criteria was changed to 0.20 g.

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

Mail Address P.O. Box 1000, Ann Arbor, Michigan 48106

November 19, 1979

CONSUMERS POWER COMPANY
RECEIVED
NOV 26 1979
MIDLAND PLANT PROJECT
MIDLAND, MICHIGAN

BLC- 8474

Consumers Power Company
3500 E. Miller Road
Midland, Michigan 48640

ATTN: T.C. Cooke

Subject: Consumers Power Company
Midland Plant - Job 7220
Meeting Notes No. 1074
File: 0270, C-88-PR,
C-98-PR

Gentlemen:

Attached for your information are the meeting notes generated from the October 30, 1979, meeting in Ann Arbor concerning both temporary and permanent dewatering.

Very truly yours,

for
L.H. Curtis
Project Engineer

JGH/bjm
11/15/11

Enclosures: Meeting notes no. 1074

cc: L. Curtis w/a
D. Horn w/a
D. Sibbald w/a
T. Thiruvengadam w/a
Com Log

Bechtel Associates Professional Corporation

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Ann Arbor, Michigan

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MEETING NOTES NO. 1074

MIDLAND PLANT UNITS 1 & 2

CONSUMERS POWER COMPANY

BECHTEL JOB 7220

DATE: October 30, 1979

PLACE: Ann Arbor, Michigan

SUBJECT: Dewatering (Temporary and Permanent)

FILE: 0279, C-88PR, C-98PR

ATTENDEES:

Bechtel	CPCo	Consultants
S. Afifi	T. Cooke	C. Gould
S. Blue	D. Horn	A. Hendren
K. Bostick	S. Sibbald	R. Loughney
P. Chen	T. Thiruvengadam	
B. Dhar		
W. Ferris		
J. Hook		
W. Paris		
M. Rothwell		
M. Rung		
C. Russell		
J. Wanzeck		
K. Wiedner		

PURPOSE: To discuss the status of both temporary and permanent dewatering.

ITEM DISCUSSED:

1) Temporary Dewatering

D. Loughney presented the history of the temporary dewatering system and how it was modified to correspond with the latest available information.

The subject of cutting-off water to the underpinning operation was discussed. Loughney indicated that the majority of ground water flow should be cut-off by the temporary dewatering system, especially since the soil conditions beneath the turbine building seem relatively uniform.

By the end of the week he will have installed eight pumping wells inside the turbine building. These wells will be used as observation wells when the outside dewatering wells are activated. After drawdown information is obtained, these observation wells inside the turbine building will be converted to eductor wells, and a decision will be made whether additional dewatering wells need to be installed in the turbine building. Since the installation of wells through the turbine building is very slow and expensive it may be more cost effective to dewater from within the underpinning excavation, especially since some ground water at the lower elevations may still have to be removed during the underpinning operation. This water could seep from under the control tower area and into the electrical penetration areas through the structural backfill. It was concluded that some dewatering may have to be completed from within the excavation and Loughney will decide whether any additional dewatering wells be installed in the turbine building.

C. Gould indicated that the underpinning subcontractor should be informed of the close coordination that may be required of the dewatering subcontractor to remove small quantities of water at the lower depths. It was agreed that this item will be resolved at the underpinning subcontract preaward meeting to be attended by D. Loughney and C. Gould.

C. Gould also indicated that the underpinner may be using grout to stabilize the soil and this could result in plugging some of Loughney's dewatering wells inside the turbine building.

2) Permanent Dewatering

A presentation was made of the current status of the preliminary design of the permanent dewatering system. The presentation began with a review of the NRC licensing criteria for dewatering systems. It was noted that there are no nuclear plants that currently rely on dewatering wells to reduce ground water levels. It is also evident that all parameters used in designing the permanent dewatering system must be verified by in-situ pumping tests and the results of any temporary dewatering.

A review of original and current site conditions was made. Drawings were presented indicating original topography, original perched ground water contours, excavation configuration, subsurface cross-sections, contours on bottom of backfill, contours on top and bottom of natural sand, and thickness of natural sands. The status of the current pump test and dewatering investigation program was also given.

It was noted that the plant site is bounded on the west, north and northeast by impervious dike cut-offs. The source of recharge to the site is thought to be from seepage from the pond through natural and backfill sands. The configuration of natural sands indicates a thick sequence along the south and west portions of the plant area.

The configuration of backfill sands indicates thick sequences around the containment structures. These areas would be logical places to install dewatering wells. Where the natural sands are in direct connection with the backfill sands, dewatering will be somewhat easier. The areas of sand backfill outside the containment areas, and not in contact with the natural sands, may be more difficult to dewater. After we obtain the results on the pump tests and temporary dewatering, we will be able to finalize our design.

The following are some of the options available.

a) Install a line of cut-off wells with a series of mop-up wells.

b) Combination of a grout/slurry wall with a series of mop-up wells.

c) Combination of grout/sheet piles with a series of mop-up wells.

d) Loughney has some reservations about grouting around the utility lines and questioned the cost estimate of all of the options.

CPCo indicated that there is another option available; that is to remove the water in the pond and place an impervious blanket in front of the plant area fill. The lowering of the pond could be done concurrently with the DNR fish study.

As a result of this, engineering will recheck the cost figures for Items a, b, and c, and develop a cost estimate for placing an impervious blanket in front of the dike. CPCo will check into the feasibility of lowering the pond.

A presentation was made to determine the preliminary drawdown criteria of the proposed dewatering system from a liquefaction potential for 0.12 g and 0.20 g peak acceleration. The following items were discussed.

a) The dewatering system should be designed to have the capacity of lowering the ground water table down to el 600' to account for nonhomogeneous nature of the plant area fill.

b) Based on the blowcount from the existing borings performed at the diesel generator building, railroad bay and control tower of the auxiliary building, the dewatering system must be designed to prevent the groundwater from rising above approximately el 610' to 615' for 0.12 g and el 600' to 605' for 0.2 g.

c) C. Hendron stated that further study should be made upon other borings performed in the plant area fill to finalize the allowable groundwater table.

In addition because there are only two locations that have liquefaction potential (the northwest corner of the diesel generator building and the railroad bay of the auxiliary building), the permanent dewatering system should address these areas for licensing purposes. Additional areas will be dewatered as the result of this system and be conservative in nature, but this additional dewatering is not required for licensing purposes.

Bechtel informed CPCo and the consultants that a special task force has been formed for permanent dewatering, with B. Dhar as chairperson. CPCo indicated that it would inform Bechtel regarding the extent of its participation in the task force.

The next in-house meeting on dewatering is scheduled for November 20, 1979, and the dewatering meeting with the consultants is scheduled for the week of December 10, 1979.

ACTION ITEMS:

Bechtel Engineering	1)	At the pre-award meeting for underpinning, the subcontractor should be made aware of the close coordination required with the dewatering subcontractor. C. Gould and R. Loughney requested to attend this meeting.
Bechtel Cost/Scheduling	2)	Recheck the cost information on options available and then develop costs for draining the cooling pond and placing an impervious blanket at the face of the plant area.
CPCo	3)	Investigate the status of lowering the pond.
Bechtel Construction	4)	Investigate the records to determine the extent a clay blanket on the bottom of the cooling pond.
CPCo	5)	Inform Bechtel regarding the extent of CPCo's participation in the task force.

Originator Jon G Hook
J. Hook

Reviewed by B Dhar
B. Dhar

JH/ht
11/2/5

[illegible]

need a more positive statement of
what review was done

NRC reviewed the work for [illegible]
[illegible] had with [illegible]

PERSONNEL QUALIFICATIONS

AUG 2 2 1979

As part of the cause analysis the education and experience of personnel involved in the soils operations at the Midland Job site were reviewed.

This review indicated that during the course of the Midland Project soils operation (7/73 to date of review) 51% of the personnel assigned to soils had at least: an M.S. in civil or soils; or a B.S. plus one or more years of soils experience, or an equivalent combination of education and experience. This includes Bechtel QC inspectors, Bechtel QC personnel doing reviews only, Canonie QC, U.S. Testing technicians, Bechtel Field Engineers, and Bechtel supervisors.

This indicates that the personnel involved in the soils operations had sufficient education and experience to carry out the tasks assigned to them.

In addition, the review indicated that except for the initial period (7/73 - 1/25) when all personnel were 'new employees', an average of 39% of the senior soils people (described in the previous paragraphs) continued on from one period to the next. For the lower level soils personnel, 38% continued from the initial period over into the 1/75-10/76 period, but only 8% continued on into the 10/76-present period.

Many senior soils personnel were retained during the 1975 slowdown but there was a need to restaff with mostly new lower level personnel in 1976 to support the reactivation of soils activities. This resulted in some decrease in the average experience level of personnel, but sufficient qualified, experienced personnel were available at all times, especially when recognizing that the major portion of the soils work had been already completed.

Based on the foregoing, we have concluded that the qualification/experience level of personnel assigned to the Midland Project soils operations was not a probable (contributing) cause of the settlement problem at the Midland Jobsite.

DIESEL GENERATOR BUILDING

G. RICHARDSON
3-21-79

SUMMARY OF PERSONNEL QUALIFICATIONS

ATTACHMENTS A AND B SUMMARIZE THE EDUCATION AND EXPERIENCE BACKGROUNDS OF PERSONNEL INVOLVED IN SOILS OPERATIONS AT THE MIDLAND JOBSITE. BECHTEL AND CANONIE QC ENGINEERS WERE INVOLVED ONLY IN "Q" WORK. THE INFORMATION FOR BECHTEL FIELD ENGINEERING AND SUPERVISION AND FOR U.S. TESTING COVERS BOTH "Q" AND "NON-Q" WORK.

ATTACHMENT A SUMMARIZES THE PERSONNEL USING LEVELS AS DISCRIBED ON PAGE TWO OF THE ATTACHMENT.

ATTACHMENT B SUMMARIZES THE LEVELS OF PERSONNEL AND IDENTIFIES HOW MANY INDEVIDUALS WERE NEW TO THE JOB OR WERE CARRY OVERS FROM THE PREVIOUS PERIOD. THE EFFECT OF THE 1975 SLOWDOWN CAN BE SEEN IN TWO RIGHT HAND COLUMNS.

CONCLUSION

ATTACHMENT A INDICATES THAT PERSONNEL INVOLVED IN THE SOILS OPERATIONS PROBABLY HAD SUFFICIENT EDUCATION, EXPERIENCE AND TRAINING TO CARRY OUT THE TASKS ASSIGNED TO THEM.

ATTACHMENT B DOES INDECATE THAT THE 1975 SLOWDOWN RESULTED IN THE NEED TO RESTAFF WITH MOSTLY NEW PERSONNEL IN 1976 TO SUPPORT THE INCREASE AMOUNT OF WORK. THIS MAY HAVE RESULTED IN SOME DECREASE IN THE AVERAGE LEVEL OF PERSONNEL BUT SUFFICIENT EXPERIENCED PERSONNEL WERE AVAILABLE AT ALL TIMES.

BASED ON THE ABOVE QUALIFICATIONS OF PERSONNEL SHOULD NOT BE CONSIDERED AS A MOST PROBABLY CAUSE OF THE SETTLEMENT PROBLEM AT THE MIDLAND JOBSITE.

G. RICHARDSON
3/21/79

DIESEL GENERATOR BUILDING
PERSONNEL QUALIFICATIONS

ATTACHMENT A
SHEET 1 OF 2

	7/73 - 1/75		1/75 - 10/76		10/76 - PRESENT	
BECHTEL Q.C. INSPECTORS.	A	●●●	A	●●●●	A	●●●
	B	●	B	–	B	
	C	–	C	–	C.	–
	D	–	D	●	D	●
BECHTEL QC DOING REVIEWS ONLY	A	●●	A	●●	A	●●
	B	–	B	–	B	●
	C	–	C	–	C	●●
	D	–	D	–	D	●
CANONIE QC	A	●	A	●	A	●
US TESTING TECHNICIANS.	A	●●●	A	●●●●●●	A	●●●●●
	B	●	B	●●	B	●●●●
	C	●●●●●	C	●●●	C	●●●●● ●●●●●
	D	●●	D	●●●●	D	●●●●
BECHTEL FIELD ENGINEERS [illegible]	A	●●●●	A	●	A	●●●
	B	●	B	●●●	B	–
	C	–	C	–	C	●
	D	–	D	–	D	–
BECHTEL SUPERVISORS	A	–	A	●●●●●	A	●●●
	B	–	B	–	B	–
	C	–	C	–	C	–
	D	–	D	–	D	–

● = ONE EMPLOYEE.

NOTES: (1) FOR EXPLANATION OF LEVELS SEE SHEET 2

(2) LEVELS ARE BASED ON EDUCATION AND EXPERIENCE AT THE START OF EACH PERIOD. EXPERIENCE GAINED IN PREVIOUS PERIODS HAS BEEN CONSIDERED IN ESTABLISHING LEVELS.

(3) LEVELS ARE BASED ON RECORDS AT MIDLAND SITE. THESE RECORDS FOR BECHTEL FIELD ENGINEERS AND SUPERVISORS ARE NOT COMPLETE.

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BECHTEL

G. RICHARDSON
3/21/79

DIESEL GENERATOR BUILDING
PERSONNEL QUALIFICATIONS

ATTACHMENT
SHEET 2 OF 2

QUALIFICATION LEVEL	EDUCATION AND EXPERIENCE (1)(2)
A	-M.S.C.E or M.S. SOILS OR -BSCE + 1 or more years soils experience OR -2yrs College Eng. + 2 or more years soils experience OR -H.S + 3 or more years soils experience.
B.	-BSCE OR -2yrs College Eng+1 year soils experience OR -H.S. + 2 years soils experience
C	-2yrs College Eng OR -H.S. + one year soils experience
D.	High School

(1) SOILS EXPERIENCE IS EXPERIENCE IN THE PLACEMENT, INSPECTION OR TESTING OF EMBANKMENT OR BACK FILL OPERATIONS

(2) EXPERIENCE INSPECTING HEAVY CIVIL CONSTRUCTION ACTIVITIES SUCH AS DAMS, ROADS, POWER PLANTS, BUT OTHER THAN SOILS, IS CONSIDERED EQUIVELANT ON A TWO YEARS EQUALS ONE YEAR BASIS. FOR SUPERVISORS CONSTRUCTION EXPERIENCE IS CONSIDERED EQUIVELENT TO INSPECTION EXPERIENCE

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G.RICHARDSON OSUI 11 60
3/21/79

DIESEL GENERATOR BUILDING
PERSONNEL
QUALIFICATIONS AND TURNOVER

ATTACHMENT B

GROUP	LEVEL	7/73 - 1/75		1/75 - 10/76		10/76 - PRESENT	
		—	NEW EMP	CONT. EMP	NEW EMP	CONT EMP	NEW EMP
BECHTEL QC INSPECTORS	A		•••	••	••	•••	
	B		•				•
	C						
	D				•		•
BECHTEL QC DOING REVIEW ONLY	A		••	•	•		••
	B						•
	C						••
	D						•
CANONIE QC	A		•	•		•	
U.S. TESTING TECHNICIANS	A		•••	••	••••	••	•••
	B		•	•	•	•	•••
	C		•••••	••	•	•	••••• •••• ••••
	D		••	••	••		
BECHTEL FIELD ENGINEERS	A		••••		•		•••
	B		•		•••		
	C						•
	D						
BECHTEL SUPERVISORS	A				•••••	••	•
	B						
	C						
	D						

• = ONE EMPLOYEE.

NOTES: (1) FOR EXPLANATION OF LEVELS SEE SHEET 2 OF ATTACHMENT 1

(2) LEVELS ARE BASED ON EDUCATION AND EXPERIENCE AT THE START OF EACH PERIOD. EXPERIENCE GAINED IN PREVIOUS PERIODS HAS BEEN CONSIDERED IN ESTABLISHING LEVELS.

(3) LEVELS ARE BASED ON RECORDS AT MIDLAND SITE. THESE RECORDS FOR BECHTEL FIELD ENGINEERS AND SUPERVISORS ARE NOT COMPLETE.

G. RICHARDSON
[illegible]/21/79

DIESEL GENERATOR BUILDING
PERSONNEL EMPLOYMEN PERIOD

ATTACHMENT C

	PERIOD EMPLOYED			
	PRIOR TO 1/75	BEFORE AND AFTER 1/75	AFTER 1/75	AFTER 1/76
U.S TESTING	●●●●●	●●●●● ●	●●	●●●●● ●●●●● ●●●●● ●●●●● ●●●●

DO NOT INCLUDE IN REPORT

ADDITIONAL COMMENTS.

NOT CONSIDERING QUALIFICATIONS THE HIGH TURN OVER RATE OF PERSONNEL FOR U.S. TESTING COULD BE A FACTOR RELATING TO TESTING ERRORS AND INCORRECT SELECTION OF THE PROPER LABORATORY MAXIMUM DENSITY VALUE.

BECHTEL QC AND FIELD ENGINEERING DID NOT HAVE ANY ONE INDEVIDUAL ASSIGNED SPECIFICALLY TO SOILS. THE PERSONNEL ASSIGNED TO SOILS ALSO HAD OTHER DUTIES. THIS COULD HAVE RESULTED IN LESS THAN DESIREABLE TIME BEING SPENT ON SOILS OPERATIONS BY SOME INDEVIDUALS.

ANN ARBOR

[illegible]

MEMORANDUM

TO [illegible] LOCATION

FROM [illegible] DATE 19

SUBJECT NRC [illegible] JOB NO. [illegible]

Qualification FILE

Attached is a discussion [illegible]

[illegible] the [illegible]

[illegible] July [illegible] 1977 presented [illegible]

We would suggest that this [illegible] to the

NRC [illegible]

document MCAR 24 Interim Report 7

[illegible]16992

AAO-521

Personnel Qualifications

As part of the cause analysis the education and experience of personnel involved in the soils operations at the Midland jobsite were reviewed.

Attachment A summarizes the education and experience backgrounds of personnel involved in soils operations at the Midland jobsite. The education and experience backgrounds were organized into the following levels:

Level A - M.S.C.E, or M.S. Soils
or - B.S.C.E., plus 1 or more years soils experience
or - 2 years engineering college, plus 2 or more years soils experience
or - High school, plus 3 or more years soils experience

Level B - B.S.C.E.
or - 2 years engineering college, plus 1 year soils experience
or - High school, plus 2 years soils experience

Level C - 2 years engineering college
or - High school, plus 1 year soils experience

Level D - High school

In establishing these levels, soils experience was considered to be experience in the placement, inspection, or testing of embankment or backfill operations. Experience inspecting heavy civil construction activities such as dams, roads, and power plants, but other than soils, was considered on the basis of two years equivalent to one year. For supervisors, construction experience was considered equivalent to inspection experience

Attachment A indicates that personnel involved in the soils operations had sufficient education, experience and training to carry out the tasks assigned to them and ~~sufficient~~ qualified personnel were available. ~~at all times~~

The number of people assigned to the various soils aspects were tabulated for three different periods.

7/73 - 1/75 This is the period from reactivation of construction to the partial slowdown in 1975

1/75 - 10/76 This is the period during which construction was virtually suspended and then resumed. The termination of the prime [illegible] commitment to the [illegible] / [illegible] of soils activities. This is considered to

the portion in the [illegible] program -
where the majority of material
placed concrete from plant forces. All placed
by a subcontractor to contract concrete
placed by licensee.

10/76 - present
This corresponds to the recently resumption of activity in 1976 to present.

SOILS OPERATIONS

B[redacted]G

PERSONNEL QUALIFICATIONS

ATTACHMENT A

		7/73 – 1/75	1/75 – 10/76	10/76 – PRESENT
BECHTEL Q.C. INSPECTORS.	A	●●●	●●●●	●●●
	B	●	–	
	C	–	–	–
	D	–	●	●
BECHTEL Q.C. DOING REVIEWS ONLY	A	●●	●●	●●
	B	–	–	●
	C	–	–	●●
	D	–	–	●
CANONIE Q.C.	A	●	●	●
U.S. TESTING TECHNICIANS.	A	●●●	●●●●●●	●●●●●
	B	●	●●	●●●●
	C	●●●●●	●●●	●●●●●●●●●●
	D	●●	●●●●	●●●●
BECHTEL FIELD ENGINEERS	A	●●●●	●	●●●
	B	●	●●●	–
	C	–	–	●
	D	–	–	–
BECHTEL SUPERVISORS	A	–	●●●●●	●●●
	B	–	–	–
	C	–	–	–
	D	–	–	–

● = ONE EMPLOYEE

NOTES: ~~1) FOR EXPLANATION OF LEVELS SEE SHEET 2~~

(1) LEVELS ARE BASED ON EDUCATION AND EXPERIENCE AT THE START OF EACH PERIOD. EXPERIENCE GAINED IN PREVIOUS PERIODS HAS BEEN CONSIDERED IN ESTABLISHING LEVELS.

80116096

(2) LEVELS ARE BASED ON RECORDS AT MIDLAND SITE. THESE RECORDS FOR BECHTEL FIELD ENGINEERS AND SUPERVISORS ARE NOT COMPLETE.

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX A

DATE______

DEFICIENCY CATEGORIES

RLRixford

CATEGORY NO.	DESCRIPTION	GENERIC IMPLICATIONS	REMARKS
1	FSAR requirements for compaction not clearly reflected into specs.	[illegible]	
2	Combined with No. 6	NA	
3	Specifications not adequately clarified.	[illegible]	
4	FSAR contained conflicting information within.	[illegible]	[illegible]
5	Settlement calculations inconsistent with design basis.	[illegible]	
6	Fill not placed adequately	[illegible]	
7	Soil moisture not tested at specified time.	[illegible]	
8	Possible deficiencies in soil test results	[illegible]	[illegible]
9	Lack of Subcontractor Soil Test Procedures	[illegible]	
10	Duct bank interfered with settlement.	[illegible]	
11	Corrective action not timely.		
12	Inadequate corrective action for repetative conditions.	[illegible]	[illegible]
13	Audits lacked sufficient depth.	[illegible]	

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 1

DATE 4-6-79

SCRIPTION FSAR REQUIREMENTS FOR COMPACTION NOT CLEARLY REFLECTED IN SPECS

PAGE 1 OF

PROGRAM REQUIREMENT

(1)
PSAR, Amendment 3, Supplement (dated, 3/15/69) To Dames & Moore Report of 6/28/68, page 16 gives recommended minimal compaction criteria for support of structures as:

85% relative density per ASTM D 2049-64T for sand soils
100% maximum density per ASTM D 698, modified to 20000 ft-lbs for clay soils.

(2)
PSAR, Amendment 3, Supplement (dated, 3/15/69) to Dames & Moore Report of 6/28/68, page_____ states, "If filling and backfilling operations are discontinued during periods of cold weather it is recommended that all frozen soil be removed or recompacted prior to the resumption of operations."

Civil-Structural Design Criteria, 7220-C-501, Rev. 9, Sect. 6.1.1, gives recommended minimum compaction criteria for support of structures as:

85% relative density per ASTM D 2049-69 for sand soils
- % maximum density per ASTM D 1557, method D, *as modified by the Bechtel modified proctor test for clay soils.

*The percentages and basic standards appear to be Rev. 3 (6-18-73) while the notation "...as modified by the Bechtel Modified Proctor Test" appears to be Rev. 6 (8-28-76)

chk the sect no.

4(5)
Specification 7220-C-210, Rev. 5 & 6, Sect. 13.2.1 states "All cohesive backfill in the plant area and berm shall be compacted to not less than 95 percent of maximum density as determined by ASTM D 1557, Method D."

√(4) SPEC. 7220-C-210, REVS 1-4, SECT. 13.7 STATES, IN PART, "ALL BACKFILL IN THE PLANT AREA AND THE BERM SHALL BE COMPACTED TO NOT LESS THAN 95 PERCENT OF MAXIMUM DENSITY AS DETERMINED BY MODIFIED PROCTOR METHOD (ASTM 1557, METHOD D)....

QUALITY DEFICIENCY

Contrary to Program Requirement No:

1, 3, 4, 5 Specification 7220-C-210, Revisions 2 thru 6, Para. 13.4, 13.7 and 12.4 was interpreted and implemented to require a minimum compaction of 95% of Bechtel modified proctor for cohesive plant fill materials, including those under structure

1, 3 Specification 7220-C-210 Revs. 1-4, para 13.7, originally required 95% compaction for cohesionless soils based on maximum density as determined by modified proctor method (ASTM 1557, Method D). Revision 5 to this specification added a requirement (Para 13.7.2) to compact cohesionless soils to 80% relative density as determined by ASTM D 2049.

1, 3 Specification 7220-C-211, Rev. 5, "Technical Specification for Structural Backfill," Para. 5.5 requires compaction of cohesive soils to 95% of Bechtel modified proctor and cohesionless soils to 80% relative density. This specification includes materials under structures.

2 Specification 7220-C-211, Rev. 5 does not provide for frost protection or removal/recompaction of frozen/thawed materials. The NRC has concluded that paragraphs 10.1, 11, 12.5.1 and 12.10 of Spec 7220-C-210 do not adequately address frozen/thawed material treatment.

SB121497

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 1

DATE 4-6-79

ESCRIPTION FSAR Requirements for Compaction not Clearly Reflected into Specs.

PAGE 2 OF

PROGRAM REQUIREMENT

(6) Job 7220 procedure titled "Design Document Requirement Procedure" Rev. 1, issued for use on 11/30/78 states:

Para. 3.1 "The engineer responsible for the origination of a design document shall fill out the attached design requirement check list as he develops the design document. The purpose is to assure all applicable design and quality criteria contained in each applicable document have been incorporated into the subject design and to verify that no omission or conflict exists. The engineer shall initial the applicable blocks provided."

Exhibit 1 (DRVCL) includes under Item 1 - "Commitment List (PSAR/FSAR and Licensing)"

(7) EDPI 4.1.1, Rev. 0, Issued 7/15/794 states:

3.1 The Discipline Engineer who originates a design document shall fill out the attached Design Requirement Verification Checklist (DRVCL) as he develops the design document to assure that all applicable design criteria contained in each referenced document have been incorporated into the design document and to verify that no omission or conflict exists. If a particular Design Requirements Document is not applicable to the design document, place "N/A" in the space provided for identification.

Exhibit 1 (DRVCL) includes under Item 1 - "PSAR/FSAR."

QUALITY DEFICIENCY

Contrary to Program Requirement No:

6,7 ~~[illegible]~~

The engineering preparation, review and approval of specs 7220-C-210 and C-211 did not accurately incorporate PSAR requirements.

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 1

Revised 4-9 11:30am DATE 4-6-79

DESCRIPTION FSAR REQUIREMENTS FOR COMPACTION NOT CLEARLY REFLECTED INTO SPECIFICATIONS

PAGE 3 OF

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS

WHEN SPECIFICATIONS 7220-C-210 AND 7220-C-211 WERE GENERATED THE COGNIZANT ENGINEER CONSIDERED THE PSAR BUT DID NOT CONSIDER THE DAMES & MOORE REPORT AS AN ACTUAL COMMITMENT ON AN ITEM BY ITEM BASIS AS IT WAS AN ATTACHMENT TO THE PSAR. ~~THE DAMES-MOORE REPORT WAS NOT CHECKED IN DETAIL DURING PREPARATION OF THESE SPECIFICATIONS.~~

THIS ITEM IS CONSIDERED NOT TO HAVE GENERIC IMPLECATIONS BECAUSE OF THE FOLLOWING:

A. THERE ARE NO OTHER ATTACHMENTS TO THE PSAR WHICH, LIKE THE DAMES&MOORE REPORT, INCLUDE RECOMMENDATIONS THAT COULD BE CONSTRUED AS SPECIFIC DESIGN REQUIREMENTS.

B. EDPI 4.1.1 AND ITS PREDECESSOR PROVIDE A POSITIVE SYSTEM TO ASSURE THE PSAR WAS CONSIDERED DURING THE DEVELOPMENT OF ALL DESIGN DOCUMENTS.

ENGINEERING FEELS THAT FROST PROTECTION IS ADEQUATELY ADDRESSED AS PREVIOUSLY STATED IN THEIR RESPONSE TO NRC QUESTION NO. # 7.

SPECIFICATIONS 7220-C-210 AND 7220-C-211 HAVE BEEN REVISED TO INCORPORATE COMPACTION REQUIREMENTS FOUND IN THE FSAR. BY ISSUING:

SCN C-210-9001 DATED 3-30-79
SCN C-211-9001 DATED 4-2-79

A COMPLETE REVIEW OF THE DAMES MOORE REPORT TO ASSURE NO OTHER ~~DEFICI~~ INCONSISTENCIES EXIST WILL BE COMPLETED BY ________.

this is not correct!

It was checked in detail. Based upon D&M's recommendations, Spec C-10, and our Geotech recommendation (including [illegible] & w. Forms of [illegible]) C-2 was developed.

SB121499

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B
CATEGORY NO. 3
DATE 4-9-79
ESCRIPTION SPECIFICATION NOT ADEQUATELY CLARIFIED
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PROGRAM REQUIREMENT	QUALITY DEFICIENCY
	Contrary to Program Requirement No:
(1) NQAM, Section II, Number 5, Para 3.2 states, inpart, "Design changes shall be initiated and controlled in accordance with written procedures. These procedures shall provide for the following:,.." Para. 3.2.6, states, "The controls applied to assure that design change commitments initiated through nonconformance reports and through ~~after~~ other communications (such as TWX's, memos, etc.) are properly documented and processed into approved design output documents."	1. Specification [illegible]-C-210, Para 13.7 originally required cohesive soils to be compacted to 95% of modified proctor method (ASTM-1557, Method D). This paragraph was later clarified in Rev. 5 to read 95% as determined by ASTM D-1557, Method-D. Paragraph 13.4 requires testing to be performed in accordance with the tests listed in Section 12.4. Para. (section) 12.4.5.1 requires cohesive soils maximum density to be determined using ASTM D-1557, Method D modified to 20,000 ft/lbs of compactive effort, (Bechtel Modified Proctor). (BMP) The above conflict between paragraphs 12.4 and 13.7 were subject of clarification telecons and confusion still exists as to which standard to use, (ASTM or BMP) however the specification has not been revised.

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DESCRIPTION SPECIFICATION NOT ADEQUATELY CLARIFIED

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DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
LETTERS, TWX'S, TELECONS AND REMS$_x$ ARE OFTEN USED TO CLARIFY THE INTENT OF THE SPECIFICATIONS. IT IS POSSIBLE THAT IN SOME SITUATIONS THE CLARIFICATION PROVIDED THROUGH THE ABOVE METHODS MAY HAVE MODIFIED THE SPECIFICATION WITHOUT FORMALLY CHANGING THE WORDS OF THE SPECIFICATION. TO THE ABOVE EXTENT THIS ITEM IS CONSIDERED POSSIBLY GENERIC TO OTHER AREAS.	SPECIFICATION C-210 HAS BEEN REVISED IN SCN C-210-9001 DATED 3-30-79 ON 4-3-79 AT THE GROUP SUPERVISORS MEETING THE COGNIZANT INDIVIDUALS WERE REMINDED TO EXERCISE CARE WHEN INTERPRETING THE SPECIFICATIONS BY MEM. TWXS, ETC. THE CLARIFICATIONS GIVEN SHOULD NOT CAUSE ANY CHANGE OF THE SPECIFICATION MATERIAL BUT BE CONSISTANT WITH THE PRESENT WORDING. THE ABOVE HAS BEEN REITERATED IN A MEMO FROM THE PROJECT ENGINEER TO ALL MIDLAND GROUP SUPERVISORS DATED ______.

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SCRIPTION CONFLICTING INFORMATION WITHIN THE FSAR

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PROGRAM REQUIREMENT

(1)
NQAM, Section II, Number 2, Para. 1.0, states, "This policy contains the requirements for providing procedures necessary to control design activities...."

(2)
Para. 3.1 states, in part, "The following activities shall be described in Engineering Department procedures....(19) SAR preparation and change controls...."

(3)
EDP 4.22, Rev. 1, Section 1.0, states, in part, "This procedure describes the mechanics of preparing and controlling Safety Analysis Reports..."

(4)
Sect. 4.3, states, in part, "Between the construction permit and operating licensing phases.....particular attention shall be paid to the Engineering Department Procedure on SAR change control which will provide inputs for FSAR preparation on significant changes in SAR commitments and basic design concepts.."

(5)
Sect. 5.1, states, in part, "An SAR flow chart shall be prepared by Project Engineering showing the personnel and organizational responsibilities and the interfaces for the preparation, coordination, review, approval and publication of the SAR..."

(6)
EDP 4.22, Exhibit A, SAR Preparation Flow Chart, Step 2 requires the EGS to review the originator's draft for technical accuracy and compliance with the standard format guide.

QUALITY DEFICIENCY

Contrary to Program Requirement No:

1, 2, 3, 4, 5 and 6.

The FSAR submitted to the NRC (thru Amend. 17) contained certain inconsistencies:

- Tables 2.5-9 and 2.5-14 identify the foundations under the Diesel Generator Building to be cohesive fill. The actual materials specified and used was random fill which includes both cohesive and cohesionless materials.
- FSAR, Paragraph 3.8.5.5 indicates a settlement of 1/2 inch for shallow spread footings (such as the Diesel Generator Building), FSAR Table 2.5-48 indicates a settlement of the Diesel Generator Building of approximately 3 inches. The difference between the two values is not clear.

5 and 6, The preparation and review of the FSAR did not identify these discrepancies.

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DESCRIPTION Conflicting Information Within the FSAR

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DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS

This category of deficiency has generic implications only for sections of the FSAR which could be considered 'inactive'. Prior to the identification and investigation of the Diesel Gen. Bldg. Settlement, Tables 2.5-9 and 2.5-14, and Para. 3.8.5.5 (pg 3.8-59) had not been revised since Rev. 0 of the FSAR (8-29-77).

No NRC questions had been received that affected these areas, and no project design documents had undergone a significant revision that affected these areas.

Thus, after the initial FSAR preparation, there has been no occasion nor need to re-review these areas.

REMEDIAL AND CORRECTIVE ACTIONS

FSAR sections 2.5 and 3.8 were reviewed by the Diesel Gen. Bldg. Task Force and FSAR change notices were written to correct the inconsistencies found or to add clarification to the material presented.

These FSAR change notices were incorporated into the FSAR in Rev. 18 (2-28-79).

To ensure that no inconsistencies exist in other sections of the FSAR that could also be classified as 'inactive', a review of those sections will be made.

No review of 'active' sections is felt to be necessary due to the numerous reviews that have taken place as a result of the normal design evolution process and response to NRC questions.

A Bechtel QA Audit (Audit No. 4.0-Special-1) performed 1-22 to 30-79, confirmed that a system was being implemented to assure that design changes are reflected in the FSAR.

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DESCRIPTION SETTLEMENT CALCULATIONS INCONSISTANT WITH DESIGN BASIS

PAGE ____ OF ____

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
(1) EDP 4.37, Rev. 2, Sect. 4.0, concerns checking of design calculations. The 4th. paragraph states, inpart, "After verifying the basis of a calculation, the checker..." (2) Sect. 4.1, lists checker responsibilities and states, in part, "Checking calculations against input design documents to verify conformance with specified configurations, dimensions,....checking calculations for assumptions..."	Contrary to Program Requirement No: 1,2 Settlement calculations for the Diesel Generator Building contained the followin discrepancies: °A uniform load 3000 PSF was used rathe than the 4000 PSF shown in Section 3.8.4.1.2 of the FSAR. °An index of .001 was used rather than the index of .003 shown in Table 2.5-1 of the FSAR. °The calculations assumed a mat foundat rather than the actual design which is a spread footing foundation. The checker of these calculations failed t identify these errors.
(3) —P 4.22, Rev. 1, Sect. 5.1, states, inpart, SAR flow chart shall be prepared by ..oject Engineering showing the personnel and organizational responsibilities and the interfaces for the preparation, coordination, review, approval, and publication of the SAR..." (4) EDP 4.22, Exhibit A, SAR Preparation Flow Chart, Step 2, requires the EGS to review the originator's draft for technical accuracy.	3,4. The results of these calculations were included in the FSAR in contradication to other information in FSAR.

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DESCRIPTION SETTLEMENT CALCULATIONS INCONSISTANT WITH DESIGN BASIS.

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DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
THIS IS NOT CONSIDERED A GENERIC PROBLEM AS GEO-TECH IS THE ONLY OFF PROJECT GROUP ~~WHO~~ WHICH PROVIDES CALCULATIONS ~~WHO~~ BUT DOESNOT WORK TO THE PROJECT PROCEDURES FOR CALCULATIONS.	

IS IT GENERIC TO
ALL OTHER GEOTECH
CALCS THEN?

+ GEO TECH RESPONSE

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CRIPTION FILL NOT PLACED ADEQUATELY

PAGE ____ OF ____

PROGRAM REQUIREMENT

(1)
NQAM Section I, No. 9, RE 1-B (6/30/77) Para. 3.1; states that the Project Superintendent is responsible for the Project Construction Teams adherence to the Quality Assurance Program.

(2)
Field Procedure FPG-3.000, Rev. 0, dated 10/5/77:

- °Matrix PFS-1 (duties of superintendents) includes - "Compliance with drawings and specifications" and "overall quality of workmanship."
- atrix PFE-1 (duties of field engineers) Periodic checking to assure technical direction has been clear enough so that construction conforms to drawings and specifications."

(3)
Specifications 7220-C-210, Revs. 2-6, Para 13.7 and 7220-C-211, Revs. 0-5 Para 5.5 require cohesive soils to be compacted to 95% of EMP and cohesionless soils to be compacted to 80% relative density.

WRONG! inconsistent w/ Qual. Deficiencies in Category 1

C-210 Rev 2-8 were interpreted as 95% dmp
C-210 Rev 0-4 95% for cohesionless (1555)
Rev 5 70% " " (1979)

(4)
PSAR, Amendment 3, Supplement (dated 3/15/69) to Dames & Moore Report of June 28, 1968, page 16, states, inpart, "Filling operations should be performed under the continous technical supervision of a qualified soils engineer..."

(5)
il-Structural Design Criteria, 7220-C-501, . 9, Sect. 6.1.1, states, inpart, "Filling operations shall be performed under the technical supervision of a qualified soils engineer..."

QUALITY DEFICIENCY

Contrary to Program Requirement No:

1,2,3
Drill samples taken subsequent to the discovery of the Diesel Generator Building Settlement Problem indicate cohesive and cohesionless soils ~~have been~~ ARE IN place~~d~~ at densities less than those specified. These areas are currently known to exist under the following structures that are setting on plant fill.

- °Diesel Generator Building
- °Service Water Structure
- °Diesel Fule Storage Tanks
- °Borated Water Storage Tanks
- °Auxilary Building in the Railway Bay Area
- °United ONe Electrical Penetration Room
- °Unit One and Two Valve Pits

1,2,3
The supervision and technical guidance provided by Bechtel did not result in acceptable compaction in all cases.

C. reword this

4,5 There was no qualified Soils Engineer assigned to the Midland jobsite after 1974. Soil operations and testing was directed by supervision, field engineering, labor foreman and Quality Control for Bechtel operations. Canonie operations were directed by their supervision and testing was requested by their QC Engineer. A Bechtel subcontracts engineer coordinated Canonie's work. U. S. Testing performed all the tests for both operations.

NOTE:
This requirement was not included in the implementing procedures or specifications for soils operation.

Note: There have been no positions established in the field that specifically identify personnel as responsible for soils such as:

- °Field Soils Engineer
- °Field Soils Superintendent

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SCRIPTION Fill Not Placed Adequately

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DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
(1,2,3) The specifications for backfill and structural backfill are performance type specifications and the acceptance of this fill was based on satisfying the acceptance test requirements. The Field Supervison and Engineering structured their direction around this concept and supplemented it by monitoring of the actual soils operation. The soils test generally showed good compaction and this information was utilized by the field personnel in determining the amount of direction necessary. This area is not considered generic in that soils operations are unique because there no physical attributes available to supervision to check the quality of compactive effort other than by test results. Each life is subsequently covered by the following lift. This is unlike other work such as piping where the results of the work efforts are viable such as alignment at subassembly closure points.	Bechtel Project Management has stopped all permanent fill operations until a qualified Soils Engineer is on site to monitor soils operations.

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DESCRIPTION Fill Not Placed Properly

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DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
(4-5) The field was not aware of the Design Criteria requirement.	Same as for 1, 2 and 3
This item is not considered generic as there are no other similar requirements in the Design Standards. Other areas of construction do have specific engineers assigned such as for concrete, resteel, piping, etc.	SPECIFICATION CHANGE NOTICE C-211-9001 ADDS THE REQUIREMENT FOR SOILS WORK TO BE PERFORMED UNDER THE DIRECTION OF A QUALI SOILS ENGINEER

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SCRIPTION FILL NOT PLACED ADEQUATELY

PROGRAM REQUIREMENT

(6)
Quality Control Inspection Plans or Instructions provide for Quality Control surveillance to assure the materials are properly compacted to the specified criteria. These instructions included the following:

- °FIP C-210-4
- °FIP C-211-1
- °QCIR C-1.02

(7)

C 1.02 Rev 1, dated 4/k8/77 had the owing callout for compaction:

- °ACT 2.3.5 - "Compaction shall be achieved through the use of approved compaction equipment. All materials shall be compacted to the specified densities for the indicated zone. The entire lift shall be consistant."
- °Reference to Spec C-210, Para 12.7, 13.7 and 12.8.1
- °Inspection Code is S
- °Similar Act for Spec C-211 (2.2.5)

(8)
QCIR c-1.02, Rev 2 dated 8/2/77 only address compaction under Act 2.4 "Testing" and states "Verify that testing performance and results are in accordance with engineering requirements.

a. Materials
b. Moisture
c. Compaction

Inspection callout is S(V)
Reference is made to the applicable paragraphs specs C-208, C-210 and C-211.

QUALITY DEFICIENCY

Contrary to Program Requirement No:

6,7,8 The inspection (surveillance) by Quality Control was not sufficiently in depth to identify these areas not meeting the specified requirements.

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SCRIPTION FILL NOT PLACED PROPERLY

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DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
6, 7, 8 SEE ATTACHED IOM	NONE REQUIRED

Bechtel Power Corporation

Interoffice Memorandum

To G. L. Richardson

File No

Subject Response to NRC 50.54 Request,
Item 1 Relating to the Diesel
Generator Building, Midland
Project, Job No. 7220

Date

From D. R. Johnson

Of SFPD Construction
Quality Control

At 425 Market St. Ext 8-0343
32nd Floor D10

Copies to J. L. Newgen
R. A. Simanek
W. L. Barclay

In reply reference:

2-CQC-

Reference: ICM, C. L. Richardson to Distribution, same subject,
dated March 29, 1979.

What follows is Construction Quality Control's best effort attempt to prepare replies to those questions which you assigned to the PFQCE in the above referenced ICM:

1. Variance 6, Items 4, 5, and 6 (NOW NOS. 6, 7 AND 8)

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

The Bechtel construction quality control program of surveillance inspection over work performed by Canonie and inspection over work performed by Bechtel was complied with for the compacted backfill operations at the Midland jobsite. In the case of Canonie, they performed and were totally responsible for their own work, inspection, documentation and quality assurance; all in accordance with their Bechtel approved QA manual. Bechtel Construction Quality Control performed surveillance inspection over Canonie in accordance with FIP C-210 and QCI S/C1.10. As stated in Bechtel's construction quality control program document SF/PSP G-6.1, the purpose of surveillance inspection is to determine if an action has been accomplished or if documents have been prepared in accordance with selected requirements of the contract documents. Surveillance inspection does not mean that all or all of any subcontractor activities are observed for the purpose of determining compliance. Surveillance inspection is intended to provide a degree of added confidence that subcontractor work meets contract document requirements.

1624 REV 1/77

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.

<u>1976:</u> 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.

<u>1977:</u> 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.

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DESCRIPTION FILL NOT PLACED ADEQUATELY

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PROGRAM REQUIREMENT	QUALITY DEFICIENCY
	Contrary to Program Requirement No:
(9) Spec. 7220-C-211 Revs 0-5, Para 5.2.2 states "The uncompacted lift thickness of backfill material shall be determined by field personnel after evaluation of the proposed compaction equipment. However, in no case shall the uncompacted lift thickness exceed 12 inches".	9. There are no records available to indicate that the various types of compaction equipment used for structural backfill where evaluated by Field Personnel and exceptable lift thickness established for each type of equipment.
(10) FIP C-211-1, Revs. 0-2 address lift thickness in task No. 3.20 or 2.30 which references spec C-211, Para 5.2.2 and requires an "inspect" (I) point to assure lifts do not exceed that determined by the Field Engineer. C-1.02, Rev. 2 has the same callout in Act 2.2.4 but with a surveillance [S(V)] code.	9,10 Quality Control signatures on Inspection Plans and Records indicate lifts did not exceed the limits established by the Field Engineer after evaluation of the proposed equipment even though there are no records to verify the evaluations.
	NOTE: The stated 12 inch maximum lift thickness was used as a limit by Field Personnel and Inspection Personnel

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(9) THIS ITEM IS NOT CONSIDERED GENERIC TO OTHER AREAS AS THIS TYPE OF EQUIPMENT QUALIFICATION IS UNIQUE TO SOILS OPERATIONS AND THE FIELD USED WHAT THEY FELT IS AN ACCEPTABLE ALTERNATE METHOD OF VERIFICATION OF THE CAPABILITY OF THE EQUIPMENT. EACH GENERIC TYPE OF EQUIPMENT USED WAS EVALUATED ALONG WITH LIFT THICKNESS FOR THIS EQUIPMENT BY VERIFYING BY ACTUAL INPLACE TESTING.	* TEST PADS WILL BE RUN TO QUALIFY EQUIPMENT AND ESTABLISH LIFT THICKNESSES *FOR COHISIVE AND COHESIONLESS SOILS. THIS OPERATION WILL BE DIRECTED BY BECHTEL GEO-TECH AND WILL BE COMPLETED BY ______.

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DATE __________

DESCRIPTION FILL NOT PLACED ADEQUATELY

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DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
(9,10) SEE ATTACHED	NONE REQUIRED

2. Variance 6. Items 7 and 8 (NEW NOS. 9 AND 10)

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 memorandas:

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 Canonie 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's 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.

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SCRIPTION SOIL MOISTURE NOT TESTED AT SPECIFIED TIME

PAGE ____ OF ____

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
	Contrary to Program Requirement No:
(1) Specification 7220-C-210, Rev 2-6, Para. 13.6 requires moisture control for plant fill to be in accordance with Para 12.6. (2) Pra 12.6 states inpart - "The water content during compaction shall not be more than 2 percent - age points below optimum moisture content and shall not be more than 2 percentage points above optimum moisture content...." It also states inpart "After placement of loose material on the fill, the moisture content shall be further adjusted as necessary to bring such material within the moisture content limits required for compaction."	1, 2 Prior to 1978 moisture content was controlled by taken tests after compaction. No test were taken on the fill prior to compaction to verify adherence to the technical requirements of specification 7220-C-210 Para. 12.6. (See attached chart).
(3) Quality Control Inspection Plans or Instructions called for QC surveillance to assure proper moisture content and reference specification 7220-C-210 paragraphs 13.6 and 12.6. These documents include: °FIP C-210-4 °QCIR C-102 °QCIR SC-1.10 A typical example of this inspection callout is: °QCIR C-1.02 Rev I dated 8/2/77 ACT 2.3.3.3: "Backfill material shall be conditioned to the required moisture content through the use of approved procedures. ACT 2.3.3.3 references spec 7220-C-210, Para 13.6 and 12.6 and has an inspection code of S(V).	3-4 Quality Control surveillance did not identify the lack of testing to verify moisture content even after issuance of QAR SD-40.
(4) Note: Quality Assurance issued QAR SD-40 on 7/22/77 to identify this problem. Project Engineering's response was that tests to control mositure should be taken prior to compaction.	NOTE: THERE HAS BEEN CONTINUED CONFUSION AND CHANGING INTERPETATIONS AS TO THE PROPER TIMING OF MOISTURE TESTS.

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SCRIPTION Soil Moisture Not Tested at Specified Time

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DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
This is not a generic problem since soils is the only material in which moisture is taken. Prior to 1978, Sect. 126 of Spec. C-210 was interpreted by the field as follows: "During compaction" was interpreted as the entire process of placing, compacting, and testing fill. The moisture content was taken during the density test which was taken immediately after compaction. Therefore, by field interpretation, the moisture content was taken after compaction, the fill was not tested in its loose state. Any reconditioning was therefore done after testing. Note: The method stated above is basically the same as SCN No. C-210-9001 presently requires.	Follow SCN No. C-210-9001 dated 3-29-79 and BEBC-2835 dated 4-4-79.

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DESCRIPTION SOIL MOISTURE NOT TESTED AT SPECIFIED TIME

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DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
3, 4	
SEE ATTACHED IOM. page 5	NONE REQUIRED

3. <u>Variance 7, Items 4 and 5</u> (New 3 and 4)

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 to 9/30/77
Telecon Hook to Res of 10/10/77
Telecon Hook to Res 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 Res 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 QCT 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.

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APPENDIX B

CATEGORY NO. 8

DATE 4-6-79

SCRIPTION POSSIBLE DEFICIENCIES IN SOIL TEST RESULTS

PAGE 1 OF

PROGRAM REQUIREMENT

(1)
Spec 7220-C-208, Rev. 15, Dated 2-5-79 (previous rev. same) Para. 9.0 describes tests for soils. These tests include:

- •ASTM-D-1557 - Compaction
- •ASTM-D-2049 - Relative Density
- •ASTM-D-1556, Field Density

(2)
SF/PSP G-1.1, Rev. 3, 9-13-78 para 3.5.9 states "Onsite Construction Quality Control responsibilities for the Midland project are as follows:

5) Provide technical direction over on-site material testing laboratories and nondestructive examination subcontractors."

Quality Control Inspection Plans and Instructions provided for test (T) of surveillance points (S) for testing and review (R) points for test results as indicated below:

Plan No.	Test	Review
FIP-C-210-4	T	R
FIP-C-211-1	T	R
QCI-C-1.02	TorS or S(v)	R
QCI-SC-1.10	SI	R

The T & S Points for testing reference the applicable paragraphs of each specification for types of tests.

(4)
QCI C-1.02, Rev. 2, dated 8/2/77 ACT 3.1 states:
"Review and sign Laboratory test reports verifying:

a. Proper test method
b. Proper test frequency
c. Technical Adequacy

3.1 Inspection Code is an "R" and references are made to:

Spec	Para
•C-208	9.0
•C-210	12.4, 12.6, 12.7,

QUALITY DEFICIENCY

Contrary to Program Requirement No:

(1)
A review of soils test conducted by Geo-tech indicates there are errors and inconsistencies in some of the tests performed by US Testing. The attached report (to be attached later) summarizes these problems.

(2,3,4)
Technical direction, surveillance and test report reviews by Quality Control failed to identify these problems.

(4)
Para 5.6 of Spec 7220-C-211, Rev. 5 is not reference in QCI C-1.02, Rev. 2. This is the appropriate paragraph to establish proper test frequency.

BECHTEL POWER CORPORATION
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DATE 4-6-79

SCRIPTION POSSIBLE DEFICIENCIES IN SOIL TEST RESULTS

PAGE 3 OF

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
	Contrary to Program Requirement No:
(5) pec 7220-C-208, Revs 2-15, Table 9-1 stablishes test frequancies for soils as ollows: •Field density, moisture content - one per every 500 cubic yards of fill •Compaction, grainsize, specific gravity - one per every 10,000 cubic yards of fill.	(4,5,6) There are no records to validate the QC signoffs on QCIR's/FIP's to verify proper test frequencies were maintained for fill and structural backfill for each period covered by each individual QCIR or Inspection Plans.
(6) pec 7220-C-211, Revs 0-5, Para 5.6.2 stablishes test frequencie to be as in section .0 of spec 7220-C-208 except frequency for ill density will be as follows: •Large area - 1/500 c.y. onfined area - varies from 1/10 c.y. to /100 c.y. as determined by tha Field Engineer.	(6) Soil Tests were normally called for by the Labor foreman. It appears that the Field Engineer was not determining the test frequency for confined areas.

BECHTEL POWER CORPORATION
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DESCRIPTION Possible Deficiencies in Soil Test Results

PAGE ____ OF ____

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
Relative to program requirement 6:	
Prior to starting compaction in an area, the Field Engineer would determine the test frequency required and instruct the labor foreman. This review and the ensuing instructions were not documented.	Bechtel Project Management has stopped all permanent fill operations until a qualified Soils Engineer is on site to monitor soils operations.
This particular deficiency is not considered to have generic implications since in other areas of construction which require testing, the specifications are more specific with regard to testing frequency.	

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

[illegible]

CATEGORY NO. 8

DATE 4-6-79

DESCRIPTION POSSIBLE DEFICIENCIES

PAGE ____ OF ____

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS

This item identifies inconsistencies in the operations performed by the test laboratory subcontractor and is considered to be possibly generic to other testing performed by this subcontractor. It is not considered generic to tests performed by Bechtel or the NDE subcontractor as is indicated by recent monitors and audits as follows:

list of audits

REMEDIAL AND CORRECTIVE ACTIONS

AN INDEPTH REVIEW OF TESTING AND TEST RESULTS IS BEING CONDUCTED BY BECHTEL WITH THEIR GEO-TECH GROUP LEADING THE INVESTIGATION. THIS INVESTIGATION WILL INCLUDE:

- BORINGS TAKEN IN AREA PLACED THROUGOUT CONSTRUCTION
- TEST PITS
- LAB TESTS ON SAMPLES FROM BORINGS AND TEST PITS
- COMPUTER ANALYSIS OF PAST TEST RESULTS
- OVERLAY PLOTS OF ALL TESTS

THIS WILL BE COMPLETED BY ______.

AN INDEPTH QA AND ENGINEERIN AUDIT OF U.S. TESTING OPERATION. COVERING TESTING AND IMPLEMENTATION OF THEIR QA PROGRA WILL BE CONDUCTED IN LATE APRIL OR EARLY MAY. THIS AUDI WILL UTILIZE GENERIC ELEMENT RESULTING FROM THE INVESTIGATION.

No. 8
ATTACHMENT

POTENTIAL ERRORS IN TEST RESULTS
(PRELIMINARY)
(REPORT TO BE ATTACHED LATER)

Described below are potential problems and errors relating to tests performed by U.S. Testing Company.

- As indicated in the chart below certain laboratory standard compaction test were used many times more than would be expected considering that lab standards should be developed approximately once for every 20 field tests - many test results were over 105% - many tests plot outside the appropriate zero air voids curve.

Soil Classification Standard	Times Referenced	% over 105%	Highest Valve %	% Outside Zero Air-Voids
RD-61	574	15	137	-
RD-24	196	9	131	-
RD-55	491	51	142	-
BMP-270	210	4	-	30
BMP-271	135	2	-	30
BMP-269	217	1	-	12
BMP-277	148	11	-	49
BMP-278	81	22	-	51

- Time span over which standards were used have been found to be as long as 24 months.

- Retesting of failing tests may have improperly used different standards with lower maximum densities and resulted in passing tests. Example: Test MD-858 originally failed at 66% compaction using lab standard RD-49 (132.4pcf), this test was cleared at 110% compaction using Lab Standard RD-41 (106.7pcf).

- Certain errors in actual calculations have been discovered (details not available).

- There is some evidence that "proctor" curves that do not represent the materials may have been selected in error by U.S. Testing technicians. Reference to:
  - Administration Building footing settlement
  - Report of test in response to Bechtal NCR 55.

BECHTEL POWER CORPORATION
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APPENDIX B

CATEGORY NO. 9

DATE 9-6-79

DESCRIPTION LACK OF SUBCONTRACTOR SOIL TEST PROCEDURES

PAGE ____ OF ____

PROGRAM REQUIREMENT	QUALITY DEFICIENCY

(1)
Specification 7220-C-208, Revs 2-15, Table 9-1 "Frequency of test procedures" establishes the following test frequencies:

- °Field Density
  Moisture Content -1/500 YDS^3
- °Compaction - 1/10,000 YDS^3

(2) Specification 7220-G-22, Rev. 1, Dated 6/22/73 is an attachment to Spec 7220-C-208 and provides for U.S. Testing's QA Program. Para 3.1 (5) requires this program to provide instructions, procedures and drawings.

(3)
E [illegible].11, Rev. 0 Sect. 4.1, states inpart "Before a purchase order is awarded, Engineering is responsible for determining if the Supplier's Quality Assurance Program is capable of meeting the specified requirements. Engineering may delegate this function.... Engineering is still ultimately responsible for determining the acceptability of the Supplier's QA Program..."

(4)
EDP 6.11, Rev. 0, Part II, Sect. 2.1, states, inpart, "Upon receipt of the Supplier's proposed quality assurance program document(s), the cognizant engineer may either evaluate the submitted program or forward it to the PSQD for review...."

Contrary to Program Requirement No:

1,2 U.S. Testing's approved QA Program Rev. ___, dated _____ does not provide procedures or instructions for testing of soils in the following areas:

- °Developing and updating the family of "proctor" curves.
- °Visual selection of the proper "proctor" curve.
- °Developing additional proctor curves for changing materials occuring between normal frequency curves.
- °Alternate methods of determining the proper laboratory maximum density where visual comparison is not adequate.

3,4 [redacted]
Project Engineering [redacted] reviews of U.S. Testing QA Manual failed to identify this lack of procedures.

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 9

DATE 4-6-79

DESCRIPTION Lack of Subcontractor Soil Test Procedures

PAGE ____ OF ____

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
The only other test subcontractor on site is the NDE subcontractor who performs all tests to the ASME and SNT codes. Audits by CPCo, Bechtel and ASME have not identified any significant deficiencies in this area.	Family of curves and selection of proctor curves will no longer be a problem as each field density test will be accompanied by a separate lab standard compaction test which will provide a direct comparison. This has been directed by a letter to U S Testing. An indepth audit of the test lab subcontractor operations will be performed by Bechtel by early May. This audit will include verificat that necessary procedures exist.

BECHTEL POWER CORPORATION
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CATEGORY NO. 10

APPENDIX B

DATE 4-6-79

SCRIPTION DUCT BANK INTERFERED WITH SETTLEMENT

PAGE ____ OF ____

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
	Contrary to Program Requirement No:
(1) EDP 4.46, Rev. 3, Section 5.1, states, in part, "The Discipline Group Supervisor is responsible, but may delegate authority to the Group Leader, for: ...e. Coordination with other disciplines and departments, including their design interfaces...."	(1-2) The coordination done failed to identify a second electrical dwg. E-42, Sht 33, Rev. 4 which showed that the duct banks were stepped (i.e, had enlarged cross-sectional area) below the openings provided in the footings.
(2) Coordination of project design drawings E-502 and C-1001, Rev. 6 and C-1002, Rev. 6 resulted in a 1 in. separation gap between the duct banks and DGB foundations to allow for differential settlement.	Four vertical duct banks were designed, and constructed in the field, without sufficient clearance and restricted the settlement of the Diesel Generator Building.

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
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APPENDIX B

CATEGORY NO. 10

DATE 4-6-79

DESCRIPTION DUCT BANK INTERFERED WITH SETTLEMENT

PAGE ____ OF ____

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
1) Coordination efforts were made which resulted in design details that provided a clearance for settlement. In addition, recognizing the variability in duct bank size and configuration, the cognizant engineers went to the jobsite, measured the duct banks, and designed the openings in the footings accordingly. At the time of this jobsite visit the duct banks were covered, up to the elevation of the bottom of the footings, by backfill and mudmat and the engineers failed to identify the enlarged cross-sectional area of the duct bank below the footing. Hence, the design did not specify a vertical gap between the bottom of the footings and the enlarged duct bank section. 2) Based on the coordination done in this case, we do not believe this error has any generic implication. also added into re: past audits	1) The openings in the footings have been enlarged to allow independent movement between the building and the duct banks. 2) Areas having duct banks penetrating vertically will be investigated to determine the effect of possible duct bank enlargement. This investigation will be done by June 1, 1979. 3) Proper remedial measures will be taken if the investigation shows potential problems.

[illegible] Design [illegible]

[illegible]

[illegible]

✓

✓ [illegible]

CPCo [illegible] ✓

[illegible] ✓

✓ GE [illegible]

DATE	WHO	LIMITS	RESULTS
[illegible]	QI	[illegible] Control [illegible]	NO Findings
[illegible]	[illegible]	[illegible]	No Findings
[illegible]	QI	Design Control [illegible] [illegible]	No Findings

3 QI Audits - No Findings

[illegible]

CE-127 1-9 to 2-78 [illegible]

CE-1117 5-9 to 12-78 [illegible] No findings

CE-128 2-7 to 10-78 [illegible] Support [illegible] No [illegible] Report

CE-118 2-26 to 10-78 [illegible] Support [illegible] No [illegible]

2 [illegible]

No findings

[illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible]

[illegible]

[illegible] 19 [illegible]

[illegible] [illegible] [illegible]

No sign of any [illegible] area.

[illegible]

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
QA PROGRAM

APPENDIX B

CATEGORY NO. 11

DATE 4-6-79

DESCRIPTION CORRECTIVE ACTION NOT TIMELY

PAGE ___ OF ___

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
(1) ANSI N45.2-1977, Section 17 - "Corrective Action" states, inpart, "Measures shall be established and documented to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective materials and equipment, and nonconformances, are promptly identified and corrected as soon as practicable.:	Contrary to Program Requirement No: 1. Bechtel NCR No. 1004 was issued on 10-26-77 and identified failing compacti tests that were taken in 1976 and not previously identified. 1. On 1/13/78 Project Engineering issued IOM BEBC-2045 requesting the field to take test borings to aid in evaluating the conditions identified in the NCR. These areas included material under the Diesel Generator Building. The borings had not been done when the unusua settlement of the Diesel Gen. Bldg was first noted on 7-22-78.

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CATEGORY NO. 11

DATE 4-6-79

SCRIPTION Corrective Action Not Timely

PAGE ____ OF ____

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS

Timely identification of nonconformances is the subject of CPCo Quality Finding, QF-199.

Due to the level of the backfill, to take the borings requested by Project Engineering would have required backfilling or a ramp and subsequent re-excavation to resume construction. This was not practicable and the field requested that the borings be delayed until the areas were completed.

REMEDIAL AND CORRECTIVE ACTIONS

Each open CPCo and Bechtel NCR, QAR, or Audit Finding will be reviewed to identify the need for additional action for timely closeout. This review will be done by ________________. If the results of this review indicate a need for further correctiv actions such as programatic changes, appropriate action will be taken by ________________.

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
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APPENDIX ________

CATEGORY NO. 12

DATE 4-6-79

CRIPTION ________

PAGE ____ OF ____

PROGRAM REQUIREMENT

(1)
SF/PSP G-3.2, Rev. 4, Job 7220, Para. 5.2.1 states - "NCRs which show evidence that Construction Quality Control committed an error in the implementation of the QC Program shall be transmitted by the PFQCE to the responsible Lead Discipline Quality Control Engineer for action to prevent recurrence of the error.

(2)
Quality Assurance Department Procedure No. C-101, Rev. 1, Para. 1.0 states in part: "This procedure provides a mechanism for identifying quality trends, and initiating corrective action to prevent recurrence...."

QUALITY DEFICIENCY

Contrary to Program Requirement No:

1, 2 From 1974 on, there have been numerous nonconformances in the area of soils operations written that identify:

- °Failure to perform inspections on structural backfill.
- °Moisture content out of spec and not identified and corrected.
- °Compaction tests not calculated correctl
- °Lift thickness exceeded.
- °Gradation requirements not met.
- °Compaction tests failed but not identified and corrected.

These NCRs include but are not limited to: QF-29; QF-52; QF-68; NCR 421; QF-120; QF-130; QF-147; QF-172; QF-174; QF-199; QF-203; Audit Findings F-77-21 and F-77-32; NCR 686; NCR 698; NCR 1005.

The Corrective Actions taken in response to the Bechtel QC and QA Program requirements do not appear to have been effective in preventing repetative problems in the area of soils.

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
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APPENDIX ______

CATEGORY NO. 12

DATE 4-6-79

DESCRIPTION ______

PAGE ______ OF ______

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS

S,r

CPCO AND BECHTEL BOTH IMPLEMENT TREND PROGRAMS TO ASSIST IN THE DETERMINATION OF WHERE ADDITION CORRECTIVE ACTIONS MAY BE NEEDED TO PRECLUDE REPETITION OF REPETATIVE PROBLEMS. THE REPETITIVE PROBLEMS WITH SOILS OPERATIONS WERE INCLUDED IN THIS PROGRAM BUT THE INDEVIDUALS RESPONSIBLE FOR REVIEW OF THE TREND PROGRAM OUTPUTS FAILED TO IDENTIFY THE NEED FOR CORRECTIVE ACTIONS IN ADDITION TO THOSE ALREADY TAKEN.

THIS ITEM COULD BE GENERIC TO OTHER AREAS WHERE REPETATIVE NON-CONFORMANCES HAVE OCCURRED.

REMEDIAL AND CORRECTIVE ACTIONS

AN INDEPTH REVIEW OF THE BECHTEL TREND PROGRAM WILL BE UNDERTAKEN BY BECHTEL QA MANAGEMENT TO ASSURE THERE ARE NO OTHER SIMULAR AREAS THAT HAVE BEEN OVERLOOKED IN PAST REVIE THIS WILL BE COMPLETED BY ______

IF THE RESULTS OF THIS REVIE INDECATE A NEED FOR ADDITIO AL CORRECTIVE ACTIONS THESE WILL BE TAKEN IN ~~RESPONSE~~ AS REQUIRED BY THE EXISTING PROGRAM.

AN INDEPTH TRAINING SESSION WILL BE GIVEN TO ALL MIDLAND QA ENGINEERS (BECHTEL) BY BECHT QA STAFF COVERING THE SETTLEMENT PROBLEM AND METHODS TO IDENTIFY SIMULAR CONDITI IN THE FUTURE. THIS WILL BE COMPLETED BY ______.

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
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APPENDIX .B

CATEGORY NO. 13

DATE 4-6-79

SCRIPTION AUDITS LACKED SUFFICIENT DEPTH

PAGE ____ OF ____

PROGRAM REQUIREMENT	QUALITY DEFICIENCY
	Contrary to Program Requirement No:
(1) NQAM Section VI, No 1, Rev 4-B Para. 1.0 states in part "This policy establishes a system for the conduct of quality audits to verify implementation and assess the effectiveness of the Quality Assurance Program...."	1: The Bechtel Quality Assurance Audit and Monitor Program as written and implemente for Job 7220 fialed to identify certain problems relating to soils and the Diesel Generator Building Settlement Problem. These problems include: •PSAR requirements not reflected in specifications •Engineer calculation errors •Conflicts in specification 7220-C-210 •Required compaction not obtained •Testing errors •Lack of testing procedures •Inadequate inspection •Conflicts in the FSAR. This lack of identification of problems by the audit program resulted in a conclusion that Soils Operations were adequately controlled.

BECHTEL POWER CORPORATION
PLANT FILL AND STRUCTURAL BACKFILL
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APPENDIX B

CATEGORY NO. 13

DATE 4-6-79

DESCRIPTION Audits Lacked Sufficient Depth

PAGE ____ OF ____

DISCUSSION OF PROBLEM LIMITS AND GENERIC IMPLICATIONS	REMEDIAL AND CORRECTIVE ACTIONS
This item is considered to have possible generic implications in other areas even though it is recognized that a audit program only samples completed work.	An indepth training session will be given to all Bechtel QA Auditors assigned to the Midland job which will cover the settlemen problem and methods to identify similar conditions in the future. This will be completed by__________.

K

5-10-79

STAN / JIM

1. Attached is my evaluation of UST Co. tests.

2. Plots ref. in item 8. are being updated by AA soils. Tom Nehil.

3. An evaluation of what the specs say compared to what is called "Prudent Soils Engineering" will follow later this afternoon or tomorrow morning.

4. Please advise ASAP of NRC meeting date next week. Karl Wiedner wanted me to come.

5. Karl wanted to see the above info.

J. H. Allen

9Ha
BHM

DRAFT

REVIEW OF U.S. TESTING COMPANY
FIELD AND LABORATORY CONSTRUCTION
TEST DATA ON SOILS USED AS FILL

This in-depth review was made as a result of settlement of the diesel generator building in excess of that predicted. Soil samples indicated soil conditions not compatible with good quality fill. All fill was judged as it was being placed by the results of the field tests performed by U.S. Testing Company.

The review showed a large number of discrepancies as outlined in the following paragraphs. Review comments are based on the technical specifications and subcontract documents agreed to by U.S. Testing Company. Prudent soils engineering and soils testing judgement was assumed based on personnel resumes and previous documented work experience of U.S. Testing Company.

11. <u>Overuse of laboratory test compaction curves</u>. Table 9-1 of Specification 7220-C-208, page 14B, indicates one field density and moisture content test be taken per every 500 cubic yards of fill placed. It also indicates one compaction, grain size, and specific gravity per every 10,000 cubic yards of material. This gives a ratio of 20 field density tests to 1 lab compaction test. This requirement was not followed by U.S. Testing Company. Records show that some laboratory compaction curves were used several hundred times over a period exceeding two years.

SB 1S304

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OHa
Stm

agreement

though no time requirements on use of lab tests is specified, prudent knowledge of soils testing and variability of soils from large borrow sources would preclude such extended use.

2. Occasional use of different compaction tests to clear a failing field test. A field test that fails to meet standards dictated by the selected laboratory test data must normally be cleared by another field test in the same area on the same type of soil compacted to the same laboratory data. In some cases, laboratory data were used to clear failing tests that were classified failed by different data.

3. Test Results plot above zero air voids line on compaction data plots. For a given soil at a given specific gravity, it is impossible for a test result (defined by moisture content and density) to plot above the zero air voids curve. There are numerous cases when this supposedly happened. If some of these points are translated into a specific gravity (assuming slightly less than 100% saturation) impossibly high values result indicating something is wrong with the data.

4. Some points indicate extremely high compaction effort. Specifications call for a field compactive effort of 20,000 ft-lbs. Laboratory test curves must be related to the same effort for use in comparing with field tests. According to plots of field data

BAM

points, other field compactive effort ranged from less than 10,000 ft-lbs to over 60,000 ft-lbs of effort or field test data is wrong in many cases. It is noted that 100% of modified Proctor (ASTM D 1557) which is extremely difficult to obtain is rated at 56,000 ft-lbs of effort. Therefore, it is highly doubtful that 60,000 ft-lbs of effort was actually obtained. For comparative purposes, it was determined by testing (performed by Bechtel on a representative site soil sample) that 100% of specified effort (20,000 ft-lbs) is approximately equal to 94% of the maximum density as determined by ASTM D 1557 (56,000 ft-lbs effort).

5. Calculation Errors on field data sheets. Arithmetic errors are noted on some field data sheets that were not corrected. There is a signature at the bottom of the data sheets indicating that the data and calculations had been checked.

6. Repeated use of questionable laboratory test data. Some laboratory compaction test data were used repeatedly even though the field tests compared to them failed repeatedly. In one case, the first 15 field tests compared with the same lab test failed. Prudent soil mechanics knowledge would call suspision to this.

7. Retests too far from original tests. In some cases, retests to clear a failed test were not taken in the same area. Either

test location coordinates were incorrectly listed on some data sheets or some retests were over 20 feet from the failed test location. There is also a probabl~~y~~e error in recording dates for testing or retesting since one retest was dated 3 weeks prior to the time the original test failed.

8. <u>Limits of accuracy for laboratory data</u>. Specified compactive effort was 20,000 ft-lbs. This establishes a compaction curve relating moisture and density for a specific soil. Moisture was specified for field placed fill to be within ±2% of optimum moisture as determined by this effort. Density was specified to be greater than 95%6of the maximum density as determined by this effort. Prudent soils knowledge also indicates values over about 5% greater than this effort should be suspect. Once compactive effort becomes significantly higher than 20,000 ft-lbs or indicated density greater than about 105% of maximum, the labo laboratory test data may no longer be acceptable for comparison with field data. As compaction effort is increased, maximum density is increased and optimum moisture content decreases. The shape of the compaction curve changes with a corresponding change in range of acceptable moisture content relative to optimum. A +2% numerical value of moisture content acceptable at the specified compactive effort would be too wet at a higher effort and at very high densities may show anaapparent location to the right of the air voids curve. The basic error described here was apparently overlooked by U.S. Testing Company. Plots of selected laboratory

[illegible]
CAM

compaction test data with assigned field test results are given at the end of the text. A window of acceptability is shown for each laboratory test. The above discussion becomes readily apparent.

Troxler

9. Accuracy of test equipment. Calibration data for the ~~Drexler~~ Troxler Nuclear Density device indicates a range of accuracy of ±4%. Such a large variation should be verified as it could have impact on test results that were marginally acceptable.

10. Relative density versus Proctor type compaction curve. Cases were noted where material classified on the data sheet as zone 3 (sand) was compared to the proctor type test and other cases where clay soils were compared to relative density tests. An error exists either in listing the wrong type soil on the data sheet or in comparing field test results to the wrong laboratory test data.

In summary, referring to the attached data plots, only about 25% of the field test results fall in the zone strictly defined by the specifications and prudent knowledge of soil mechanics. About 40% of the data falls in a zone considered possible for the given soil as defined by an obtainable compactive effort of 100% of ASTM D 1557. Based on the shotgun scatter of data shown on the plots, even the laws of probability indicate this much data would fall into the acceptable window.

~~[illegible]~~

~~were noted~~

~~10. Relative density versus [illegible] type~~

Since no reliable conclusions can be drawn to clearly define good data from bad data, all points are suspect and, therefore, all of the thousands of data points determined by U.S. Testing should be discarded as totally unreliable.

tabs 4-38-43-6

(9)

MIDLAND NUCLEAR PLANT

JOB 7220-101

SPECIFICATION & SUBCONTRACT REQUIREMENTS

AND

ENGINEERING PRUDENCE

This is a comparison of what the documents call for in black and white as compared to good prudent soils engineering. Documents referred to are listed below:

Specification 7220-C-208
Specification 7220-C-210
Subcontract 7220-C-208
Specification 7220-C-211
Specification 7220-C- 22

Document	Prudent Practice
Subcontract 7220-C-208	
1. No. 24, page 7 of 15, states that the Subcontractor shall be responsible for his work and for any damages caused by him.	1. No explanation required.
2. No. 25, page 8 of 15, states that during performance of work or final inspection or during the warranty period, Subcontractor shall correct any defects caused by him.	2. No explanation required.

MIDLAND NUCLEAR PLANT

JOB 7220-101

SPECIFICATION & SUBCONTRACT REQUIREMENTS

AND

ENGINEERING PRUDENCE

This is a comparison of what the documents call for in black and white as compared to good prudent soils engineering. Documents referred to are listed below:

Specification 7220-C-208
Specification 7220-C-210
Subcontract 7220-C-208
Specification 7220-C-211
Specification 7220-C- 22

Document	Prudent Practice
Subcontract 7220-C-208	
1. No. 24, page 7 of 15, states that the Subcontractor shall be responsible for his work and for any damages caused by him.	1. No explanation required.
2. No. 25, page 8 of 15, states that during performance of work or final inspection or during the warranty period, Subcontractor shall correct any defects caused by him.	2. No explanation required.

(B)

Document	Prudent Practice
Subcontract 7220-C-208, Con'd	
3. No. 40, page 13 of 15 states that Contractor can terminate Subcontractor for default. Lack of properly skilled workmen is considered default.	3. Properly skilled workmen would have recognized bad test results.
4. No. 42, page 14 of 15, states that final acceptance by Contractor is subject to inspection and tests proving work was done in accordance with requirements.	4. No explanation required.
5. No. 45, page 14 of 15 discusses payments to Subcontractor on successful completion of work. Subcontractor is responsible for defaults.	5. All retesting and exploration is due to faulty testing by U.S. Testing; therefore, they should pay for it.
6. Exhibit C, page 17 of 47. The last sentence of the first paragraph states: "Our Company's responsibility to the Utility is to provide them with data to allow them to accept or reject specific construction materials."	6. U.S. Testing Company position as stated by themselves.

6. U.S. Testing Company position

as stated by themselves.

construction materials."

construction materials."

"construction materials."

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Document	Prudent Practice
Subcontract 7220-C-208, Con't	
7. Exhibit C, page 17 of 47. No. 2 states, "You are to <u>immediately</u> report data that indicates material that does not comply to specifications or procedures."	7. This recognizes U.S. Testing Co. responsibility of having personnel competent to judge acceptability of test data results.
8. Exhibit C, page 20 of 47. Item F states: "Immediately inform the designated Quality Control Engineer of any specification violation or failure in test results. Such notification must be indicated on the appropriate daily report."	8. See Note 7 above.
9. Exhibit C, page 21 of 47. The <u>Note</u> states that U.S. Testing is to provide inspection and test data to the QC staff.	9. No explanation is required.
10. Exhibit C, page 26 of 47. Soils inspection and testing as understood by U.S. Testing is outlined here.	10. U.S. Testing did not do what they said they would do. Refer to items B, C, D, E, F, and <u>Note</u> on page 27 of 47.

Document	PrBdedanPr8catcece
Subcontract 7220-C-208, Con't	
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9. Exhibit C, page 21 of 47. The <u>Note</u> states that U.S. Testing is to provide inspection and test data to the QC staff.	9. No explanation is required.
10. Exhibit C, page 26 of 47. Soils inspection and testing as understood by U.S. Testing is outlined here.	10. U.S. Testing did not do what they said they would do. Refer to items B, C, D, E, F, and <u>Note</u> on pages22 of 47.

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Document	Prudent Practice
Subcontract 7220-C-208, Con't	
11. Exhibit C, Page 29 of 47. Item E quotes wrong ASTM designations for referencing laboratory tests.	11. ASTM D 698 at 12,400 ft-lbs effort is referenced rather than 20,000 as specified.
Spec 7220-C-208	
12. Sec. 9.1, page 14. When directed by Contractor, ASTM D 1557 is to be modified to 20,000 ft-lbs effort.	12. Do we have records that we directed U.S. Testing to do this?
13. Table 9-1. This table specified test frequency relative to cubic yards of fill placed.	13. Subcontractor should take initiative in determining amount of fill placed so as to determine when to run a new compaction test. However, responsibility should be shared with Bechtel/Client QC to provide this data to Subcontractor.

Document	Prudent Practice
Subcontract 7220-C-208, Con't	
11. Exhibit C, Page 29 of 47. Item E quotes wrong ASTM designations for referencing laboratory tests.	11. ASTM D 698 at 12,400 ft-lbs effort is referenced rather than 20,000 as specified.
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12. Spec 7220-C-208	
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13. Table 9-1. This table specified test frequency relat relative to cubic yards of fill placed.	13. Subcontractor should take initiative in determining amount of fill placed so as to determine when to run a new compaction test. However, responsibility should be shared with Bechtel/Client QC to provide this data to Subcontractor.
14......	
Spec 7220-G-22	
14. Sec. 4.1, page 2. Review by the Contractor does not relieve the Subcontractor of any of his contractual responsibilities.	

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Document	Prudent Practice
Spec 7220-G-22	
14. Sec. 4.1, page 2. Review by the Contractor does not relieve the Subcontractor of any of his contractual responsibilities.	14. No explanation required.
Spec 7220-C-210	
15. Sec. 12.6, page 50. Moisture content is specified as 2% above or below optimum.	15. Spec refers only to ±2% from optimum, not to optimum as defined by ASTM D 1557, ASTM D 698, or 20,000 ft-lbs effort. Also, a prudent soils lab technician knows that optimum changes with changing effort.
16. Sec. 13.7, page 57. Refers to compaction equal to 95% of ASTM D 1557 for cohesive soils and relative density of 80% for granular material.	16. Does section 9 of Spec 7220-C-208 modify section 13.7.1 of Spec 7220-C-210? It appears to do so.
17. Sec. 12.4.4.2, paragraph 2, page 43. Nuclear device may be used provided results are compatible with those obtained by the specified procedure.	17. A statement of ±4% deviation on the Troxler equipment seems to preclude compatibility of this device with conventional tests.

Document	Prudent Practice
Spec 7220-G-22	
14. Sec. 411, page 2. Review by the Contractor does not relieve the Subcontractor of any of his contractual responsibilities.	14. No explanation required.
15.	
Spec 7220-C-210	
15. Sec. 12.6, page 50. Moisture content is specified as 2% above or below optimum.	15. Spec refers only to ±2% from optimum, not to optimum as defined by ASTM D 1557, ASTM D 698, or 20,000 ft-lbs effort. Also,aa prudent soils lab technician knows that optimum changes with changing effort.
16. Sec. 13.7, page 57. Refers to compaction equal to 95% of ASTM D 1557 for cohesive soils and relative density of 80% for granular granular material.	16. Does section 9 of Spec 7220-C-208 modify Section 13.7.1 of Spec 7220-C-210? It appears to do so.
17. Sec. 12.4.4.2, paragraph 2, page 43. Nuclear device may be used provided results are compatible with those obtained by the specified procedure.	17. A statement of ±4% deviation on the Trexler equipment seems to preclude compatibility of this device with conventional tests.

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	Document		Prudent Practice
	Spec 7220-G-~~22~~ 210		
18.	Sec. 12.4.5.1, page 43. This section tells in detail how to determine maximum density and optimum moisture content.	18.	Prudent soils technicians know ~~this~~ optimum moisture content is not a vertical line but that optimum moisture varies with density.
19.	Section 12.6.1, page 50. Spec states minimum density but not a maximum.	19.	Prudent soils engineers or technicians would realize that densities above 100% of that specified would have a lower numerical value of optimum moisture content. Also, any values above about 105% should be suspect.

Document	Prudent Practice
18. Sec. 12.4.5.1, page 43. This section tells in detail how to detemmine maximum density and optimum moisture content.	18. Prudent soils technicians know this is not a vertical line but that optimum moisture varies with density.
19. Section 12.6.1, page 50. Spec states minimum density but not a maximum.	19. Prudent soils engineers or technicians would realize that densities above 100% of that specified would have a lower numerical value of optimum moisture content.

Document	Prudent Practice
18. Sec. 12.4.5.1, page 43. This	

Document	Prudent Practice
Spec 7220-G-22	
18. Sec. 12.4.5.1, page 43. This	

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Question 362.2 ([illegible].5.4.5.1)

Question 1 and the resulting discussion on Page 8.00-1 included in Amendment Number 3 to your PSAR stated that all natural sands with relative densities less than 75% would be removed beneath all Class I structures and beneath non-Class 1 structures so sited that their failure could endanger the adjacent Class 1 structures. Discuss the methods employed in mapping and removing the sands having less than 75% relative density. Provide plan and sectional figures showing the areas where these materials were removed. Figure A9-2 of the PSAR which displays subsurface profiles of Class I piping should be updated to show removal of sands of less than 75% relative density and be presented in the FSAR. Figure 2.5-21 of the FSAR shows loose sands beneath the Class I tanks although they were to have been removed. Explain this inconsistency, and provide proper documentation of as-built conditions.

Responses

In 1970, 61 soil borings were made at the possible locations of Category I structures and systems to investigate loose surficial sands. These were shallow depth borings with depths ranging from 9 to 40 feet. The borings were designated D-1 through D-60 and are included in Appendix 2A. The locations of the borings are shown on FSAR Figure 2.5-17.

It is seen from Figure 2.5-42 that standard penetration blowcount values of 10 to [illegible] blows per foot are required at depths from zero to 15 feet for a relative density of 75%. Examination of Table 2.5-25 and the boring logs shows the D-borings had the blowcounts necessary for relative densities in excess of 75%. Standard penetration blowcounts were recorded at various depths in these borings. Blowcount values were in excess of 20 blows per foot with one exception. Borehole D-48 (refer to Table 2.5-25) indicated one blowcount of five at an elevation approximately 595 feet. However, borehole D-48A, located 5 feet away from D-48, showed a minimum blowcount of 20 at approximately 600 feet elevation.

Shortly after the D-borings were completed, project activities were postponed from 1970 to 1973 because soil borings under one of the Category I tanks were not made until 1978. The subsurface profile shown in Figure 2.5-21, Rev 1 (January 3, 1979), indicated the possible existence of loose sands. /?

During 1978, numerous soil borings were made in the tank farm area and elsewhere in the plant area. These borings are designated [illegible], C, H_T, L_N, [illegible], D, D_G, Q, and [illegible], and their locations are included in Figure 2.5-17. The boring logs are included in Appendix 2A.

The plant area now consists of man-made fill ranging from 25 to 35 feet high. Under this condition, standard penetration blowcount values of 20 to 25 blows per foot are required(1) for a relative density of 75% at depths between 25 to 35 feet as can be seen from Figure 2.5-42. The T-borings in the tank farm area register blowcounts more than the minimum for a relative density of 75% (refer to Table 2.5-25). Therefore, the sands can be classified as moderately dense to dense. Based on this, the subsurface profile, Figure 2.5-21, has been revised excluding the possible existence of loose sands. 18

A few borings elsewhere in the plant area, namely DG-7, DG-28, and CT-1, indicate blowcounts of 9 to 17 blows per foot at elevations of 599 to 604 feet. These are isolated lenses and will not endanger the integrity of Category I structures.

Based on the facts discussed above, it is concluded that the surficial sands existing in the plant area have relative densities greater than 75%.

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(1) H.J. Gibbs and W.G. Holtz, "Research on Determining the Density of Sands by Spoon Penetration Testing," Proceedings-Fourth International Conference on Soil Mechanics and Foundation Engineering, Vol I (1957), London, England, pp 35-39 15

<u>Question 362.1</u> (2.5.4.5.3)

Provide a summary of the results of field density tests for compaction and moisture control of structural fill beneath and adjacent to Category I structures. 8

<u>Response</u>

Subsection 2.5.4.5.3 has been revised in response to this question.

density/moisture results in this Section are not valid based on investigation results.

Question 362.9 (2.5.4)

The response to Request 362.4 is insufficient. Table 2.5-14A shows the structural settlement measurements available to date. Provide the reasons for the lack of survey data at Benchmark Numbers A-3 and 4; C-2, 3, 4, 5, 6, and 7; and T-2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, and 15. In Subsection 2.5.4.13.1 of the FSAR, reference is made to Figure 2.5-78. The figure number is in error and should be corrected. 14

Response

Table 2.5-14A has been revised to include the settlement measurements for the subject benchmark numbers.

Subsection 2.5.4.13.1 has been revised to reference the correct figure.

Settlement benchmarks have been installed and monitored at selected locations on the major plant structures. Benchmark locations are shown in Figure 2.5-48A. Benchmark elevation measurements are presented in Table 2.5-14A.

Measured settlements were not measured from the start of construction. Available settlement measurements are presented graphically in Figures 2.5-89 through 2.5-91 for the reactor, auxiliary, and turbine buildings. Building load intensities estimated from actual material quantities used in construction are also shown in Figures 2.5-89 through 2.5-91. 18

Examination of measured settlements indicates they are small and relatively uniform. Settlement measurements will be continued and provided. Settlement measurements will be compared with predicted settlements based on available load-settlement behavior for the reactor buildings and will be presented in the April 1979 amendment. This comparison cannot be made for the auxiliary and turbine buildings because only limited load-settlement data are available.

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Responses to NRC Questions
Midland 1&2

Question 362.11 (2.5)

The March 15, 1969, report by Dames & Moore for foundation investigation and preliminary exploration for borrow materials which is included in your PSAR provided final foundation design criteria, including:

> "d) Recommended foundation type and estimated total settlement for the auxiliary building which is located between the two reactor buildings. Its structure and foundation will be separate from those of the adjacent three buildings to allow for possible differential settlement which must not exceed 3/4 inch." (Emphasis added) 1

The June 29, 1968, report by Dames & Moore on this same subject also states their understanding that the maximum allowable differential settlement between the radwaste building and the adjacent reactor containment building is 3/4 inch.

Provide documentation that this maximum differential settlement between buildings has not and will not be exceeded throughout plant life.

Response

Allowable differential settlements referenced from Dames & Moore reports dated June 28, 1968, and March 15, 1969, refer to settlements between the reactor containments and the auxiliary building.

Settlement of these structures has not been monitored since the start of construction. Settlement benchmarks were installed at locations shown in Figure 2.5-48A. Available settlement data and estimated building loads for the reactor containments and the auxiliary building are shown in Figures 2.5-89 through 2.5-91. Applied loads were estimated from material quantities used in construction. 1

Examination of measured settlements for these structures indicates that differential settlements are small and relatively uniform. An evaluation is being made to determine when interconnections were made to allow determination of the amount of differential settlement occurring since that date. This information will be provided by amendment in April 1979. Further settlement analyses considering ultimate building loads, loads from adjacent structures, and the construction sequence will be made to provide estimates of differential settlements. Settlement measurements will also be continued during and after application of final loads.

Question 362.12 (2.5.4)

Describe your preloading program which is planned to further consolidate backfill material underneath the Diesel Generator Building. Include your schedule for these activities. 17

Response

The diesel generator building is founded on 25 feet of backfill material (el 603 to 628 feet) as described in FSAR Section 2.5. In July 1978, the settlement of the diesel generator building exceeded the anticipated values shown in FSAR Figure 2.5-48. Independent consultants, Dr. R. Peck of Albuquerque, New Mexico, and Dr. A. Hendron, Jr. of the University of Illinois, have been retained to evaluate the problem.

A preloading program recommended by Dr. Peck and Dr. Hendron was chosen to consolidate the soil under the diesel generator building. The preload program accelerates the soil consolidation process so that the major part of the settlement occurs when it can be evaluated. Additional recommendations made by the consultants include:

1. Raising the site groundwater table by filling the cooling pond to its maximum operating level
2. Completing the construction of the diesel generator building to maximize the soil pressure 18

The preloading program includes filling the interior of the diesel generator building and the surrounding area with uncompacted pit run granular materials. A system of soil instruments recommended by the consultants is installed to measure the effects of the preload. The types of soil instruments are recommended by Goldberg-Zoino-Dunnicliff & Associates, Inc. and installed under the direction of C.J. Dunnicliff.

The depth of preload recommended is 15 to 20 feet. The preload covers the interior of the diesel generator building and an area 20 feet outside the diesel generator east, west, and south walls. The preload on the north side is retained by temporary retaining forms because the turbine building is located on the north side of the diesel generator building. The material quantities and in situ densities are measured to estimate applied loads. The preload sequence is dictated by the turbine building wall reinforcement and the requirement to gather data from the soil instrumentation. The preload sequence includes an initial hold at a 10 foot depth to obtain any soil data followed by 5 foot lifts to obtain additional data.

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Activities performed prior to placement of preload material are as follows:

1. Isolation of the structure from settlement restraints
2. Reinforcement of the turbine building basement wall
3. Baseline survey of selected underground utilities
4. Installation of the soil instrumentation system

Each of the above activities is discussed in detail in the following paragraphs.

1. The restraints preventing the diesel generator building from settling with the fill material are four electrical duct banks. The duct banks extend vertically through the footing and plant fill down to undisturbed material at el 593'-0". As a result, the duct banks transferred appreciable building weight to the natural soil and prevented the structure from following the settlements associated with the fill material. The area near the duct bank was excavated to expose the extent of support. The duct banks are chipped back to below the footing for a height of 12 inches and to a size less than the opening in the footing. The ducts are wrapped with resilient material to a size 2 inches larger than the duct. The excavated area under the footings is backfilled with lean concrete. 18

2. Because of the close proximity of the turbine building, temporary reinforcement of the basement wall is required to support the additional lateral earth pressure from the preload. The reinforcement consists of a system of tie rods to the diesel generator building, shimming to existing structures, adding structural steel bracing, buttresses, and composite concrete reinforcement inside of the turbine building.

3. Selected utilities are profiled using a pressure registering device to provide a base survey to compare with a profile to be taken after removal of preload. The profiling device and profile measurements are made by Goldberg-Zoino-Dunnicliff & Associates, Inc. under the guidance of C.J. Dunnicliff.

   The soil instrumentation installed consists of piezometers, settlement platforms, and Borros anchors at selected locations and elevations within and around the diesel generator building. The soil instrumentation is monitored at frequencies appropriate to the rate of settlement and dissipation of pore water pressure. The instruments are expected to be monitored at daily intervals during preload placement and for one more week thereafter and at weekly intervals during static conditions.

The schedule to complete the activities described is as follows:

The soil boring program, placement of the soil instrumentation, and removing settlement restraints have been completed.

The turbine building reinforcements, the pond filling, and construction of the structure are in progress now. 18

The placement of the first 10 feet of preload directly north and south of the building plus within will be completed in March 1979. The preload is estimated to be removed within 6 months.

When the diesel generator building settlement evaluation is completed, the results will be included in the FSAR. It is presently estimated that the details of the preload evaluation will be included in the July 1979 amendment of the FSAR.

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Question 362.13 (2.5.4)

Provide your program for reassessing the properties of the backfill materials after completion of the preloading program of request 362-12. This program should differentiate between:

1. Areas affected by the vertical conduits in the Diesel Generator Building area, and 17
2. Areas not affected by the conduits.

Also, provide your program for confirming the dynamic characteristics of the fill materials used in seismic analyses of supported structures. Include your schedule for this program.

Response

Backfill material properties in the diesel building area will be assessed based on the settlement, pore water pressure, and rebound results obtained from the preloading program described in the response to FSAR Question 362.12. Preloading will involve loading the foundation soils in excess of the final building loads.

With respect to the areas being affected by vertical conduits, they have been separated from the building as discussed in the response to FSAR Question 362.12. Where possible, results of monitoring the building and instrumentation will be reviewed to evaluate the effects, if any, of the vertical conduits.

Compressibility of the backfill materials will be estimated from settlements of the building and underlying soils measured during preloading. Measurements will be made on the building, and Borros anchor settlement rods and settlement plates will be installed at selected locations and elevations throughout the backfill. Post-preload ultimate settlements and time settlement behavior will be estimated from load settlement responses obtained during preloading, taking into account the final building loads being lower than those experienced during preloading. Shear strength of the backfill materials will be assessed considering both frictional and cohesive strength properties. To aid in this assessment, laboratory consolidated, undrained triaxial tests accounting for stress history effects will be conducted on samples taken before preloading. The consolidation stage of these tests will be designed to simulate field conditions experienced through removal of the preload. 18

Dynamic characteristics of the backfill materials will be reassessed from moduli obtained from rebound measurements because stress behavior of the soils measured during rebound will be at strain levels comparable to those experienced during dynamic loading.

Estimations of post-preload settlements will be made based on settlement versus time behavior obtained during preloading. A sequence of the preload program is discussed in the response to FSAR Question 362.12. 18

Question 361.7 (2.5)

You have not responded fully to Question 361.5. Provide a comparative quantitative analysis of the seismicity within 200 miles of the site and other similar sized areas in the Central Stable Region. The purpose of this analysis is to permit a more detailed evaluation of your contention that the Michigan Basin should be considered separate from the Central Stable Region. 18

Response

A comparative, quantitative analysis of the seismicity within 200 miles of the Midland site and other similar size areas in the Central Stable Region will be conducted. The results of this analysis will be provided ~~in the April~~ 1979 amendment.

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Question 362.14 (2.5.4.10.3)

In the light of the large settlements of the plant area fill that has occurred and the fact that the unconstructed portion of the service water intake structure is intended to be founded in the plant area fill, what measures will be taken to avoid the possibility of excessive settlements of this structure?

Response

A review of measured settlements after application of 95% of the building loads shows that settlements of the service water intake structure have been small and relatively uniform. Settlement benchmark locations and measured settlements are provided in the answer to NRC Question 362.11. Settlement measurements will be continued. 18

A review of field records will be made to determine the types of backfill, its configuration, and properties indicated by density tests to further evaluate the possibility of future settlements. This information will be submitted by amendment in June 1979.

open

Question 362.15 (2.5.4.5)

Provide a detailed list of changes that have occurred in the compaction control specifications. Begin with what is specified in the PSAR and proceed to those specifications that are applicable at present, giving the dates and justification for all changes. Include in the listing any changes in types of fill material required for different areas, methods of compaction control, required degree of compaction, allowable moisture content variations, and lift thickness.

Response

Earthwork operations began in June 1969. Technical Specification 7220-C-10 was initiated in April 1969. This specification was primarily used for excavation of plant structures and for constructing cooling pond dikes. The earthwork operations were discontinued during the latter part of 1970 because the project was shut down.

The project was reactivated in 1973. Technical Specification 7220-C-210 was initiated and Technical Specification 7220-C-10 18 was superseded to cover earthwork for plant area fill as well as cooling pond dikes. Technical Specification 7220-C-211 was originated to cover the structural backfill which is to be performed in areas not accessible to motorized rollers. Several changes to these specifications were made at various stages of the project. The changes in the specifications with justifications are listed in Tables Q&R 2.5-1, 2.5-2, and 2.5-3.

A comparison between PSAR (Dames & Moore recommendations) and the specification applicable at present (7220-C-210) has been made and is included in Table Q&R 2.5-4. Earthwork in areas not accessible to motorized rollers and criteria for structural backfill is not discussed in the PSAR.

Tables Q&R 2.5-1 through 2.5-4 address the areas such as foundation preparation, materials, freeze protection, lift thickness, moisture control, compaction, slopes, and supervision. Editorial, administrative, and other changes not pertaining to earthwork are not addressed.

Question 362.16 (2.5.4)

Provide a copy of the Midland settlement study by P.K. Chen entitled "Settlement Evaluation for Plant Area."

Response

The Midland settlement study entitled Settlement Evaluation for Plant Areas is a Bechtel engineering calculation. A summary of this settlement study, including the parameters used to establish the analytical model, the methods of analysis, and a discussion of the results, is provided in FSAR Subsection 2.5.4.10.3. If additional information or detail is required, a meeting can be scheduled and the full calculation made available for review and discussion. 18

A revised settlement analysis is in progress and will consider the following as-built conditions:

1. The foundation elevation and type for diesel generator building
2. The compressibility coefficient ($C_c/1+e_o$) of the plant area fill based on borings, laboratory tests, and monitoring results of the diesel generator building
3. Final reactor containment building loads

The revised analysis is scheduled for completion in July 1979.

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Question 362.17 (2.5.4.10.3)

It is our understanding that the estimated settlement values for the diesel generator building shown in Figure 2.5-48 are based on the building having a mat foundation. If this is so, provide settlement calculations and ultimate settlement values based on the design foundation configuration as presented in section 3.8.5.1.3 of the FSAR.

Response

*

The estimated ultimate settlement values indicated on Table 2.5-48 were based originally on the diesel generator building having a mat foundation. A comparison of the induced vertical stresses versus depth between a mat foundation with uniform load intensity and the present design of the diesel generator building at various locations will be made by amendment in March 1979. 18

Because of the variable soil conditions under the diesel generator building, the predicted ultimate settlement will be based on the measured values which will be obtained from the ongoing monitoring program. ← July 79

open

TABLE Q&R 2.5-1

CHANGES IN COMPACTION CONTROL SPECIFICATION, TECHNICAL SPECIFICATION C-10

Rev No.	Date	Description or Purpose of Issue	Change or Changes Made	Justification, Remarks
0	4/17/69	Issued for bids		
1	5/2/69	Issued Addendum 1	Section 1.1.3 in Section 1.1, Work Included, was modified to include a definition of work limits.	Clarification
			Section 11.2.1 in Section 11.2, Excavation, was expanded to include any excavation required for the Miller Road Culvert.	Scope change
			Section 12.5.6 in Section 12.5, Backfill, was modified to specify 5 feet of surcharge with slurry backfill material over the backfilled slurry trench instead of 2 feet of Zone 1 material and 6 passes of 50 ton rubbertired roller.	Alternate means of providing surcharge
			Section 13.1 was modified to include that the foundation should be scarified and moisture conditioned as required. It also specifies that an alternative roller can be used if approved by the contractor. Additional passes may be required.	To provide bond between embankment and original ground surface. Alternate roller approved by contractor was allowed to facilitate constrution. Improved subgrade preparation.
			Section 14.1.2, Suitability of Materials, identifies the responsibility of the subcontractor to conform to the specified material requirements by making tests as required. The results are to be approved by the contractor.	Assurance to meet the requirements of specifications

18

TABLE Q&R 2.5-1 (continued)

Rev	Date	Description or Purpose of Issue	Change or Changes Made	Justification, Remarks
			Section 14.4.1 clarifies the responsibility of the subcontractor to make tests on the materials to be used in the construction of embankments.	To emphasize that the materials used in the embankment should meet the specification requirements
			The gradation requirements for Zone 1 material was revised. The requirement that not more than 60% passing a #200 sieve was dropped.	The PSAR(1) indicates that the materials available onsite are acceptable for fill. Some onsite borrow materials had fines in excess of 60% passing sieve #200.
2	2/18/69	Addendum 2 was added. Issued for construction	The intent of this addendum was to raise the top of the dike elevation to 632' and the excavation to elevation 615'. Various paragraphs throughout the specifications were modified to reflect these changes	Reflect design changes
3	7/18/69	Addendum 3 was added	This addendum dealt exclusively with Section 10.0, Sealing Wells. It was expanded to include exploratory holes and specified pressure grouting for both wells and exploratory holes.	To delineate requirements for sealing wells and exploratory holes
4	8/28/69	Addendum 4 was added	Section 4.2, List of Drawings, was modified by adding Drawings C-119, Cooling Pond-Dike Sections, Sh 3 and C-120, Channel Excavation.	The scope change included additional sections for cooling pond dike and added channel excavation to dredge and widen the Tittabawassee River.
			The specification was revised to include Zones 1A and 4A. The gradation, lift thickness, and compaction requirements were all specified.	To allow the use of onsite excavated material for dike construction(1)
5		Addendum 5 was originated. However, it was not issued for construction		Project was shut down.

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TABLE Q&R 2.5-2

CHANGES IN COMPACTION CONTROL SPECIFICATION, TECHNICAL SPECIFICATION C-210

Rev.	Date	Description or Purpose of Issue	Change or Changes Made	Justification and Remarks
A	1/12/73	Issued for client review and approval		
0	3/29/73	Issued for bids		Incorporated client comments and comments from other disciplines.
1	4/25/73	Revised to incorporate changes	Section 11.3: "Prior to placement of new fill, the outer slope will be excavated to a minimum depth of 2 feet" was changed to read "... a maximum depth of 2 feet."	Revised design criteria.
1	4/25/73	Revised	Section 14.1.1: The ASTM designation for the cement to be used in the grout was changed to ASTM C-150, Type 11A, from ASTM C-175, Type 11A.	ASTM C-175 was discontinued and replaced by ASTM C-150.
			Section 17.2.1: Coarse aggregate for concrete conforming to MDSHSS was changed from Type 6A to Type 6AA.	Physical requirements for Type 6AA materials are more stringent.
2	7/27/73	Issued for subcontract	Various paragraphs were modified to reflect the lowering of the bottom elevation of the cooling pond from elevation 615' to 614'.	To allow for additional borrow material.
			Section 12.4.4: Density of soil in place was modified by the sentence, "A nuclear density device may be used provided that the results are compatible with those obtained by the specified procedure."	To provide alternate means for testing the in place materials.
3	7/10/74	Revised to incorporate changes	Section 8.2.1 was modified by the addition of the following clause, "...nor lower than el 612'..."	To allow for additional borrow material.

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TABLE Q&R 2.5-2 (continued)

Rev.	Date	Description or Purpose of Issue	Change or Changes Made	Justification, and Remarks
			Section 12.5.5 was modified to include instructions for the placing of 4Z material.	Crushed stone material 4Z was added to be used for baffle dike.
			Modifications to Table 12-1 are as follows:	
			1) For Zone 1, impervious fill, the requirement that not more than 60% fines passing a #200 sieve was deleted.	The PSAR indicates that the materials available onsite are acceptable for fill. Some onsite borrow material had fines in excess of 60% assing sieve #200.
			2) The description of Zone 4 material was changed from a "clean gravel graded as specified" to "crushed stone." The gradation requirements were also revised.	Improved riprap bedding material over originally specified Zone 4 material.
			3) The gradation requirements for Zone 5A, Riprap, originally specified that 50% (by weight) of the material shall have particle sizes of 10 inches (#100) or larger. This was reduced to 40% (by weight).	The riprap stocked in a quarry was tested and the graduation was close to that specified in the specifications. Therfore, the material was acceptable.
4	6/4/75	Revised to incorporate changes	In Section 12.4.4 the hole size of soil with little or no gravel was changed from a 6 inch diameter, 9 inch depth, cylindrical hole to that specified in ASTM D 1556.	Clarification of testing procedures.
5	7/8/77	Revised to incorporate changes	ASTM designation C-136 was added to Section 12.4.3	This change was made to include additional testing capabilities.

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TABLE Q&R 2.5-2 (continued)

Rev.	Date	Description or Purpose of Issue	Change or Changes Made	Justification, and Remarks
			Section 12.5: Placement of materials in areas inaccessible to motorized rollers was deleted.	Scope of work in areas inaccessible to motorized rollers was to be performed under a separate specification, C-211.
			Section 12.6 was modified from +2% of optimum moisture content to -2% and not more than +5% of of the optimum in areas away from plant area for Zone 2 material.	Materials in the borrow areas were wet. Materials with moisture content not more than +5% of optimum were allowed to be placed in the construction laydown area due to schedule requirements.
		Does not STATE that 13.7.1 WAS not implemented	Section 13.7.2 was added.	This change was added to accommodate the compaction requirements for cohesionless soil. NOTE: For compaction requirements of cohesive soils, see Table Q&R 2.5-4.
			Section 16 was increased in scope to include document control, nonconformance, corrective actions, and internal audits.	Reevaluation of quality program position on subcontractors.
6	4/25/78	Revised	Sections 12.4.2 and 12.4.4 were modified by adding the provision that if a nuclear density device is used it should be used in accordance with ASTM D 3017, using manufacturers instructions.	Added ASTM standards for using a nuclear device for testing materials.

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TABLE Q&R 2.5-3

CHANGES IN COMPACTION CONTROL SPECIFICATION, TECHNICAL SPECIFICATION C-211

Rev	Date	Description or Purpose of Issue	Change(s) Made	Justification, Remarks
0	4/25/74	Issued for construction		
1	1/15/75	Revised to incorporate changes	The grain size gradation was originally determined by ASTM D 422-1963. This was changed to ASTM C 136-1971 and ASTM C 117-1969 as required (see Section 5.1).	The ASTM standard specified, ASTM D 422, was inappropriate for this application.
2	6/4/75	Revised to incorporate changes	Section 5.1 was revised to show that the material within 3 feet of any plant area structure should be considered structural backfill. Outside this 3 foot limit, other materials were allowed.	In areas 3 feet away from the outside walls of the plant structure, the structural backfill was unnecessary and other materials were allowed.

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TABLE Q&R 2.5-3 (continued)

Rev	Date	Description or Purpose of Issue	Change(s) Made	Justification, Remarks
2	6/4/75 (continued)		Section 5.4, Compaction Equipment, was revised to allow the use of other than operator-held, vibratory power transfers. The use of this equipment within 3 feet of any structure would have to be reviewed by project engineering.	Compaction equipment was to be selected based on the demonstrated ability to accomplish the required compaction. Use of compaction equipment other than operator-held equipment within 3 feet of structural walls should be reviewed by project engineering to evaluate the effect of these rollers on the structural walls. 18
		True [redacted]	Added Section 5.5.2, stating that cohesive soil, used as structural backfill, should be compacted to not less than 95% maximum density as determined by modified proctor method ASTM D 1557, Method D.	The compaction requirement for materials other than structural backfill was introduced.

TABLE Q&R 2.5-3 (continued)

Rev	Date	Description or Purpose of Issue	Change(s) Made	Justification, Remarks
3	11/8/76	Revised	Section 5.1.4 was added allowing the top 2 feet of backfill to be Zone 1, where excavation was 6 feet or more. It also specified that Zone 4 material could be used for the top 6 inches, if necessary.	To accommodate vehicular traffic adjacent to structures and to divert surface water runoff from the structural backfill areas.
		FALSE	Section 5.5.2 was modified to allow use of the Bechtel modified proctor test in determining the maximum dry density and optimum moisture content.	Compaction criteria for cohesive soils were revised to be consistent with Specification C-210. For compaction criteria of cohesive soils under Specification C-210, see Table Q&R 2.5-2.
4	9/21/77	Revised	Section 5.1.1 was revised to show that the grain size gradation should be determined by ASTM D 422, instead of ASTM C 136-1971 and C 117-1969.	To conform with Bechtel standards.
5	10/23/78	Revised	Sections 5.6.1 and 5.6.2 were revised to delete references to ASTM designations C 136-1971 and C 117-1969.	To reflect changes made in Revision 4.

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MIDLAND 1&2

TABLE Q&R 2..

COMPARISON OF COMPACTION CONTROL SPECIFICATIONS IN PSAR WITH PRESENTLY APPLICABLE TECHNICAL SPECIFICATION C-210

Item	Specification C-210		PSAR-Dames & Moores Final Report 3/15/69		
	Section	Description/Requirement	Section	Description/Recommendation	Remarks
1. Subgrade preparation	10.0	Foundation Preparation: Foundations shall be cut to firm undisturbed material and free of loose materials. Foundation shall be approved before placing fill material. Prior to placing fill material on the foundation, the surface shall be scarified, moisture conditioned as required, and rolled with four passes of a 50 ton rubber tired roller or other approved rollers.	Page 13	Following stripping and excavation, the exposed surfaces shall be thoroughly proof rolled with two passes of a 20 yd³ loaded scraper under the supervision of a qualified soils engineer. Zones of loose or soft soils delineated by proof rolling should be compacted or removed and replaced with controlled compacted fill	
2. Materials	12.3. Table 12-1	Various zones of materials were used to construct the embankment and identified in Table 12-1.	Page 14	Onsite excavated soils are considered suitable fill material. As sandy soils are more readily compacted with small equipment sand fill was recommended in areas of limited access.	For areas not accessible to motorized rollers and adjacent to plant structures, structural backfill in accordance with Specification C-211 was used.

TABLE 2.5-4 (continued

Item	Specification C-210 Section	Specification C-210 Description/Requirement	PSAR-Dames & Moores Final Report 3/15/69 Section	PSAR-Dames & Moores Final Report 3/15/69 Description/Recommendation	Remarks
3. Freeze protection (for excavation and embankment construction)	8.0, 12.5, 12.10, 13.8	No embankment shall be placed on a frozen surface nor shall any ice or frozen earth be incorporated into the embankment. Embankment construction requiring moisture conditioning shall be suspended if the ambient air temperature is 32F and falling. Precautions shall be taken to protect partially completed embankment during winter. Required reconditioning shall be performed resulting from lack of winter protection.	Page 14	If excavations are to be kept open during winter, at least 3-1/2 feet of natural soils or similar cover should remain in place over the final subgrade or overlying the mud mat. No compacted soils shall be allowed to freeze. Frozen soils are to be removed or recompacted prior to resumption of earthwork.	No freeze protection is covered under Specification C-210 for excavations.
4. Lift thickness for construction of embankments	12.5, 13.5	For Zones 1, 2, and 3, the lift thickness shall be determined based on the evaluation of compaction equipment. Maximum uncompacted lift thickness is limited to 12 inches.	Page 15	All fill and backfill material should be placed in nearly horizontal lifts approximately 6 to 8 inches in loose thickness.	Test pads were prepared to qualify the density achieved by testing 12 inch thick layers for several types of rollers.

18

Verify that Zone 2 had test pads

TABLE 2.5-4 (continued

<table>
<tr><th></th><th colspan="2">Specification C-210</th><th colspan="3">PSAR-Dames & Moores Final Report 3/15/69</th></tr>
<tr><th>Item</th><th>Section</th><th>Description/Requirement</th><th>Section</th><th>Description/Recommendation</th><th>Remarks</th></tr>
<tr><td>5. Moisture control</td><td>12.6,
13.6</td><td>Insofar as practicable, Zones 1, 1A, and 2, which require moisture control shall be moisture conditioned in the borrow areas. The water content during compaction shall be ±2% of the optimum moisture content. The wet limit for Zone 2 shall be that moisture content at which the tires of the specified rubber tired rollers rut the surface of fill by more than 6 inches.</td><td>Page 15</td><td>All fill and backfill materials should be placed at or near the optimum moisture content.</td><td>The optimum moisture content was determined per ASTM D 1557 modified to obtain 20,000 ft-lb of energy per ft³ of soil.</td></tr>
<tr><td>6. Compaction</td><td>[illegible],
13.7</td><td>
<table>
<tr><th>Zone</th><th>Equipment</th><th>Passes[2]</th></tr>
<tr><td>1</td><td>50 ton[1]</td><td>4</td></tr>
<tr><td>1A</td><td>50 ton[1]</td><td>4</td></tr>
<tr><td>2</td><td>50 ton[1]</td><td>4</td></tr>
<tr><td>3</td><td>50 ton[1]
(or vibratory roller)</td><td>4</td></tr>
<tr><td>4</td><td>Construction equipment routed over the zone or additional rolling as directed by contractor</td><td></td></tr>
<tr><td>4A</td><td>50 ton[1]
(as directed by the contractor)</td><td>-</td></tr>
<tr><td>5</td><td>Not required</td><td>-</td></tr>
<tr><td>5A</td><td>Not required</td><td>-</td></tr>
<tr><td>6</td><td>Not required</td><td>-</td></tr>
</table>
</td><td>Page 16</td><td>
<table>
<tr><th></th><th colspan="2">Recommended Minimum Compaction Criteria</th></tr>
<tr><th>Purpose of Fill</th><th>Sand Soils % Relative Density[3]</th><th>Clay Soils % of Max. Density[4]</th></tr>
<tr><td>Support of structures</td><td>85</td><td>100</td></tr>
<tr><td>Adjacent to structures</td><td>75</td><td>95</td></tr>
<tr><td>Area fill (not supporting or adjacent to structures)</td><td>70</td><td>90</td></tr>
</table>
</td><td>Compaction was done in accordance with ASTM D 1557 modified to obtain 20,000 ft-lb energy per ft³ of soil.</td></tr>
</table>

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TABLE 2.5-4 (continued

	Specification C-210		PSAR-Dames & Moores Final Report 3/15/69		
Item	Section	Description/Requirement	Section	Description/Recommendation	Remarks
		A pass shall consist of the entire coverage of the area with at least one trip of the equipment specified. To effect complete coverage of the area being rolled, each trip of the roller shall overlap the adjacent trip by not less than 2 feet. Dumping, spreading, sprinkling, disking, or harrowing and compacting may be performed at the same time at different points along the section where there is sufficient area to permit these operations to proceed simultaneously. Additional Rolling - As determined by the contractor, if the desired compaction of any portion of embankment is not obtained by the minimum passes specified, additional passes shall be made over the surface area of such designated portions of the embankment until the desired degree of compaction has been attained. However, where lift thickness is greater than specified, or moisture content at time of rolling is improper or specified rolling has not been performed, such rolling shall be by and at the expense of the subcontractor.			

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TABLE 2.5-4 (continued

Item	Specification C-210		PSAR-Dames & Moores Final Report 3/15/69		Remarks
	Section	Description/Requirement	Section	Description/Recommendation	
		Fill Not Accessible to Specified Rollers			
		General - Unless otherwise specified, all embankment fill not accessible to roller compaction shall be compacted by power or hand tampers, or by rolling or other approved means to the same degree required for like materials compacted by roller. Fill containing both sides of a wall, pipe, or structure shall be kept at approximately the same elevation and compacted equally on the sides until placement has reached the required elevation.			
		Compaction Requirements for Plant Area Fill			
		Cohesive Soils - All cohesive backfill in the plant area and the berm shall be compacted to not less than 95% of maximum density as determined by ASTM D 1557, Method D.		WAS NOT implemeted	
		Cohesionless Soils - All cohesionless backfill in the plant area and the berm shall be compacted to not less than 80% of relative density as determined by ASTM D 2049, with the exception that Zones 4, 4A, 4Z, 5, 5A, and 6 materials need no special compactive effort other than as described in Section 12.8.1.			

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TABLE 2.5-4 (continued

	Specification C-210		PSAR-Dames & Moores Final Report 3/15/69		
Item	Section	Description/Requirement	Section	Description/Recommendation	Remarks
7. Slopes	2.5	During construction of the embankment, the slope should not exceed 3 horizontal to 1 vertical to have a differential elevation of 20 feet maximum.	Page 15	For cohesive soils, the recommended slope is 2:1, and for cohesionless soils a slope of 4:1 or flatter is recommended.	
		The design drawings indicate a minimum of 3:1 slopes or flatter for permanent embankments.		Temporary excavations in dewatered sand fills are to be 1-1/2:1 or flatter. Compacted clay fills may be cut vertically up to 10 feet in height.	
8. Supervision	-	All earthwork operations were subject to approval by the contractor.	Page 16	Filling operations should be performed under the continual 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.	A qualified soils engineer supervised the earthwork operations at various stages but not on a continuous basis.

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(1)Rubber tired roller

(2)Minimum number of passes per lift

(3)Maximum and minimum density of sand soils should be determined in accordance with ASTM Test Designation D-2039-64T.

(4)Maximum dry density and optimum moisture content should be determined in accordance with ASTM Test Designation D-698, modified to require 20,000 ft-lb of compactive energy per ft^3 of soil.

Bob Wheeler has [illegible] at [illegible] 4C, 501 & FSAR & PSAR & C-210 & 211 & compared [illegible]

10/11/78

RMW

INCONSISTENCIES DISCOVERED TO DATE

Is boring an Engineering list?

1) References:

a. Dames & Moore Report (Page 15)

b. Standard No. 7220-C-501, "Civil & Structural Design Criteria" (Page 8)

Bob [illegible] memo asking [illegible] predict [illegible]

Bob [illegible] could be [illegible] we have the problem

"Filling operations shall be performed under the technical supervision of a qualified Soils Engineer who will perform in-place density tests in compacted fill to verify that all materials are placed and compacted in accordance with recommended criteria."

Bechtel Field did not have a Soils Engineer on site.

Take sample of material to be used for fill & run test. This gives optimum [illegible] it as you place it [illegible] & its too [illegible] a density [illegible] 500 yds [illegible] test).

2) References:

a. Dames & Moore Report (Page 14)

b. Bechtel Specs C-210 and C-211

[illegible] 10, [illegible]

Dames & Moore - "All fill and backfill materials should be placed at or near the optimum moisture content in nearly horizontal lifts approximately six to eight inches in loose thickness."

Bechtel Specs - C-211, Section 5.2.2 - "However, in no case shall the uncompacted lift thickness exceed 12 inches."

Obviously, these two requirements conflict.

[illegible] exceeded [illegible] 12" [illegible] to Bechtel [illegible] may not have had a [illegible] ground [illegible] Pocket [illegible] blow [illegible] like a Concrete dike [illegible]

Random fill is permitted [illegible] may have not [illegible] type [illegible] Bechtel [illegible] assigning Proctor Tests [illegible]

3) References:

a. Dames & Moore Report (Page 15)

b. Bechtel Specification C-211

Dames & Moore - "In addition, no compacted soils should be allowed to freeze. If fill or backfilling operations are discontinued during periods of cold weather, it is recommended that all frozen soils be removed or recompacted prior to resumption of operations."

Bechtel Spec - "No backfill shall be placed upon frozen surface nor shall any frozen material be incorporated in backfill."

This does not address the question of removal or recompaction upon resumption of work.

[illegible] less than [illegible] is being [illegible] compared to [illegible] criteria.

Bob was told [illegible] to [illegible] pond [illegible]

4) References:

a. Bechtel Design Standard C-501

b. Bechtel Spec C-211

AA <u>Bechtel Design Standard</u> - Table of Minimum Compaction Criteria

<u>Purpose of fill</u>	-	On site
support of structure		Sand soil Percent relative density 85% (D2049-69)

Could be significant under bldg.

✓

<u>Spec C-211, Section 5.5.1</u> - "Cohesionless (sand) material shall be compacted to not less than 80% relative density.... by ASTM D. 2049"

Spec and Design Standard conflict.

5) References:

a. Dames & Moore Report (Page 14)

b. FSAR Page 2-7

c. Drawing C-44

Sand[illegible] Diesel

<u>Dames & Moore</u> - "It is recommended that all areas in which the final grade will be raised by placement of fill be stripped of all topsoil and other unsuitable soil if any and be thoroughly proof rolled."

<u>FSAR</u> - "All loose in-site sands, soft or compressible clay soils, and organic soils will be excavated in the Turbine Building area."

✓ Bechtel Drawing C-44, Note #4 - "Within the excavation area shown all loose surficial sands with relative density less than 75% shall be removed."

Added to this drawing 8/23/75. — Work was done year b[illegible] this

boring logs show us that the soil was not removed, however, it may be greater than 75%.

Vibration + water

INCONSISTANCIES DISCOVERED TO DATE

Question #1

Discussion

Work performed during Diesel Generator area fill era was not done under the direct supervision of a qualified soils engineer. In fact, Geotech (soils consultants to Bechtel) did not have anyone on site between late 1974 and June/July of 1976 (the grade beam failure). Attachment 1 is an I.O.M. describes the responsibilities of Geotech during the early phases of the job. The item of the letter indicates that the need for Geotech personnel is based solely on the availability of Field Engineers and Q.C. personnel. The letter concludes by stating that the acceptance authority for earthwork was delegated to Q.C. and Field Engineers.

It would have seemed prudent at the remobilization after the 1975 slowdown to reaffirm under the supervision of Geotech that work was being performed properly. Failure to do this has resulted in specification and work operation misunderstandings.

RMW/11-1-78

(Bob Wheeler)

RECEIVED
OCT 0 4 1974
FIELD QUALITY ASSURANCE
MIDLAND, MICHIGAN

	JLC	
	REW	
	DRK	
	DRH	
	FILE	
	RETURN	

Q# 1

Bechtel Power Corporation

Interoffice Memorandum

To J. P. Connolly

Date October 1, 1974

Subject Job 7220 Midland Project
Geotechs Responsibility on
Earthwork Subcontract
0-817

From T. C. Valenzano

Of Construction

Copies to

At Midland, Michigan

This is in response to your request for clarification of Geotech's responsibilities during summer 1973: Geotech's responsibilities were that of providing design assistance to project engineering and assistance to field engineering and QC. Furthermore, Geotech has the responsibility for being cognizant of all phases of the soils work in both engineering and construction. It is their responsibility to be assured that the design is properly interpreted, construction properly performed, and the specified testing requirements properly implemented, and if they are not satisfied, to advise appropriate management personnel. It was within this context that Geotech was allowed to perform acceptance validation for both field engineering and quality control.

This was done because sufficient numbers of experienced Bechtel field engineering and quality control personnel were not available on the site. Geotech's assistance was requested for this reason.

Sufficient numbers were later made available and Geotechs services as an acceptance authority was delegated to QC and field engineers for Q and non-Q work respectively.

T. C. Valenzano
T. C. Valenzano

TCV/sw

INCONSISTANCIES DISCOVERED TO DATE

Question #2

Discussion

Although lift thickness may not be solely responsible for the poorly compacted soil, we believe that it is a factor particularily if the following is considered:

1. Dames and Moore recommended 6" - 8" lifts and the report as written today and supposedly used as a design document, still states that the recommended lift thickness be 6-8 inches. (See attachment #1)
2. It has been documented by letter and log entries that on several occasions the 12" left thickness which is unconservative to begin with were exceeded. (See attachment #2)

In conclusion, it is evident that the unconservative approach to lift thickness has aggrevated and contributed to the poor soil conditions.

RMW/11-1-78

Power
Company

P.O. Box 1963
Midland, Michigan 48640

July 23, 1974

Midland Project GWO 7020
Canonie QA/QC Daily Report
File: 16.0 Serial: 81FQAE74

Mr. J. P. Connolly
Bechtel Power Corporation
P.O. Box 2167
Midland, Michigan 48640

Dear Mr. Connolly:

There is a discrepancy in the Canonie Fill Placement QA/QC Daily Report and Lift Thickness Check for June 4, 1974, in the QC File. This report gives length 1075' ±, width 150' ±, load count 428, and average lift thickness of 1' uncompacted. Using 18 uncompacted cubic yards per load and the data above, we obtain an average lift thickness of 15.5" uncompacted. According to Specification C-210 Rev 2, Section 12.5.2, "the uncompacted lift thickness shall be not more than 12"."

We request an explanation for this discrepancy by July 31, 1974.

Yours very truly,

J. L. Corley
Field Quality Assurance Engineer

JLC/DEH/dm

CC: HWSlager
RCBauman
TCCooke

CONSUMERS POWER COMPANY
RECEIVED
JUL 30 1974
MIDLAND PLANT PROJECT
MIDLAND, MICHIGAN

Bechtel Power Corporation

Post Office Box 2167
Midland, Michigan 48640

July 29, 1974

✓	JLC	
	REW	
	DRK	
	DEH	
	FILE	
	RETURN	

Consumer Power Company
P. O. Box 1963
Midland, Michigan 48640

Attention: J. L. Corley

Reference: 81 FQAE 74
Date: July 23, 1974
FQCL-019

Dear Mr. Corley:

Verification of lift thickness is performed, in the field, by Quality Control personnel of both the subcontractor and Bechtel. Lift thickness verification is documented on the subcontractor's lift thickness report and the Bechtel Quality Control inspection plan for that area. The approximate location of the placement and amount of fill placed (truck count) are also recorded on the subcontractor's report. Further investigation of reports for the day in question, (June 4, 1974) indicate that some of the fill reported to have been placed in a "Q" area was actually placed in a non "Q" area. This situation has now been corrected by having the truck count made at the point of placement rather than at the borrow area, as was previously done.

It should again be stressed that the inspection of the earthwork lift thickness is performed at the point of placement by Quality Control personnel. The load count discrepancy for the day in question, or any other day, has no effect on the quality of the completed work.

Sincerely,

JPConnolly
J. P. Connolly

JPC/jmw

Bechtel Corporation

Interoffice Memorandum

To J. P. Connolly

Subject Discrepancies in Report

Copies to

Date August 5, 1974

From L. V. Hendry

Of Quality Control

At Midland, Michigan
Job No. 7220

This letter will confirm the fact that there are a few minor differences between my daily field inspection report, subcontracts daily report and Canonies QA-QC daily report for the day of June 4, 1974. All reports agree that it was Zone 1 material that was placed upstream from the sand drain, but the actual area covered is a little cloudy, as is the actual load count for this area. Corrective action has since been taken to more closely keep track of placement bays and all loads are counted on the fill by the dump man.

L. V. Hendry

L. V. Hendry

LVH/jmw

0800 (6-73)

All of the materials mentioned above should be considered suitable for use in the construction of the plant fills. However, it is recommended that preference be given to placement of granular materials in the plant area, if possible, due to the relative ease of compacting these materials. Granular materials can generally be placed and compacted properly under a range of moisture conditions using a variety of compaction equipment. Cohesive clay soils can generally not be placed during periods of wet or freezing weather. In addition, clay soils would be difficult to place in restricted backfill areas because heavy compaction equipment would be required to break-up and compact hard chunk-size pieces that would be removed from on-site excavations.

Filling and Backfilling - It is recommended that fill and backfill materials be placed at or near the optimum moisture content in lifts approximately six to eight inches in loose thickness and that each lift be compacted in accordance with the following criteria:

	RECOMMENDED MINIMUM COMPACTION CRITERIA PERCENT OF MAXIMUM DENSITY*	
PURPOSE OF FILL	ON-SITE COHESIVE SOILS	ON-SITE GRANULAR SOILS
Support of Critical Structures	95	100
Support of Non-Critical Structures	90	95
Adjacent to Structures	90	95

---

* Maximum density and optimum moisture content should be determined by the ASTM Test Designation D 1557-66T.

Slopes of excavations cut into compacted fill materials should be the same as the recommended slopes provided for excavations into natural soils.

INCONSISTENCIES DISCOVERED TO DATE

Item #4 - References: a) Bechtel Design Standard, C-501
b) Bechtel Spec., C-210, C-211

Conflict: C-210, C-211 both specify 80% relative density.

C-501 specifies 85% relative density for structure support.

Question: Has Bechtel's specifications, C-210 and C-211, always used 80% relative density as a compaction standard?

Answer:

1) Specification C-211 for structural backfill has always specified 80% relative density.
2) Specification C-210 did not originally address the requirements for compaction of cohesionless materials to be utilized as plant area fill. Revision 5 of the specification is where the requirements for Sands first appeared. When the specification was revised to add a paragraph about sands, it was added at 80% relative density.

In conclusion, the specifications have always been inconsistant with the Project Design Standard.

RMW/10-24-78

INCONSISTANCIES DISCOVERED TO DATE

7. The Bechtel specs do not reflect the compaction requirements as found in the Engineering Design Documents and the Dames and Moore Soils Investigation Report.

References: Confirming ASTM-D1557-Method D.

1. Page A-76 of "Soils and Foundation Investigation Report", December 1975.

   Support of Structures - 100% B.M.P.

2. Page A-18 as in #1 -

   Support of Critical Structures - 95% D1557

3. Table 10 of as in 1 -

   Support of Structures - 95% D1557

* 4. Standard #C-501 - Under Design Documents - 2.4.4 - "Soil and Foundation Investigation Report."

5. Specification C-210 - Section 13.7 -

   95% ASTM D1557

References to BMP (95%)

1. Spec. C-208 - Section 9.1 - 957.B.M.P.
2. Spec 210 - 12.4 Refers to - 95% B.M.P.
3. Spec C-211 - 95% B.M.P.

From the point in which Bechtel anticipated (field) doing the plant fill work the question of which proctor was correct was an area of confusion. In fact, the field wrote Engineering a letter asking for a clarification which was not addressed by letter (the question of proctors). FCR C-302 was finally the vehicle for answering the question, in that Engineering approved the use of the B.M.P.

Apparently, the specification (C-210) was still not clear since a telecon was recorded (attached) in which Engineering stated that their method for the plant fill area is acceptable. However, in 1974 Geotech stated in a memo (attached) that the plant fill compaction requirements are as that stated in section 13.7 (ASTM D1557). Obviously, the intent of which proctor to use has always been unclear. It is my opinion that 95% of D1557 is what was intended to be used under the plant structures.

This conclusion is based on the following:

1. All design related supportive documents indicate 95% of

MEMORANDUM

TO J. C. CHURCH LOCATION MIDLAND NUCLEAR PL
FROM J.C. WANZECK GEOTECH DATE SEPT 18 19 74
SUBJECT COMPACTION REQUIREMENTS JOB NO. 7220
PLANT ZONE II FILL FILE

SPECIFICATION 7220-C-210 REV 2
SECTION 13.0 PLANT AREA BACKFILL & BERM BACKFILL.

HEREIN WE ADDRESS 13.7 COMPACTION REQUIREMENTS ONLY

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 ZONE 4, 4A, 5, 5A AND 6 MATERIALS NEED NO SPECIAL COMPACTION EFFORT OTHER THAN DESCRIBED IN SECTION 13.8.1

J.C. Wanzeck

CC: J ALLEN
SS AFIFI
FILE ANN ARBOR

All of the materials mentioned above should be considered suitable for use in the construction of the plant fills. However, it is recommended that preference be given to placement of granular materials in the plant area, if possible, due to the relative ease of compacting these materials. Granular materials can generally be placed and compacted properly under a range of moisture conditions using a variety of compaction equipment. Cohesive clay soils can generally not be placed during periods of wet or freezing weather. In addition, clay soils would be difficult to place in restricted backfill areas because heavy compaction equipment would be required to break-up and compact hard chunk-size pieces that would be removed from on-site excavations.

Filling and Backfilling - It is recommended that fill and backfill materials be placed at or near the optimum moisture content in lifts approximately six to eight inches in loose thickness and that each lift be compacted in accordance with the following criteria:

	RECOMMENDED MINIMUM COMPACTION CRITERIA PERCENT OF MAXIMUM DENSITY*	
PURPOSE OF FILL	ON-SITE COHESIVE SOILS	ON-SITE GRANULAR SOILS
Support of Critical Structures	95 ←	100 ←
Support of Non-Critical Structures	90	95
Adjacent to Structures	90	95

---

* Maximum density and optimum moisture content should be determined by the ASTM Test Designation D 1557-66T.

Slopes of excavations cut into compacted fill materials should be the same as the recommended slopes provided for excavations into natural soils.

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.

RECOMMENDED MINIMUM COMPACTION CRITERIA

PURPOSE OF FILL	ON-SITE SAND SOILS PERCENT RELATIVE DENSITY*	ON-SITE CLAY SOILS PERCENT OF MAXIMUM DENSITY**
Support of Structures	85	100
Adjacent to Structures	75	95
Areal Fill (Not supporting or adjacent to structures)	70	90

---

* Maximum and Minimum density of sand soils should be determined in accordance with A.S.T.M. Test Designation D-2049-64T.

** Maximum dry density and optimum moisture content should be determined in accordance with A.S.T.M. Test Designation D-698, modified to require 20,000 foot-pounds of compactive energy per cubic foot of soil.

FOUNDATION DESIGN DATA

General - Foundation design data presented in this section assumes that individual building areas will be prepared in the manner previously recommended. It is our opinion that the major plant structures may be satisfactorily supported on mat foundations established at the presently planned elevations. Similarly, shallow spread foundations founded on controlled compacted fill soils will provide satisfactory support for the appurtenant structures.

12.0 COMPACTION CRITERIA

Fills up to 35 feet thick will be required to obtain the final plant grade elevation of 634. Fill will also be required to achieve the foundation elevation portions of the auxiliary building and the turbine building. Backfills will also be required around all structures.

On-site excavated soils, both sands and clays, are considered suitable for general fill material. Soils containing organic matter are not suitable for use as fill material.

All fill and backfill material should be placed at or near the optimum moisture content in six to eight inch lifts. Each lift should be compacted in accordance with the recommendations shown in Table 10.

No compacted soil should be allowed to freeze. It is recommended that all frozen soils be removed and the affected zone be recompacted prior to resumption of operations each season. Fill compaction and decisions regarding remedial measures for frozen soils at the surface should be performed with the supervision of a soils engineer. In-place density tests in compacted fill will be

TABLE 10

MINIMUM COMPACTION CRITERIA
PLANT AREA FILL AND BERM

Function of Fill	Minimum Compaction Criteria In Situ Sand[1]	 In Situ Clay[2]
Support of Structures[3]	85%	95%
Adjacent to Structures[4]	80%	-
Category I Slopes	-	95%
Berm	-	95%
Area Fill (not supporting or adjacent to structures)	-	95%

Notes

[1] All sand compaction is in terms of relative density as determined from ASTM D 2049 test.

[2] All clay compaction is in terms of maximum density as determined by ASTM D 1557, Method D except for area fill not supporting or adjacent to structures. In these areas, ASTM D 1557 may be altered such that only 20,000 ft-lb/ft^3 of energy would be required.

[3] Strength and compressibility testing may be required.

[4] Gradation Specification

The materials used for structural backfill within three feet of the exterior wall of any plant area structure shall be cohesionless and free-draining. The grain-size gradation, as determined by ASTM C-136 (and C-117 when required by the Field Engineer), shall be within the range shown below:

Sieve Size	Percent retained Fine	 Coarse
1 inch	-	0
#4	-	25
#10	0	50
#40	40	95
#200	95	-

TUVESON . A^2

BECHTEL CORPORATION
POWER DIVISION

Telephone call

Route J. HOOK
G. RICHARDS
B. CHEEK
B. WARD
J. DEAN

By F. G. TEAGUE Of SITE
To S. RAO Of A^2
Date 10/7 1977 Time 8:00 AM
Subject SPEC C-210 BACKFILL TESTING Job No. 7220

TEAGUE Q.A. HAS ASKED FOR CLARIFICATION OF SUBJECT SPECIFICATION, SECTION 13, FOR PLANT AREA + 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 THE ASTM D-1557, METHOD D PROCTOR, WITHOUT SPECIFIC REFERENCE TO THE BECHTEL MODIFICATION.

RAO THIS APPARENT CONFLICT IS CLARIFIED BY SPEC. C-208 SECTION 9.1.9, DIRECTIONS TO THE TESTING SUBCONTRACTOR, WHICH CALLS FOR THE ASTM-D155, TEST FOR THESE MATERIALS AND ALSO ALLOWS BECHTEL FIELD (THE CONTRACTOR) TO CALL FOR THE BECHTEL MODIFICATION OF THAT TEST, EITHE METHOD IS THEREFORE ACCEPTABLE TO PROJECT ENGINEERING.

Fred G Teague

Response to RMW 11/1/78

Consumers Power Company

INTERNAL CORRESPONDENCE

To Midland File: B3.0.3

From GSKeeley/TCCooke, P-14-408B GSKeeley

Date December 4, 1978

Subject MIDLAND PROJECT -
DIESEL GENERATOR BUILDING
SETTLEMENT MEETING -
FILE: B3.0.3 SERIAL: 6175

CC DBMiller/TCCooke, Midland
CAHunt, P-14-209B
DRHorn, Midland

CONSUMERS POWER COMPANY
RECEIVED
DEC 8 1978
FIELD QUALITY ASSURANCE
MIDLAND, MICHIGAN

On Thursday, November 2, 1978, a meeting was held in Ann Arbor between Bechtel and Consumers Power Company technical people to review the situation on the settlement of the diesel generator foundation. An agenda and names of personnel in attendance are attached (Attachments A and B).

During this meeting the following discussion took place:

I. A. <u>See Attachment C for Listing of Inconsistencies</u>

1. Tuveson of Bechtel stated the following:

   C-501 is an AA design guide. Bechtel feels that Geo Tech, although not there full time, performed technical supervision. They did not have a man full time for either dike work or power block backfill.

   Geo Tech only reviewed data if field requested them to review and only if field had problems. Bechtel feels that field engineers' personnel involved in compaction were qualified soils engineers and could interpret tests and correlation of tests. CP Co does not feel that they were qualified soils engineers on site (most were right out of school). Bechtel (PAMartinez) had said in July 1974 they would have a man full time on the job, but not the site.

2. Bechtel feels that relaxation of Dames & Moore recommendations is supported by field testing on compaction and the D&M Report does not specify the type of equipment to be used. 1973 testing showed that it varied depending on equipment and material. Would have used different compaction if lifts were 6" - 8". CP Co talked to Rexford about difficulty of monitoring spreading and compaction especially in small areas. Bechtel says they feel as comfortable with 12" lifts as 6" - 8". See J L Corley letter to Connolly, 7/23/74. Don Horn says there were areas around containment where they went above mark. During July 1974 PAM committed to CAH that JWanzek would be on job full time - affected by slowdown.

3. Bechtel does not feel there is any conflict. If backfill froze and then thawed, it should be removed. It was all scraped off (usually 2") and then tested with a pickax.

4. C-501 - On-site sand.

   C-211 - Structural backfill so does not have to be too high a percentage (bought off-site sand). CP Co feels that the Bechtel C-210 specification did not require sand soil to be compacted to 85%. Bechtel feels that whether it is 80% or 85% it has no structural effect assuming the sand meets the gradation for structural sand (imported off-site).

5. Bechtel says that they requested that more borings be done before diesel generator problem and they have now demonstrated that we do have adequate compaction of material in sand lens area questioned.

6. Bechtel says that, in some cases, the wrong standards could be followed and that this was the problem with grade beam. There have been times when inexperienced man could have selected the wrong coorelation. Since the diesel building problem, Bechtel has gone to running proctors as soil is being placed although they had taken some borings after grade beam, but did not see any problems. How many proctors were run as material was removed from borrow pit - none. This would have shown whether technicians were utilizing the correct proctors. Present practices require higher density which is more difficult to obtain watching wheel action in small areas was assumed to be impractical.

7. Should Bechtel modify proctor vs ASTM (see NRC Exit #6 below)?

B. <u>NRC Exit (See Attachment D for Listing of Findings)</u>

1. During construction, we are doing every week on diesel and every 60 days on others. We see no need to change from FSAR commitment.

2. Use of random fill was identified as okay in Dames & Moore and PSAR and as long as adequately compacted is okay. Will change FSAR to indicate random fill will be used. In addressing judgment on area and non-uniformity of soil, we should also cover conservatism of structure design to settlements. The building is a stiff structure and can span settlements.

3. Due to various types of equipment, acceptance was performance rather than procedure. Copied from dike work, but not applicable to backfill. The table should be modified.

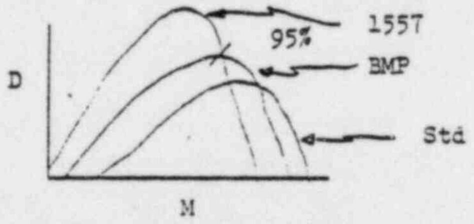
4. Cover this in compaction explanation. Review and change the FSAR. The PSAR said 1/2" is a ballpark figure.

5. Typo; grade instead of actual.

6. C-10 specification in 1969 used four-pass performance specification and test to 20,000 foot pounds Bechtel Modified Proctor (BMP). On restart in 1973, C-10 became C-210 for dike (methods) and performance for rest of fill (testing to BMP with modified - 95% of 1557D). Was added to Section 13 - testing is still based on BMP per Section 12.

   In 1977, Revision 5 was rewritten to 1557 for placement (was rewritten for type of materials - sand). On clays said 95% of 1557. Q-List dike was tested to 95%, but rest was accepted on 4-pass. Test in these areas shown less than 95%. There were 3,000 tests taken.

1557	BMP
95%	100%



(Varies from 8 to 16%.)

   BMP was originally implied to be used for dikes. 20,000 ft lb vs 56,000 ft lb of effort on BMP vs 1557. On other jobs Bechtel uses 95% of 1557. Dames & Moore recommended 95% of 1557 or 100% of BMP. Bechtel does not know why 95% BMP was used - possibly 56,000 ft lb was accidently copied out of the D&M Report. As it ended up, Bechtel used 95% of BMP for everything.

	Referenced 1557 (1968)	BMP (1969)
Under & Support Of	95	100
Adjacent to Structure	90	95
Nonsupportive & Adjacent	90	90

7. Working on. Continue monitoring. The elastic foundation question has not yet been analyzed for the worst case.

8. Will discuss utilities and random fill calculations which are major concerns.

9. Feels no problem and could close up later. It is under observation. 0.02" maximum allowable under ACI architectural.

10. Okay.

11. Will be monitoring. Initial calculations did consider variations on water level.

12. Okay. Check consultant on preload.

13. Okay.

14. Mat foundations not used normally over random fill or in diesel building; Bechtel disagrees.

    Bechtel disagrees on blow count question and noted that tests may have been taken at planes.

15. Does not believe material was placed as indicated (low blow counts).

II. A. Planned Future Actions

1. Start monitoring underground utilities prior to other activities.
    a. Condensate lines - measure gaps and survey (elevation).
    b. Other pipes - measure sleeve gaps - do additional excavation as required.
    c. Get initial readings on adjacent underground pipes.
2. Release the duct banks.
3. Grout gaps between building footings and soil for more uniformity in soil pressure and avoidance of building stress.
4. Check the relative displacement between duct bank and footings - include the off-set duct bank.
5. Run a profile along the bore of pipe beneath the building before and after preloading. Include horizontal and vertical measurements on center line.
6. Monitor condensate pipes and duct banks and check continuity on one duct per bank.
7. Install soils instrumentation.
    a. Building settlement markers.
    b. Piezometer for pore water pressure (in and out).

c. Settlement monitoring of existing fill at varying elevations.

d. Inclinometers.

8. Preparation for surcharge.

   a. Three feet of sand will be placed approximately 20' around the outside of the Diesel Generator Building and inside the Diesel Generator Building for frost protection.

   b. Manholes may be utilized in the approximately 2,000 cubic feet of sand.

   c. Excavate both sides of duct banks.

   d. Protect the turbine generator basement wall, if a surcharge is required in that area.

9. Resolve what will be done in the transformer areas.

B. Scheduling

The duct bank should be cut loose on November 6, 1978. This operation will take approximately 2½ weeks. On November 24, 1978 start grouting operation (1½ weeks maximum time estimate). The pond should be filled by January 1, 1979 if at all possible. Instrument preparation should start immediately to complete in 2-2½ weeks. The meeting with consultants will be held on November 7, 1978 in Champaign, Ill. Decisions on surcharge will be made November 14, 1978.

It is anticipated that cribbing for the surcharge will be complete by mid-December. NRC confirmation of the planned course of action may be required. Once fill has been started, it will take approximately 2 weeks to complete. The surcharge will then remain until approximately June 1, 1979 (assumption). Removal would take about 2 weeks. It is assumed that work would continue where possible in mechanical and electrical areas. Civil work on Diesel Generator Building would probably continue from March 1, 1979 through May 1979 and complete June 1, 1979. One machine must be turned over on March 1, 1980 for hot functional.

Monitoring operations should start as soon as possible prior to cutting the building loose (initial work has been completed).

The NRC, Darl Hood, will be contacted on November 7, 1978 and a meeting will be set up with Messrs Hood and Lyman Heller.

GSK/cg

Attachment A

Bechtel Power Corporation

MEETING AGENDA

Midland Units 1 and 2
Consumers Power Company
Bechtel Job 7220

DATE: Thursday, November 2, 1978, 10 a.m.

PLACE: Ann Arbor Office, 4 D 5

SUBJECT: DIESEL GENERATOR REVIEW MEETING

ATTENDEES: Consumers Power Company / Bechtel

DISCUSSION ITEMS:

(I) CPCo/NRC Questions & Concerns
  (A) "Inconsistencies Discovered to Date"
  (B) NRC Exit Meeting October 27, 1978

(II) Future Activities
  (A) Releasing Duct Banks
  (B) Grouting Gaps Under Footing
  (C) Utilities Monitoring During Release of Duct Banks
  (D) Soil Settlement Instrumentation and Monitoring of Utilities During Surcharging
  (E) Preparation for Surcharge
    (1) Protective Measures
    (2) Frost Protection
  (F) Schedule

PP

Attachment B 11/2/7[illegible]

Diesel Generator Review Meeting

Attendees:

P. Martinez	BECHTEL
N. Swanberg	"
KARL NIEDNER	"
MO ROTHWELL	✓
B.C. McConnel	—
A P Betts	"
M. R Williams	" QA
J.O WANZECK	BECHTEL
STAN BLUE	Bechtel
RN Wheeler	CPCO
DE Sibbald	CPCO
D.E. HURN	CPCo
G.S. Keeley	CPCo.
T.C. COOKE	CPCo.
C. A. Hunt	CPCo
G A Tuveson	Bechtel

ATTACHMENT C

INCONSISTENCIES DISCOVERED TO DATE

1) References:

a. Dames & Moore Report (Page 15)

b. Standard No 7220-C-501, "Civil & Structural Design Criteria" (Page 8)

"Filling operations shall be performed under the technical supervision of a qualified Soils Engineer who will perform in-place density tests in compacted fill to verify that all materials are placed and compacted in accordance with recommended criteria."

Bechtel Field did not have a Soils Engineer on site.

2) References:

a. Dames & Moore Report (Page 14)

b. Bechtel Specifications C-210 and C-211

Dames & Moore - "All fill and backfill materials should be placed at or near the optimum moisture content in nearly horizontal lifts approximately six to eight inches in loose thickness."

Bechtel Specs - C-211, Section 5.2.2 - "However, in no case shall the uncompacted lift thickness exceed 12 inches."

Obviously, these two requirements conflict.

3) References:

a. Dames & Moore Report (Page 15)

b. Bechtel Specification C-211

Dames & Moore - "In addition, no compacted soils should be allowed to freeze. If fill or backfilling operations are discontinued during periods of cold weather, it is recommended that all frozen soils be removed or recompacted prior to resumption of operations."

Bechtel Spec - "No backfill shall be placed upon frozen surface nor shall any frozen material be incorporated in backfill."

This does not address the question of removal or recompaction upon resumption of work.

4) References:

a. Bechtel Design Standard C-501

b. Bechtel Specification C-211

Bechtel Design Standard - Table of Minimum Compaction Criteria

Purpose of Fill -	On Site
Support of Structure	Sand Soil Percent Relative Density 85% (D2049-69)

Spec C-211, Section 5.5.1 - "Cohesionless (sand) material shall be compacted to not less than 80% relative density...by ASTM D. 2049."

Specification and Design Standard conflict.

5) References:

a. Dames & Moore Report (Page 14)

b. FSAR Pages 2-7

c. Drawing C-44

Dames & Moore - "It is recommended that all areas in which the final grade will be raised by placement of fill be stripped of all topsoil and other unsuitable soil if any and be thoroughly proof rolled."

FSAR - "All loose in-site sands, soft or compressible clay soils and organic soils will be excavated in the Turbine Building area."

Bechtel Drawing C-44, Note #4 - "Within the excavation area shown, all loose surficial sands with relative density less than 75% shall be removed."

Added to this drawing 8/23/75.

Boring logs show us that the soil was not removed; however, it may be greater than 75%.

Discussion

The question of whether the loose sands as described in the PSAR were ever removed is a good example of why there should be mechanisms to insure that commitments are properly conveyed to the Construction Group and that the outlined work is successfully concluded. When the note to Drawing C-44 was added, it was too late to economically excavate the loose sand since they had for the most part been covered by backfill.

The attached boring logs and locations confirm existance of the sands, although the blow counts look very good.

6) We question the method used to select the proctors. Errors in reported compaction probably resulted in selection of lower maximum density proctors. See Bechtel letter to US Testing dated February 1, 1978.

Attachment D

Consumers
Power
Company

INTERNAL
CORRESPONDENCE

TO BWMarguglio, JSC-220A

FROM DEHorn, Midland DEH

DATE October 31, 1978

SUBJECT MIDLAND PROJECT - NRC EXIT
INTERVIEW OF OCTOBER 27, 1978
File: 0.4.2 Serial: 280FQA78

CC SAfifi, Bechtel - Ann Arbor
WRBird, JSC-216B
RLCastleberry, Bechtel - Ann Arbor
TCCooke, Midland
JLCorley, Midland
GSKeeley, P14-408B
DBMiller, Midland
JFNewgen, Bechtel

The following people were in attendance at the subject exit interview which was conducted at the end of G. J. Gallagher's inspection of October 24-27, 1978:

CPCo	Bechtel	NRC
RCBauman	WLBarclay	RJCook
TCCooke	ABoos	GJGallagher
JLCorley	RLCastleberry	
DEHorn	LADreisbach	
GSKeeley	PAMartinez	
DBMiller		
BHPeck		
RMWheeler		

Mr. Gallagher stated that the visit was a follow-up on 50.55(e) report of the diesel generator settlement and that it was also a fact finding visit. The inspection consisted of a review of past data, activities in progress and planned activities for future work. Inspection was performed by review of the FSAR commitments; Specification C-210; Specification C-211; PQCI/IR C-1.02; Dames and Moore Report of Foundation Investigation and Preliminary Explorations for Borrowed Materials dated June 28, 1968 and supplement to this report dated March 15, 1969; preliminary data on diesel generator settlement problem including boring plan, cross sections of fill, blow count versus the elevation graphs, lab data, settlement data, boring logs, dutch cone logs, weather data and penetrameter readings in test pits; design drawings C-45, C-109, C-117 and C-1001; soil tests taken in the diesel generator building area during construction compiled by B. T. Cheek, Bechtel QC; observation of soil testing at the test lab and in the field; and discussions with Bechtel Geo-Tech, Project Engineering, Field Engineering, Quality Control Engineering, U.S. Testing, Consumers Power Company, PMO and QA personnel. Mr. Gallagher stated that he would not handle the findings as noncompliances, however, they could become items of noncompliance when they are reviewed by his management.

His findings/observations were as follows:

1. The FSAR states that during operation, settlement readings will be taken every 90 days. Because of the diesel generator settlement problem, this frequency should be re-evaluated for adequacy.

2. FSAR Table 2.5-14 "Summary of Foundation Supporting Seismic Category I Structures" identifies the supporting soil materials under the diesel generator building as being controlled, compacted cohesive soils. However, construction drawing C-109, Rev. 9 and C-117, Rev. 6 identifies the material in this area as Zone 2 material. Zone 2 material is identified as random fill described as any material free of organic or other deleterious materials. In the field a variety of materials have been used for the diesel generator foundation material, in particular, sands, clay, and lean concrete, silty sands and clayey sands. The apparent conflict is that Table 2.5-14 identifies cohesive soils where, in actuality, cohesionless sands have been utilized. A review of the records indicate that sands have been used between elevation 594'-608', areas of elevation 611'-613' and areas between 616'-623'. This indicates the extent of the variability of the material placed under the diesel generator building foundation. Mr. Gallagher did not feel it was good judgement to use random material under the support of a structure.

3. FSAR Table 2.5-21 "Summary of Compaction Requirements" identify random fill to require a compaction effort of a minimum of 4 passes with the specified equipment in this table. This requirement has not been an imposed requirement of Bechtel Specification C-210 nor an inspection requirement of Bechtel Quality Control Instruction C-1.02 for backfill.

4. FSAR section 3.8.5.5 states that settlements of shallow spread footings founded on compacted fill are estimated to be on the order of ½" or less. Site Survey Program has identified settlements in the diesel generator building foundation on spread footings to range from 0.55 inches to 2.30 inches and in excess of 3.0 inches for the diesel generator pedestal.

5. FSAR figure 2.5-47 indicates the foundation of the diesel generator building to be at elevation 634', according to design drawings C-1001, Rev. 5 it is indicated for the diesel generator spread footings and pedestal foundation to be at 628'.

6. A. Specification C-210, section 13.7.1 requires all cohesive backfill in the plant area to be compacted to not less than 95% maximum density as determined by ASTM D1557 method D which requires an effective compactive effort of 56,000 foot-pounds of energy per cubic foot of soil. However, section 13.4 Testing requires testing of the materials placed in the plant area to be performed in accordance with tests listed in section 12.4. This section, in particular section 12.4.5.1, "Cohesive Soils," requires maximum lab densities to be determined using ASTM D1557 Method D provided a compactive energy equal to 20,000 foot-pounds per cubmic foot is applied (Bechtel Modified Proctor Density). To date, the Bechtel Modified Proctor Density for determining maximum proctor density versus optimum moisture content has been utilized. This conflict results in an unconservative method of determining the maximum proctor density and method of assuring that the required percent compaction is achieved. In particular, the actual in-place compaction would be less using the Bechtel Modified Proctor Density as a reference than using the standard ASTM D1557 method D. This is due to the fact that the compactive energy exerted using the Bechtel Modified Method is less than the effort exerted by the standard method D - example: 20,000 foot-pounds versus 56,000 foot-pounds.

6. B. Bechtel Quality Control Instruction C-1.02 section 2.4 testing identifies the applicable inspection criteria and includes Specification C-210, section 13.7 and 12.4 which includes the apparent conflict as described in detail in Part A above.

C. A further review of the original subsurface investigation performed by Dames and Moore and documented in report supplement dated March 15, 1969 page 16 indicates that the recommended minimum compaction criteria for support of structures be 100% of maximum density using a compactive effort of 20,000 foot-pounds (resulting from Bechtel Modified Proctor determination). However, this 100% of Bechtel Modified Proctor corresponds to 95% compaction according to the standard ASTM D1557 method D and not 95% compaction according to Bechtel Modified Proctor method which has been utilized for the entire plant fill area to date. Furthermore, Dames and Moore Report, page 15 states that all fill and backfill material should be placed at or near the optimum moisture content in near horizontal lifts approximately 6-8" in loose thickness. Bechtel specification permits a maximum of 12 inches which affects the compactability of the material.

7. Piping, condensate lines, duct banks, and other utilities under the diesel generator building may also be affected and must be evaluated.

8. Mr. Gallagher stated he was leaving not having seen ~~design~~ settlement calculations and will be discussing design calculations, assumptions made, and conflicts with the FSAR with Licensing.

9. The inspector observed the structural concrete crack that has developed in the east exterior wall. The crack was observed with members from Bechtel Geo-Tech and Consumers Power Company. The crack extended full height of the wall and continued down through the spread footing as seen from the inside of the building. The crack is expected to have been induced flexurally caused by differential settlement. Discussion with Bechtel design staff has indicated that this crack is under study and is currently being evaluated. ACI-318-71 in the commentary section 10.6.4 limits flexural crack exposed to the outside to 0.013". Corrective action may be required if this limit is exceeded.

10. The following tests were observed to be performed in accordance with the applicable tests standards by U.S. Testing:

A. Lab Test ASTM D1557-70

B. Field Test ASTM D/1556-64

11. Calculations should be evaluated on the increase and the rate of increase of the pond fill and the effects of the water in other areas.

12. Mr. Gallagher stated that the NRC does not view preloading of the structure to be a fix or resolution of the problem at this time.

13. Seismic loading calculations should be determined for the type of material existing in its present condition.

E. Gallagher
ATTACHMENT 1

BECHTEL
ANN ARBOR

MEMO FROM

JERRY CLEMENTS

DATE
12/12/79

TO:
Lynn Curtis

Attached is my response to your question:

Are there any statements in the NRC's "Prohibition" order [illegible] that are not factual?

I will be glad to discuss this in more detail if you want.

Jer

ATTACHM-

there any statements in the NRC "prohibition"
der that are not factual?

In reviewing the NRC order, I found the following
statements to be incorrect in the "purest" sense:

a. NRC order Part II, Page 2, and appendix B, state that:
"All ... Section 2.5.4.5.3, Fill, states:
fill and backfill were placed according
to Table 2.5-9."

I cannot find such a direct quote in the FSAR.
The closest statements I can find are indicated
on the attached copy of FSAR pages 2.5-51 and -52.

b. NRC order appendix A, Parts 1e, 1f, and 2.b.(2)
refer to PSAR amendment 3 and imply that hard
commitments were made through the use of such
words as: "... would be removed or recompacted ..."
1e "... frozen soil would be compacted to 85% ..."
1f "... cohesionless soil ... would be compacted to 85% ..."
2b(2) " — this is required by ... PSAR, amendment 3 ..."

PSAR amendment 3 consisted of (and only of) a
supplement to the Dames & Moore report entitled
"Foundation Investigation and Preliminary Explorations for
Borrow Materials." The actual wording used in this
supplement, corresponding to the above three statements,
are:

[1e] D&M Page 15 "... it is recommended that all frozen
soils be removed or recompacted ..."

[1f] D&M Page 16 — contains a table of "Recommended
minimum Compaction Criteria"

[2b(2)] D&M Page 16 "Filling operations should be performed
under the continuous technical supervision ..."

A review of the PSAR for references to the Dames &
...,, revealed that the only direct

commitment made was in the responses to AEC
questions 2.14 [PSAR page 2.14-1] and 8 [PSAR
page 8.00-1] where the backfill used to replace
loose sands would be "compacted in accordance with
Page 16 of the report entitled FOUNDATION INVESTIGATION
... dated March 15, 1969."

Thus, the interpretations made by the NRC do
not agree "absolutely" with the wording of the
documents they reference. However, the differences
probably do not alter the conclusions that the
NRC reached with respect to these documents.

Joe
12-12-79

G. Richardson
2-9-79

Diesel Generator Building

Introduction

In Order to Establish the five most probable causes of the Diesel Generator Building one must first make a determination as to whether it was Bechtels' or Consumers' or both operations which resulted in the placement of the materials which are not capable of supporting the structure. I have indicated below those areas I feel are most probable based on my knowledge of the problem gained by review of documents and debriefing of personnel interviewed by The NRC.

Potential Causes

I Inspection of field operations (NOT including work in test lab)

A. Bechtel Operations: QC inspection of "S" listed operations

- not sufficient in detail and time spent to assure construction operations (lift thickness, compaction etc) and Testing (Methods and selection of BMP Curve) were done adequately.

a cause only if thickness, ~~in testing shown~~ evidence of inadequacy. /g

Supportive information:

QCI C-1.02 "Compacted Backfill" calls for "S" (V) surveillance for Materials, placement and Testing. Only inspect in for start of placement. "S" (V) is for visual surveillance as often as necessary (decision by QCE) To assure adequacy.

QC has stated they spent from 10-20% of time on soils operation including test result reviews. US Testing stated QC was on job only about 1% of time.

What do reports indicate? /g YES

Should be compared to QC. /g NO

Note: QCI C-1.02 Rev 2 in effect, rev 0 issued 10/76 both approved by CPCo Q.A.

g [illegible] /g

Supportive evidence would be:

- experience of B superintendents
- experience/qualification of test technicians
- " of B QC

3. Canonie Operations: Inspection by Canonie QC not sufficient to assure compliance to specifications. Surveillance by Bechtel QC and Audits by Bechtel QA may not have been frequent enough to assure Canonie placed materials properly.

Supportive Information.

QCI C1.10 "Earthwork Subcontract Surveillance calls for SI(V) Surveillance Inspections of Subcontract operations on a regular but Not full time basis. QCI approved by CPCo

If this is a cause then one must assure The first line inspection by Canonie QC (full time) was not adequate.

QA audits run One.

8-15-75 sub control
8-15-75 earth work control
8-6-76 earthwork control
9-17-76 Sub control
8-4-77 earthwork control
10-4-77 sub control

Canonie' QA program does provide for daily lift checks, corrective action and daily reports but does not provide a step by step instruction for inspections in the magnitude of a QCI

? Did cann have a QCI - no (a QA Manual) + Daily, NCR, lift Thick report
Experience of cann inspectors [illegible] civil - [illegible] De Greer
Training program of cann inspectors - one man

8. Canonie Operations: Inspection by Canonie QC not sufficient to assure compliance to specifications. Surveillance by Bechtel QC and Audits by Bechtel QA may not have been frequent enough to assure Canonie placed materials properly.

Supportive Information.

QCI C-1.10 "Earthwork Subcontract Surveillance calls for SI(V) Surveillance Inspections of Subcontract operations on a regular but Not full time basis. QCI approved by CPCo

If this is a cause then one must assume The first line inspection by Canonie QC (full time) was not adequate.

QA audits were done

8-15-75 sub control
8-15-75 earthwork control
8-6-76 earthwork control
9-17-76 Sub control
8-4-77 earthwork control
10-4-77 sub control

Canonie's QA program does provide for daily lift checks, corrective action and daily reports but does not provide a step by step instruction for inspection in the magnitude of a QCI

7. Did canon have a QCI - no (a QA Manual) + Daily, NCR, Lift Thickness report
Experience of canon inspectors (Graduate civil - Jim De Stree)
Training program of canon inspectors - one man

III No requirement to produce monthly summaries of test results for evaluation by Gold/P.E./Geo Tech. Specifically,

- Cubic yards placed / Test frequencies
- % of failing tests
- % of failing Tests not corrected
- Compaction /moisture averages / histograms etc.
- Corrective actions taken on failing tests
- Plots of test locations
- Summary of test results

Backup - lack of reliability of test data?

IV. Testing frequencies /locations of tests under Diesel Generator Building not adequate

Supportive information

- Test plots for top 10 feet under D.G.B. show only one test within the confines of the foundation -

Supportive of III - But would spec. be better written to require test densities.

V Construction sequence and methods resulted in less compacted areas that were not identified by Testing /Inspection or where identified were not adequately reworked /retested

Supportive information:

There was considerable removal of fill for the installation of utilities etc after the initial placement. This increases the chances of pockets of low density materials occurring -

6 In addition to the five above items we must address known deficiencies.

- PSAR commitment to 100% BHP
- FSAR inconsistancies
- Interpretation of Specification C-210
    - ASTM vs BHP
    - Moisture Control
- Design coordination Project → Geo Tech
- Use of laborers to control the work and call for tests without documented training.

D1557. A telecon with Geotech also confirmed that the intent was to use the more conservative method.

2. Justification for clarifications were within the specs themselves, which were not clear to begin with.

M

Bechtel Power Corporation

Interoffice Memorandum

To G. L. Richardson

File No

Subject Response to NRC 50.54 Request, Item 1 Relating to the Diesel Generator Building, Midland Project, Job No. 7220

Date APR 9 1979

From D. R. Johnson

Of SFPD Construction Quality Control

At 425 Market St. Ext 8-0343
32nd Floor D10

Copies to J. L. Newgen
R. A. Simanek
W. L. Barclay ✓

In reply reference:

2-CQC- 402679

Reference: IOM, G. L. Richardson to Distribution, same subject, dated March 29, 1979.

What follows is Construction Quality Control's best effort attempt to prepare replies to those questions which you assigned to the PFQCE in the above referenced IOM:

1. Variance 6, Items 4, 5, and 6

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

The Bechtel construction quality control program of surveillance inspection over work performed by Canonie and inspection over work performed by Bechtel was complied with for the compacted backfill operations at the Midland jobsite. In the case of Canonie, they performed and were totally responsible for their own work, inspection, documentation and quality assurance; all in accordance with their Bechtel approved QA manual. Bechtel Construction Quality Control performed surveillance inspection over Canonie in accordance with FIP C-210 and QCI S/C1.10. As stated in Bechtel's construction quality control program document SF/PSP G-6.1, the purpose of surveillance inspection is to determine if an action has been accomplished or if documents have been prepared in accordance with selected requirements of the contract documents. Surveillance inspection does not mean that all or all of any subcontractor activities are observed for the purpose of determining compliance. Surveillance inspection is intended to provide a degree of added confidence that subcontractor work meets contract document requirements.

ROUTE	QC 07220	INIT.
	PFQCE	
1	A. PFQCE	
2	CIVIL	
	ELECT.	
	PIPING	
	MECH.	
	WELDING	
5	DOC.	
	RECEIVING	
	ADM ASST	
3	Matls. Test Lab Super.	
4	Supple	

OPEN LOOP
☐ YES ☐ NO
DATE..........

RECEIVED
APR 13 1979
QUALITY CONTROL
BECHTEL JOB 7220

8024, REV 1/78

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) <u>Canonie</u>

<u>1975:</u> 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.

<u>1976:</u> 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.

<u>1977:</u> 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) <u>Bechtel</u>

<u>1975:</u> 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.

<u>1976:</u> 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.

<u>1977:</u> 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. <u>Variance 6, Items 7 and 8</u>

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 Canonie 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's 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 eu blish 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 (cohensionless, 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
B
C } Refer to 4A, B, C and D above
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 perfomed 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:

QC Corrective Action Report	Based On
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.

	Opened	Closed	Sent To	On
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.

DR Johnson

D. R. Johnson

DRJ/adm

3-16-79

DRAFT

ANALYSIS OF MIDLAND PLANT AREA FILL

SOIL TEST RECORD:

FINDINGS TO DATE

Prepared by: T. Nehil

The following report is a brief summary of initial findings in the investigation of the Midland Plant Area Fill Soil Test records. The analysis has been conducted by T. Nehil and J. O. Wanzeck. Though a computer aided analysis is being prepared which will be far more extensive, the present findings were obtained merely by scanning the records.

Most glaring is the departure from Spec. C 208 regarding frequency of soil TESTING ~~classification~~. According to this spec., Bechtel Modified Proctor and Relative Density classifications were to be established one per every 10,000 cubic yards of fill, with field density tests being made every 500 c.y. Thus approximately twenty tests should be made under any one classification.

1. RD 24 is referenced 196 times
2. RD 55 is referenced 491 times
3. RD 61 is referenced 574 times $\Sigma = 1,261$

4. BMP 270 is referenced 210 times
5. BMP 271 is referenced 135 times
6. BMP 269 is referenced 217 times
7. BMP 277 is referenced 148 times
8. BMP 278 is referenced 81 times $\Sigma = \underline{791}$

SB 10834

TOTAL 2,052 AVERAGE $\frac{2052}{8} = 256$ TESTS

Thus a relatively small number of classifications were used to represent vast quantities of fill placed. Furthermore, the time span over which a classification was used has been found to be as much as 24 months.

It is assumed that no single stockpile of a uniform soil type was available for borrow for two years straight. This is supported by the misuse of the classifications which result in field relative densities exceeding 100%. For example, 9% of the RD 24 tests show relative densities greater than 105% with the highest value being 131%. RD 61 tests over 105% represent 15% of the total 574, with the highest value obtained being 137%. RD 55 tests with over 105% relative density comprise 51% of the 491 test, i.e., this classification was misapplied more than half the time. The highest relative density obtained under this class was 142%.

Compaction of cohesive soils at times exceeded 105%. In addition, many tests on cohesive soils show combinations of inplace dry density and moisture content which place them outside the zero-air-voids curve for their assigned classification.

The following table illustrates the trend to misapplication of the BMP test classifications:

Soil Classification Number	% of tests over 105% Compaction	% of tests outside zero-air-voids curve
BMP 278	22	51
BMP 277	11	49
BMP 269	1	12
BMP 271	2	30
BMP 270	4	30

There is a tendency for obvious misuse of a classification to appear very early and yet not be flagged. The very first field density test referencing RD 55 shows 119% relative density, throwing doubt on both the in-situ soil and the classification itself. Another, BMP 278, was first used on 4/1/77. All tests in 4/77 were invalid (i.e. outside sero air voids curve or 105% compaction), as were 57% of the tests made in 5/77. Yet the classification was referenced 52 more times over the next 5 months.

Similar patterns are revealed for the other BMP's referenced above, where discrepancies in the use of a classification were apparent almost immediately, yet QC continued to accept all test results.

The wrong pass-fail criterion was used for non-cohesive soils at various times. From the fall of 1974 to the fall of 1975 <u>all</u> relative density calculations were made by dividing the in-place dry density by the mzximum lab dry density. Many of the tests which passed by the above method fail when properly calculated.

For ex ample MD 215 references RD 24 and show a compaction fo 95%, calculated by the wrong method. When recalculated, the relative density turns out to be 72%, failing. This test was used to clear four other failing tests. None of the bad calculations were ever flagged.

NOTES ON PROCTOR DENSITY

The moisture density curve is a result of plotting to suitable scales the dry densities obtained at various moisture ontents used for the trials. It shows that the range of increasing and decreasing densities are due to the water content of the soil. The highest density indicated by this curve for any moisture content is the standard or proctor density; the water content at which this occurs is the optimum water content.

The zero air void curve may be drawn as soon as the specific gravity of the soil is known or estimated. This curve represents graphically the theoretical maximum density that can be produced under a given moisture content.

We reconize the fact that the density obtained by the standard technique is not an absolute maximum, explains the occurrence of field densities higher than this value obtained during construction. Such densities must be secured below the optimum. However, a density that approaches the zero air voids value might theoretically be obtained, but with much more compactive effort.

Example   Specific gravity = 2.63

A cubic foot volume containing 120 lbs. of dry soil is occupied entirely by soil and water. Then the soil occupies 120/62.4 x 2.63 = 0.73 cubic feet. The remainder 1.00 - 0.73 = 0.27^3 must be the volume of water. This water will weigh 0.27 x 62.4 = 16.85 lbs., which when expressed as a percentage of dry soil weight = 16.85/120 = 14.0%. This represents one point on the zero air void curve.

JOW/cf

[illegible]

Bechtel Associates Professional Corporation

Inter-office Memorandum

RECEIVED
JAN 1 9 1979
KARL WIEDNER

To	R. L. Castleberry	**Date**	10 January 1979
Subject	Midland Units 1 & 2-Job 7220-001 Plant Area Fill	**From**	S. S. Afifi
		Of	Geotechnical Services
Copies to	S. L. Blue H. H. Burke/W. R. Ferris w/a P. Martinez w/a J. O. Wanzeck w/a K. Wiedner w/a 1320, 3410	**At**	Ann Arbor 10(D)5 7220-79-3

Attached you will find J. O. Wanzeck's memo in reference to plant area fill placement records.

We feel that further evaluation of these records would be in the best interest of the project. It is possible that some commitments may not have been met. The matter was discussed with K. Wiedner today and it was agreed the task force will work on the subject.

S. S. Afifi

JOW/lap
Attachment

JAN 1 6 [illegible]

JOB 7220				
	ACT.	IN. [illegible]	[illegible]	INIT.
PROJ. ENGR.		2		
ASST. P. E. T		1		[illegible]
ASST. P. E. T				
ASST. P. E. P				
ASST. P. E. F				
MECH.				
ELECT.				
CS				
CIVIL			✓XC	
P.D.				
ARCH.				
Q.C.				
[illegible]				
PROJ. [illegible]				
PROC. [illegible]				
FIELD				
CONST. [illegible]				
[illegible]				
[illegible]				
K Wiedner			✓XC	
[illegible]	0170 ST			

[illegible]638

Bechtel Associates Professional Corporation

Inter-office Memorandum

To	S. S. Afifi	Date	10 January 1979
Subject	Midland Units 1 & 2-Job 7220-001 Plant Area Fill	From	J. O. Wanzeck
		Of	Geotechnical Services
Copies to	S. L. Blue 1310, 3410	At	Ann Arbor 10(D)5

I have made a simple review of the plant area quality control records and the following is a brief summary of this review.

Under specification C-210 as monitored by the field testing specification C-208, the following is offered for further evaluation.

1. Relative density test results were used for density control on Zone 1 soil. Zone 1 is classified as cohesive; relative density is used for granular soils.

2. Maximum density as determined by the relative test was used as a basis for arriving at 95% of proctor density (i.e., $\frac{109.0 \text{ Field}}{114.0 \text{ Rd max.}} = 95.6\%$. In terms of relative density, this would be about 40-50%.

3. Failing tests as determined above were also cleared using the same erroneous procedure.

4. RD #55 ($\gamma_{max.}$ = 109.7 #lbs^3) was used in many cases to check densities. This may have appeared to be the material described, but in many cases, the maximum density was more than 109.7 lbs per cubic foot as evident by other tests and many cases of relative densities exceeding 100%.

5. Some relative density standards along with BMP standards were changed and passing results were obtained (i.e., MD 858, RD #49 @ 66% was cleared by MD 872, RD #41 @ 110%).

On specification C-211 structural backfill, the major fault I can see at this time is that Zone 3 material was used for structural fill. This material (Zone 3) was specified for the sand chimney in the dikes and has a different gradation than was called for in C-211. I believe that this material is suitable, but it may have a conflict as far as the FSAR is concerned.

We can see from these observations that the findings from the administration building may hold true for other areas of the plant fill. It also indicates the testing lab may not have always had qualified supervision.

I have not yet completed all studies that I am doing but I want to keep you aware of my progress.

JOWanzeck

J. O. Wanzeck

[illegible]

D1556 – No impact }
D1557 – No impact } "zero air voids"

<u>D2922</u>

3.2.1 "... Because of the variability and scatter inherent in field tests, the technique of comparing average in-place density ~~determination~~ determined in the field by sand-cone or rubber-balloon methods with the nuclear methods at the same locations is considered less accurate than techniques using blocks or prepared containers."

3.3.1 — Provides a method for adjusting calibration curves using sand density tests. (3-5 lbs ±, no correction. 2lb + or 2lb −, make correcti

4.3 – Precision statement. Generally provided by manufacturer. ($P = \sigma/s$, where P = precision; σ = std. deviation; and s = slope, cpm/pcf) Allows $P \leq 1.25$ lbs/ft^3

<u>Appendix A</u>, A1.5 —
"... It is believed, however, that if the procedures herein are carefully followed, the standard deviation of the nuclear measured values, in terms of accuracy, will not be greater than on the order of some 3 to 5 lbs/ft^3 while in terms of precision or repeatability, determined without moving the test equipment, this should not be greater than on the order of 1 lb/ft^3.

A 1.7 —

Advantages

- "Relative ease with which the test can be performed..."
- "If information is sought on in-place densities only, and test determinations of maximum density are not involved, many more tests can be performed per day than by the older [sand density/rubber balloon] ~~meth~~ methods."
- ... apparently erratic measurements can be immediately detected and checked since the nuclear tests are more nearly nondestructive.

Disadvantages

- "...Sacrifices the opportunity to examine the soil in depth

G. Richardson

→ c: ~~SHAF~~ AFIFI

Bechtel Power Corporation

Post Office Box 2167
Midland, Michigan 48640

RECEIVED
MAY 02 1979
KARL WIEDNER

April 25, 1979

U. S. Testing Company
1415 Park Avenue
Hoboken, New Jersey 07030

Attention: Dave Edley

/ FILE
TASK GR
7220-101

Job 7220 Midland Project
Subcontract 7220-C-208
Meeting Notes
C-208-B-364

Dear Mr. Edley:

Attached for your information and files please find one copy of meeting notes for the jobsite meeting held on Monday, April 9, 1979, at Hoboken, New Jersey.

Very truly yours,

J. F. Newgen
Project Superintendent

JFN/LFS/DLP/km

Attachments

RECEIVED
ANN ARBOR
QUALITY ASSURANCE
MAY 1 '79

Route	Info.	Act.	Copy 1e
QA MGR.	X		
~~QA Orient~~			
FQAL 7220			X
LQAE 7220			
FQAE 2912			
MQAE 12467			
PQAE 12179			
GC			
QE			
PSQD			
MARTINEZ			X
WIEDNER			X
SFPO QA MGR.			
QA SEC'Y			
FILE NO.			

P. BECNEL X

[redacted]

MEETING NOTES

U. S. TESTING, CONSUMERS POWER COMPANY AND BECHTEL POWER CORPORATION

DATE: April 9, 1979

PLACE: U. S. Testing Headquarters, Hoboken, NJ

SUBJECT: See Below*

ATTENDEES:	E. Basile	U. S. Testing Company
	E. Zadena	U. S. Testing Company
	E. Edley	U. S. Testing Company
	M. Anzelmo	U. S. Testing Company
	J. Speltz	U. S. Testing Company
	B. Marguglio	Consumers Power Company
	D. Worn	Consumers Power Company
	R. Wheeler	Consumers Power Company
	D. Palmer	Bechtel Power Corporation
	G. Richardson	Bechtel Power Corporation

I)* Ben Marguglio opened the meeting by establishing the following agenda:

1) Describe the problems relating to the Midland soils problem.

2) What U. S. Testing thinks may be the problem: where did U. S. Testing contribute to the problem?

3) What did U. S. Testing say to the NRC during the NRC investigation.

II) Ben Marguglio presented the following to describe the types of problems:

1) Inconsistencies in the SAR

2) SAR Requirements not translated accurately/clearly into the specifications.

3) Requirements for testing were not totally stated. Callout for proctor not total story.

4) Interpretations were varied and not released through normal specification channels.

5) Client suspects there was not a total understanding of the process by any one individual. Lack of expertise.

6) There may have been incorrect proctor selection.

7) There may not have been timely corrective action in identifying the extent of the problem and identification of the problem as opposed to fix.

[redacted] 1

8) Accountability for inspection may have been lacking.

Who inspected
What inspected
How inspected, etc.

9) U. S. Testing may have utilized to a sampling process without sufficient historical background on the process.

10) U. S. Testing may have failed to qualify the test or the inspection process.

Ben added that all of the above contributed or could have contributed to the problem.

III) The main discussions during the meeting centered around the above. The following is a brief description of the important points of this discussion.

1) Ben discussed the conflicting test methods in specification C- 210 and asked what U. S. Testing did to assure themselves that they had a clear Specification to work to.

U. S. Testing responded that their direction to use Bechtel modified proctor came from Bechtel as did direction of when to take moistures. There was nothing in writing - direction was verbal.

U. S. Testing added that it was not their responsibility to determine when or where to take a test.

U. S. Testing clearly stated that U. S. Testing responsibility was for performing the testing and not to inspect as to where and when testing is to be performed - this is a Bechtel responsibility.

Question by Don Horn concerning moisture, compaction, and fitting of sample to the proper proctor was directed to U. S. Testing. Inherent error and judgement could be highly contributary factors in giving the wrong result.

U. S. Testing stated that variables exist within a soils testing program that can cause erroneous data. U. S. Testing suggested that the testing agency be given more autonomy in making decisions. It was suggested that possibly the testing agency would serve best if it were responsibile directly to the Client.

Ben stated that on Consumers Power Company jobs (future) he expects U. S. Testing to assure that specification interpretations/changes are obtained officially - and added that U. S. Testing Q A should not allow this to happen.

U. S. Testing responded that their Contract does not provide for this type of QA involvement.

2) Ben asked what type of mechanism U. S. Testing used to determine when a new proctor was required.

U. S. Testing responded that this was (is) normally triggered by the lab technician during selection of the proctor in response to a field test.

U. S. Testing added that there are no procedures to cover this operation; that it is a judgement operation that would be difficult to procedurize.

Ben summarized the problem of direction during testing as being unsatisfactory and a more stringent direction process between Contractor and Subcontractor would be required, particularly that any change in test or specification changes must be received in writing prior to implementation.

3) Ben asked who notified U. S. Testing when a new proctor was needed.

U. S. Testing responded this was an ongoing item and proctors were taken as a regular thing and were taken at material changes and new borrows - again there were no procedures.

U. S. Testing stated that they could not remember ever being requested by Bechtel to take a sample specifically to develop a proctor.

U. S. Testing added it was not their responsibility to maintain the test frequency and that they were not privileged to quantity information.

Question of frequency revealed that:

1) 10,000 yard frequency test was not accurately followed as related to exact yardage being moved but was an ongoing check basis based on frequency roughly correleted with yardage - this was done because exact yardage movement was not immediately available to prompt the precise frequency implied by the specification.

U. S. Testing added they felt that they did more than their Contract required in:

Determining new sources and material changes where new proctors are required.

Selection of the appropriate proctor to compare to the field density.

Over involvement with Canonie.

4) Ben asked how U. S. Testing identified the proper curve to use when the curve may be six months old.

U. S. Testing responded, they kept approximately 15 samples to be used.

[redacted]

Ben inquired what the field procedure was in determining when a new proctor is needed. U. S. Testing responded that:

1) Judgement factor by experienced field personnel determines a large portion of the decision.

2) If characteristics changed, or a new borrow was started then an additional proctor would be made .

Ben added following statement:

> For Consumers Power Company projects U. S. Testing should take the attitude that, in the absence of a controlled single source or specific designation for a change in soils, the most conservative approach should be taken.

5) General discussion on testing calculations:

   A) Some conflicts noted in D. Horn's audits - U. S. Testing should consider.

   B) All test reports submitted to Bechtel Q. C. for review - does not include actual calculations.

   C) There normally was not a plot of field test results on the proctor curves - no comparisons to zero air-voids curve.

   D) If test plots on wrong side of zero air-voids curve there is an error (per D. Edley).

   E) Errors are inherent in test methods being applied:

   Troxler has ± 3% error.

   Results are conservative.

6) Ben asked what U. S. Testing thought might be the problem - U. S. Testing had no input.

7) Ben asked if U. S. Testing had recommendations for future work - U. S. responded:

   A) Take a look at the role you want the test lab to perform.

   B) U. S. Testing added that it was Bechtel's responsibility to determine when a new proctor is needed.

   C) Review area of what is acceptable material.

Ben requested that U. S. Testing provide Consumers Power with testimonial information that was provided to the NRC during the interviews covering the soils investigation at Midland.

[redacted]

U. S. Testing inquired whether Bechtel would object to this release. Bechtel Subcontracts representative stated that there would be no objection.

The dialogue of these interviews is attached.

Prepared by:

For KRA
David L. Palmer 4-26-79
David L. Palmer Date

NRC DIESEL GENERATOR BUILDING SOILS INVESTIGATION
at the Midland, Michigan, Project Site

Interviewers: Gene Gallagher, NRC Soils Specialist
G. A. Phillip, NRC Investigation Specialist

Interviewee: John Speltz, U.S. Testing Site Project Supervisor

The following notes were generated from notes taken by John Speltz during an interview in the Consumers Power Company conference room on 12/14/78.

Q.) Did you see a conflict in C-210 (earthwork specification) between BMP (Bechtel Modified Proctors) and ASTM D-1557?
A.) Yes, there was an area of concern in section 13.

Q.) What criteria were you working to?
A.) The BMP, as indicated on our reports.

Q.) What is your period of activity on site?
A.) Since December, 1976.

A letter to Church (Subcontracts) from Valenzano (Engineering) of 6/10/74 was shown. Section 13.7 of C-210 was pointed to in the letter.

Q.) What does modified Proctor mean to you?
A.) ASTM D-1557 modifying ASTM D-698.

Q.) Do modified Proctor, BMP, and D-1557 mean the same?
A.) No.

Q.) Does BMP and modified Proctor mean the same?
A.) No.

Showed telecon Hook (Bechtel Q.A. onsite) to Rao (Ann Arbor, Project Engineering), October, 1977, and telecon Teague (Lead Civil Field Engineer) to Rao, October 10, 1977 (copy attached), noting that either D-1557 or BMP can be used.

Q.) What was your source of direction on this?
A.) Verbally, as mentioned in a note on top of the original of the telecon.

Q.) Do you feel Hook or Teague were responding to you (John Speltz)?
A.) No, not to me directly.

Q.) Who would respond to you with this information?
A.) Bechtel Q.C.

Q.) Why is the response so late? → ref: Oct 10, 77 date
A.) I have no information on that.

Q.) Were there other areas where soil work was going on?
A.) What work are you referring to?

[redacted]

Q.) Were there Q.A. problems in soils at that time?
A.) I believe that Bechtel Q.A. and Consumers Power Company Q.A. were active in soils during this time period (fall of 1978), but I have no specific recollection.

Q.) Is the BMP and type of materials specified for the Diesel Generator fill normal for construction?
A.) I had no interface with Project Engineering and Design.

Showed QCIR SC-1.05 (a Bechtel Q.C. report form).

Q.) Are you aware of Q.C. field activities and responsibilities in soils?
A.) I am aware that they have a program and functions to fulfill, but not of their specific requirements.

Q.) Do you think that Canonie was aware of the specification for compaction and what it was being tested for?
A.) I have no specific knowledge, but assume that they were aware of their job requirements.

Q.) Was Bechtel working soils in addition to Canonie during this time period (1977)?
A.) Yes.

Q.) When did Canonie quit working?
A.) In 1977, there was a big push to be off site for deer hunting season which began November 15th.

Q.) Why are you working to D-1557 now?
A.) Q.C. direction with a memo from Cheek to Siple of 9/29/78 (copy attached).

Q.) What is random fill?
A.) It could be any of several types of material.

Q.) Why would they call random fill just clay?

Cheek to Siple memo was shown. The statement "Random Fill (Clay)" was pointed out.

Q.) If it could be other materials, why would he (Cheek) define it as clay?
Q.) Did he know the difference?
A.) My interpretation of this memo was that it was addressing testing and that he was distinguishing test procedures for granular vs. cohesive soils.

Q.) Do you have anything you wish to add to this discussion?
A.) No.

[redacted]

Bernie Thompson & Roger Smith
NRC Interviews of 1-22-79 & 1-23-79
Same day - validity was established?!

Q.) Was it difficult to determine what proctor value to use by comparison to the jar samples?
A.) No

Q.) Who gave you the locations and elevations for the tests?
A.) Generally the labor foreman or sometimes the laborers.

Q.) Who selected the site for the test?
A.) The laborers would prepare the site of the test where the foreman selected most of the time. In some instances we would select the exact site in the general area for which the test was requested.

Q.) How often were either Q.C., or Engineering present at the time of the test?
A.) Very seldom.

Q.) Did Q.C. do surveillance on your test activities in the field on a regular basis?
A.) No, not that we were aware of.

Q.) How often did they observe you doing the tests?
A.) Very seldom.

Q.) Do you know what their requirements are for surveillance of soils?
A.) No. I have not had access to that information.

Q.) Were they short of people to do this work?
A.) I cannot answer that question.

Q.) Did they have qualified people for this work?
A.) I cannot answer that question.

Q.) Who was in charge of soils for Q.C.?
A.) Primarily, Daryl Osborn.

Q.) Did he have other responsibilities besides soil work?
A.) Yes. To the best of my knowledge, he had other areas of responsibility.

Q.) Were there grade stakes available for elevations?
A.) Very seldom.

Q.) How were elevations determined?
A.) Mostly from nearby buildings where elevations were written on the walls.

[redacted] 1

Q.) Were locations established by the use accurate measuring devices?
A.) No. They were usually by walking off from a wall or just eyeballing the distance.

Q.) Were lift thicknesses measured?
A.) Not in my presence.

Q.) Were the areas free of debris prior to the placement of fill material?
A.) I cannot answer that question.

Q.) Did Q.C. make sure that areas were free of debris before placement?
A.) I cannot answer that question.

Q.) How were retests done? Did they (Bechtel) supply you with a sample?
A.) Retests were taken by a technician as close to the original test as possible at the request of Bechtel when they felt the area was ready for a retest. No, Bechtel did not supply us with a sample.

Q.) Was special attention given to test areas?
A.) Yes, although not a common occurance, I did feel that special attention was given to test areas on certain occasions.

Q.) Can you recall such occasions?
A.) Yes.

Q.) Would you discribe such instances?
A.) Roger spoke of a test on the 30" SWI discharge line. Bernie mentioned a test in the same area.

Q.) Did the foreman asking for the tests know the requirements for the frequency of tests?
A.) I cannot answer that question.

Q.) Were lift thicknesses reasonable or were they excessive?
A.) Generally yes, however there were occasions that they were not.

Q.) How was the moisture controlled prior to placement?
A.) Prior to August of 1977, there was no control of moisture prior to placement. After that date until the spring of 1978, one moisture was taken in the morning from the stockpile.

Q.) How was the moisture reported?
A.) The moisture was given to Q.C. and Engineering.

Q.) Was the moisture associated with a proctor value?
A.) No, it was not at this time.

[redacted]

Q.) Were there more than one proctor used during a days production?
A.) Yes.

Q.) Were additional moistures taken for these proctors?
A.) No, not at first. Later the conditions changed.

Q.) What happened after the spring of 1978?
A.) A number of changes transpired in the moisture control via letters from Bechtel personnel. The last letter for direction to U.S.T. was from Rao in the spring of 1978. Most of this correspondence was generated from questions we presented to Bechtel concerning the moisture control.

Q.) Do you have a copy of this letter?
A.) Yes.

Q.) Can we see this letter tomorrow?
A.) Yes.

Q.) Did you feel there were similar problems with soils concerning the Administration Building.
A.) Yes.

Q.) At that time did you feel there were problems with other buildings on the site?
A.) I would say no, based on the fact that most of the other major structures were done or well under construction and there was no other similar circumstances of settling of structures known at that time.

Q.) Was there a difference between Bechtel and Canonie operations?
A.) Yes.

Q.) What were these differences?
A.) Canonie Q.C. Engineer, Gene DeGeer, gave locations by coordinates paced off from grade stakes and elevations by use of a hand level and engineers rule from grade stakes. Canonie also had much heavier equipment to work with.

Q.) Was placed material ever removed and placed at another location?
A.) Yes.

Q.) Who did you report test failures to?
A.) Primarly to Bechtel labor foreman until the use of the test failure stamp was started in the fall of 1977, then they were reported to Engineering and Q.C.

[redacted]

Q.) Who did you interface with in C.C. and Engineering?
A.) In C.C., it was Daryl Osborn and Steve Gilnett. In Engineering, Jerry Morris and Gary Coaster.

Q.) Who were the Bechtel foremen?
A.) Barney J., Mike Davis, Roger Ott, Scott Haney.

[redacted]

bc:
J. Milandin w/Att
P. A. Becnel w/Att
K. Wiedner w/o
S. L. Blue w/o
R. Hermeston w/Att
J. O. Wanzeck w/o
J. F. Newgen w/Att
L. A. Dreisbach w/Att
T. E. Johnson w/Att
R. L. Castleberry w/o

001719

August 10, 1979

BLC-7993

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

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

Dear Mr. Keeley:

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

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

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

Very truly yours,

/S/

P. A. Martinez
Project Manager

PAM/pp

001719

MIDLAND UNITS 1 & 2
JOB NO. 7220

REVIEW OF U.S. TESTING FIELD AND LABORATORY CONSTRUCTION TEST DATA ON SOILS USED AS FILL

BECHTEL ASSOCIATES PROFESSIONAL CORPORATION
July 1979

~~8106090636~~

TABLE OF CONTENTS

REVIEW OF U. S. TESTING
FIELD AND LABORATORY CONSTRUCTION TEST DATA ON SOILS USED AS FILL

001719

This review of the quality control tests of the earth fill at the Midland Site was made as a result of settlement of the fill supported diesel generator building in excess of that predicted. Soil samples obtained in borings indicated that soil conditions beneath the plant structures are not compatible with the quality of fill that could be expected based on the results of the control tests made by U. S. Testing Company. All fill was accepted as it was being placed based on the results of the field tests performed by U. S. Testing Company.

The review showed many discrepancies in the test results as outlined in the following paragraphs. Review comments are based on the requirements of the technical specifications for fill placement and to subcontract entered into by U. S. Testing Company.

1. Use of Laboratory Test Compaction Curves

Table 9-1 of specification 7220-C-208, Page 14B required one field density and moisture content test be taken for each 500 cubic yards of fill placed. It also required one compaction, grain size, and specific gravity for each 10,000 cubic yards of material. This gives a ratio of 20 field density tests to 1 laboratory compaction test. Although 20:1 is not a strict upper limit, it is a guideline; should density tests be taken more frequently than one per 500 cubic yards of fill the ratio could be higher. The actual ratio is shown in Table A attached. In fact, some of the laboratory compaction tests were used to determine percent compaction for several hundred field density tests taken over a period exceeding two years. Even though no time requirements for the period of use of laboratory tests are specified, it is unlikely that any borrow source in this area would be of such uniform character that such extended use of a compaction curve, truly representative of a large quantity of material, would be applicable. Listed below are selected laboratory test data results indicating the wide range of soil properties that were reported. Such a wide range is typical for soils of the kind used in the fill making prediction of maximum density, based on visual inspection extremely difficult if not impossible without testing.

TEST	MIN. DENSITY (lbs/Ft^3)	MAX. DENSITY (lbs/ft^3)	OPT. MOISTURE (percent)
*BMP269		127.3	10
*BMP278		117.0	15.2
*BMP279		140.8	5.7
**RD24	100.9	119.2	
**RD55	90.2	109.7	
**RD61	109.3	125.3	

*BMP refers to proctor type test.
**RD refers to relative density test run by dry method.

2. Questionable Retests

A field density test that fails to meet requirements of the specification should have been reported to Bechtel who then would have required reworking of the area and retesting.

Of the 668 "failing" tests which were marked "cleared" by another test, in over 10% (72 tests) of the results, the clearing of the "failed" density test was apparently resolved by merely using another laboratory compaction curve with either lower maximum density, which resulted in in the percent compaction being increased sufficiently, or different optimum moisture content which caused the fill to meet the requirements of the specification. The possibility exists that soil was removed after a "failing" test and replaced by different material, but the records do not indicate this and it is not possible from the record to determine if a new density test was made. In other cases, tests labeled "failed" were incorrectly cleared though the same laboratory standard was referenced. For example, in some cases retests to clear a "failed" test were not taken in the same area or at the approximate same elevation. More than 40 retests were over 20 feet from the "failed" test location (as recorded in the test reports) and some were over 200 feet from the original test location. In general, if after a "failing" test the whole area is reworked, the density test location is not too critical assuming that the correct laboratory compaction curve is used for comparison. However, in the plant fill work areas were relatively small, and soil characteristics showed considerable variation necessitating retesting in the immediate vicinity of the "failing" test. Retest should be taken in the lift or soil layer that has been reworked. Almost 50 retests were taken at different elevations, some up to 10 ft. from the "failed" test. It should be noted that Bechtel field personnel gave the locations for retesting. This was not a U. S. Testing responsibility. Two retests were dated prior to the time the original test "failed". Over 130 "failing" tests were marked as ("non Q") and never recorded cleared, as they were outside the saftey related area.

Table B is a compilation of notes relative to questionable clearing of failed tests.

3. Theoretically Impossible Test Results

Soils cannot be more than 100 percent saturated; therefore, all field density test data points, when plotted as dry density versus moisture content, must be below the zero air voids curve as defined by the specific gravity of the material. Specifications do not require examination of the zero air voids curve, but it is considered common practice relative to compaction plots. There are numerous cases in the U. S. Testing Company data where points plot above the zero air voids curve. Figure 1 attached shows a typical laboratory compaction test curve with field test results plotted on it. Many of the field test results are to determine percent compaction plot above the zero air voids curve. Provided the specific gravity is correct this is not possible so that all such points must represent erroneous data.

The fact that a large number of test results plot above the zero air voids curve tends to make all test results questionable.

Also, referring to Figure 1 it would appear that soil density varied widely. Specifications called for compactive effort results as defined by ASTM D 1557 which is 56,255 ft-lb/ft^3 energy. This was modified to a laboratory test compactive effort of about 20,000 ft-lbs/ft^3 energy, often referred to as Bechtel Modified Proctor (BMP). Laboratory compaction test curves should be related to the same effort as that called for in the field for use in comparing with field density tests to determine percent compaction. According to plots of field data shown on Figure 1, density varied from about 108 lb/ft^3 to about 130 lb/ft^3. It is doubtful that the soil classification or other properties would be similar for such a wide variation in density. It is noted that 100 percent of modified Proctor (ASTM D 1557) which is difficult to obtain, is rated at 56,255 ft-lb/ft^3 energy. The curve plotted on Figure 1 is at about 20,000 ft-lb/ft^3 energy. For comparative purposes it was determined by U. S. Testing in 1974 that 100 percent of specified effort (20,000 ft-lb/ft^3) is approximately equal to 95 percent of the maximum density as determined by ASTM D 1557 (56,255 ft-lb/ft^3) Reference Figure 8.

4. Repeated use of Questionable Laboratory Test Data

Some laboratory compaction test data were used repeatedly even though they continued to show suspect field test results. This could be indicative of questionable laboratory data or the fact that soil was not being placed or compacted according to specifications. Either case is a cause for concern.

Several specific gravity calculations are in error, such as for BMP 273 and 274. In the case of BMP 273, the zero air voids curve passes through the laboratory compaction curve. In another example, BMP 297, the laboratory compaction curve is invalid due to calculation errors, yet was referenced by field density tests 22 times.

Table C is a compilation of notes relative to questionable test data.

5. Limits of Accuracy and Acceptability for Test Data

Figures 1 through 7 attached will be referenced in discussing limits of accuracy of acceptability for field test results as compared to laboratory test data. The figures show plots of compaction data for BMP 278 which are typical of all test results.

Specified laboratory compactive effort was 20,000 ft-lbs/ft^3 and field compaction effort was originally specified at 56,255 ft-lbs/ft^3 but was changed by Revision 5, dated 7/8/75, specification 7220-C-210, Section 13.7, Page 57 to also be equal to about 20,000 ft-lbs/ft^3.

The specified 20,000 ft-lbs/ft^3 effort establishes a compaction curve relating moisture and density for a specific soil. Moisture was specified for field placed fill to be within ± 2 percent of optimum moisture as determined by this effort. Density was specified to be greater than 95 percent of the maximum density. As compactive effort is increased in the laboratory test, maximum density will be increased and optimum moisture content will decrease. This change can only occur in the field to the extent that the field moisture content will permit it. Once field compaction is such that the fill density is significantly higher than about 105 percent of maximum, the specified tolerance from optimum moisture content in the laboratory compaction test may no longer be applicable for field control. A + 2 percent numerical value of moisture content acceptable at the specified compactive effort would be too wet at a higher effort since the zero air voids curve defines the absolute maximum that can be achieved, indicating that higher densities for that soil are impossible. Therefore, if the record shows high densities for such material, the data are in error. This was apparently overlooked.

Plots of field data for compaction test BMP 278 are shown on Figures 1 through 6. The title of each figure gives the assumptions made in plotting data for the figure. In comparing figures 3 and 4 it is seen that a majority of field tests were made using the nuclear device. The two test results shown on Figure 4 for the sand cone method indicates one test result on each side of the zero air voids curve. The one falling above the zero air voids curve (shown on Figure 4) is designated by U. S. Testing Company as the only passing sand cone test (shown on Figure 6).

For a field test result to be valid as well as "Passing" it must fall within a well defined area on the plot containing the laboratory compaction curve. This area or window of acceptability is shown for a hypothetical compaction curve on Figure 7a that would meet requirements of Specification 7220-C-210. It is defined by horizontal lines at 95 percent and 105 percent of specified density, vertical lines through ± 2 percent of optimum moisture content, and a line parallel to the zero voids line indicating saturation about half way between the compaction curve and 100 percent saturation (zero air voids curve). The practical upper limit of 105 percent of specified density is not defined in the specifications. It was arbitrarily chosen as numbers greater than this give increasingly invalid comparisons between field test results and the specified laboratory compaction test curve. Therefore, if all data points fall within the defined window there would be no reason to assume that they are wrong. However, when many data points fall outside the designated area there is something wrong with the information and then all data points become suspect. A review of all data indicates that about 25 percent of the cohesive soil test results fall within this area.

Figure 7B shows an area where field test results would be acceptable, in theory even though not in strict accordance with the specifications. Figure 7B was arrived at by expanding Figure 7a to include test results up to a compactive effort related to ASTM D 1557 (56,255 ft-lb/ft^3) which is considered to be a practical upper limit. About 40 percent of all cohesive soil test results would plot in this area.

6. Accuracy of Test Equipment

Almost all (over 95%) field density tests on cohesive soils were made using the Nuclear Density device. Specification 7220-C-210 section 12.4.2 page 42 indicates this to be acceptable for moisture content determination provided that the results are compatible with those obtained by ASTM D 2216. Similarly, section 12.4.4 says density determined by the nuclear device is acceptable when results are compatible with density as determined by ASTM D 1556.

In a letter from U. S. Testing to Bechtel (dated May 30, 1974), the average deviation of the nuclear device from oven-dry moistures was +.12% for a set of 30 tests. However, the standard error of estimate is 1.8% for the data with the range of differences being from - 3.2% to +3.9%. Thus, accuracy of the nuclear device is questionable, and could translate into errors of about ± 4 pcf in the dry density calculation. (It should be noted that errors in the moisture content tend to shift the position of test results on a moisture density plot approximately parallel to the zero air voids curve, assuming the in-place wet density is correct, and thus do not explain the large number of points which plot outside the zero air voids. Compare Figures 1 and 9).

No reliable correlation between sand cone and nuclear density tests were carried out therefore there is no basis for determining if U. S. Testing would have performed better using the sand cone procedure.

However, it is clear that a large number of the nuclear density tests are wrong. This can be explained by considering the wet unit weight may have been wrong or both the moisture content and unit weight may have been wrong. A reliable correlation with properly conducted sand cone tests should have revealed this, but it was not apparently done.

7. Relative Density Tests

Cases were noted where densities in material classified on the data sheet as zone 3 (sand) were compared to the maximum densities in proctor type tests and other cases where densities in clay soils were compared to the maximum density in relative density tests. An error must exist in the record in such cases either in the classification of the soil on data sheet or in comparing field test results to inappropriate laboratory test data. In general, it appears that relative density tests were used in controlling density of sand fill. There were a significant number of arithmetic errors on calculation sheets even though there are signatures on the sheets indicating they had been checked. Over 100 errors were found in calculations, of relative density from 8/15/79 through 12/78 (not all of these errors change the acceptability of the test results).

ASTM D 2049 section 7.1.2 Wet Method states: "Note 1 - While the dry method is preferred from the standpoint of securing results in a shorter period of time, the highest maximum density is obtained for some soils in a saturated state. At the beginning of a laboratory test program, or when a radical change of materials occurs, the maximum density test should be performed on both wet and dry soil to determine which method results in the higher maximum density. If the wet method produces higher maximum densities (in excess of one percent) it shall be followed in succeeding tests." An example of wet and dry relative density is shown on Figure 10. U. S. Testing Company apparently did not do this frequently enough, or on a broad enough range of non-cohesive soil types. As a consequence many field density test results exceed 100 percent of maximum dry laboratory relative density. As an example, for laboratory test RD55 a total of 566 field tests were made. Of this total, 364 tests were greater than 100 percent compaction. The highest relative density found was 142.2 percent with the majority of tests over 100 percent falling in the range of 100 percent to about 130 percent. Since the difference in maximum density between wet and dry methods is about 4 to 5 lbs/c. ft. (based on recent data) any test result greater than about 115 percent (based on the dry method) is suspect.

Even if the wet laboratory test method data were available for all sands, it appears an unacceptably high number of field test results would greatly exceed 105 percent relative density even based on the wet maximum.

8. Summary

In summary, there are five major faults contained in the Midland Compacted Fill Density Test Reports as follows:

1. erroneous field density test data.
2. incorrect soil identification
3. incorrect (or questionable) laboratory test data.
4. calculation errors
5. improper or incomplete clearing of "failed" tests.

Items 4 and 5 represent existing faults in the data which could be corrected. However, as a result of items 1 through 3, there is no rational means of determining which test results are valid and which are not. Since more than one half of the test results for relative density and percent compaction fall outside the possible theoretical comparison limits, it must be concluded that these test results are suspect and should not be used alone for acceptance of plant area fill. Therefore, other means of testing have been established and employed to determine if the fill in any given area is acceptable.

Also in item 4 it should be noted that on many occassions the inplace density was divided by the maximum density from the relative density test to get percent compaction, these tests were also used to clear other pricing tests.

TABLE A

Listing of All Classifications Referenced in Plant Area Fill Soil Test Records Which were Used for 20 or More Field Density Tests

Classification	No. of Tests
B200	90
B251	31
B252	22
B254	42
B255	57
B260	68
B261	36
B262	165
B269	227
B270	226
B271	141
B274	37
B276	21
B277	158
B278	82
B297	22
R015	20
R016	61
R024	248
R030	54
R035	59
R038	39
R039	28
R040	35
R041	69
R042	103
R043	48
R044	71
R045	43
R049	63
R054	118
R055	566
R059	65
R061	589
R063	42
R065	59

Note: Spec. 7220-C-208 gives a ratio of approximately 20 field tests to each laboratory test.

TABLE B

Notes on Questionable Clearing of Failed Tests

1. Test number MD 245 fails due to high moisture. Cleared by MD 246 which references a proctor with higher optimum moisture content (OMC) such that the ±2% of optimum requirement is met.

2. MD 205 fails with moisture content 6% above the OMC. Cleared by MD 215, which references a relative density lab standard, and is itself still 6% away from the OMC of the proctor referenced by MD 205.

3. MD . 223 fails because of high moisture. Cleared by MD 228 which has actually a higher moisture content and lower density, but references a different proctor; the retest passes and clears the failure.

4. Both MD . 844 and 886 fail because of high moisture and low density. They are cleared by MD . 888 which references a new proctor with lower maximum density and higher OMC than the first.

5. MD 251 fails due to moisture being too high. Cleared by MD 253 which uses a higher OMC proctor.

6. MD 668 clears MDR 634, but the two tests show no correspondence in location, moisture, density, or lab standard.

7. MD 771 failed, being too dry. Cleared by MD 782, which has almost identical moisture content and dry density but uses a new BMP with lower optimum moisture.

8. MD 2384 clears MD 2342, referencing a different proctor with an OMC which fits the in-situ conditions. However, the dry density of MD 2384 is way too high to fit the original soil classification, and in addition, it falls outside of the zero air voids curve for the classification which it has been changed to.

9. MD 556 clears MD 554 by using a BMP with lower moisture requirements. The field densities differ by 24 pcf and would seem to be different material.

10. MD . 558 clears MD 555 but has too high a density to be the same soil as MD 555. It also uses a different proctor.

11. MD 566 and 568, classified as BMP 262 cohesive soils, are cleared by MD . 569 which is classified as RD 33 and has totally different soil properties than the two failures.

12. MD 1317, 18, 19 and 20 fail and are all cleared by MD 1477 taken over 5 weeks later. There is poor correspondence in the soil properties and the proctor is different from failing to passing test.

13. MD 2965 clears MD 2963 with a different proctor through the test results would have been passing with the original BMP.

14. MD 1388, classified as BMP 278, is cleared by MD 1461, classified as RD 55.

15. MD 170, classified as RD 24 is cleared by MD 173, classified as BMP 234.

16. MDR 287 fails with a relative density of 77%. Cleared by MDR 291 which has .1 pcf lower density but arbitrarily rounds up the relative density to 80%; it passes and clears the failure.

17. In all of the following field density tests on sand, the passing test has approximately the same or lower density than the failures, but references a lower maximum density RD lab standard:

    MDR 343 clears MDR 339
    MDR 514 clears MDR 507
    MDR 513 clears MDR 508
    MDR 515 clears MDR 509
    MDR 516 clears MDR 510
    MDR 522A clears MDR 521
    MDR 558 clears MDR 556, 557
    MDR 480 clears MDR 473
    MDR 555 clears MDR 525, 527, 534
    MDR 533 clears MDR 526, 530, 531

18. MD 2384 clears MD 2342, but is at 7' lower elevation.

19. MD 123 clears MD 122, but is at 10.5' lower elevation.

20. MD 149 clears MD 142, but is at 10' higher elevation.

21. MD 1694 clears MD 1693 but is 43' away from the site of the first test.

22. MD 3114 clears MD 3102, but the two tests are 68' apart.

23. MD 186 clears MD 183 though it is 110' away.

24. MD 1209 clears MD 1207 and MD 1205, yet is 183 ft. away from the failures.

25. MD 1097, dated August 4, 1977, cleared by MD 1048 dated July 16, 1977.

Note: This table gives typical observations and is not meant to be all-inclusive.

TABLE 6

Notes on Questionable Test Data

1. The first field density test to reference RD 24 (5/75) has a relative density of 170.6%. The standard continued to be used, however, with relative densities greater than 100% occuring repeatedly.

2. Similarly for RD 30, the first two tests (9/75) have 114% and 122% relative densities, yet the standard was used for 10 months, 54 tests, with 52% of the results over 100%.

3. During the first two weeks of use (7/76), RD 41 was referenced 22 times with 12 tests over 100% relative density (6 tests over 110% and 3 over 120%). The standard was used for 5 months, however, with over 40% of the results over 100%.

4. The first test using RD 55 (8/76) has a relative density of 119%, with the field test being made the same day as the standard and, thus, assumedly the same material. These results would throw doubt on the lab standard, yet it was used for two full years and 566 tests, with 64% of the results over 100% relative density.

5. Even high density structural backfill standards such as RD 61 (maximum density of 125.3 pcf), used 593 times, show over 25% of the tests having greater than 100% relative density.

6. The first seven tests referencing BMP 269 (scattered over a two month period around 7/76) <u>all</u> fall outside the zero air voids curve. This classification was used for 1 1/2 years, referenced 227 times.

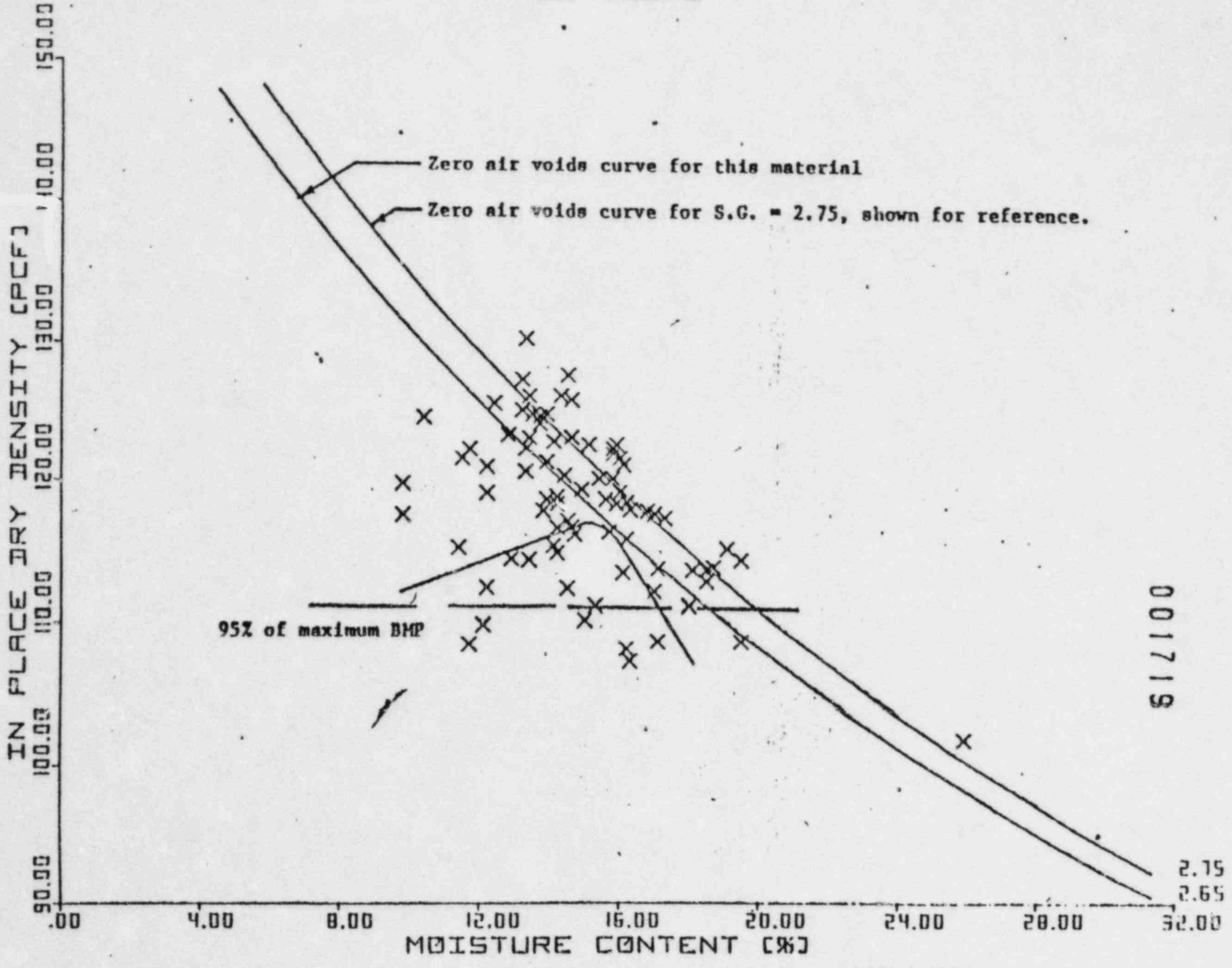
7. The first two tests referencing BMP 270 (7/76) fall 6 pcf above the zero air voids curve. Continued use of this proctor for over 2 years resulted in 226 tests with 82 outside the theoretical maximum.

8. For the first month (4/77) all BMP 278 tests fell on or outside the zero air voids curve. For the next month, over half the tests did the same, or have greater than 105% compaction. The standard was used over half a year, with 43 out of a total of 82 tests outside the zero air voids curve.

Note: This table gives typical observations and is not meant to be all-inclusive.

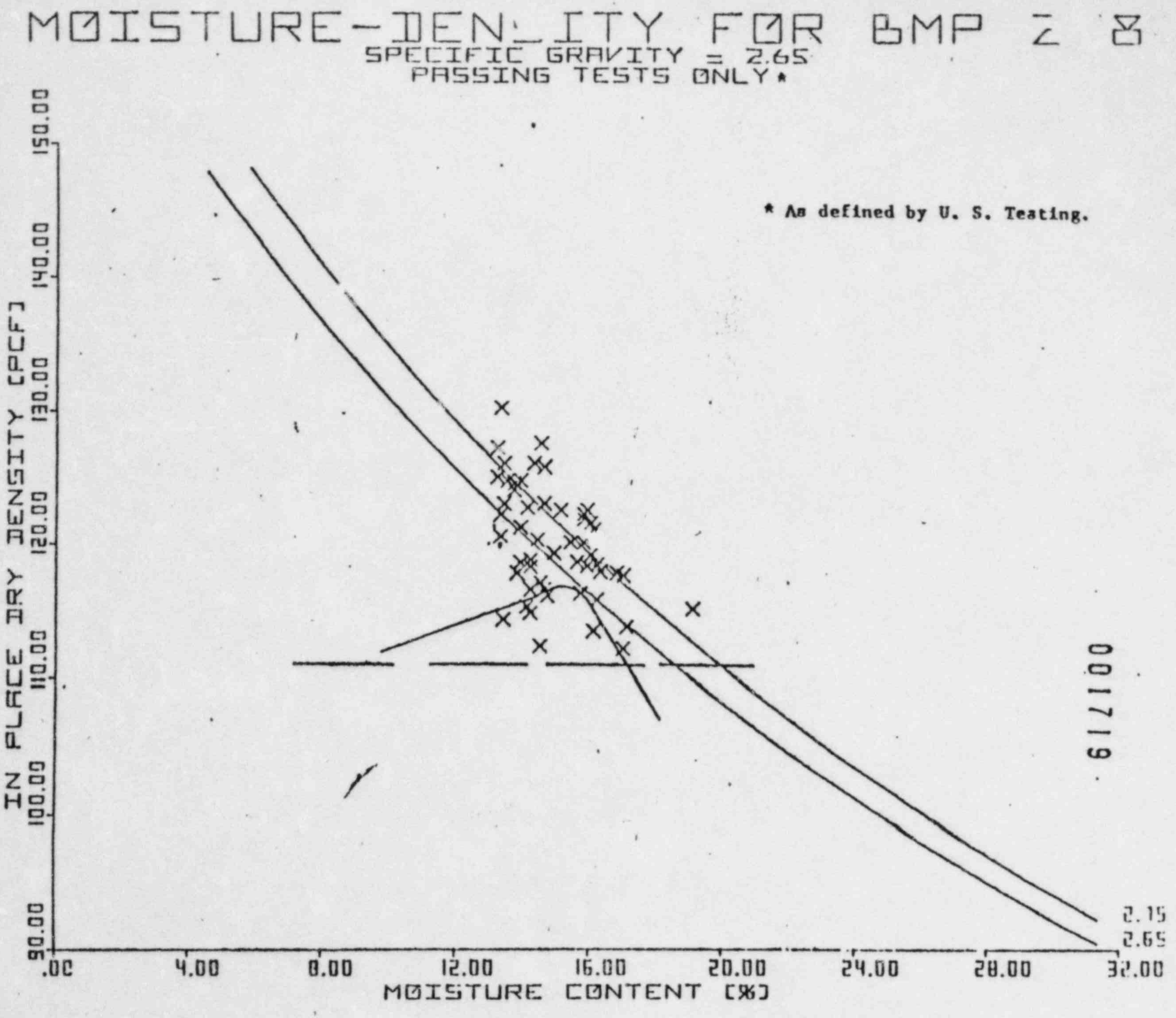
MOISTURE-DENSITY FOR BMP 2,8

SPECIFIC GRAVITY = 2.65
ALL TESTS



001719

FIGURE 1



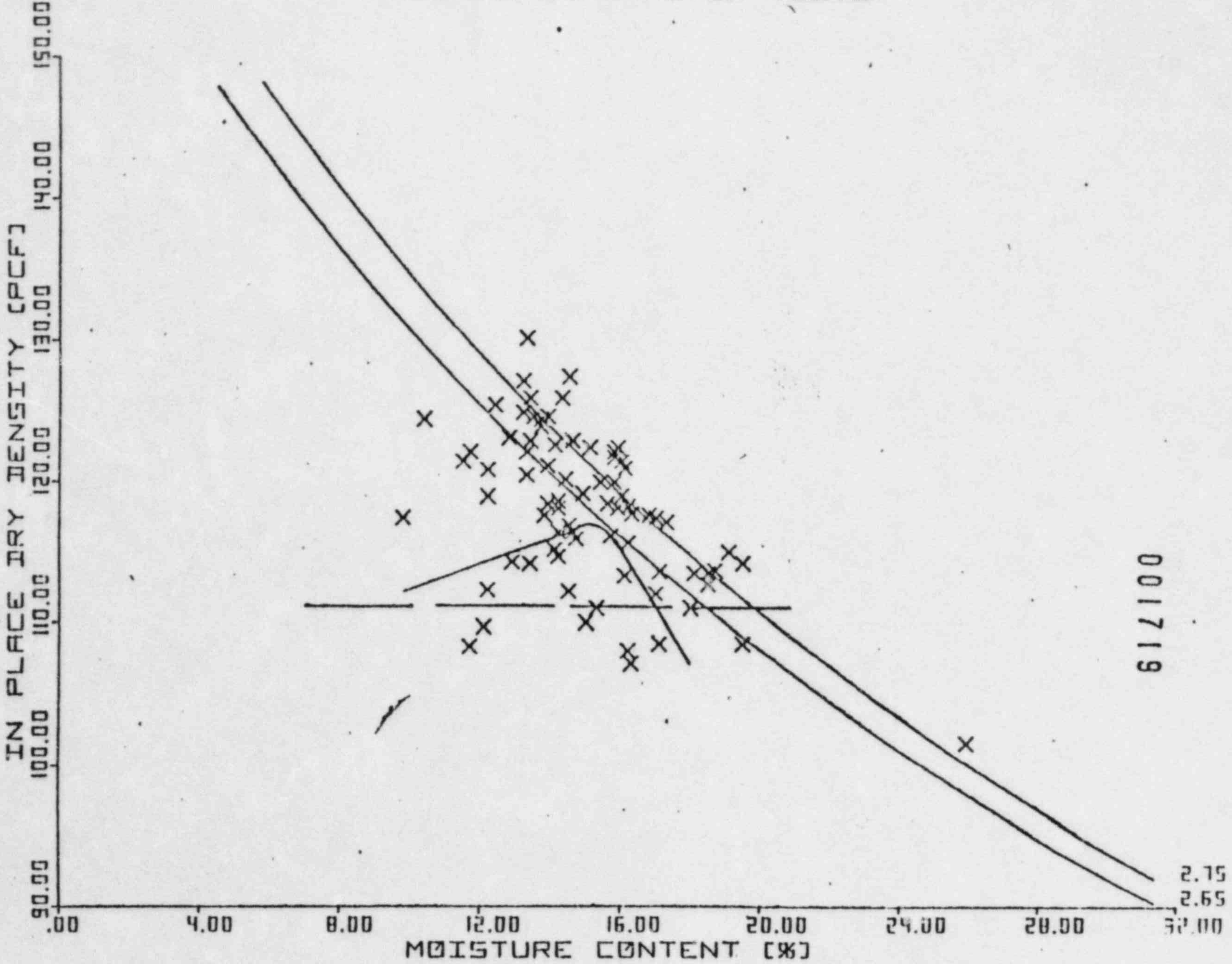
* As defined by U. S. Testing.

FIGURE 2

MOISTURE-DENSITY FOR BMP 2.8

SPECIFIC GRAVITY = 2.65

NUCLEAR DENSOMETER TESTS



001719

FIGURE 3

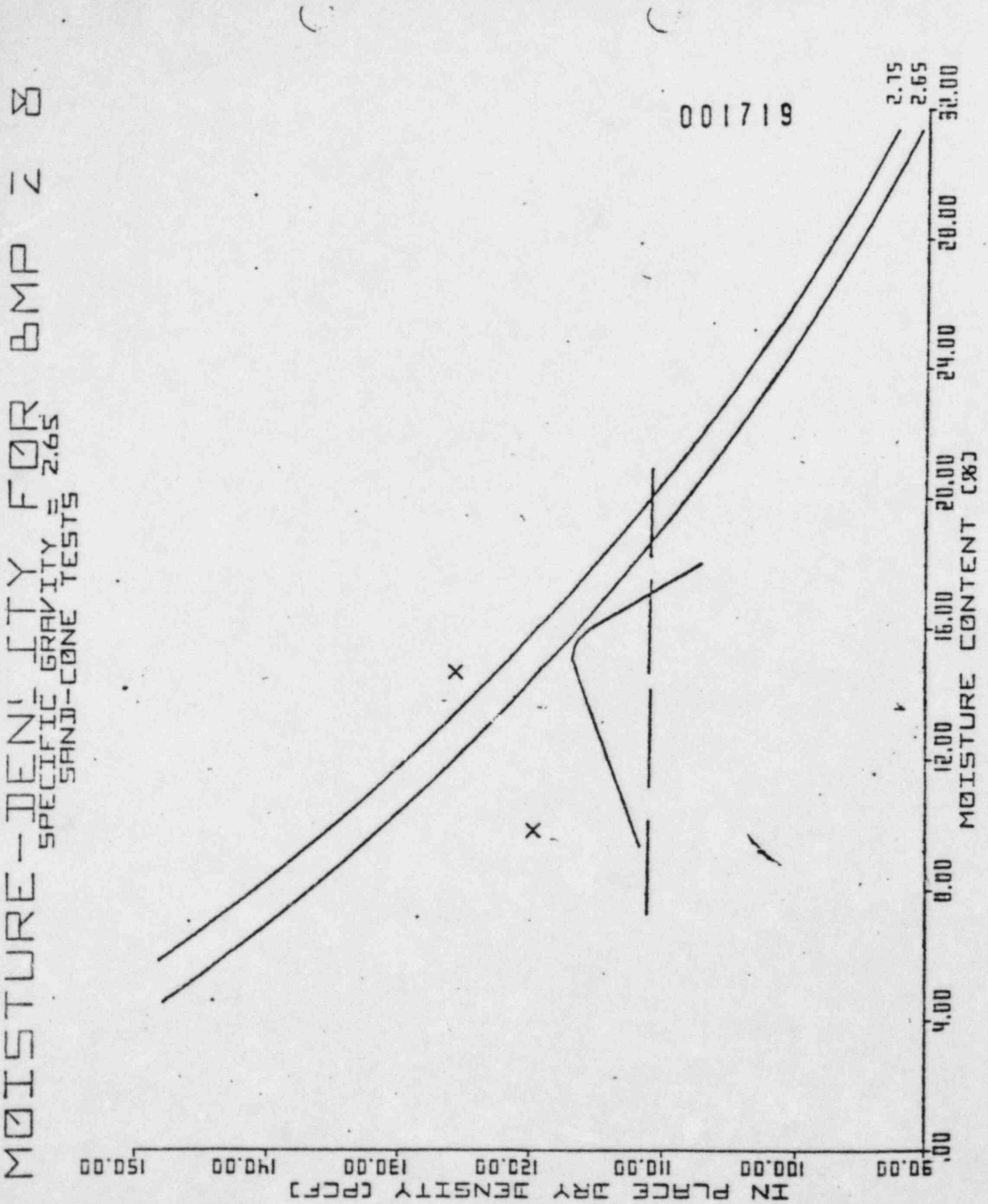
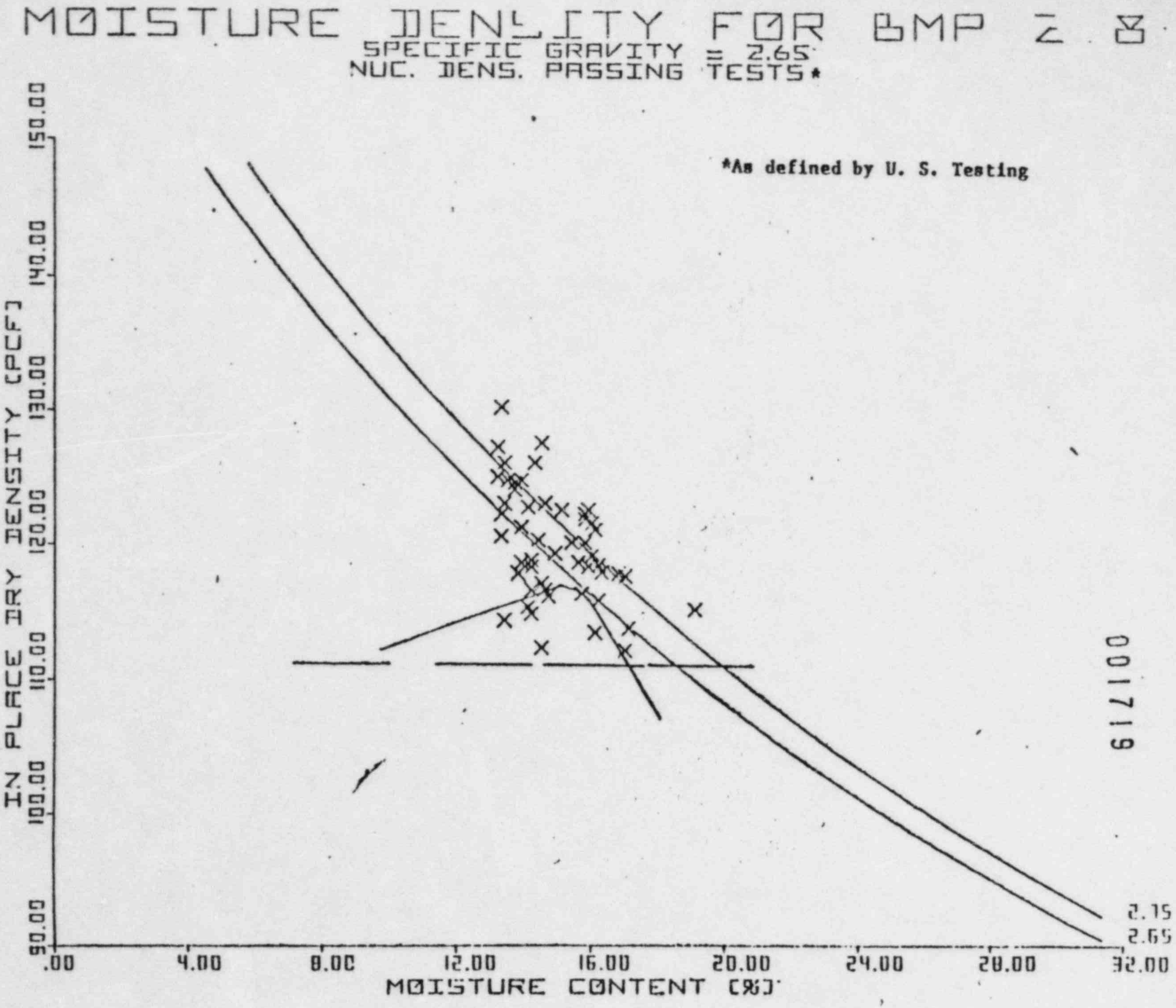

MOISTURE-DENSITY FOR BMP 2 B
SPECIFIC GRAVITY = 2.65
SAND-CONE TESTS
001719
2.75
2.65
IN PLACE DRY DENSITY (PCF)
90.00
100.00
110.00
120.00
130.00
140.00
150.00
MOISTURE CONTENT (%)
.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00

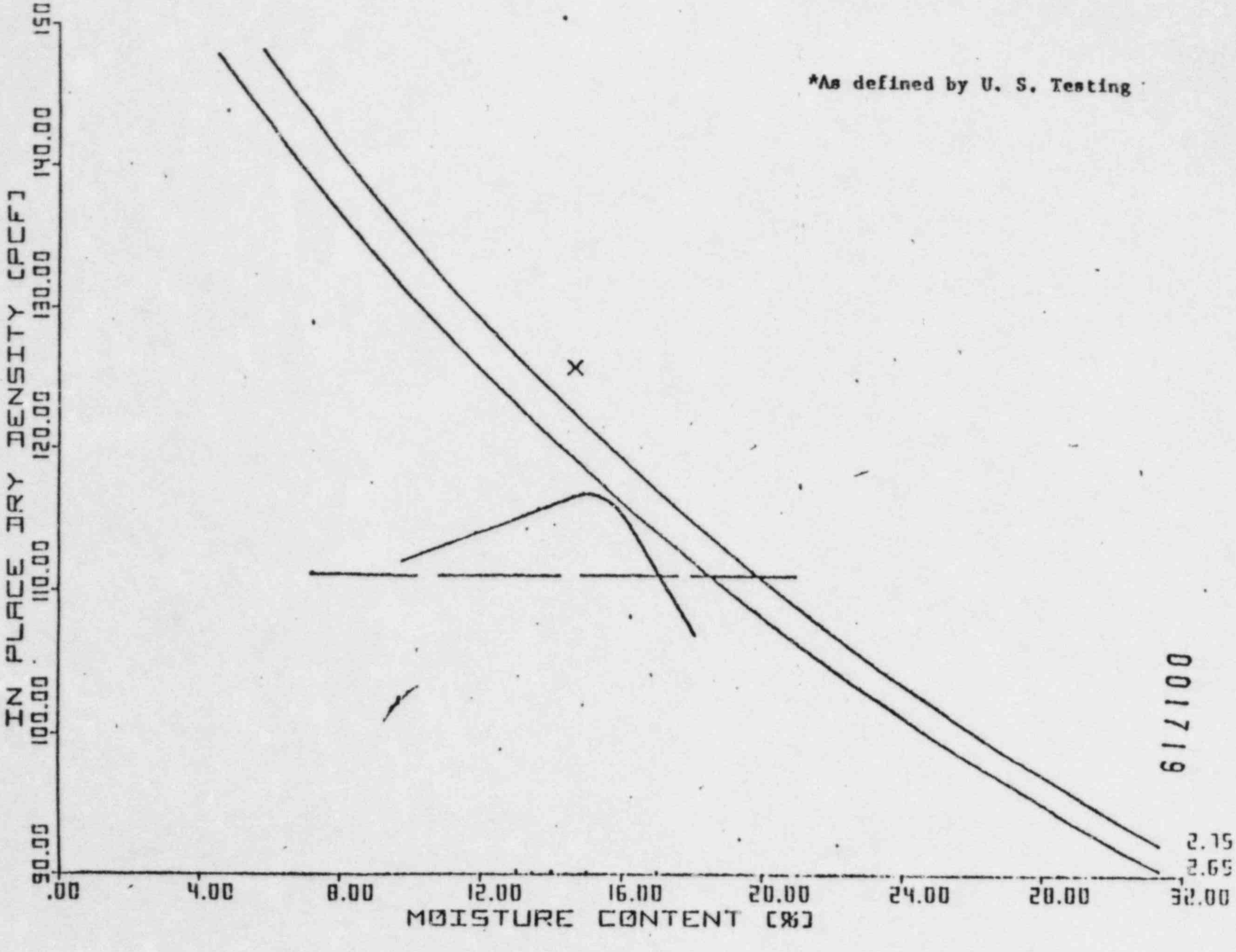
FIGURE 4



*As defined by U. S. Testing

FIGURE 5

MOISTURE-DENSITY FOR BMP 2 8
SPECIFIC GRAVITY = 2.65
SAND-CONE PASSING TESTS*



*As defined by U. S. Testing

001719

FIGURE 6

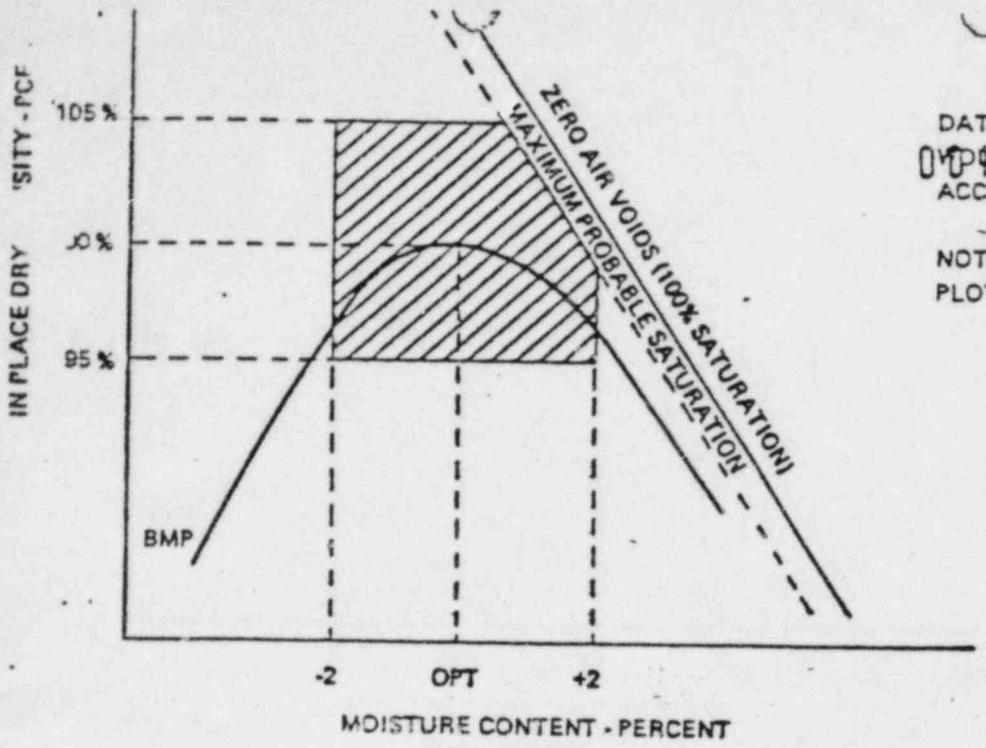


FIGURE 7-A-

DATA POINTS THAT PLOT IN SHADED AREA
WOULD BE GENERALLY ACCEPTABLE
ACCORDING TO SPECIFICATIONS

NOTE: ABOUT 25% OF ALL FIELD DATA PLOTS IN THE SHADED AREA

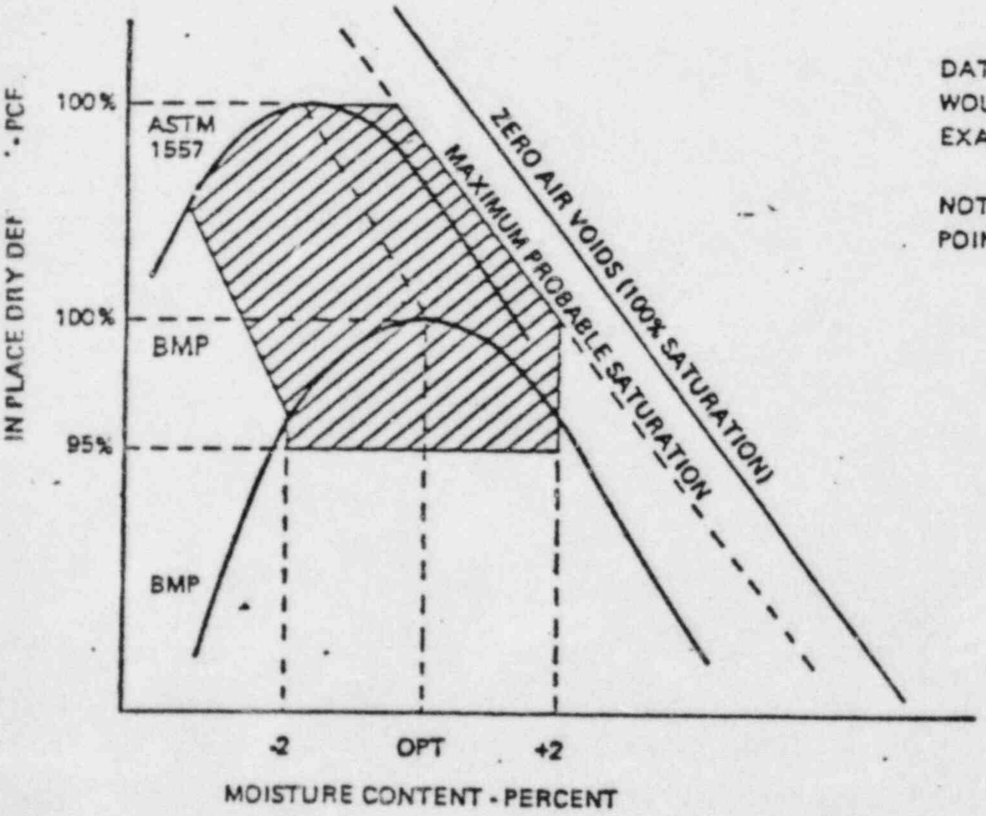


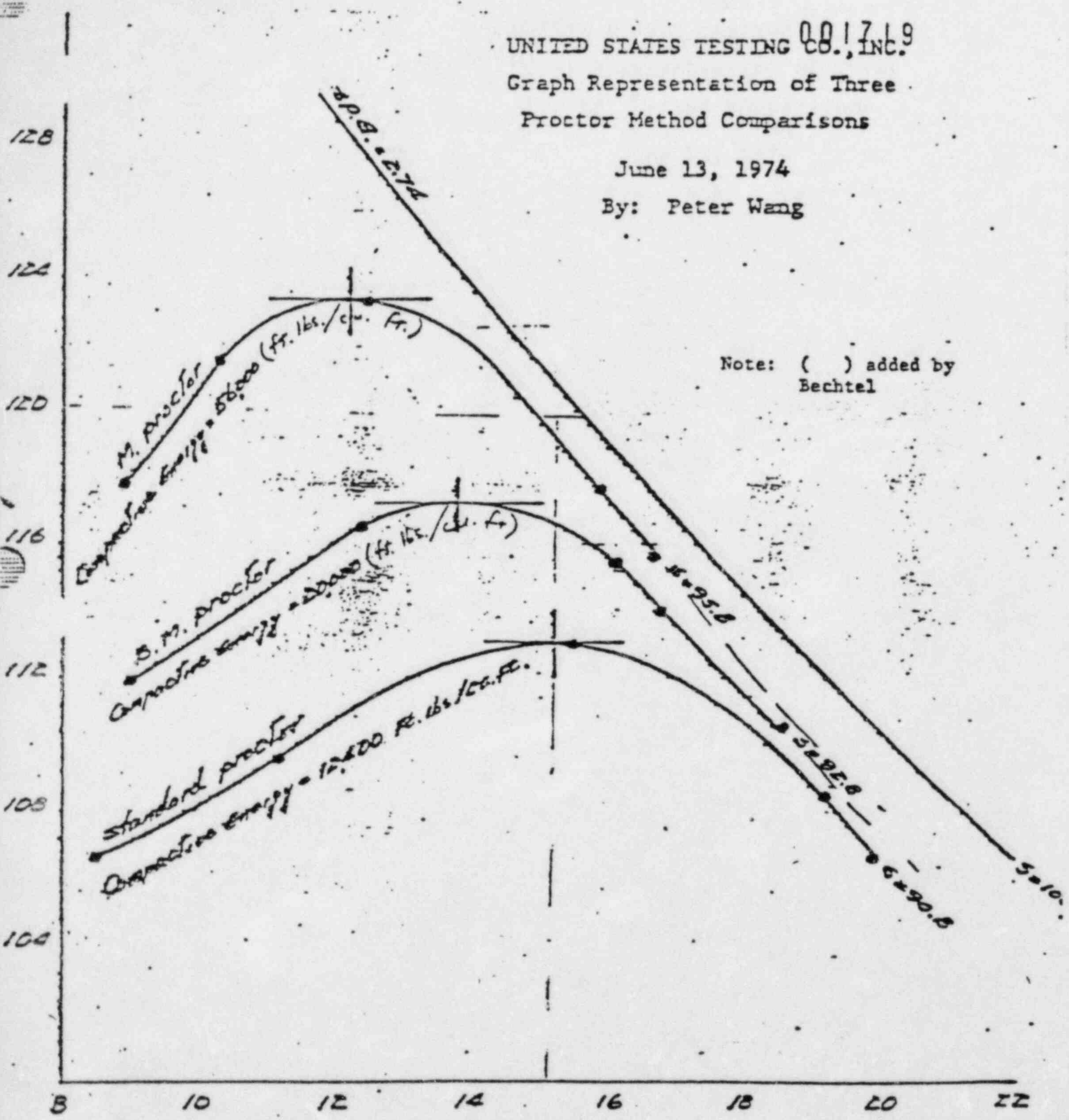
FIGURE 7-B-

DATA POINTS THAT PLOT IN SHADED AREA
WOULD BE ACCEPTABLE REGARDLESS OF
EXACT SPECIFICATION WORDING

NOTE: ABOUT 40% OF ALL FIELD DATA POINTS PLOT IN THE SHADED AREA

FIGURE 7: WINDOWS OF ACCEPTABILITY (A) BASED ON BMP SPECIFICATION (B) REGARDLESS OF EXACT WORDING OF SPECIFICATION

0017 19



UNITED STATES TESTING CO., INC.
Graph Representation of Three
Proctor Method Comparisons

June 13, 1974

By: Peter Wang

Note: ( ) added by
Bechtel

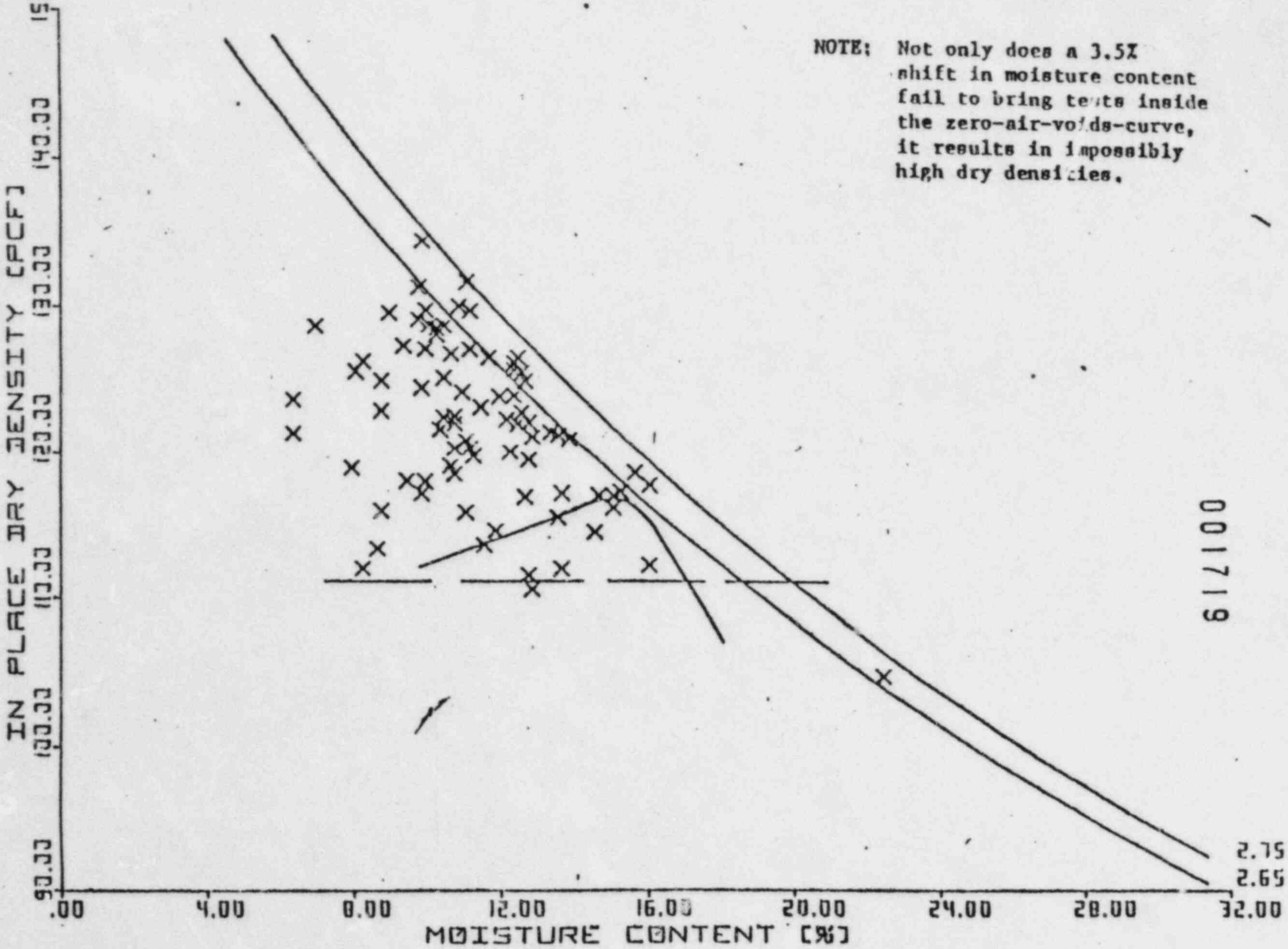
FIGURE 8

FIGURE 9

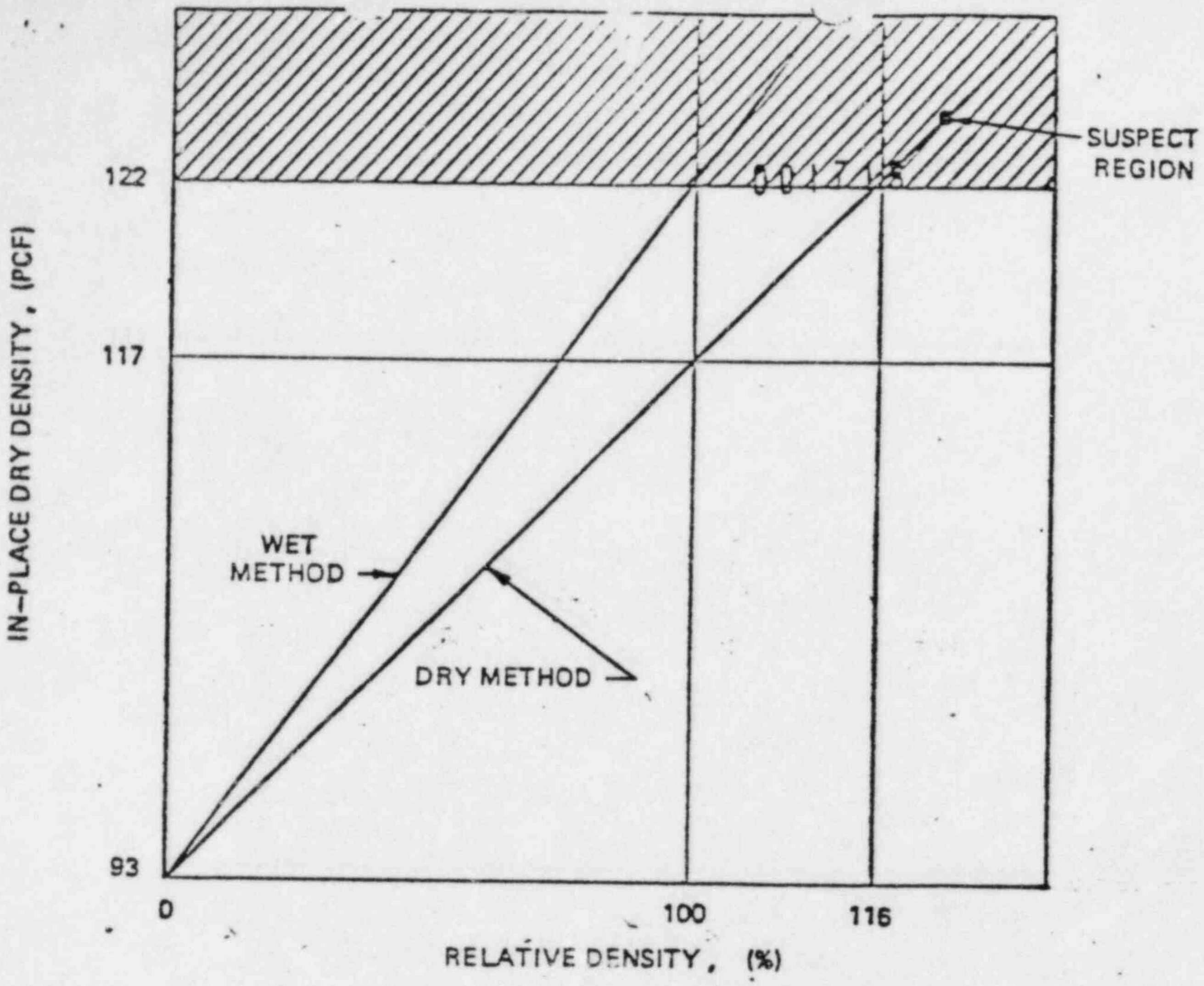
MOISTURE-DENSITY FOR BMP 2 3

SPECIFIC GRAVITY = 2.65
ALL TESTS

3.5% Subtracted from Moisture Content, Dry Density Recalculated



NOTE: Not only does a 3.5% shift in moisture content fail to bring tests inside the zero-air-voids-curve, it results in impossibly high dry densities.



NOTE: VALUES FOR DRY DENSITY ARE TYPICAL OF A RANDOM FILL SAND. ANY TESTS SHOWING MORE THAN 117% RELATIVE DENSITY WOULD BE SUSPECT IN THIS EXAMPLE. STRUCTURAL SANDS TEND TO SHOW ONLY 2 OR 3 PCF INCREASE IN MAXIMUM DENSITY AND THUS RESULTS AT MUCH LOWER RELATIVE DENSITY WOULD BE SUSPECT, SAY 105 – 110 PERCENT

FIGURE 10

CHANGE IN RELATIVE DENSITY SCALE FROM DRY TO WET METHODS OF OBTAINING MAXIMUM DENSITY, BASED ON RECENT LAB RESULTS

United States Testing Company, Inc.

1415 PARK AVENUE
HOBOKEN, NEW JERSEY 07030 (201) 792-2400 (212) 943-0488

program audits
vendor surveillance
concrete testing
on-site inspection
nondestructive testing
environmental evaluation
training programs

File: C-208-222/1015.900
October 1, 1979

Bechtel Power Corporation
P. O. Box 2167
Midland, Michigan 48640

Attention: Mr. J. F. Newgen

Subject: Midland Project Job 7220
Subcontract 7220-C-208
U.S. Testing's Response to "Geotech Review of U.S. Testing Field and Laboratory Tests on Soils

Dear Mr. Newgen:

Please find attached United States Testing's response to the Bechtel report "Review of U. S. Testing Field and Laboratory Tests on Soils" dated July 1979.

You requested that we respond solely to the summary contained in Section 8, however, we feel it is necessary to respond to all the sections, which in itself details Section 8.

Our response appendices the Bechtel report in so far that it closely follows its logic, answering questions or making statements on each particular point. This U. S. Testing report is not meant to point fingers in any direction but only to indicate, to Bechtel, some of the problems and concerns we faced.

If you have any questions, do not hesitate to contact me.

Very truly yours,

UNITED STATES TESTING COMPANY, INC.

M. Anselmo
Project Engineer

MA:hg
Attachments

UNITED STATES TESTING COMPANY'S

Response to the Bechtel Report

"Review of U. S. Testing Field
and Laboratory Construction
Test Data on Soils Uses as Fill"

Midland Units 1 & 2
Job No. 7220

Note: This U. S. Testing report must be read in connection with the Bechtel report in so far that it will provide clarification and rebut statements contained therein.

1. Use of Laboratory Test Compaction Curves

This section of the Bechtel report is concerned with the implied ratio of Field Density Tests to Laboratory Compaction Tests (Ratio 20:1) given in Table 9-1 of Specification 7220-C-208 and the period of time lapse between Laboratory Tests vs. Field Tests.

It is the position of U. S. Testing that Bechtel was then and is now responsible for the monitoring, determining and communicating with U. S. Testing on the fill yardage for use in performing Lab Density Tests. In fact, there were more Lab Density Tests performed by U. S. Testing Technicians (who were double checking results) than directed by Bechtel. It should also be noted that, in most cases, our only Bechtel interface in the field was a labor foreman.

The testing of soil will yield the same densities no matter what time lapse has expired between original testing and subsequent re-tests as long as the material re-tested is representative of the original tests and the test method has not changed. The actual volume of soil that may be represented by any one compaction curve has not been nor can it now be determined. In addition, Bechtel did not control excavated material as required by their specifications and drawings (documented in report on Admin. Bldg.) and it would be likely that any given cubic yard of soil was not only placed several times but tested several times, i.e., the same proctor values would be employed each time a yard of that particular soil was placed.

Visual proctor selection was many times backed-up by pounding a new proctor, in fact, most proctors on the job were generated in this manner as opposed to Bechtel maintaining a frequency list.

During the original submittal of U. S. Testing QA Manual, Bechtel (Project Engineering & Subcontracts) removed the provisions for performing one-point proctor tests for each Field Density Test.

2. Questionable Retests

The statement "A Field Density Test that fails to meet requirements of the specification should have been reported to Bechtel..." is incorrect. All failing test results were reported to either Q.C. or our field interface. However, it has become apparent that our field interface may not have been responsible for making these decisions. Any test U. S. Testing dispositioned as "clearing" was done so at the direction of Bechtel. The clearing of failing tests still is a Bechtel responsibility and on the occasions where U. S. Testing noted clearing tests, the report was a mode of conveying information from our interface. The Bechtel Report mentions three (3) cases where failing tests were cleared, one was "apparently resolved by merely using another Laboratory Compaction Curve...", another "tests labeled 'failed' were incorrectly cleared though the same laboratory standard was referenced.", and the third "two retests were dated prior to the time the original test failure." In fact, these 'clearings' were the action of Bechtel employees who were also in the habit of marking up U. S. Testing reports. It appears that the standard Bechtel procedure for the dispositioning of failures was to scan reports looking for passing results in the same general area. The direction of U. S. Testing to a test area and provisions for test locations is the responsibility of Bechtel, on those occasions where the Bechtel interface could not relate specific locations the suggestion may have been made by U. S. Testing personnel.

We agree with the Bechtel assumption that it was possible to encounter different soils in the same location, however, it is more likely that the different soils were encountered as a result of the non-control of excavated materials as opposed to the removal and replacement subsequent to a test failure.

U. S. Testing responsibility on this project is to perform testing not control its placement, and in fact, U. S. Testing was excluded from being involved in placement control.

3. Theoretically Impossible Test Results

Any given soil has individual components that cover a broad spectrum of specific gravity values. The major factor contributing to specific gravity values determined by the test method Bechtel requested (ASTM-D854) results from a 25 gram sample and thus the specific gravity values resulting there from should be interpreted with that in mind. The application of the likely band of specific gravity values represented in the Bechtel report figure 1 results in a 49 percent reduction of theoretically impossible results. The remainder of these test points falling above zero-voids line will be discussed in Section 6. However, specific gravity values from 2.57 to 2.82 for soil fractions are documented for material on this project.

The comment regarding the doubtfullness of the variation of soil properties is likely to be discounted by an examination of the data of the current soils evaluation program.

4. Repeated use of Questionable Laboratory Test Data

Although"...the fact that soil was not being placed or compacted according to specifications" was a major cause for concern. It is evident that another area of concern existed. Errors in calculations went unnoticed thru a good checking system. It is unfortunate that Bechtel's checking system simultaneously experienced difficulty.

5. Limits of Accuracy and Acceptability for Test Data

Although Bechtel statements conclude that only 25 to 40 percent of all clay tests represent compliance to specification, it should not be construed to represent the percentage of valid test data. The envelop of reasonably encountered test values would encompass the vast majority of test data. It has been demonstrated that the nominal scattering of data that may not have been anticipated was well within the statical variance that would be applied to this data.

6. Accuracy of Test Equipment

The average deviation of the nuclear device from oven-dry moistures was +.12 % for a set of 30 tests. The range of differences was approximately from -3 % to + 4 %. It was the assumption of U. S. Testing that Bechtel Engineering was appropriately applying this data to placement tests.

Contrary to the assumption regarding figure 9 with its "impossibly high dry densities" current test data closely resembles this graphical representation.

The use of the nuclear device was employed at the consent of Bechtel to facilitate production.

7. Relative Density Tests

Some of the specification 7220-C-210 zone numbers are an area of concern because of the overlapping soil classifications, i.e., clay could be either zone 1 or 2. The inherent nomenclatural difficulties that plagued the Bechtel Organization in providing data was not addressed in the limited potential problem areas. A re-evaluation of test data, with this third concern in mind, would probably change Bechtel conclusions.

Regarding calculation errors of relative densities and assuming the validity of these errors, it is again unfortunate that our checking systems broke-down.

The re-evaluation of maximum density by the wet method was in response to a relatively recent innovation of Bechtel assigning a geotechnical engineer to oversee the soils operation, here-to-fore there have been no "radical changes" or Bechtel material controls that would serve to flag the need for maximum density method re-determinations. Subsequent to this, the comparison of maximum density methods have been done routinely by U. S. Testing in response to material changes that were identifiable by newly instituted material controls and routine communication with assigned geotechnical representatives. These current comparisons have yielded maximum density variations that result in relative density changes from minimal to 20 %. The acceptability of high relative density results should have been evaluated as part of Bechtel process control that did not exist.

Summary

The Bechtel request that U. S. Testing respond to items 1 thru 5 has been detailed in this report.

The closing remarks of the Bechtel report makes the statement that"...on many occasions the inplace density was divided by the maximum density from the relative density test to get percent compaction..." is true. However, the report fails to mention that this method of calculation was a specific Bechtel directive.

In conclusion, the problems and concerns attributed to U. S. Testing results from a lack of proper soil identification and material quantities normally covered in inspection and placement responsibilities, none of which are contractually the responsibility of the U. S. Testings scope of operations. We are the testing arm of Bechtel. Our function is the reporting of data not its evaluation.

Bechtel Power Corporation

Inter-office Memorandum

To J. A. Rutgers

Date November 28, 1979

Subject US Testing Company's Response to Bechtel Report of Test Data on Soils Used as Fill - Midland Units 1 & 2 - Job 7220

From J. Milandin

Of Quality Assurance

At Ann Arbor

Copies to

P. Becnel	E. Rumbaugh
L. Dreisbach	S. Blue
R. Rixford	S. Heisler
K. Wiedman	D. R. Johnson
R. Simanek	T. E. Johnson

The subject report is attached with seventeen (17) mark-up comments by G. L. Richardson. As you recall, Gary conducted several audits of US Testing operations, was the Lead Quality Assurance Engineer at the site during the time most of this work was in process, headed up the Quality Assurance effort in the Plant Fill Task Force and assisted in the preparation of our initial response to the NRC 50.54(f) report. Gary's comments are annotated 1 through 17 in the report and identifies areas where Geo-Tech should provide technical comments.

Generally, the opinion of Gary is that the response is defensive and does not address basic cause for many of the problems reported by the Bechtel Test Data Review.

I would suggest that Geo-Tech and Qualit y Control provide comments for the US Testing response.

John Milandin
J. Milandin

mwk:

attached response from US Testing
is Chron 2265
& is related to Cause L AJR

JM/le
JM-79-121

File: AAO-QAR-79-66
Attachment

Bechtel [illegible] Corporation

Interoffice Memorandum 002265

To J. Rutgers

File No

Subject Job 7220 Midland Project
Subcontract 7220-C-208
U. S. Testing Comments of Bechtel
Geo-Technical "Review of U. S. Testing
Field and Laboratory Tests on Soils"
BCBM-521-R

Date October 29, 1979

From L. E. Davis

Of Construction

At Midland, MI

Ext

Copies to

Attached is a report submitted by U. S. Testing commenting on Bechtel Geo-Tech's review of test procedures dated July, 1979.

If we can be of further assistance, please contact us.

for L. E. Davis

LED/JWL/km

RECEIVED
ANN ARBOR
QUALITY ASSURANCE

NOV 5 - '79

Route	Info.	Act.	
[illegible]			

This responds to Chron 001719

Please annotate any remarks on this and discuss w/ me by 11/30/79

QAR re problem alert on Soils Testing
and
copy of cover letter in my follow-up file

9024, REV 1/78

United States Testing Company, Inc.
Power Generation Services Division

1415 PARK AVENUE
HOBOKEN, NEW JERSEY 07030 (201) 792-2400 (212) 943-[illegible]

concrete testing
on site inspection
nondestructive testing
environmental evalua
training programs

File: C-208-222/1015.900
October 1, 1979

RECEIVED
OCT 9 1979
BECHTEL POWER CORP.
JOB 7220
FEP 565(E) C-208

Bechtel Power Corporation
P. O. Box 2167
Midland, Michigan 48640

Attention: Mr. J. F. Newgen

Subject: Midland Project Job 7220
Subcontract 7220-C-208
U.S. Testing's Response to "Geotech Review of U.S. Testing Field and Laboratory Tests on Soils

Dear Mr. Newgen:

Please find attached United States Testing's response to the Bechtel report "Review of U. S. Testing Field and Laboratory Tests on Soils" dated July 1979.

You requested that we respond solely to the summary contained in Section 8, however, we feel it is necessary to respond to all the sections, which in itself details Section 8.

Our response appendices the Bechtel report in so far that it closely follows its logic, answering questions or making statements on each particular point. This U. S. Testing report is not meant to point fingers in any direction but only to indicate, to Bechtel, some of the problems and concerns we faced.

If you have any questions, do not hesitate to contact me.

Very truly yours,

UNITED STATES TESTING COMPANY, INC.

M. Anselmo

M. Anselmo
Project Engineer

MA:hg
Attachments

002265

001434

UNITED STATES TESTING COMPANY'S

Response to the Bechtel Report

"Review of U. S. Testing Field
and Laboratory Construction
Test Data on Soils Uses as Fill"

Midland Units 1 & 2
Job No. 7220

Note: This U. S. Testing report must be read in connection with the Bechtel report in so far that it will provide clarification and rebut statements contained therein.

1. Use of Laboratory Test Compaction Curves

This section of the Bechtel report is concerned with the implied ratio of Field Density Tests to Laboratory Compaction Tests (Ratio 20:1) given in Table 9-1 of Specification 7220-C-208 and the period of time lapse between Laboratory Tests vs. Field Tests.

It is the position of U. S. Testing that Bechtel was then and is now responsible for the monitoring, determining and communicating with U. S. Testing on the fill yardage for use in performing Lab Density Tests. In fact, there were more Lab Density Tests performed by U. S. Testing Technicians (who were double checking results) than directed by Bechtel. It should also be noted that, in most cases, our only Bechtel interface in the field was a labor foreman.

LEGAL
?

GR1

CAN UST
BACK THIS
STATEMEN
WITH FACTS

NRC WILL
BACK THIS
UP.

GR2

The testing of soil will yield the same densities no matter what time lapse has expired between original testing and subsequent re-tests as long as the material re-tested is representative of the original tests and the test method has not changed. The actual volume of soil that may be represented by any one compaction curve has not been nor can it now be determined. In addition, Bechtel did not control excavated material as required by their specifications and drawings (documented in report on Admin. Bldg.) and it would be likely that any given cubic yard of soil was not only placed several times but tested several times, i.e., the same proctor values would be employed each time a yard of that particular soil was placed.

R3

THIS RESPONSE DOES NOT ADDRESS THE "OVERUSE OF CURVE" OR
THE LACK OF PROCEDURES TO CONTROL" THE SELECTION
OF THE PROCTOR CURVE.

Visual proctor selection was many times backed-up by pounding a new proctor, in fact, most proctors on the job were generated in this manner as opposed to Bechtel maintaining a frequency list.

THERE ARE NO RECORDS TO SUPPORT THIS

GR-4

During the original submittal of U. S. Testing QA Manual, Bechtel (Project Engineering & Subcontracts) removed the provisions for performing one-point proctor tests for each Field Density Test.

TRUE

GR-5

2. Questionable Retests

The statement "A Field Density Test that fails to meet requirements of the specification should have been reported to Bechtel..." is incorrect. All failing test results were reported to either Q.C. or our field interface. However, it has become apparent that our field interface may not have been responsible for making these decisions. Any test U. S. Testing dispositioned as "clearing" was done so at the direction of Bechtel. The clearing of failing tests still is a Bechtel responsibility and on the occasions where U. S. Testing noted clearing tests, the report was a mode of conveying information from our interface. The Bechtel Report mentions three (3) cases where failing tests were cleared, one was "apparently resolved by merely using another Laboratory Compaction Curve...", another "tests labeled 'failed' were incorrectly cleared though the same laboratory standard was referenced.", and the third "two retests were dated prior to the time the original test failure." In fact,

GR-2

THIS SHOULD BE VERIFIED BY QC

SR8 DISAGREE A MUCH SMALLER BAND MUST BE ASSUMED GEOTECH SHOULD QUESTION.

band of specific gravity values represented in the Bechtel report figure 1 results in a 49 percent reduction of theoretically impossible results. The remainder of these test points falling above zero-voids line will be discussed in Section 6. However, specific gravity values from 2.57 to 2.82 for soil fractions are documented for material on this project.

The comment regarding the doubtfullness of the variation of soil properties is likely to be discounted by an examination of the data of the current soils evaluation program.

4. Repeated use of Questionable Laboratory Test Data

Although"...the fact that soil was not being placed or compacted according to specifications" was a major cause for concern. It is evident that another area of concern existed. Errors in calculations went unnoticed thru a good checking system. It is unfortunate that Bechtel's checking system simultaneously experienced difficulty. AGREE

COULD NOT HAVE BEEN A GOOD SYSTEM

SR9

5. Limits of Accuracy and Acceptability for Test Data

Although Bechtel statements conclude that only 25 to 40 percent of all clay tests represent compliance to specification, it should not be construed to represent the percentage of valid test data. The envelop of reasonably encountered test values would encompass the vast majority of test data. It has been demonstrated that the nominal scattering of data that may not have been anticipated was well within the statical variance that would be applied to this data.

SR10 GEOTECH SHOULD COMMENT

HEARSAY ?

these 'clearings' were the action of Bechtel employees who were also in the habit of marking up U. S. Testing reports. It appears that the standard Bechtel procedure for the dispositioning of failures was to scan reports looking for passing results in the same general area. The direction of U. S. Testing to a test area and provisions for test locations is the responsibility of Bechtel, on those occasions where the Bechtel interface could not relate specific locations the suggestion may have been made by U. S. Testing personnel.

We agree with the Bechtel assumption that it was possible to encounter different soils in the same location, however, it is more likely that the different soils were encountered as a result of the non-control of excavated materials as opposed to the removal and replacement subsequent to a test failure.

U. S. Testing responsibility on this project is to perform testing not control its placement, and in fact, U. S. Testing was excluded from being involved in placement control.

TRUE

3. Theoretically Impossible Test Results

Any given soil has individual components that cover a broad spectrum of specific gravity values. The major factor contributing to specific gravity values determined by the test method Bechtel requested (ASTM-D854) results from a 25 gram sample and thus the specific gravity values resulting there from should be interpreted with that in mind. The application of the likely

Accuracy of Test Equipment

The average deviation of the nuclear device from oven-dry moistures was +.12 % for a set of 30 tests. The range of differences was approximately from -3 % to + 4 %. It was the assumption of U. S. Testing that Bechtel Engineering was appropriately applying this data to placement tests.

GR-11
UST IS RESPONSIBLE EXPERT RE TESTING ACCURACY

Contrary to the assumption regarding figure 9 with its "impossibly high dry densities" current test data closely resembles this graphical representation.

GR-12
DOES UST HAVE BACK UP?

The use of the nuclear device was employed at the consent of Bechtel to facilitate production. TRUE

GR-13
TRUE

Relative Density Tests

Some of the specification 7220-C-210 zone numbers are an area of concern because of the overlapping soil classifications, i.e., clay could be either zone 1 or 2. The inherent nomenclatural difficulties that plagued the Bechtel Organization in providing data was not addressed in the limited potential problem areas. A re-evaluation of test data, with this third concern in mind, would probably change Bechtel conclusions.

Regarding calculation errors of relative densities and assuming the validity of these errors, it is again unfortunate that our checking systems broke-down. !

GR-14

The re-evaluation of maximum density by the wet method was in response to a relatively recent innovation of Bechtel assigning a geotechnical engineer to oversee the soils operation, here-to-fore there have been no "radical changes" or Bechtel material controls that would serve to flag the need for maximum density method re-determinations. Subsequent to this, the comparison of maximum density methods have been done routinely by U. S. Testing in response to material changes that were identifiable by newly instituted material controls and routine communication with assigned geotechnical representatives. These current comparisons have yielded maximum density variations that result in relative density changes from minimal, to 20 %. The acceptability of high relative density results should have been evaluated as part of Bechtel process control that did not exist.

SHOULD HAVE DONE ALL ALONG REQUIRE BY ASTM ITH MAC GEOTECH CHECK

~~WHERE THE~~

GR-15

WHY NOT UST

Summary

The Bechtel request that U. S. Testing respond to items 1 thru 5 has been detailed in this report.

The closing remarks of the Bechtel report makes the statement that "...on many occasions the inplace density was divided by the maximum density from the relative density test to get percent compaction..." is true. However, the report fails to mention that this method of calculation was a specific Bechtel directive.

GR-16

THI IS CORREC

In conclusion, the problems and concerns attributed to U. S. Testing results from a lack of proper soil identification and material quantities normally covered in inspection and placement responsibilities, none of which are contractually the responsibility of the U. S. Testings scope of operations. We are the testing arm of Bechtel. Our function is the reporting of data not its evaluation.

GR-17

1. UST LACKED PROCEDURES
2. UST FAILED TO RECOGNIZE OBVIOUS FLAWS IN THEIR TEST PROGRAM
3. UST FAILED TO RAISE CONCERNS TO MANAGEMENT LEVELS AND OBTAIN ACTION
4. UST FAILED TO I.D. MANY PROBLEMS IN THEIR OPERATIONS AS IS EVIDENCED BY MANY BECHTEL & CPCO FINDINGS
5. NO CLEAR DESCRIPTION OF UST/BECHTEL INTERFACE/RESPONSIBILITIES.

DISTRIBUTION INFORMATION FOR INCOMING COMMUNICATIONS

PROJECT NAME MIDLAND JOB NO. 7220 002265

COMMUN. CONTROL NO. ______ WRITTEN RESPONSE REQUIRED? YES ___ NO ✓

DATE RECEIVED OCT 31 1979 DATE DUE ______

Entity/Group	Resp. Code	Responsible	Information	Attachment	Addt'l Distr.
ADMINISTRATIVE SERVICES	( )				
CONSTRUCTION COORDINATOR	( )				
ENGINEERING			✓		L.H. CURTIS
PROJECT ENGINEER	( )				
ASSISTANT PROJECT ENGINEERS	( )				
______	( )				
______	( )				
QUALITY ENGINEER	( )				
CONTRACTS ENGINEER	( )				
ENGINEERING PLANNER	( )				
COST TREND ENGINEER	( )				
ARCHITECTURAL	( )				
CIVIL	( )				
CONTROL SYSTEMS	( )				
ELECTRICAL	( )				
MECHANICAL	( )				
PLANT DESIGN	( )				
PROCUREMENT					
PROCUREMENT MANAGER	( )				
PURCHASING	( )				
EXPEDITING	( )				
SUPPLIER QUALITY	( )				
S/C SPECIALIST	( )				
QUALITY ASSURANCE	( )		✓		L. DREISBACH
SERVICES					
SUPERVISOR	( )				
COST ENGINEER	( )				
PLANNING & SCHEDULING	( )				
STARTUP	( )				
FIELD	( )				
CLIENT	( )				
TO PROJECT MANAGEMENT - JAR	( )		✓	✓	
			✓		[redacted]
			✓		P. Becnel
			✓		K. Wiedner
			✓		S. BLUE
			✓		J. WANZECK
			✓		T.E. Johnson

CHRONOLOGICAL FILE ______ FILE CODE 2816 SPEC/PO ______

Chron: ① Please also copy Staple chron 001719 to the

GENERAL above Additional Distribution, with this IOM.

The distribution form is completed by PDCC for incoming/ internal communications. Further distribution within the entity/group is the responsibility of the entity/group. Changes and additions to standard distributions should be brought to the attention of the PDCC supervisor.

② Please return this package to J.A. Rutgers on Monday, Nov. 5.

P.P.

AAG-082478 REV 1

N

0

E. Gallagher

Region III

MIDLAND SOILS

CHRONOLOGY AND SUMMARY

Soils placement on the Midland job is broken down between cooling pond dike construction and plant fill. This write-up will address the soils placement history for both areas, however, greater detail will be provided for the plant fill as that is the area where significant soils problems have been encountered.

A subcontractor (Cannonie, Inc.) constructed the dikes during the period of 1969-1950 and 1973-77. The original contract was let to Cannonie in 1968. The dike design is basically a clay berm with a sand core. The dike was designed to be constructed from on-site clay materials and imported sand. Shortly after work started, it was discovered that sufficient specified clay materials were not available on site. In response, Project Engineering revised the specification to allow greater fines (i.e., delete the requirement that not more than 60% pass the No. 200 sieve). Work continued and the emergency cooling water pond was essentially completed and some dike work completed prior to subcontract closeout in 1969. This subcontract closure was a part of project shutdown due to licensing problems.

The subcontract was rebid in 1973 upon project reactivation and was again awarded to Cannonie. The previous specification change on increased fines was omitted from the new subcontract specification and had to be added after award.

Cannonie continuously complained about the lack of "good soil" to build

JAN 19 1981 SB 17131

haul roads. Even when well compacted by heavy earth moving equipment, the roads turned to quagmires when heavy rains fell. Cannonie also experienced continual problems with moisture control in the borrow and fill areas. In 1975 a contract change was negotiated for over $1,000,000 to compensate Cannonie for changed conditions.

Cannonie completed the pond dikes, the plant area dikes and the north plant fill during the 1973, 1974, 1975 (part thereof) and 1976 seasons. In 1977 Cannonie returned to the site to complete site fill south of the power block, part of which had been completed by Bechtel.

The specification for the dike construction required the use of mechanized equipment for fill placement and compaction. It also required this equipment and the maximum lift thicknesses for which the material was to be placed to be qualified. These qualification tests were run and documented.

In process acceptance of fill placement was based on the number of passes of the equipment, the minimum number to achieve compaction being determined in the aforementioned tests. Final acceptance of the clay fill was based on in place density and moisture tests taken within specified frequencies.

Cannonie's Quality Assurance program included an on site quality control engineer to provide a continuous overview and inspection of their work. His duties included verification of proper equipment selection and performance, material lift thickness, number of roller passes and maintenance of quality related documentation. The Bechtel Subcontracts

Group administered the subcontract for Bechtel while the Bechtel Quality Control Department provided a surveillance inspection over Cannonie's Q-listed work for the period of 1974 thru 1978. Bechtel's Geo-Technical Group provided an overview of Cannonie's work by a series of periodic site visits. These site visits were most frequent in the 1973-1974 work period. Bechtel's Quality Control Department was responsible for reviewing the in place moisture and density tests for final acceptance of dike material. There were Bechtel and Cannonie generated nonconformances over the dike work. These nonconformances have been resolved owing in part to borings taken to qualify questionable materials.

Plant area fill (which is essentially complete) has been placed by both a subcontractor (Cannonie, Inc.) and Bechtel. Cannonie's work was limited to placement of large, open plant fill areas with mechanical equipment, while Bechtel generally placed smaller areas inaccessible to mechanized equipment with "hands on" compactors. Bechtel has, however, placed some areas of plant fill with mechanized equipment. Placement of plant fill has extended from 1974 to present.

There are some noteworthy differences between the dike work and plant fill which should be examined. First, the Project Engineering call out for plant fill, including that under Q-listed structures on fill, consisted of random fill. Random fill, by definition, could consist of any site materials which were free of humus, organics, or other deleterious material that could be compacted to meet specification requirements. Concrete could be and was utilized as a random fill material at the discretion of the field engineer. There were no specification directions prohibiting or specifying the use of different types of random fill materials in a common area. Layering of different random fill materials was allowed. Secondly, the acceptance of plant fill has been based upon meeting the specification compaction requirements as determined by taking tests within specified frequencies as opposed to a number of equipment passes. The specification did specify maximum lift thicknesses (12" for clay and sand) and required that qualification tests be run to verify that the compaction requirements could be met. Qualification tests were run, albeit, as production tests on fill placements.

The Project Engineering documents for compaction of clay materials used for plant fill have been contradictory in the past. The Dames and Moore soil report, which was a part of the PSAR, specified a compactive effort to yield 95% of the maximum density by ASTM 1557 Method D. The "Placement" section of the projection specification indicated that the material should be placed to meet the aforementioned criteria, however, the "Testing" section of the same specification called for the material to be tested to 95% of maximum density by the Bechtel Modified Proctor (BMP) (95% maximum density by the BMP is equivalent to approximately 90% maximum density by ASTM 1557 Method D). The project specification for the on site materials testing subcontractor (U. S. Testing, Inc.) also specified that the clay material be tested to 95% of maximum density by the BMP. Field Engineering questioned Project Engineering on this contradiction and were advised that 95% of maximum density by the BMP was to be used. Geo-Tech maintains that Project Engineering was in error in their position;

specifically, 95% of maximum density by ASTM 1557 Method D has always been and is still required. Project Engineering did revise the affected specifications recently to require 95% of maximum density by ASTM 1557 Method D, however, the field has only been able to qualify a single piece of hand held compaction equipment ("jumping jack") at a 4 inch lift thickness. All other hand held equipment has failed at the 4 inch lift thickness. Attempted qualification of a 25,000 pound dynamic force sheeps foot roller at an 8 inch lift thickness has also failed. It would appear from these qualification tests, that the on site clay material is suitable for dike construction using large equipment but is not suited for use as plant fill in the power block area where the work areas are small and generally inaccessible to mechanized equipment.

As stated previously, an overview of dike construction was provided by Geo-Tech (most notably) in the 1973-1974 period. The Dames and Moore soil report and a Project Engineering internal design criteria procedure required that all soils work on the Midland project including testing be performed under the continuous direction of a qualified soils engineer. Neither of these documents defined a qualified soils engineer nor did the project specification require the presence of this individual. (The field found out about this requirement during the NRC investigation of the "soils problem". Geo-Tech did not provide an overview on past soil placements for plant fill. The project specification has, however, been changed recently to require an on site Geotechnical Soils Engineer to provide technical direction over soils placement. Geo-Tech was not able to provide this individual so Construction retained the services of an individual with a masters degree in civil engineering (soils) and 3 years consulting experience. This person was deemed to meet the requirements of being a qualified soils engineer.

All soils testing on the project has been performed by a subcontractor (U.S. Testing, Inc.). Their responsibilities include taking tests in accordance with ASTM Standards at locations specified by Bechtel or Cannonie, While not explicitly stated in their contract, in the past U. S. Testing also accepted the job of soils classification to facilitate testing. This has been changed in that the specification now requires U.S. Testing to run a proctor for each clay test and a relative density for each sand test.

Soils placement by Bechtel has been done in the past under the technical direction of Bechtel field engineers assigned to specific plant areas i. e., yard facilities, Auxiliary Building, etc. There was not a designated soils field engineer on the jobsite. Because they were assigned responsibilities in addition to soils placement (i. e., rebar and formwork inspection, material requisitioning, etc.) the field engineers were not always physically present during the fill placement. Labor foremant were utilized to help call of soils tests under the direction of the field engineer. Technical acceptance of plant fill was based on satisfactory test results. As stated previously, the specification now requires that all fill be placed under the continuous direction of the on site Geotechnical Soils Engineer.

His responsibilities include in part:

1. Approval of all subgrade preparations.

2. Suitability of materials used for random fill.
3. Approving the use of different random fill materials in layers and zones so that the structural integrity of buried utilities and supported structures is not jeopardized.
4. Selection of lift thicknesses for the equipment used for compaction.
5. Maintaining moisture control during the placement.
6. Proper performance and application of compacting equipment. This includes speed, frequency, number of passes, proper overlap, and lift thickness.
7. Calling for soil tests within the required specification frequencies.
8. Reviewing the acceptability of all soil test reports.

Bechtel Field Quality Control Engineers performed surveillance inspection of Cannonie's placement of Q-listed plant fill. They also provided surveillance over Q-listed plant fill placed by Bechtel. In general, this meant that two to three times a day the Q. C. field engineer observed the fill placement and testing operations. Full time inspection was not implemented. Quality Control has now revised its inspection program to provide field and laboratory Q. C. Engineers to provide continuous surveillance over the placement and testing activities.

The settlement of the Diesel Generator Building was noted during routine construction survey work. Settlement markers were assigned and an extensive soil boring program was undertaken to ascertain the extent of the problem.

The results of the boring program which are included in MCAR 24 show material with highly variable properties in the first 15 feet under the structure. This fill which consists essentially of sand over the northern half of the building and clay over the southern half, was placed by Bechtel in 1977.

As a result of the problems with the Diesel Generator Building an extensive settlement monitoring and soil boring program was undertaken for the balance of the plant. This program included borings taken through building base slabs. The results of this investigation are included in MCAR 24. As a general rule, in those instances where "soft" fill was encountered the fill was placed by Bechtel using hand held equipment. It has been determined that remedial actions will be required to correct the discrepant soils conditions. The most noteworthy is a plan to provide a permanent plant dewatering system for the power block. It is felt that a draw down of the water table will eliminate the potential for liquefaction of sand fill under a seismic event. A summary of other remedial actions is provided below.

Structure	Proposed Remedial Action
Diesel Generator Building	Surcharge Program (In progress since 4/79)
Unit 01 Main Transformer Area	Surcharge program (In progress since 6/79)
Condensate Tank Area	Provide flexible pipe connections to tanks to accommodate anticipated settlement

Structure	Proposed Remedial Action
Service Water Structure (North Corner)	Piles and pile cap to provide vertical support
Diesel Generator Fuel Storage Tanks	Proof Load by filling with water (In progress since 3/79)
Borated Water Storage Tanks	Proof load by filling with water
Auxiliary Building Train Bay	None
Units 1 & 2 Feedwater Isolation Valve Pits	Remove and replace defective soil. Will require local dewatering
Units 1 & 2 Electrical Penetration Rooms	Remove and replace part or all of the defective material. Will require local dewatering and temporary underpinning

The above actions are described in more detail in Bechtel's response to the NRC's 50.54 (f) request for information.

As investigation into the soil problems on the Midland jobsite continues certain conclusions are being reached by individuals as to the probable cause. No <u>single</u> root cause has been identified; the general consensus is that several items combined to produce the problem. The items most prominently suggested are summarized below with the field's comments on them.

<u>Item 1</u> - Far too great a reliance was placed on testing for acceptance of the fill. When combined with questionable test results (as observed by a detailed review of U. S. Testing operations and some 6,000 soil test reports) this could produce placements not meeting specification requirements without raising questions.

Field Comment - The acceptance of plant fill was based on acceptance of in place density tests by Project Engineering specification direction. All parties (Bechtel Field, Q. C. and Project Engineering and CPCO) participated in the selection of U. S. Testing as the on site testing laboratory and the eventual monitoring of their activities. No adverse trends were uncovered in audits of their soil testing activities.

Item 2 - The lift thicknesses at which the fill was placed were excessive. The required compaction could not be achieved using these thicknesses and the equipment that was used.

Field Comment - The lift thicknesses used were within the specification limits and were qualified by in place density production tests.

Item 3 - A "qualified" soils engineer was not on site to provide continuous technical direction over plant fill placement and associated testing. This individual would have identified that the testing was questionable and the lift thicknesses excessive.

Field Comment - Project Engineering's failure to include this requirement in the project specifications and Geo-Tech's failure to provide an overview of plant fill have been identified earlier in this report. The current On Site Geotechnical Soils Engineer who fills this requirement has a Masters Degree in Civil

Engineering (soils) and 3 years consulting experience. Without being specifically directed, the field would not have been expected to use someone with these qualifications as the field engineer assigned to soils placement.

Item 4 - If test pads had been run on the material for varying lift thicknesses, moisture content and equipment use, the field would have known that their placement techniques were improper.

Field Comment - This seems unlikely since the qualification tests were run and accepted, albeit, as part of production tests.

Item 5 - There was insufficient inspection of the fill placement and too much responsiblity and reliability was placed on the foreman of the soils crew.

Field Comment - The quality of soils placement, or any other activity, is not achieved by inspection. The techniques used by craftsmen, field engineers and supervision were the equivalent of those used previously and appeared to achieve satisfactory results when checked in accordance with specification requirements. (Note that specification relies on testing for acceptance.)

Item 6 - The nuclear densiometer (Troxler device) can give erroneously high moisture contents. This can lead to erroneous conclusions about compaction of clay soils.

Field Comment - It appears that this is a true statement. Although initial correlations with traditional techniques for moisture content determination were utilized to approve the use of the Troxler device, subsequent correlation checks were not made. Use of the Troxler device has been discontinued.

Item 7 - If clay is under compacted and is on the dry side of the optimum moisture content, the uncompacted clay lumps may soften when saturated by groundwater.

Field Comment - This appears logical, however, it is difficult to assess the actual moisture content at the time of placement in light of the reliability of the Troxler device.

Item 8 - Quality Assurance problems with reinforcing steel in the 1975-1977 time period detracted from the effort required to ensure a proper program for plant fill soils placement.

Field Comment - This is a highly subjective comment and if applicable was not a major cause. It could have been contributory, however, as rebar did take top civil priority during this time period.

General Field Comment - It appears that no one item will be traced which caused the "soil problem," however a series of probable causes could be put together as follows:

1. Site fill is designed as a "saturated area (il e., the impervious dike follows the site perimeter allowing free flow of cooling pond water into the site fill).

2. Random fill is specified for the plant fill which allows significant use of sand (around pipe, duct runs, buildings, general backfill, etc.) and concrete. The sand provides flow paths for water as do the interfaces between the various fill types (concrete/sand, concrete/clay, sand/clay).

3. Decrease in compaction requirements from 95% ASTM 1557-D to 95% BMP (about 90% ASTM 1557-D).

4. Design material was not available on site and a material containing significantly more fines was substituted. The substitute material was much more difficult to handle, particularly in terms of moisture control. Small, hand held equipment may not have been able to properly compact even though tests were OK. Also, this material was subject to "pumping" and breakdown when exposed to water flow, perhaps as seen at soil type boundaries

5. Soils testing apparently gave erroneous results both from the point of Troxler use and generally poor testing results and errors.

6. Inadequate Non-Manual control of the placement process to assimilate the various deviations from ideal and recognize the potential problem This would include Field

Engineering Supervision and Field Quality Control, Quality Assurance, Project Engineering and Geo Tech were also contributory.

* Note as of 8-24-79 it has become necessary to abandon efforts to compact random fill to 95% ASTM 1557-D as we have not been able to consistently achieve such compaction with any hand held or motorized equipment (except jumping jacks inventoried earlier) available to the field.

E Gallagher

MIDLAND SOILS CHRONOLOGY AND SUMMARY

Soils placement on the Midland job is broken down between cooling pond dike construction and plant fill. A subcontractor (Canonie, Inc.) constructed the dikes during the period of 69-70 and 1973-77. Plant area fill (which is essentially complete) has been placed by both a subcontractor (Canonie, Inc.) and Bechtel. Canonie's work was limited to placement of large, open plant fill areas with mechanical equipment, while Bechtel generally placed smaller areas inaccessible to mechanized equipment with hand compactors. Bechtel has, however, placed some areas of plant fill with mechanized equipment. Placement of plant fill has extended from 1974 to present.

All soils testing on the project is performed by a subcontractor (U.S. Testing, Inc.). Their responsibilities include taking tests in accordance with ASTM standards at locations specified by Bechtel or Canonie. While not explicitly stated in their contract, U.S. Testing has also accepted the job of soils classification to facilitate testing.

Soils placement by Bechtel has been done under the technical direction of Bechtel field engineers assigned to specific plant areas i.e. yard facilities, Auxiliary Building, etc. There was not a designated soils field engineer on the jobsite. Because they were assigned responsibilities in addition to soils placement (i.e. rebar and formwork inspection, material requisitioning, etc.) the field engineers were not always physically present during the fill placement. Labor foremen were utilized to help call for soils tests under the direction of the field engineer. Technical acceptance of plant fill has been based on satisfactory test results.

Bechtel Construction Quality Control performed surveillance over the work done by Canonie. Canonie implemented their own approved QA program and Bechtel QC verified proper implementation by observation and review of records. Two to three times a day Bechtel QC would observe fill placed by Bechtel construction. Full time inspection was not required.

The settlement of the Diesel Generator Building was noted during routine construction survey work. Settlement markers were assigned and an extensive boring program was undertaken to ascertain the extent of the problem. The results of the boring program which are included in MCAR 24 show material with highly variable in-place properties in the first 15 feet under e structure. This fill which includes both clay and sand was placed by Bechtel during 1977.

As a result of the problems noted with the Diesel Generator Building an extensive settlement monitoring and soils boring program was undertaken for the balance of the plant. This program, which is still underway, includes borings taken through building base slabs. Those structures/facilities which are or may be effected by soil not meeting specification requirements to date include:

1) Diesel Generator Building
2) Unit #1 Main Transformer Area
3) Condensate Tank Area
4) Service Water Structure (North corner)
5) Unit #1 Penetration Room
6) Units #1 and #2 Feedwater Isolation Valve Pits
7) Borated Water Tank (Western tank only)

As a general rule we note that the "soft" soil encountered under these structures/facilities was placed by Bechtel using hand held equipment.

A surcharging program is currently underway to preconsolidate the fill under the Diesel Generator Building. Remedial measures to correct soils problems with the other above listed structures/facilities are under investigation.

P

Consumers
Power
Company

Midland Project: P.O. Box 1963, Midland, Michigan 48640 · Area Code 517 631-0951

December 7, 1978

Mr. P. A. Martinez
Bechtel Power Corporation
P.O. Box 1000
Ann Arbor, MI 48106

MIDLAND PROJECT GWO 7020 - DECEMBER 3 & 4, 1978
NRC VISIT REGARDING DIESEL GENERATOR SETTLEMENT
File: B3.0.3 Serial: CSC-3663

While this is not a set of minutes or an open item action list, during the subject visit several issues or questions were raised or inferred as noted below:

1. New settlement readings taken after duct bank freeing would seem to indicate the building may be pivoting about a north-south axis located somewhere in the vicinity of the condensate pipes. This raised a question concerning the potential hard spot developed by the 20" condensate line encased in the 24" lines surrounded by concrete and possibly resting on well compacted sand. If this is the case, we should examine the Diesel Generator Building structure in the vicinity for cracks in the concrete and consider the possibility of cutting loose the condensate lines immediately adjacent to the Diesel Generator Building.

2. When Mr. Ferris discussed possible causes, he made the point that it may be impossible to state the exact cause and that the more immediate concern was the remedial action. Although we concur that remedial action is most important, it should be noted that Mr. Gallager took strong issue with this point in that I & E believed cause determination to be mandatory and relative "to preclude repetition," etc. This aspect should receive more attention.

3. During this discussion it was noted that instrumentation will show when surcharge may be removed. In response to the NRC question regarding same, it was also noted that most settlement should occur rapidly as the area is being preloaded and that total settlement could take weeks or months. Our final response will have to provide sufficient rationale for determination that required settlement has taken place and answer the question of how we arrived at what was required.

4. Bechtel agreed to provide R. Cook a list of the equipment (small hand equipment and vibratory rolling equipment) which Bechtel utilized for compacting the fill from EL 618' to EL 628' in the Diesel Generator Building.

5. During Mr. McConnell's discussion regarding Item V, Mr. Gallager questioned the possible interference by the 20" condensate line. Bechtel should in-

vestigate and document the effects of additional outside pressure on the condensate lines resulting from the preload. Again Bechtel should consider cutting same at this point in time since it appears that it could be acting as a cantilever type restraint with the fixed end being the Turbine Building wall and/or the well compacted sands existing in that area. In a separate discussion, Mr. Don Miller noted that we have to consider the effect of rupture of the condensate line and subsequent flooding on a Class I structure during a tornado and/or an earthquake.

6. Mr. Gallager appeared to find Mr. Dahr's explanation connected with VII a. 1), table oversite, unacceptable or at least extremely difficult to accept. Bechtel should be prepared to completely satisfy the NRC concern in this area.

7. VII a. 7) Mr. Gallager appeared to find the ± 2% Industrial Standard discussion unacceptable. Bechtel should be prepared to completely satisfy the NRC concern in this area. We believe Mr. Gallager's question not only relates to the characteristics of the proctor curves in terms of optimum moisture content but additionally whether the material being placed relates to the selected proctor. To go a little further, he may be questioning the validity of your tests; i.e., was it really 80% or 95% compaction.

8. In my opinion, we should be prepared to fully address Mr. Heller's summary comments regarding the fact that the response to the Diesel Generator Settlement questions will have to improve or exceed the reviewer's expectations. Mr. Heller was discussing the fact that the construction permit was based on the original reviewer's examination of the program, and that licensing will now have to judge whether or not the modification program meets or exceeds the construction permit intentions and qualifications. This would seem to indicate that our responses are going to undergo an extremely critical review and that none of our answers will be acceptable unless they can withstand the most intense scrutiny. It would also appear that this will become part of the operating license hearings. In that respect, I cannot emphasize too strongly the need for absolute documented accuracy and the strongest argument in our responses.

As a separate issue we are also extremely interested in as early as possible resolution to the Turbine Building basement wall problem and preload relative of the area between the Turbine Building and the Diesel Generator Building.

I am submitting this list of items for your review and consideration as part of the overall development or resolution to the Diesel Generator Settlement problem. No response is required at this time.

T. C. Cooke
Project Superintendent

TCC/sd
cc: DBMiller
JLCorley
ABoos

CONSUMERS POWER COMPANY
RECEIVED
JUN 14 1979
FIELD QUALITY ASSURANCE
MIDLAND, MICHIGAN

Consumers Power Company

INTERNAL CORRESPONDENCE

To File

From TCCooke

Date June 13, 1979

Subject MIDLAND PROJECT GWO 7020 -
NRC SITE TOUR AND OBSERVATION OF TEST PITS
File: 0460.2 Serial: CSC-4138

CC *Attendees GSKeeley, P14-408B
DBMiller JJZabritski, P14-416
*Bechtel and Consumers attendees only.

NRR meeting on site of
June 7, 1979

I. Individuals Present:

Sherif S. Afifi	Bechtel Assistant Chief Soils Engineer
R. E. Lipinski	DSS/NRC
J. P. Knight	DSS/NRC
Daniel M. Gillen	DSS/NRC
C. A. Hunt	Consumers Power Executive Civil Engineer
P. A. Martinez	Bechtel Project Manager
*A. J. Boos	Bechtel Project Field Engineer
*R. J. Cook	Resident Inspector/NRC
*T. E. Vandel (Entrance only)	US NRC Region III
Lyman Heller	US NRC NRR
T. E. Johnson	Bechtel Chief Civil/Structural Engineer
K. Dhar	Bechtel Supervisory Engineer
T. C. Cooke	Consumers Power Project Superintendent
D. E. Sibbald	Consumers Power Senior Construction Advisor
K. Wiedner	Bechtel Engineering Manager
*D. Horn	Consumers Power Quality Assurance Group Supervisor/Civil
R. M. Wheeler	Consumers Power Civil Section Head

*Part time

II. Discussion Tour Comments

A. The individuals from the NRC were extremely interested in cracks in the Auxiliary Building, Service Water Building, and Diesel Generator Building. Many questions were asked regarding differential settlement. They seem to be under the impression that there was a great deal of building settlement other than the Diesel Generator Building and that large cracks exist somewhere on the site. We continually had to reiterate the fact that remedial actions were based on soil borings which showed questionable material and not settlement problems. Mr. Lipinski, in particular, was very interested in why we had cracks and analysis regarding same.

B. During the tour it was apparent that the NRC's questions were oriented towards seismology aspects. They were also interested in whether or not we had re-reviewed the different seismic conditions in the light of our concrete backfill revisions for the Auxiliary Building, wing walls, etc., since the addition of concrete could cause new reactions and forces requiring reanalysis. It was noted that the concrete backfill would be separated from the structures by styrofoam and not tied to the structures. The NRR alluded to possibly more stringent earthquake requirements.

C. When observing the test pits, Mr. Heller expected more sand in the "random fill". It was noted that sand was used primarily around utilities and next to buildings.

D. Mr. Heller appears to be of the view that the simpler engineering fix on the service water overhang, such as concrete backfill as opposed to more complex remedial action, would stand a much better chance of passing review, due at least partially to the fact that much of the available manpower in Washington was involved with Three Mile Island and also because simple straightforward engineering practices will be much easier to discuss in any hearing process. The NRR was informed that piling at the Service Water structure was only for vertical load and that no moments were involved. It appears that possibly Mr. Knight's staff has been reduced from about fifty to near eight, with the forty people being tied up on Three Mile Island activities. There will be a corresponding cutback in the normal amount of licensing activities that will be undertaken by his staff over the next several months.

E. NRR noted that they should receive copies of any Diesel Generator (total site related) material that is being transmitted to Region III directly from the licensee. It also appears that Mr. Knight is more interested in resolving the Midland fill problems in the near future on a "real time basis" as opposed to later review and approval functions such as might be found in going the FSAR route. (Note: Consumer Power Company has been attempting for weeks to arrange a meeting with NRR but it was not until the week of June 4, 1979 that we were able to set a meeting date with them of July 10, 1979.) He recognized that presently the licensee was involved in answering the same or possibly similar questions on three fronts, namely the I&E questions, 50.54f responses and future FSAR revisions, and agreed that it would be beneficial to all parties to consolidate these areas. During the tour it also appeared that in the future NRR may become much more deeply involved in the details in all licensing aspects than they have in the past.

F. It would appear that we should provide more rationale and better arguments for support of duct bank and pipes and man holes, valve pits, etc. during the seismic event. We have to verify or prove that duct banks, for example, will not shear during the earthquake. Mr. Heller was of the opinion that our responses on the safety aspects concerning the borated water storage tank lines will have to be extremely conservative, and that at this point in time for our responses to be accepted, he would be inclined to say that questionable material should be removed and fixed rather than going through some complex explanation as to why it was "acceptable as is" since this was a Category One item which would be required during the postulated accident conditions.

Generally, the NRR personnel appeared to find the information gathered during the tour and observation of the test pits to be of value and the type of information which would expedite their decision making process.

plw

Consumers
Power
Company

Midland Project: P.O. Box 1963, Midland, Michigan 48640 . Area Code 517 631-0951

July 6, 1979

Mr. R. L. Castleberry
Bechtel Associates Professional Corporation
P.O. Box 1000
Ann Arbor, MI 48106

MIDLAND PROJECT GWO 7020 -
STAINLESS STEEL PIPE ATTACK
File: B1.7 Serial: CSC-4198

Recently a 6" section of stainless steel pipe, partially buried in the area of the condensate tanks, was noted to have pitting and stains. A section of the pipe was cut off and sent to our Trail Street Laboratory for analysis. Preliminary indications are that this pitting may be due to an electro-chemical attack. The stain was reported to be high in calcium and silicon with small peaks of sulfur, chloride, potassium, titanium and copper.

At this point we do not know whether the soil itself has initiated the problem or whether something was spilled on the pipe. However, the soil is being questioned. Since excavation or examination or replacement of buried stainless steel pipe at this site would have extensive commercial implication and possibly NRC Regulatory involvement, it is requested that your office set up an immediate investigative program concerning the soils with an outside laboratory. Our Trail Street Lab may not have the capability of doing the soils analysis.

By copy of this letter to Mr. J. F. Newgen, it is requested that he immediately check to see whether or not anything containing the above mentioned material could have been inadvertly spilled on the pipes. Please contact our Mr. Derk J. Vokal should you have any questions on this subject.

T. C. Cooke
Project Superintendent

TCC/bd

CC: RCBauman
JLCorley
GSKeeley
JFNewgen

Q

coast. Superimposed are areas of sand dunes and salt flats which could present special foundation problems. Availability of construction materials is dictated by bedrock geology varying from relatively good availability in the western areas to poor in the eastern region. As is the case in many marine environments, offshore conditions in the Red Sea are characterized by varied subsurface conditions at relatively short distances, thus affecting the design of offshore facilities. Offshore conditions are relatively more uniform along the Persian (Arabian) Gulf.

ACKNOWLEDGMENTS

The writers are grateful to the staff of the Foundation, Material and Survey Branch, United States Army Corps of Engineers, Middle East Division, for their assistance in providing data; to D. Murphy, who reviewed the paper and provided data; to J. Portelli, who helped in preparing the illustrations; and to J. Sorensen, who typed the manuscript. The writers are also grateful to ASCE reviewers for their helpful comments and to A. Prevost and B. Randa for providing illustrations on cavity development.

APPENDIX.—REFERENCES

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JOURNAL OF THE
GEOTECHNICAL
ENGINEERING DIVISION

SAFETY OF A CONSTRUCTED FACILITY: GEOTECHNICAL ASPECTS

By T. William Lambe,[1] F. ASCE, W. Allen Marr,[2] M. ASCE,
and Francisco Silva,[3] M. ASCE

INTRODUCTION

Civil engineers have always given priority to the safety of the facilities they design and help construct. Indeed, the public, through its action groups and governmental regulatory agencies, demands a high degree of safety for certain constructed facilities. However, differences exist in the degree of safety employed by engineers. Structural engineers use factors of safety ranging from 1-1/2-4 and higher in designing structures of steel, concrete, and wood to allow for "unknown and unforseen factors." Geotechnical engineers also employ factors of safety for the geotechnical aspects of constructed facilities. Unfortunately, economic considerations often require that the geotechnical engineer use lower factors of safety than those used by the structural engineer despite the fact that the properties of soil, the geotechnical medium, vary more than those of steel, concrete, and wood. The geotechnical engineer usually employs factors of safety ranging from 1.1-1.5 for earth slopes (but higher safety factors for foundations).

As a consequence of these relatively low safety factors, the geotechnical engineer necessarily employs greater supervision and review of construction and surveillance of operations than do other engineers in order to help ensure the safety of their constructed facilities.

With the recent dam failures in the United States [a coal slag dam at Buffalo Creek, W. Va. (Feb. 1972); the Bouldin Dam near Montgomery, Ala. (Feb.

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Note.—Discussion open until August 1, 1981. To extend the closing date one month, a written request must be filed with the Manager of Technical and Professional Publications, ASCE. Manuscript was submitted for review for possible publication on February 5, 1980. This paper is part of the Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, ©ASCE, Vol. 107, No. GT3, March, 1981. ISSN 0093-6405/81/0003-0339/$01.00.

1975); the Teton Dam in Idaho (June 1976); and the Kelly Barnes Lake Dam at Toccoa Falls, Ga. (Nov. 1977)], and the resulting loss of life and property, national attention has focused sharply on dam safety. In August 1972, Congress passed Public Law 92-367 concerning dam safety; in a December 2, 1977 statement, the President initiated the Federal Dam Safety Program. We can expect further regulations on dam safety from both state and Federal agencies. Responding to the increased concern for safety of geotechnical facilities such as dams, offshore structures, and foundations for nuclear power stations, engineers have devised and executed systems of "quality control" to help reduce risks.

The details and the effectiveness of an appropriate safety program for a constructed facility depend on various factors, including: (1) Consequences of failure; (2) stage of life of the facility; (3) desired degree of safety; and (4) nature of the facility and the site. An engineer can tailor the comprehensive safety program presented herein to suit a particular situation.

This document presents an approach to "safety of a constructed facility" by outlining, analyzing, and illustrating various components of a comprehensive "safety program." Aided by Massachusetts Institute of Technology (MIT) associates, we have, over a period of 25 yrs, developed this safety program and applied parts of it to approximately 20 facilities, primarily dams and natural slopes. We continue to develop the program as we gain experience with its use.

Comprehensive Program

Approach.—When dealing with important, complex geotechnical facilities experience clearly shows that the geotechnical profession cannot feasibly create a facility which completely fulfills all performance criteria for the entire life of the facility. Rather, the only logical approach is to "engineer a facility for its design life," i.e., create a reasonable design, construct the facility according to the design, and then execute an appropriate ongoing safety program.

Factors Dictating Approach.—For two decades, we have investigated the geotechnical engineer's capability to predict the performance of a geotechnical facility. Students of MIT, practicing engineers, and leaders in the geotechnical profession have made predictions for a variety of situations prior to the occurrence of the event. The predictors did not know of the actual outcome at the time of their predictions. By comparing *predicted performance* with *measured performance,* we obtained an approximate measure of the profession's capability to predict performance. Our evaluations suggest that the geotechnical engineer can predict with the following reliability:

1. Deformation—Predicted vertical deformation = ±50% of the measured deformation. Predicted horizontal deformation = ±150% of measured deformation.
2. Stress—Predicted change of pore pressure = ±25% of measured change of pore pressure. Predicted lateral stress = ±50% of measured lateral stress.
3. Stability—Predicted factor of safety = ±25% of measured factor of safety.
4. Flow—Predicted flow = ± one order of magnitude of measured flow.

Candidate Facilities.—Experience shows the desirability of a long-term safety program for the following types of facilities: (1) Natural slopes, especially cut slopes; (2) excavations; (3) fluid retention systems; and (4) offshore and waterfront facilities. Natural slopes, particularly those involving a reduction of stresses from cutting, can become less safe over a period of time. The drop in stability results from a rise in pore water pressure and, for certain types of soil, a loss in shear strength. Professor Skempton's work in England and our own experience in Puerto Rico and Venezuela show natural slopes that failed years after formation.

Dams, like natural slopes, can weaken with time. Filling a reservoir tends to increase the pore water pressures in the dam, thereby lowering its strength. In addition, the removal of soil fines by flowing water may worsen with time.

Structures designed for earthquakes or sea storms will normally experience their most severe loading months or years after construction. Engineers should use measurements of performance during the early life of the facility to check on its safety prior to arrival of the maximum loading. This procedure, a feature of the program described herein, may prevent a failure similar to that which occurred at Sines, Portugal where a large breakwater failed under storm conditions less severe than the design storm.

Components of Program.—The Geotechnical Safety Program has the following purposes:

1. To determine the degree of safety of a constructed facility (geotechnical aspects).
2. To help maintain a predetermined degree of safety of a constructed facility.
3. To furnish the technical base to permit alteration of the facility to obtain a different, usually higher, degree of safety.

Our comprehensive geotechnical safety program has nine components:

1. Performance Criteria:
   a. Determine the consequences of failure.
   b. Select an acceptable level of risk.
   c. Establish criteria of performance.
   d. Ensure that the criteria meet appropriate legal requirements and accepted standards of practice.
2. Design Assessment:
   a. Check the design conditions, such as loads.
   b. Identify the critical mechanisms of performance.
   c. Identify typical and critical sections.
   d. Review the field and laboratory data used by the designer. Inspect the site and run selected tests on the soil(s) that greatly affect the design.
   e. Examine the prediction methods employed by the designer. Check to see whether the designer's methods rest on mechanisms approximating the expected actual ones.
   f. Check the designer's predictions of performance and compare them with the performance criteria.
   g. Prepare a Design Summary which states clearly and references the loads used by the designer as well as his prediction methods and parameters, and portrays the predicted performance.

b. Use the designer's methods and parameters to predict performance for conditions expected during the early life of the facility.

c. Identify major uncertainties and critical aspects of performance.

3. Field Measurement System:

a. Select appropriate field instruments and place them so they can measure critical aspects of performance.

b. Install instruments which can reveal mechanisms and values of key parameters. The engineer should observe the installation of instruments to ensure that they are placed at the correct locations and that they read correctly.

c. Periodically check and maintain the field instruments.

4. Construction Assessment:

a. Make periodic inspections of the facility during its construction. Compare the actual construction with the design and document the significant features of construction, particularly those features which vary from the original design.

b. Assess the significance on predicted performance of such departures from the design.

c. Make frequent site visits where difficult site conditions prevail. For highly complex situations, have a representative present on the site during critical stages of construction.

5. Surveillance:

a. Make periodic visual inspections of the project, searching for any evidence of malfunction.

b. Measure important aspects of performance.

c. Obtain information—data on mechanisms and parameters.

d. Portray (versus time) field measurements, significant events, and predicted values.

6. Performance Evaluations:

a. Periodically compare predicted performance, measured performance and performance criteria. Attempt to explain any differences shown by the comparison.

b. Compare predicted and measured mechanisms and parameters.

7. Safety Assessment:

a. Determine and indicate (in terms of safety factor or probability of failure) the degree of safety of the facility.

b. State and evaluate any change in degree of safety during the period since the last safety assessment.

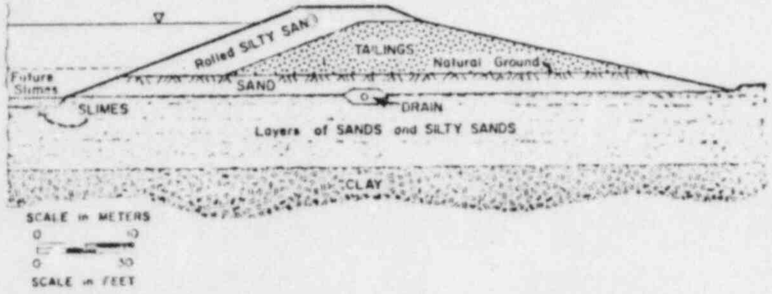


FIG. 1.—Critical Section of Dam

c. State whether or not the existing degree of safety meets performance criteria.

8. Remedial Measures:

a. Design and assist in executing remedial measures to bring the degree of safety to a satisfactory level if the safety assessment reveals an inadequate level of safety.

b. Evaluate the effectiveness of remedial measures.

9. Contingency Plan:

a. Develop a plan to limit the consequences of a failure.

The preceding nine components constitute the comprehensive safety program. The following portion of this paper illustrates "Design Assessment," "Performance Evaluation," and "Safety Assessment." These illustrations come from actual projects.

DESIGN ASSESSMENT

The preceding section listed the components of a design assessment. The thoroughness of and approach to the design assessment depends on the nature and importance of any given project. The engineer making the design assessment should maintain independence from the organization designing the facility. The following six steps give a general framework for the design assessment:

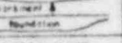
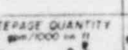
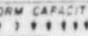
1. Review the design documents and drawings.
2. Examine the site.
3. Consider the design with the designer and the owner.
4. Perform selected check or supporting tests and analyses, or both.
5. Summarize the design assessment.
6. Analyze the assessment with the designer and the owner.

Fig. 1 shows a critical section of a design for a dam built to initially store

TABLE 1.—Design Parameters

Soil (1)	Designer's Value (2)	Assesser's Value (3)
(*a*) Permeability, in meters per second × 10^{-6}		
White sand	10	25
Black silty sand	0.1	1
Silty sand (hardpan)	0.5	1
Brown sand	1	25
Marly sand	10,000	300
Silt	0.1	50
Clay	0.001	0.001
(*b*) Strength, in degrees		
White sand	37	37
Black silty sand	38	32
Silty sand (hardpan)	38	32

TABLE 2.—Summary of Typical Design Assessment

	PERFORMANCE ASPECT	OWNER'S CRITERIA	DESIGNER'S PREDICTION	BASIS FOR PREDICTION	ASSESSOR'S EVALUATION	ASSESSOR'S RECOMMENDATIONS
FORCE DEFORMATION	CRACKING 	width ≤ 0.5 inch length ≤ 6 ft depth ≤ 6 inches	$w_c \geq 0.5$ inch $l_c \geq 6$ feet $d \geq 6$ inches	Observed cracking of adjacent, existing dam		Initiate steps to reduce likelihood and consequence of cracks
	SETTLEMENT 	total settlement ≤ 2 ft	$\rho_{max} \leq 1.5$ feet	Settlement of embankment from self-weight		Local regrading may be required to maintain surface drainage
		differential settlement ≤ ℓ/200	$\Delta\rho/\ell \leq 1/2000$	Difference in total settlement due to varying height of embankment	$\Delta\rho/\ell$ may exceed criterion where dam crosses from mined to unmined foundation and at connections to existing dam	Observe these locations during construction Repair any cracks
STABILITY	SHEAR SLIDE 	factor of safety ≥ 1.5	F.S. ≥ 1.8	Stability analyses for deep circles	F.S. may decrease to 1.5 with $\bar{\phi}$ from assessor's lab test	
			F.S. = 1.1	Stability analyses for shallow circles	Local sloughs possible. Repair immediately to avoid progressive failure	Criterion not met. Must observe and prepare remedial plan
					Stability of mass on east side between dam toe and mine cut not considered	Have designer evaluate
	LOW EFFECTIVE STRESS 	artesian head ≤ 0	$a_{max} \approx 3$ ft	Flow nets	Control of artesian heads depends on assumptions that • R.L. < 125 ft until slimes reach elev. 120 • slimes effectively seal bottom of reservoir FEDAR analyses show "a" could exceed 5 ft below black sand	R.L. cannot exceed +125 until slimes reach +120 Piezometers required at locations with predicted artesian head May require [illegible] work during operation to reduce [illegible] Install dra[illegible] black sand and hardpan to reduce a[illegible] head
SEEPAGE	SEEPAGE QUANTITY = gpm/1000 lin ft 	collected flow ≤ 70 flow into ground ≤ 200 flow off property ≤ 20 total flow ≤ 275	$Q_c = 0$ $Q_g = 0$ $Q_0 = 400$ $Q_t = 400$	Estimated Vertical seepage thru slimes and foundation $Q_0 = Q_t - Q_g - Q_c$ From flow net with R.L. = 135 and slimes	From FEDAR $Q_t = Q_0 = 650$	Criterion on total flow exceeded. Requires further consideration
	SOIL TRANSPORT 	$\frac{\text{critical gradient}}{\text{gradient}} \geq 5$	ratio = 1.1 on downstream slope ratio = 2.1 at toe	Stability analyses for shallow circles Corps of Engineers method	Designer's calculation not consistent with definition of criteria From designer's nets $i_{max} = 1.0$ From FEDAR analyses $i_{max} = 3.5$ F.S. = 10/3.5 = 3 Seepage breakout predicted to occur	Criterion on maximum gradient exceeded Requires further consideration
	SEEPAGE QUALITY $s^{\circ\circ}$ in ppm	Meet Federal and State requirements	Off-property flow will meet requirements		Seepage of mine water thru dam improves mine water quality	
MISCELLANEOUS	STORM CAPACITY 	Freeboard ≥ 5 ft Spillway capacity for 12 in. rainfall in 24 hr	Freeboard > 5 ft Spillway capacity > 12 in. rainfall in 24 hr	Dam crest 5 ft > max. R.L. Rainfall over reservoir and capacity of spillway		
	ANIMAL HOLES 	Hole length ≤ 2 feet Hole diameter ≤ 3 in.	Not a problem	Previous experience with earth dams in this area		
	VEGETATION 	Height ≤ 6 inches	Height > 6 inches unless mowed	Previous experience in this area	High thick vegetation hinders geotechnical inspection	Requires maintenance by owner

water, and later clay slimes. The foundation consists of layers of clay, silty sands, and sands. The embankment consists of hydraulically-placed mine tailings with a drain and an upstream face of mixed and rolled silty sands.

Tables 1 and 2 summarize a design assessment for this facility. Table 1 compares parameters for permeability and strength used by the designer with values selected by the assessor. Different results from lab tests and different interpretations of the field conditions explain the disparity in values. Table 2 presents a detailed comparison of performance criteria and predicted performance, along with an evaluation of the design. The first column indicates critical aspects of performance for the facility and the second column lists numerical criteria for performance as adopted in considerations among the owner, designer, and assessor (one desirable product of a design assessment may be a clear statement and understanding of design criteria for the facility). The third and fourth columns summarize the designer's predictions of performance and the basis for these predictions. The fifth column gives the assessor's evaluation of the designer's prediction methods, parameters, and mechanisms, and the last column lists departures of predicted performance from the owner's design criteria and indicates required future actions.

This design assessment resulted in investigations which ultimately led to modifications in the design. Performing the assessment helps to clarify the intended function, predicted performance, and any anticipated problems for the owner and designer, as well as for the assessor.

Performance Evaluation

Figs. 2 and 3 show two aspects of a performance evaluation for a recently constructed dam. Figure 2 portrays stress conditions downstream of the dam for a headwater elevation 15 ft (5 m) below the design reservoir level. As this figure indicates, effective stresses fell below the values specified in the performance criteria.

Figure 3 shows the flow net for a partially full reservoir using pore pressures measured prior to the execution of remedial measures. While the net indicates that flow through the dam met the criterion, predicted flow for full reservoir level exceeded the criterion.

The performance evaluation summarized in Fig. 4 led to the design and execution

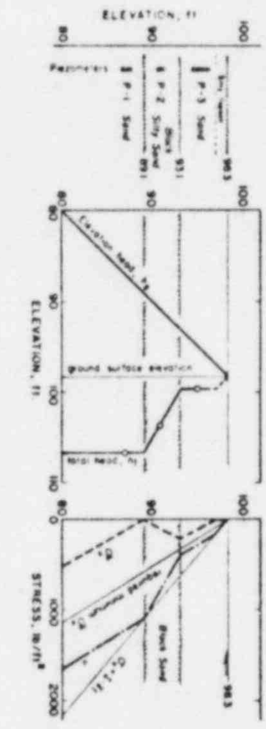


FIG. 2.—Performance Evaluation for Effective Stresses (1 ft = 0.305 mm, 1,000 lb/sq ft = 4.88 tons/m² = 47.85 kN/m²)

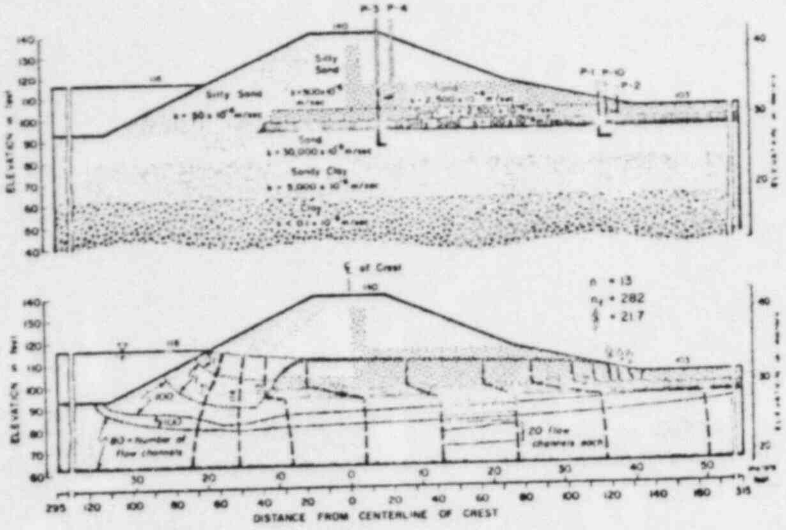


FIG. 3.—Performance Evaluation for Flow through Dam

of remedial measures which corrected nearly all of the deficiencies. Continu periodic evaluations check deficiencies not yet fully corrected.

Approximate Safety Assessment For Dam

The engineer often must perform an approximate safety assessment due circumstances such as:

1. Limited financial resources.
2. Limited time.
3. A need to define the scope for a complete safety program.
4. The project existing at an intermediate stage of completion.

An approximate safety assessment for a dam attempts to classify the exist conditions of the dam as follows:

1. A *safe* condition, i.e., no action required.
2. An *unsafe* condition, i.e., remedial action required.
3. A *questionable* condition, i.e., further investigation needed.

An approximate assessment normally utilizes existing drawings, construct records, performance data, and a site inspection. The site inspection team sea for the presence or absence of design and construction features associated w good performance, or both, plus any evidence of unsatisfactory performa An approximate assessment of dam safety normally does not include additi soil borings, lab tests, or field measurements.

	PERFORMANCE ASPECT	DESIGN PREDICTIONS	MEASURED PERFORMANCE Before remedial measured	PERFORMANCE CRITERIA
FORCE - DEFORMATION	Cracking	Not discussed	No cracks observed	Crack width ≤ 1/2 inch Crack depth ≤ 6 inches Crack length ≤ 6 feet
	Settlement	Not predicted	Not measured	Settlement ≤ 2 feet Angular distortion ≤ 1/200
STABILITY	Shear Slide	Safety Factor ≥ 1.6 @ Fluid Level = 136 ft.	Fluid Level / Safety Factor 116 ft. 1.83 135 ft. 1.23	Safety Factor > 1.5
	Low Effective Stress	No artesian heads	Artesian Heads at Stations 20-60 75-95 66-71 100-115	No artesian heads
FLOW	Seepage Quantity	Total flow ≤ 50 gpm per 1000 ft. of dam	Fluid Level / Total Flow 116 ft. 210 gpm/1000 ft. 135 ft. 560 gpm/1000 ft.	Total flow ≤ 275 gpm per 1000 ft. of dam
	Soil Transport	Gradient ≤ 1.2	Fluid Level / Maximum Gradient 116 ft. 0.8 135 ft. 1.8	Actual gradient ≤ 1/5 Critical gradient I_c = 10
	Seepage Quality	Not predicted	Seepage conforms to state and federal regulations	Seepage must conform to state and federal regulations
MISCELLANEOUS	Storm Capability	Spillways can lower reservoir 1 ft./day; 5 feet of freeboard	Spillway capacity not measured freeboard ≥ 5 ft.	Spillways can lower reservoir 1 ft./day; freeboard ≥ 5 ft.
	Animal Holes	Not discussed	No large animal holes reported	Hole length ≤ 2 feet Hole diameter ≤ 3 inches
	Vegetation	Not discussed	Most vegetation ≤ 6 inches	Vegetation height ≤ 6 inches

NOTE: 1 gpm = 0.063 ℓ/sec 1 foot = 0.305 meters

FIG. 4.—Summary of Typical Performance Evaluation

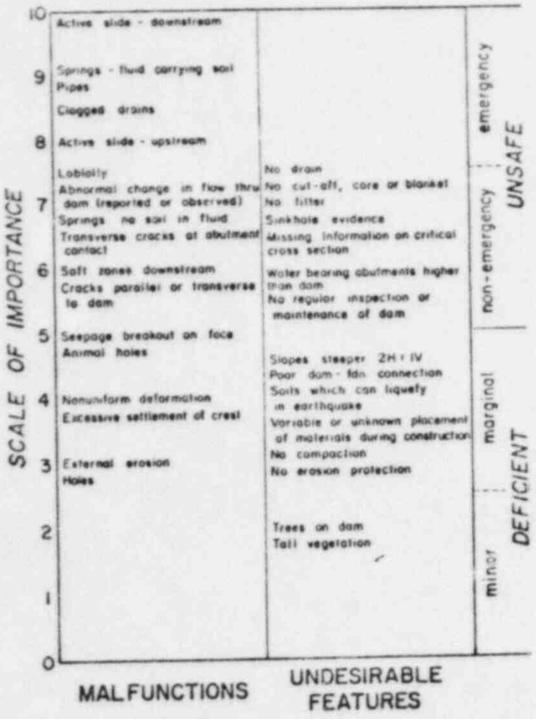


FIG. 5.—Undesirable Features and Malfunctions in Dam

Fundamentals and experience permit one to list features associated with good and poor performance of dams. We assign a scale to these features to indicate the relative importance of the various undesirable features and malfunctions. Fig. 5 gives a list which uses both a numerical scale and a descriptive scale. Key descriptive words frequently require concise definition to avoid confusion in the safety assessment. Definitions of terms used in Fig. 5 include:

1. Property—Characteristic quality, action, state, or condition.
2. Behavior—Manner in which something acts, responds.
3. Performance—Execution of function.
4. Safe—Freedom from danger, hazard, or accident.
5. Stable—Firmly established; fixed.
6. Risk—Exposure to loss.
7. Inspect—View closely; scrutinize.
8. Measure—Ascertain extent, dimensions, quantity.
9. Monitor—Watch, observe, check.
10. Surveillance—Close watch, constant guard, control, management.
11. Assess—Analyze critically and judge definitively the nature, significance, status, or merit.
12. Determine—Fix conclusively, decide, discover.

---

13. Evaluate—Express numerically; examine and judge worth or condition of.
14. Interpret—Explain the meaning of.

A figure depicting as accurately as possible the cross section at the station with maximum head difference and a plan of the dam and reservoir constitutes a useful means of systematically assembling and assessing information on the dam. A lack of critical information in this figure constitutes an undesirable feature which one must consider in the safety assessment.

Safety Assessment Using Risk Analysis

Execution of a complete safety assessment requires sufficient information concerning loads, parameters, and field conditions to select, represent, and analyze a critical section of a facility. Such a clearly-defined situation rarely occurs, and the engineer must therefore accommodate incomplete knowledge and limited data by making "conservative" choices.

Engineers in fields such as aircraft design, nuclear power plant design, and fire hazard reduction have developed safety programs which utilize concepts from probability theory to assess safety where mechanisms, analyses, and parameters remain uncertain. Geotechnical engineers have developed an interest in these techniques, particularly in the design of foundations for nuclear power plants to withstand extreme earthquake loads.

Risk analysis fits conceptually into our safety program because it helps us to assess numerically the degree of safety of a facility, to compare the safety of alternate designs, and to evaluate the benefits of remedial work. A numerical assessment of safety promises results superior to the normal deterministic finding of "safe," "unsafe," or "questionable."

A risk analysis attempts to identify all undesirable or abnormal events and assess the probability and consequences of each occurring. One can exclude consideration of events of low consequence.

To help organize a risk analysis one can arrange events in an event tree or a fault tree. Figures 6 and 7 present a partial combined fault-event tree for a waste storage dam. The owner plans to raise the dam crest, thereby increasing reservoir storage capacity. Conversations with the owner and an initial safety assessment of the dam revealed that the most serious event consists of a loss of contaminated fluid stored within the waste storage facility. Loss of fluid would result in major negative consequences—principally, the flow of contaminated water off property and the shutdown of the processing plant until containment of fluid was achieved and the water supply replenished.

The following five mechanisms result in loss of fluid:

1. Flow occurs along a path of high permeability resulting in flow through the dam in excess of the capability of the perimeter collection ditch.
2. Excessive rainfall nullifies freeboard and overtops the dam.
3. A sinkhole develops beneath the dam or reservoir.
4. A shear slide occurs through the crest of the dam.
5. A pipe develops through the dam by internal erosion.

The occurrence of any of these events depends on the combination of various conditions depicted in the fault-event tree in Fig. 6. One can use various techniques to determine the probability that each mechanism will lead to loss of containment, e.g., determining the probability of loss of containment by a large shear slide in the downstream section involves estimating uncertainties in geometry, pore

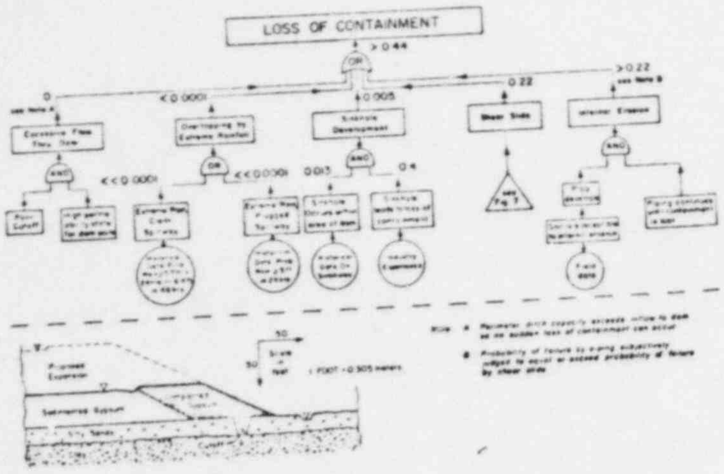
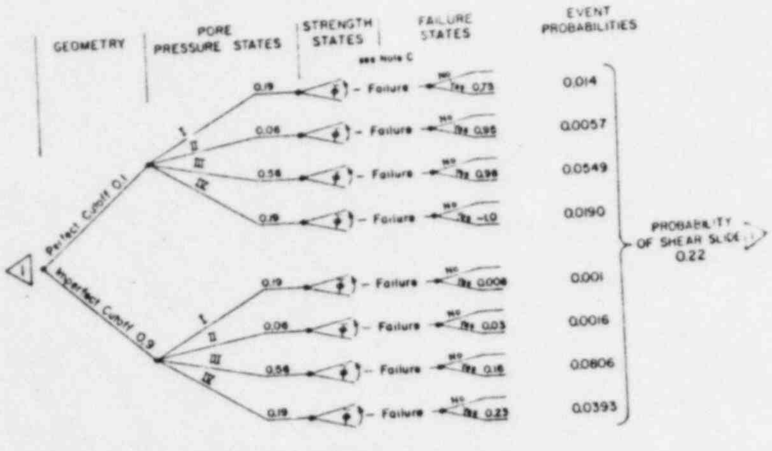


FIG. 6.—Fault Tree for Risk Assessment



NOTE C: Mathematical operation involving mean and variance in friction angles, model uncertainty and probability distribution function for factor of safety

FIG. 7.—Event Tree for Risk Assessment

pressure, strength, and analytical method. Figure 7 shows the steps inv in obtaining these failure probabilities using an event tree. Steps in the prob assessment follow:

1. From the geometry of the facility, determine that the main uncer

resides in the effectiveness of the core trench to cut off seepage.

2. Establish probability distributions for permeabilities and strength using laboratory data, field data, and the experience of the analyst.

3. Obtain pore pressures from flow nets drawn for ranges of permeability of soils.

4. Compute the minimum factors of safety against a shear slide for a range of friction angles for each set of pore pressures. We used the simplified Bishop method of slices with circular arc failure surfaces which lead to loss of containment.

5. Compute the mean and standard deviation of factor of safety for each set of pore pressures using the probability distributions of friction angles from Step 2 and an estimated analytical uncertainty of ±6% error in the calculated factor of safety.

6. Calculate the probability of failure using the results from Step 5 for each set of pore pressures, i.e., F.S. ≤ 1 with some probability distribution for F.S., for which in this case we tried both normal and lognormal distributions, with little difference in results.

7. Combine results for each set of pore pressures and geometry into one probability of failure using probabilities from Steps 1, 2, and 6.

Figure 7 gives the probabilities for each of the aforementioned steps, e.g., from piezometric data, we estimate that an *imperfect cutoff* exists with a probability of 0.9. The probability that flow net IV (which we based on sedimented gypsum being more than three times as permeable as compacted gypsum, and sand being less than 1/3 as permeable as the sedimented gypsum) represents flow in the dam equals 0.19. This calculation results from the probability distributions established in Step 2. A probability of 0.23 exists that friction angles combined with pore pressures from flow net IV give a factor of safety less than or equal to one. Consequently, the probability of a shear slide due to the combination of low friction angles, pore pressures from flow net IV, and an imperfect cutoff equals 0.23 × 0.19 × 0.9, or 0.039. Combining all paths to failure in Fig. 7 gives a probability of failure by a large slide and loss of containment of 0.22.

Internal erosion, or piping of the silty sand foundation stratum underlying the reservoir, causes great concern. Substantial pipes developed in the existing dam, but loss of containment did not occur.

The fact that pipes have already developed in the sand foundation of the existing dam with some pipes inducing small slumps leads us to suspect that the probability of failure by piping of the enlarged facility must equal or exceed the probability of a shear slide. Consequently, the fault tree shows a probability of loss of containment by piping of greater than 0.22.

In summary, the probability of loss of containment in the expanded facility equals more than 0.44 during its 10-yr design life. Essentially all of the risk stems from failure by internal erosion and a shear slide. With this information, the owner readily identifies the main contributors to the risk and assesses the need for an alternate design.

As parts of this analysis suggest, we do not know the actual probabilities as precisely as the number of significant figures Fig. 6 and 7 indicate. The figures include the artificial precision to allow clear illustration of how the probabilities combine.

SUMMARY AND CONCLUSIONS

This paper describes a comprehensive program to help ensure that a geotechnical facility meets performance criteria, particularly safety criteria. The program's systematic approach rests on the fundamentals of geotechnical engineering—specifically, the effective stress principle, the stress path method, Darcy's Law, and stress-strain principles.

Successful application of the program yields:

1. A portrayal and evaluation of actual performance.
2. An assessment of prediction capability.
3. A reservoir of evaluated performance, including data on the effectiveness of remedial work.

This approach integrates activities known and applied by geotechnical engineers. These activities include: (1) Field investigations; (2) laboratory tests; (3) analyses; (4) field measurements; and (5) site inspections. The program employs "average elements," a feature of the stress path method (first and second writers, 1979). No program can guarantee "zero risk" of failure. The engineer must still search for "minor geological details" that may cause a facility to malfunction. Further, the geotechnical engineer must still deal with phenomena such as piping, dam cracking, and soil disturbance, which the profession only partially understands.

Believing in the approach of "engineering certain constructed facilities for their entire lives," we have developed—or actually evolved—the program described in this paper. We have found this approach highly effective and worthy of the effort required to implement it.

ACKNOWLEDGMENTS

This program, both in concept and execution, benefitted from contributions by many people. R. V. Whitman and G. B. Baecher assisted in the risk assessment work. T. L. Neff made many site investigations and helped portray and interpret field data.

The Borden Company and LAGOVEN, S.A. encouraged and assisted in the development and application of the program described in this paper. They permitted us to publish work performed for them.

Engineers, especially B. Moore from the St. Louis District of the Corps of Engineers and J. Boehmer from Rijkswaterstaat in the Netherlands, helped on the assessment of dam safety.

We acknowledge with appreciation the assistance we received.

JOURNAL OF THE GEOTECHNICAL ENGINEERING DIVISION

TECHNICAL NOTES

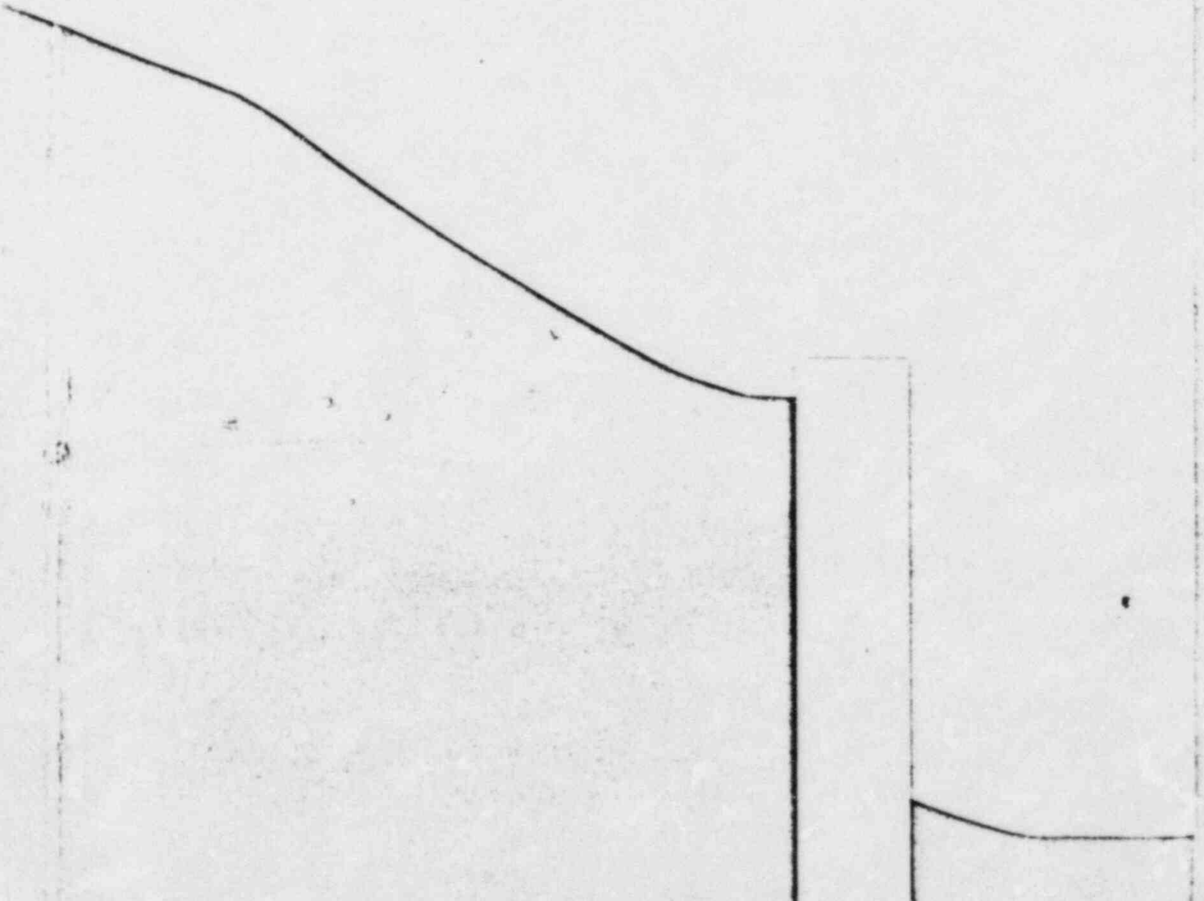
Note.—Discussion open until August 1, 1981. To extend the closing date one month, a written request must be filed with the Manager of Technical and Professional Publications, ASCE. This paper is part of the Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, ©ASCE, Vol. 107, No. GT3, March, 1981.

FOUNDATIONS, RETAINING AND EARTH STRUCTURES

THE ART OF DESIGN AND CONSTRUCTION AND ITS SCIENTIFIC BASIS IN SOIL MECHANICS

By Gregory P. Tschebotarioff

Second Edition



FOUNDATIONS, RETAINING AND EARTH STRUCTURES
by GREGORY P. TSCHEBOTARIOFF, Second Edition
Published by McGRAW HILL

PARA 1-8 (Special Need for Construction
QUALITY CONTROL)

"In Foundation work this need is much greater than in any other branch of civil Engineering."

"Constant attention to every detail of construction procedures is therefore a MUST in all foundation work. Above all, continuous competent on-the-site inspection is essential, supplemented in special cases by various types of field measurements."

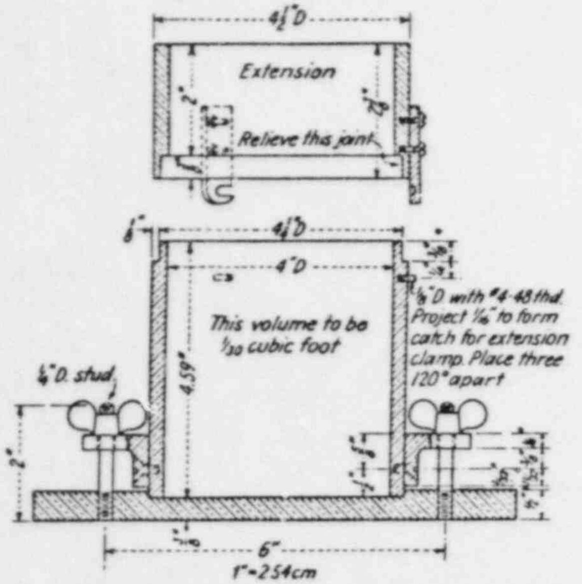


Fig. 5-10. Standard Proctor type (also ASTM and AASHO) mold for soil compaction.

each layer. The extension piece shown in Fig. 5-10 is then removed, the soil along the surface of the lower mold, the volume of which is $\frac{1}{30}$ ft³ (950 cm³), is leveled off with a straightedge, the soil and mold are weighed, and the moist unit weight of the soil is computed. Let us assume that the value obtained was 124.5 lb/ft³ (1.99 g_r/cm³) and that the natural water content of that soil was found to be $w = 4.8$ percent. This will give us point *a* in Fig. 5-12.

If we add some water to increase the water content to $w = 6.0$ percent and repeat the same compaction procedure, point *b* in Fig. 5-12 will be obtained.

TABLE 5-1. Data on Laboratory Compaction Procedures

Type	Weight of hammer		Height of drop		Number of blows per layer	Number of layers	Compaction energy	
	lb	kg_r	in.	cm			ft-lb/ft³	m-kg_r/m³
(A) modified Proctor (or AASHO)†	10.0	4.54	18	46.7	25	5	56,200	272,000
(B) standard Proctor (or AASHO)†	5.5	2.50	12	30.5	25	3	12,300	59,600
(C) 15-blow Proctor	5.5	2.50	12	30.5	15	3	7,400	38,800

† American Association of State Highway Officials.

By increasing the water content in small increments an[illegible]ing the same compaction procedure each time, points *c*, *d*, *e*, and *f* can be plotted. These points represent the moist density, i.e., the unit weight of the soil solids plus the weight of the water in the voids. The dry density, i.e., the unit weight of the soil solids only, can then be computed from Eqs. (3-7) and (3-9), giving the corresponding points *a*′, *b*′, *c*′, *d*′, *e*′, and *f*′ and curve B_1 (Table 5-1) applied to soil 1 (Table 5-2) at different moisture contents.

By applying compaction procedures *A* and *C* in the same manner to soil 1, curves A_1 and C_1 are obtained, as shown in Fig. 5-12. The three compaction procedures applied to soil 2 give curves A_2, B_2, and C_2, and applied to soil 3 give curves A_3, B_3, and C_3. It will be noted from Fig. 5-12 that in the case of soils 1 and 3 the *greatest dry density* $\gamma_{d(max)}$ is reached at a definite moisture content, which is termed the *optimum moisture content* w_{opt} (see Table 5-3).

The explanation of the recorded facts is as follows. At a low moisture content cohesive soils form lumps which cannot be broken up easily. They therefore hamper compaction. Addition of water at first helps to soften up these lumps and break them down, so that with the expenditure of the same compactive effort a greater density is obtained. The addition of water, however, is beneficial only up to a certain point. Theoretically this point is reached when the amount of water present is sufficient to fill all the voids of the soil, after having coated the individual particles, so that any further water added will only serve to keep the solid particles apart from each other and thereby will decrease the dry density. In other words, the experimental curves should at the optimum moisture content reach the zero-air-voids curve, which corresponds to the value of the specific gravity *G* of the soil tested, and follow that curve if any more water is added. Three such theoretical zero-air-voids (100 percent saturation) curves have been plotted in Fig. 5-12 for values of $G = 2.8$, $G = 2.7$, and $G = 2.6$. Equations (3-6) and (3-7) were used for the computations. It will be noted from Fig. 5-12 and Table 5-2 that at moisture contents greater than the optimum, the experimental curves do not quite reach their theoretical zero-air-voids curve but run parallel to it. This is an indication that saturation is not complete but that some air is unavoidably trapped in the voids of the soil during its compaction.

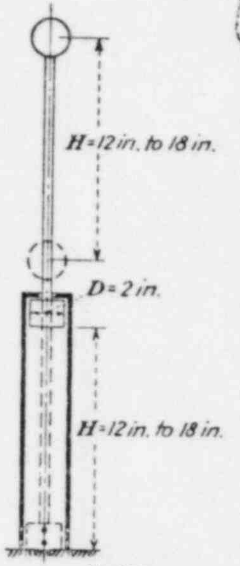


Fig. 5-11. Type of hammer employed for the field-laboratory compaction of soil in the mold shown in Fig. 5-10.

Other conditions being equal, an increase of the compactive effort produces an increased density of the soil, but only at moisture contents smaller than

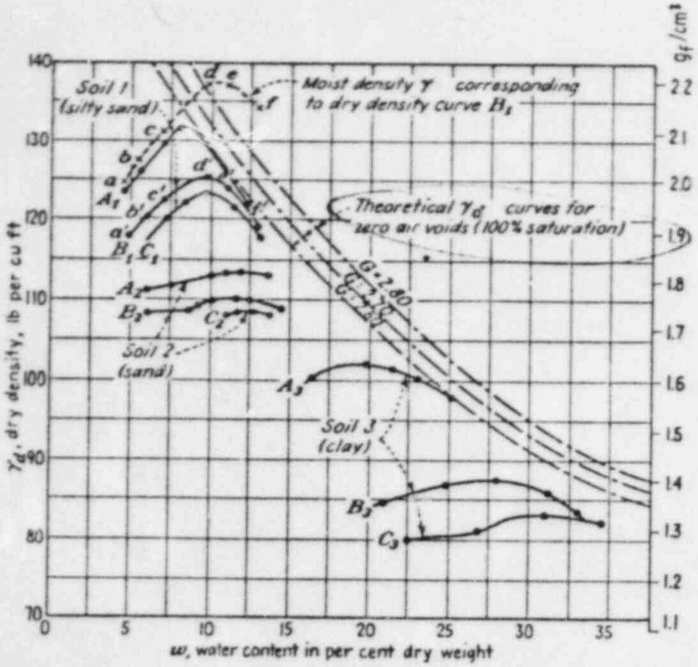


Fig. 5-12. The moisture-density relationship of three limit types of soils and the effect thereon of the energy expended on the compaction (see Tables 5-1, 5-2, and 5-3).

the optimum content which corresponds to the greater effort. At moisture contents higher than the optimum no further compaction can be produced by an increased effort, since instantaneous expulsion of the excess water entrapped in the voids is not possible. As a result, increased compactive efforts at water contents higher than the optimum only serve to set up excess pore pressures in the water filling the voids, which then facilitate shearing deformations of the entire soil mass. This fact has considerable practical importance for the selection of the water content at which field compaction should be undertaken and explains why it is usually preferable to make that selection "on the dry side" of the optimum.

TABLE 5-2. Characteristics of the Three Soils Referred to in Fig. 5-12

Soil type	Specific gravity G	Consistency limits, percent			Grain-size distribution, percent		
		w_L	w_P	I_p	Sand	Silt	Clay
No. 1, silty sand...	2.67	17	16	1	80	15	5
No. 2, sand.......	2.67	†	†	0	92	5	3
No. 3, clay	2.73	68	21	47	10	28	62

† Nonplastic

Table 5-3. Summary of Data Given in Fig. 5-12

Soil type	Optimum moisture, percent			Maximum dry density					
				lb/ft³			g_f/cm^3		
	A	B	C	A	B	C	A	B	C
No. 1, silty sand	8	10	10	132	125	123	2.11	2.00	1.98
No. 2, sand....	†	†	†	113	110	108	1.81	1.76	1.73
No. 3, clay	20	28	31	102	88	83	1.63	1.41	1.33

† Indefinite

The following additional important facts will be noted from Fig. 5-12 and Table 5-3. The water content of a relatively clean sand (soil type 2) has practically no influence on its dry density, as produced by the same compactive effort. A slight addition of silt or of clay to sand improves its grading and permits the development of a greater density for the same compactive effort. The effect of moisture during molding is then considerable. So long as the amount of silt and clay added is only small and no greater than is needed to partially fill the voids of the sand, the maximum density will increase and the optimum moisture content will decrease, compared with cleaner sand and the same compactive effort. A larger amount of clay reverses this trend; the maximum density decreases, and the optimum moisture content increases. Because of the greater surface area of fine particles, more water is required to coat them and part of the water is adsorbed.

Most of the above facts were first ascertained experimentally and reported by R. R. Proctor (Ref. 257). His original method is listed as method B in Table 5-1. As the weight of field-compaction equipment increased, it was found necessary to increase the compaction energy if laboratory results were to correspond to those obtained in the field. Method A of Table 5-1 was developed to meet this requirement. Method C, which is seldom used, was designed to duplicate conditions produced in the field by lightweight compaction equipment.

There are a number of devices used for the mechanical operation in the laboratory of the hammer illustrated in Fig. 5-11. Also, a different type of the so-called CBR mold, which is larger, 6-in. (15.3-cm) diameter, is frequently used (see Art. 3-6). As compared to Table 5-1, the number of hammer blows is then increased in proportion to the volume of the molded specimens.

Reference 219 gives data on the compaction of a layer of sand fill 10 ft (3 m) thick, 7 ft (2.1 m) of which was below the free-water level. Eight coverages with a DynaPac model CT-60 vibratory compactor produced an appreciable increase of density from a depth of 1.5 ft to 5.5 ft (46 to 168 cm) and had some effect to a depth of 10 ft (3 m). The upper 1.5 ft (46 cm) were loosened. The vibratory drum assembly of the Vibro-Plus CT-60 compactor weighs 25 kips (11,000 kg$_f$), and a centrifugal force of 60 kips (27,200 kg$_f$) is obtained at an operating frequency of 25 Hz = 25 cycles/sec.

Figure 5-14 shows a somewhat lighter model, the CH-43, the vibrating drum assembly of which weighs 10 kips (4,450 kg$_f$) and develops a centrifugal force of 23 kips (10.420 kg$_f$) at an operating frequency of 26.7 Hz (1,600 cycles/min). A considerable variety of models is now available in different sizes, some of them self-propelled.

The effectiveness of compaction depends upon vibrator weight and the centrifugal force (see Arts. 15-1 and 15-2). The vibration destroys the shearing strength of the sand, but the application of an external force is needed to move the grains past each other into a denser position. Brumund and Leonards (Ref. 43) have concluded from their laboratory-model tests that the ultimate densification of a granular sand mass under a vibrating footing resting on its surface depends on the logarithm of transmitted energy, which is influenced by the static weight applied, the impressed dynamic force, the acceleration, and the frequency of vibration. (See Ref. 11 for further relevant points obtained in the field by D'Appolonia et al.)

A method of rating compactors has been proposed by Selig, Ref. 286b. A general review of the art of soil compaction is given in Ref. 148a.

Moisture control during field compaction is very important. It is no accident that the methods of soil compaction in relation to proper moisture control were developed in the semiarid regions of the western United States. It is comparatively easy to add water to a fill, but it is very difficult rapidly to dry out soil which is too wet, e.g., as a result of rain. No rolling can be done during protracted rainy spells. This is one reason why hydraulic fills are sometimes selected instead of rolled fills for earth dams in regions with high precipitation. Where compaction by rolling is essential, e.g., in the construction of highway and airport base courses, the sequence of the work should be planned to permit at all times the easy runoff of rainwater from the surfaces where compaction is to be continued. Only a small depth of a few inches of soil will then get mushy on such surfaces after a heavy rainfall, and it can be quickly scraped off by a bulldozer before compaction is resumed.

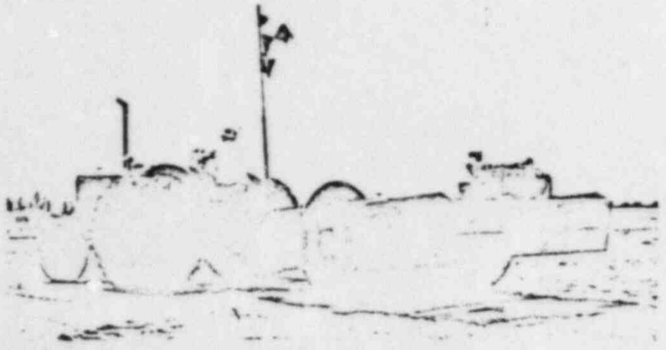


Fig. 5-14. DynaPac model CH-43. (*Vibro-Plus Products, Inc.*)

An *impact soil-compaction* device initially developed in Germany (see 1st ed., Art. 11-4) has been modified by the Barco Mfg. Company of Chicago. A gasoline motor is incorporated in the head of the device, which has two inner pistons. An explosion of the mixture between the two pistons lifts the heavy head of the device into the air, past the lower piston, which is attached to the foot of the device, thereby compressing a spring below that piston. This spring pulls up the foot of the device while the rest of it is still in the air. The entire rammer then falls to the soil surface before the next explosion in the gasoline motor occurs. It weighs 210 lb (95.5 kg$_f$). The diameter of its foot is 9.5 in. (24.2 cm) ($A = 0.492$ ft^2 $= 457$ cm^2). The device rises approximately 14 in. (35.6 cm) into the air, and the compaction energy developed by it is thus 240 ft-lb (33.3 m-kg$_f$) per blow. The device is particularly well suited for the compaction of backfill in trenches dug for sewer or water pipes, or quite close to concrete structures, where there is no space for rollers to operate. In such cases it may have advantages over the smaller pneumatic tampers connected to jackhammer-type devices operated by compressed air. Tampers of the latter type have been conventionally used so far for compaction in cramped space, but to be effective, because of their small foot area, they appear to require the fill to be placed in very thin layers.

Control checks of the fill density achieved in the field should be performed as a matter of routine. The usual procedure consists in removing the loose surface layer of a fill and then making a hole in the fill with a hand-operated auger. The soil extracted from the hole is carefully collected, sometimes in a special tray which is laid on the planed-off surface of the ground and which is provided with a hole in its center for the passage of the auger. The soil thus extracted is weighed both before and after drying in a field laboratory. The volume of the hole is measured to determine the volume which the soil originally occupied in the ground. From these data the dry density of the soil is computed (see Prob. 5-1).

There are three methods for determining the volume of the hole. In the first, heavy oil is poured from a measuring cylinder into the hole. This procedure is quite simple but can be safely used only in fills with some clay content. In more pervious soils one has to use either a rubber balloon filled with water or uniform dry sand poured into the hole from a specified height

Bechtel Power Corporation

Inter-office Memorandum

To Distribution

Subject Midland Job 7220
Plant Fill Soil Test Results
Review - Generic Implications

Copies to H. W. Wahl
P. Hansen
R. K. Vassar
S. Blue
A. Betters
J. Amaral
M. Mitchell
J. Bashore

Date June 26, 1979

From J. Milandin

Of Quality Assurance

At Ann Arbor

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ADMIN				
DRFT				
SOILS				
[redacted]				
Proj Mgr				
Prj Eng			1330	

JOB 7220 FILE 3416
REC'D JUN 27 1979

An engineering problem alert will be issued July 30, 1979 to document a comprehensive set of actions as set forth in the attached minutes.

The actions are a result of a report issued by H&CF which identified seven questionable areas of concern resulting from a review of U. S. Testing field and laboratory test data on soils used as plant area fill. The report concludes that all soil test results are suspect and should not be used alone for acceptance of the fill.

Please note that for loop closure purposes, the problem alert will identify a plan and schedule to accomplish actions to prevent recurrence should such actions be identified.

J. Milandin

JM/le
JM-79-66
attachment

Distribution: E. Rumbaugh [redacted]
K. Wiedner T. Johnson
D. Johnson P. Martinez
R. Simanek S. Heisler
J. Milandin G. Richardson

REPORT OF MINUTES OF THE SOILS TEST RESULTS

JUNE 13, 1979

Those in attendance were:	E. Rumbaugh	T. Johnson
	K. Wiedner	P. Martinez
	D. Johnson	S. Heisler
	R. Simanek	J. Milandin
	J. Wanzeck	G. Richardson

DISCUSSION

A meeting was held to discuss the Midland plant fill associated soils test report impact on Ann Arbor Office projects and other Bechtel projects. The report, current draft forwarded by P. Martínez letter dated 6/12/79, entitled "Draft Review of U. S. Testing Field and Laboratory Construction Test Data on Soils Used as Fill", addresses seven (7) areas which should be evaluated and appropriate corrective action taken. The areas are:

1. Over use of certain laboratory testing compaction curves.
2. Questionable retests.
3. Test results plot above zero-air-void curve on compaction data plots.
4. Reported use of questionable laboratory test data.
5. Limits of accuracy and applicability for test data.
6. Accuracy of test equipment.
7. Relative density tests.

ACTION ITEM #1

Engineering will issue a problem alert(s) which is(are) to address the following:

1. Soils placement and testing specification revisions which should be made as demanded by the results of the review in the subject report.
2. Administrative systems revisions which are necessary as a result of such systems having had an effect on the technical performance of soils placement and testing. Administrative systems to be considered are: QA Program including adding technical audits of testing lab performance, Sub-contract Administration, Job Staffing (i.e. qualifications, accountability of soils engineers), and Methods for dispositioning and documenting consultant's recommendations.
3. Soils interface conditions. Interfaces where differential settlement could exist under a given structure.
4. A plan and schedule to accomplish the revisions to implement the necessary actions for Ann Arbor Office, Midland, and TPO specifications and administrative systems.

The problem alert is to be issued by July 30, 1978.

ACTION ITEM #2

Don Johnson to evaluate the documentation and intent associated with the technical direction of testing laboratories on Midland and other projects.

Complete by June 22, 1979

S3 19117

J. Milandin

LVMID JOB 1220

HANDOUT BY B. MARGUGLIO

RE LESSONS LEARNED FROM
PLANT FILL EXPERIENCE

RCVD

7/26/79

CPCO MEETING

1. Provide a system by which to verify that commitments given in the PSAR or FSAR are carried through to the detailed specifications and drawings.

2. Perform adequate review of specifications and drawings for quality-related factors:

    a. Detect the inconsistency between two paragraphs of Specification C-210 relative to density testing requirements;

    b. Detect the inadequacy and confusion in Specification C-210 relative to moisture control prior to, during and after compaction;

    c. Detect the lack of criteria for the selection of proctors.

3. Require specification changes to be consistent with a number of specification "clarifications" and "interpretations."

4. Understand the process in sufficient detail and with sufficient engineering expertise to implement appropriate process controls regardless of specification inadequacies.

5. Qualify the process equipment and the process control techniques:

    a. Equipment used to compact different lift thicknesses;

    b. Nuclear densometer used to measure moisture;

    c. Test process used to measure compaction and moisture.

6. Adequately specify the sampling (surveillance) plan. Give criteria for the frequency of sampling or sample size or for the return to 100% inspection should the sampling inspection indicate such a need.

7. Recognize that the specification of the location of the soil sample for moisture control measurements and density tests is a Quality organization responsibility, not a Field Engineering or Construction organization responsibility.

8. Require a recording of what was actually inspected or surveilled and provide single point inspection accountability.

9. Establish single point accountability for test procedures.

10. Recognize the need for process corrective action and cause corrective action dispositions to be implemented as exemplified by CP Co's NCR No 199.

BWM
7-26-79

10-30-80 (Afifi)

Inter-office Memorandum

To Distribution
Date August 3, 1979

Subject PROBLEM ALERT - Incorrectly Placed Backfill
From T. E. Johnson
Of Civil/Structural

Copies to File: 502
At Ann Arbor Office

GEOTECH
ANN ARBOR
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[illegible]		4		[illegible]
Proj Mgr				
Proj Engl				1330

JOB 7220 FILE 3418
REC'D AUG 4 1979

Attached for your review is a draft copy of the Problem Alert to be issued on the large settlements at Midland due to the incorrectly placed backfill. It is requested that your comments be forwarded to us by August 10, 1979.

T. E. Johnson

T. E. Johnson

xc Copies F
ORG
JGG
VA
ASM

TEJ/GT/wh

Attachments

Distribution:

- E. Rumbaugh
- K. Wiedner
- J. Milandin
- P. Martinez ✓
- R. Castleberry
- B. Dhar
- S. Blue ✓
- S. Afifi

— PROBLEM ALERT —

I. DESCRIPTION OF PROBLEM

Insufficiently compacted plant area backfill under the diesel generator building was discovered because of excessive settlement during construction. Both granular and cohesive soils were improperly compacted in other areas of plant fill as well as the diesel generator building. This required extensive reanalysis and/or modifications of the diesel generator building, the service water structure, the feedwater isolation valve pits, and portions of the auxiliary building.

Based on a thorough investigation, the most probable causes for the resulting remedial work include the following.

A. All types of compaction equipment used for plant area backfill were not prequalified for lift thickness and number of passes. This was particularly true for the small hand-operated equipment. Except for the heavy earth-moving equipment used to construct the plant area dikes, reliance was placed on acceptance being established by end result ASTM acceptance tests.

B. An audit has shown that the testing laboratory failed to obtain meaningful and accurate results after performing the ASTM acceptance tests. Some examples are the following.

  1. More than one-half of the test results for relative density and percent compaction were outside the theoretical comparison limit.

  2. Incorrect soil indentification and calculation errors were also present.

C. The quality assurance (QA) and quality control (QC) departments only provided a surveillance program in lieu of an inprocess, in-depth inspection program. In addition, a continuous, thorough review of the testing methods being performed was not carried out.

II. APPLICABILITY

These conditions are applicable to all projects where structures are supported fully or partially by compacted backfill material.

ORIGIN: AAO	ENGINEER: G.A. Tuveson	CHIEF ENGINEER: T.E. Johnson	PROBLEM ALERT Large settlements due to incorrectly placed backfill	DATE: NO:

III. CORRECTIVE ACTION

A. The structures are being modified to compensate for the in situ soil conditions using the following solutions:

1. Underpinning by the use of caissons and piles for structures partially supported by fill
2. Reduction of residual settlement by surcharge loading structures totally supported by fill
3. Elimination of the possibility of liquefaction of extensive sand backfill areas during a seismic event by installing a permanent dewatering system

B. The earthwork specification has been revised so that all soil compaction requirements are clearly defined in the specification.

C. QA rewrote its inspection plans to implement the requirements in the specifications.

D. A resident geotechnical soils engineer has been assigned to the site to oversee the backfill operation.

E. The soils testing laboratory has been made aware of all testing discrepancies and have taken actions to prevent recurrence.

F. All of the construction equipment to be used for compacting the various types of soils at the site are being qualified to a maximum lift thickness with a specified number of passes.

IV. ACTION RECOMMENDED TO BECHTEL PROJECTS

A. The backfill compaction criteria for project earthwork specifications should have a method basis as well as performance criteria for acceptance; i.e., each type of compaction equipment should be qualified at the jobsite for the respective type of soils to be compacted. This qualification includes lift thickness and number of passes. The final acceptance criteria are still to be based on testing by the appropriate ASTM acceptance standard.

B. A resident geotechnical soils engineer should be assigned to the construction site to provide technical guidance and assistance in directing the earthwork, which includes coordination with the soils testing laboratory.

C. The soils laboratory testing specification should be a separate specification and not part of the physical testing specification which includes other materials such as concrete and reinforcing steel.

D. The subcontract for soils testing performed at the jobsite should be awarded to an engineering firm that is specialized in the soils area.

E. Quality assurance manuals or vendor procedure manuals for the soils laboratory testing should be reviewed by geotech as well as project engineering.

F. A maximum limit of the number of times a proctor curve may be used as representative of the material being placed should be established.

G. To minimize errors in testing, the soils testing laboratory should include the following practices in its testing procedures manual.

1. Cohesive Soils - The moisture content of the field densities cannot fall outside the zero air voids curve for the respective specific gravity.

2. Granular Soils - The stock piled material should be tested for relative density by both the wet and dry methods as defined in the ASTM standards to ensure that the maximum density attainable will be used in placement.

H. Backfill Under Structures

1. Only granular material should be used with a specified gradation band monitored by frequent gradation tests.

2. To ensure that proper compaction is obtained, the frequency ~~of plotting proctor curves or maximum/minimum density tests should be increased.~~ OF TESTING IN-PLACE FILL AND SHOULD BE INCREASED AS JUDGED BY THE RESIDENT SOILS ENGINEER

3. Consideration should also be given to performing static plate bearing tests as defined in the ASTM standards. The resident geotechnical soils engineer should have the option of requesting this type test when appropriate.

Bechtel Power Corporation

Interoffice Memorandum

To Distribution

Subject Soil Fills, Bechtel Generic Position

Copies to

File No. 2.0, 2.2

Date August 27, 1979

From K. P. Buchert

Of SFPD - Civil/Structural

At MET/34/B9 Ext. 0552

The following Bechtel Generic Position on soil fills has been finalized after coordination between Engineering and Construction.

1. See that soil report, PSAR, and specifications are in agreement on all projects. Test fills will be used on all projects.
2. Assign a Soils Field Engineer in Construction (Bechtel Construction or on a Subcontractor's staff) to oversee fill operations. Testing will normally be done by a testing laboratory.
3. QC will be responsible for surveillance of the work done by the testing laboratory. This will be done if Bechtel does the work or a subcontractor does the work. This will be in addition to that done in item 2.
4. Construction will prepare an inspection plan and it will be reviewed by Project Engineering with consulting by the Civil Chief's staff and by H&CF. Acceptance and rejection limits will be specified.
5. H&CF soils representative will make periodic visits to the site to make an overall review of entire operation to determine if performance criteria are met.

Please proceed with implementation.

K. P. Buchert

KPB:slh

Distribution

A. J. Arnold (GPD)
A. L. Cahn
J. A. Dunlap
H. B. Friend
R. F. Gibson
D. W. Halligan
~~T. E. Johnson~~ (AAO)
R. J. Kosiba (LAPD)
M. J. Mitchell
J. N. Mulay (MOO)
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Civil Supvs.
W. R. Ferris (H&CF)
R. A. Schnaible (H&CF)

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W. R. Ferris (H&CF)
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8024, REV 1/78

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SEP 24 1979

Bechtel Power Corporation

Interoffice Memorandum

To: D.L. Johnson QA B.T. Stojkov
D.B. Hardie T.Y. Mullen
(all w/a)

File No.

Subject: Midland Diesel Generator Building Settlement - PIL File #111

Date: September 13, 1979

From: F. Plutchak
FP-79-72

Of: SFPD-Quality Assurance

At: MET-32/A24 Ext. 1156

Copies to: S.I. Heisler - w/o att.
✓J. Milandin - w/o att.

Since issuance of the CAB meeting agenda for 9/18/79, I received a report that gives further information on the matter. Attached are Sections 7 & 8 of this report which was a presentation made to the NRC by the Midland project regarding the Diesel Generator Building settlement problem at Midland (PIL #111). These sections list the most probable causes of the problem and the actions taken by the project.

Please review and be prepared to determine in our Tuesday, September 18, 1979 meeting what corrective actions are necessary on a division-wide basis to preclude repetition on other projects. Hopefully, some corrective actions have already been taken that are not visible to me. If this is the case, please bring to the meeting documentation of what has been done.

The rest of the report is available in my office along with previous interim reports. I did not reproduce the complete file because of the bulk and because you have received reports previously. Please advise if you require additional information.

F. Plutchak
F. Plutchak

FP:fe

Attachments

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5D.348

Bechtel Associates Professional Corporatio

Inter-office Memorandum

To K. P. Buchert

Date October 19, 1979

Subject Problem Alert.
Large Settlements Due to
Incorrectly Place Backfill

From T. E. Johnson

Of Civil/Structural

At Ann Arbor

Copies to File: 502
A. J. Arnold
P. A. Becnel
R. J. Kosiba
J. Milandin
K. Wagstaff

Attached for your review is a copy of the problem alert on incorrectly placed backfill which occurred at the Midland jobsite. I strongly urge you to issue this as a TPO problem alert.

A copy has been coordinated with P. Becnel of San Francisco Legal, and his comments have been incorporated in the attached draft of the problem alert.

T. E. Johnson

T. E. Johnson

TEJ/js

Attachment

Bechtel Associates Professional Corporation
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TEJ/js

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sometime after
10-16-79

Discipline: Civil Engineering   Origin: Ann Arbor

Subject: Large Settlements Due to Incorrectly Placed Backfill

Discipline Problem Alert Number: ____________________

I. APPLICABILITY

These conditions are applicable to all projects where structures are supported fully or partially by compacted backfill material.

II. PROBLEM DESCRIPTION

Insufficiently compacted plant area backfill under the diesel generator building was discovered because of excessive settlement during construction. The settlement monitoring program, which is designed to detect such conditions, did alert the project to this problem. Further investigation by a soils boring program has indicated that both granular and cohesive soils were improperly compacted in other areas of plant fill as well as at the diesel generator building. This required extensive reanalysis and/or modifications of the diesel generator building, the service water structure, the feedwater isolation valve pits, and portions of the auxiliary building.

Based on a thorough investigation, the most probable causes for the resulting remedial work include the following.

C/A II A. All types of compaction equipment used for plant area backfill were not prequalified for lift thickness and number of passes. This was particularly true for the small hand-operated equipment. Except for the prequalified heavy earth-moving equipment used to construct the plant area dikes, reliance was placed on acceptance being established by end result ASTM acceptance tests.

B. A review of test results by the geotechnical soils group has shown that the testing laboratory failed to obtain meaningful and accurate results after performing the applicable ASTM acceptance tests. Some examples are the following.

   1. More than one-half of the test results for relative density and percent compaction were outside the theoretical comparison limit.

2. Incorrect soil indentification and calculation errors were present.

3. Clearing of failed tests was improper or incomplete.

III. CORRECTIVE ACTION TAKEN WHERE PROBLEM OCCURRED

A. The structures are being modified to compensate for the in situ soil conditions using the following solutions:

   1. Underpinning by the use of caissons or piles for portions of structures partially supported by fill

   2. Reduction of residual settlement by surcharge loading the structure totally supported by fill

   3. Elimination of the possibility of liquefaction of extensive sand backfill areas during a seismic event by installing a permanent dewatering system

B. The earthwork specification has been revised to provide more guidance to construction. The specification now requires compaction methods be established which include the number of passes for a given lift thickness for all approved equipment.

C. The quality control (QC) department has rewritten its inspection plans. Instead of essentially providing a surveillance program for the administrative aspects of the soils testing program, an inprocess, in-depth inspection program has been adopted. This program includes the verification of equipment qualifications for the placement methods adopted.

D. A resident geotechnical soils engineer has been assigned to the site to oversee the backfill operation.

E. The soils testing laboratory has been made aware of all testing discrepancies and has taken actions to prevent recurrence. Procedures to control testing activities are now being provided.

F. All of the construction equipment to be used for compacting the various types of soils at the site has been qualified to a maximum lift thickness with a specified number of passes.

IV. ACTION TO BE TAKEN BY BECHTEL PROJECTS

A. Each type of compaction equipment should be qualified at the jobsite for the respective type of soils to be compacted. This qualification includes lift thickness and number of passes, which adds a method criterion to the performance criteria for acceptance. However, the final acceptance criteria are still to be based on testing by the appropriate ASTM acceptance standard.

B. A project soil engineer and a field soil engineer should be assigned to each major project. The project soil engineer is assigned by the geotechnical services department and reports to the head of the soils group in the engineering office. The field soil engineer is on the project construction staff and reports directly to the construction superintendent. The field soil engineer will be hired by Bechtel construction or retained through a subcontract with an outside organization specializing in soil engineering. Project engineering and the geotechnical services group will review the qualifications of the candidate for field soil engineering and monitor the adequacy of his technical performance. The project specifications should clearly establish the responsibilities of the project and field soil engineers. As a minimum, the project and field soil engineers will have the following duties.

1. The project soil engineer's responsibilities will include, as a minimum, the coordination of all project soil engineering activities, the continuous review of soil-related construction activities, and the monitoring of the technical performance of the field soil engineer.

2. The field soil engineer's responsibilities will include, as a minimum, the monitoring of fill placement activities, soil testing laboratory activities, foundation excavations and pile or cassion foundation installations. In addition, he will coordinate all soil-related activities between project engineering/geotechnical services and construction, and forward progress reports to project engineering.

3. In the event the soils and foundation work becomes minor, project engineering/geotechnical services may agree that a full-time field soil engineer may not be needed. The project soil engineer will then assume the responsibilities of the field soil engineer.

C. Quality assurance manuals and vendor procedure manuals for the soils laboratory testing should be reviewed by geotech as well as project engineering.

D. A maximum limit of the number of times a proctor curve may be used as representative of the material being placed should be established. The procedures manual should be reviewed by geotechnical services as well as quality engineering to ensure that proper controls are outlined.

E. To minimize errors in testing, the soils testing laboratory should include the following practices in its testing procedures manual.

1. Cohesive Soils - The moisture content associated with a given field density cannot fall outside the zero air voids curve for the respective specific gravity.

2. Granular Soils - The stockpiled material should be tested for relative density by both the wet and dry methods as defined in the ASTM standards to ensure that the maximum relative density attainable will be used in placement.

F. Backfill Under Structures

1. To ensure that proper compaction is obtained, the frequency of plotting proctor curves or maximum/minimum density tests should be increased.

2. Consideration should also be given to performing static plate bearing tests as defined in the ASTM standards. The project or field soil engineer should have the option of requesting this type of test when appropriate.

V. ACTION TO BE TAKEN BY THE TPO CHIEF CIVIL/STRUCTURAL ENGINEER

A. TPO Specifications C-441 Rev 6 and C-442 Rev 0 which are the materials testing services specifications for both nuclear power plants and fossil fuel power plants are to be revised to eliminate the soil laboratory testing section.

B. New TPO soil laboratory testing specifications are to be issued by February 1, 1980. In addition to the information presently in TPO Specifications C-441 and C-442, these specifications should be expanded to include the following items:

1. Establish a limit on the number of times a proctor curve may be used as representative of the material being placed.

2. Require a check to ensure that for cohesive soils the moisture content associated with a given field density does not fall outside the zero air voids curve.

3. Require stockpiled granular soils should always be tested for relative density by both the wet and dry methods as defined in the ASTM standards.

4. Require procedures to control testing methods.

C. Reevaluate and revise as necessary the soils sections of the following TPO Specifications by February 1, 1980.

C-033 Rev 1	Site Grading
C-052 Rev 0	Pressure Water Piping, Furnishing and Installing
C-053.2 Rev 1	Furnish and Installing Yard Fire Protection System
C-054 Rev 0	Storm Sewer, Furnishing and Installing
C056.1 Rev 1	Furnishing and Installing Culverts
C-058 Rev 2	Constructing a Sanitary Sewer
C-062.1 Rev 0	Circulating Water Pipe Installation (Steel)
C-062.2 Rev 0	Circulating Water Pipe Installation (Concrete)
C-314 Rev 0	Circulating Water Pipe Installation (Fiberglass)
C-234 Rev 2	Structural Excavation and Earthwork Construction

VI. FURTHER INFORMATION

For further information contact G. Tuveson, Ann Arbor office, (313) 994-7727.

VII. FURTHER COORDINATION

Reevaluation and modifications of the TPO specifications should be coordinated with the geotechnical services department of the H&CF division.

10/17/25

Bechtel Associates Professional Corpor

Inter-office Memorandum

To K. P. Buchert

Subject Problem Alert
Large Settlements Due to
Incorrectly Place Backfill

Copies to File: 502
A. J. Arnold
P. A. Becnel
R. J. Kosiba
J. Milandin
K. Wagstaff

Date October 19, 1979

From T. E. Johnson

Of Civil/Structural

At Ann Arbor

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NOV 13 1979
CIVIL ENGINEERING
FILE 502

TEJ/js

Copied for: ~~T. E. Johnson~~
A. J. Arnold
K. Wagstaffe
R. J. Kosiba
P. Becnel
R. F. Gibson
A. L. Cahn
J. N. Mulay

TED: Sections I, II, III generally okay. Delete Sections IV, V, VI, VII. Add my memo.

KPB

Ed Salinas, please prepare TPO Problem Alert.

KPB

11/9/79

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Subject: Large Settlements Due to Incorrectly Placed Backfill

Discipline Problem Alert Number: ____________________

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C056.1 Rev 1	Furnishing and Installing Culverts
C-058 Rev 2	Constructing a Sanitary Sewer
C-062.1 Rev 0	Circulating Water Pipe Installation (Steel)
C-062.2 Rev 0	Circulating Water Pipe Installation (Concrete)
C-314 Rev 0	Circulating Water Pipe Installation (Fiberglass)
C-234 Rev 2	Structural Excavation and Earthwork Construction

VI. FURTHER INFORMATION

For further information contact G. Tuveson, Ann Arbor office, (313) 994-7727.

VII. FURTHER COORDINATION

Reevaluation and modifications of the TPO specifications should be coordinated with the geotechnical services department of the H&CF division.

10/17/25

Bechtel Associates Professional Corporation

Inter-office Memorandum

To	J. Milandin	Date	November 16, 1979
Subject	Problem Alert Large Settlements Due to Incorrectly Placed Backfill	From	T. E. Johnson
		Of	Civil/Structural
Copies to	File: 502	At	Ann Arbor Office

Attached for your information is a copy of the TPO response to the proposed problem alert on incorrectly placed backfill submitted for review by my IOM dated October 19, 1979.

G. Tuveson

G. Tuveson for

T. E. Johnson

TEJ/GT/wh

Attachment

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Route	Info.	Act.
FILE NO.		

Bechtel Associ s Professional Corporation

Inter-office Memorandum

To	J. Milandin	Date	November 16, 1979
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T. E. Johnson

TEJ/GT/wh

Attachment

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NOV 16 '79

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QC			
QE			
PQD			
SFPE QA MGR.			
QA SEC'Y			
FILE NO.			

DISTRIBUTION OF THIS PROBLEM ALERT OUTSIDE OF BECHTEL REQUIRES WRITTEN APPROVAL FROM DIVISION ENGINEERING MANAGEMENT. INFORMATION FROM IT MAY BE USED IN DEVELOPING APPROPRIATE NOTIFICATION OR RECOMMENDATIONS TO CLIENTS, BUT PRIVILEGED OR OTHERWISE SENSITIVE INFORMATION SHALL NOT BE EXTRACTED WITHOUT ABOVE APPROVAL.

1. APPLICABILITY

These conditions are applicable to all projects where structures are supported fully or partially by compacted backfill material.

2. PROBLEM DESCRIPTION

Insufficiently compacted plant area backfill under the diesel generator building was discovered because of excessive settlement during construction. The settlement monitoring program, which is designed to detect such conditions, did alert the project to this problem. Further investigation by a soils boring program has indicated that both granular and cohesive soils were improperly compacted in other areas of plant fill as well as at the diesel generator building. This required extensive reanalysis and/or modifications of the diesel generator building, the service water structure, the feedwater isolation valve pits, and portions of the auxiliary building.

Based on a thorough investigation, the most probable causes for the resulting remedial work include the following:

A. All types of compaction equipment used for plant area backfill were not prequalified for lift thickness and number of passes. This was particularly true for the small hand-operated equipment. Except for the prequalified heavy earth-moving equipment used to construct the plant area dikes, reliance was placed on acceptance being established by end result ASTM acceptance tests.

B. A review of test results by the geotechnical soils group has shown that the testing laboratory failed to obtain meaningful and accurate results after performing the applicable ASTM acceptance tests. Some examples are the following.

1. More than one-half of the test results for relative density and percent compaction were outside the theoretical comparison limit.
2. Incorrect soil identification and calculation errors were present.
3. Clearing of failed tests was improper or incomplete.

3. CORRECTIVE ACTION TAKEN WHERE PROBLEM OCCURRED

A. The structures are being modified to compensate for the in situ soil conditions using the following solutions:

1. Underpinning by the use of caissons or piles for portions of structures partially supported by fill

ORIGIN:	STAFF ENGINEER	TPO CHIEF CIVIL ENGINEER	PROBLEM ALERT NO. PA-C-TPM-30 DATE: NOVEMBER 15, 1979
AAO CIVIL	E. Salinas E. SALINAS	K P Buchert K. P. BUCHERT	LARGE SETTLEMENTS DUE TO INCORRECTLY PLACED BACKFILL

2. Reduction of residual settlement by surcharge loading the structure totally supported by fill

3. Elimination of the possibility of liquefaction of extensive sand backfill areas during a seismic event by installing a permanent dewatering system

B. The earthwork specification has been revised to provide more guidance to construction. The specification now requires compaction methods be established which include the number of passes for a given lift thickness for all approved equipment.

C. The quality control (QC) department has rewritten its inspection plans. Instead of essentially providing a surveillance program for the administrative aspects of the soils testing program, an inprocess, in-depth inspection program has been adopted. This program includes the verification of equipment qualifications for the placement methods adopted.

D. A resident geotechnical soils engineer has been assigned to the site to oversee the backfill operation.

E. The soils testing laboratory has been made aware of all testing discrepancies and has taken actions to prevent recurrence. Procedures to control testing activities are now being provided.

F. All of the construction equipment to be used for compacting the various types of soils at the site has been qualified to a maximum lift thickness with a specified number of passes.

4. EFFECTIVENESS OF ACTION TAKEN

The actions taken will correct the problem so the structures will meet their required design criteria.

5. ACTION TO BE TAKEN BY BECHTEL PROJECTS

See attached IOM from K. P. Buchert "Soil Fills, Bechtel Generic Position" dated August 27, 1979.

6. ACTION TO BE TAKEN BY CHIEF ENGINEER'S STAFF

No action is required.

7. FURHTER INFORMATION

For further information contact G. Tuveson, Ann Arbor office, (313) 994-7727.

8. FURTHER COORDINATION

Civil/Structural supervisors should review this problem alert according to EDP 4.74 requirements.

EDP-4.74, Rev. 1
Exhibit B
Page 1 of 1 1

PROBLEM ALERT

TRANSMITTAL AND ACKNOWLEDGEMENT

FORM

To: Project Engineers Date: November 15, 1979

cc: Distribution per EDP-4.74

Subject: Engineering Feedback System (Reference EDP-4.74, Sect. 3.0)

Problem Alert No. PA-C-TPM-30 is forwarded to you for action as required.

Please complete the bottom portion of this form and return the form within ten (10) days of receipt.

The last Problem Alert issued from my office was No. PA-C-TPM-29 dated 6-14-79

Civil/Structural
Discipline

Discipline Chief Engineer

ACKNOWLEDGEMENT

To: Discipline Chief Engineer Indicated Above

Subject: Experience Feedback System (Reference EDP4.74, Sect. 4)

The Problem Alert listed above has been received, reviewed, and the project action documented as required by EDP-4.74.

☐ Content is not applicable to this project.

☐ Required project action is already completed.

☐ Required project action is listed in the project open item log.

Project	Project Engineer's Signature (or designee)	Date

SFP-21380 Rev. 9/79

NOV 15, 1979

Page 1 of 2
(Page 2 on reverse)

DEC 0 6 1979

0118.03 CIVIL PROBLEM ALERT-PA-C-TFM-30

	('P IDENTITY	ID	RECIPIENT	CTY
	THERMAL POWER ORGANIZATION			
	QA	B32131	BETTERS, AR	1
	SFPD DEPARTMENT MANAGERS			
	MANAGER DIV ENG	F88400	FRIEND, HB	1
	MANAGER DIV QA	H39990	HEISLER, SI	1
	SFPD CONSTRUCTION			
	DIV CHIEF CONST ENGR	J44250	JOHNSON, DL	1
	SFPD ENGINEERING			
	ARCH GROUP SUPV/ACTING PE	288756	GIBBON, AH	1
	ASST PROJ ENGR	204498	FALKENBERG, RC	1
*	ASST PROJ ENGR	258512	PETERSON, KD	1
	CIVIL GROUP SUPV/ACTING PE	892556	BROMAN, R	1
	ENG MANAGER	A54020	ANDERSON, RC (DICK)	1
	ENG MANAGER	466271	HOLLINGSHAUS, H	1
	ENG MANAGER	214051	WILLETT, RF	1
	ENG MGMT STAFF	674966	SHOR, SWW (WILL)	1
	EXECUTIVE ENGR	M14600	MARSH, HP	1
	MANAGER OF ENG	D50547	DICK, CW	1
	MANAGER OF ENG	G32800	GIBSON, RF	1
	MECH GROUP SUPV/ACTING PE	P19068	PATCH, AE	1
	PROJ ENGINEER	213225	BRIDENSTINE, DE	1
	PROJ ENGINEER	C34600	CHANG-LO, PL	1
	PROJ ENGINEER	C49000	CLARK, DH	1
	PROJ ENGINEER	D06106	DAMON, DL (LARRY)	1
	PROJ ENGINEER	E40716	ELIAS, RH	1
	PROJ ENGINEER	228419	GILL, CJ	1
	PROJ ENGINEER	G52152	GOITEIN, EE	1
	PROJ ENGINEER	G90446	GROVER, SK	1
	PROJ ENGINEER	247316	JAGELS, RE	1
	PROJ ENGINEER	K45324	KING, AM	1
	PROJ ENGINEER	L04360	LAGACHE, M	1
*	PROJ ENGINEER	L90930	LUND, E	1
	PROJ ENGINEER	447781	MAC DONALD, RR	1
	PROJ ENGINEER	462039	MAY, GW	1
	PROJ ENGINEER	M83200	MORRIS, HE	1
	PROJ ENGINEER	P80430	POSER, EB	1
	PROJ ENGINEER	P97944	PUSHECK, BN	1
	PROJ ENGINEER	S14060	SCHMIEDEL, JR	1
	PROJ ENGINEER	S55800	SMORTCHEVSKY, JJ	1
	PROJ ENGINEER	S60600	SOTELO, E	1
	PROJ ENGINEER	588377	WOLTER, RA	1
	PROJ ENGINEER	213705	ZUTTERMEISTER, JW	1
	QE SUPV	569615	HARDIE, DB	1
	CORP PROCUREMENT			
	MANAGER, SUPPLIER QUALITY	A27380	ALEXANDER, RW	1
	SFPD STARTUP & OPER SVCS(S&OS)			
	CHIEF STARTUP ENGR	533130	VANDER MEER, DD	1

***PE'S PLEASE COPY FOR: CIVIL GROUP SUPVS.

CIVIL ENGINEERING - POWER
ANN ARBOR

171	INFO	ACT	INT	DATE
JOHNSON	✓		DJ	
		✓		
TUVESON				
ROTZ				
YOSHII				
SHUNMUGAVEL				
NOWAK				
LEE				
WILMA				
FILE: 502				

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DEC 1 '79

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0[illegible] 03 CIVIL PROBLEM ALERT-PA-C-TPM-30

GROUP	IDENTITY	ID	RECIPIENT	QTY
ANN ARBOR				
	MANAGER OF ENG	R86400	RUMBAUGH, EA	1
SFPD ENGINEERING				
	CHIEF CIVIL ENGR	811882	BUCHERT,KP	1
	CIVIL STAFF	F02200	SALINAS, E	1
	CIVIL STAFF SUPV	E66960	EPSTEIN, EH	1
ANN ARBOR				
	CHIEF CIVIL/STRUCT ENGR	J60150	JOHNSON, TE	1
NORWALK				
	CHIEF CIVIL/STRUCT ENGR	K73040	KOSIBA, RJ	1
	MANAGER DIV QA	B15180	BASHORE, JE	1
HOUSTON				
	CHIEF CIVIL/STRUCT ENGR	W01080	WAGSTAFFE, K	1
GAITHERSBURG				
	CHIEF CIVIL/STRUCT ENGR	333824	ARNOLD, AJ	1
	QA MANAGER	537144	AMARAL, JM	1
PE&C, LTD.				
	(LATER)	B41630	BLASINGAME, JH	1
MADRID SPAIN OFFICE (MSO)				
	CHIEF CIVIL ENGR/ARCH	M86930	MULAY, JN	1
			TOTAL	53

Bechtel Power Corporation

Inter-office Memorandum

To E. A. Rumbaugh

Date November 28, 1979

Subject Problem Alert - Large Settlements Due to Incorrectly Placed Backfill

From J. Milandin

Of Quality Assurance

At Ann Arbor

Copies to
T. E. Johnson
G. A. Tuveson
S. I. Heisler
W. T. Kellermann
S. L. Blue

See me

AJAP.

502

The subject Problem Alert was originated by Ted Johnson as a result of a meeting which we held on June 13, 1979. The Problem Alert was, in effect, issued to take advantage of the Midland problem by providing for certain revisions in our specifications and controls to preclude such a situation from recurring on another project. As you recall, I suggested the Problem Alert. Ted Johnson has been working very closely with me to insure that QA concerns were included. Ted issued the report to Ken Buchert on October 19 and received a reply, attached, from Ken Buchert, apparently incorrectly dated, on August 27, 1979.

Buchert's reply, in effect, deleted all the recommended corrective actions by the Ann Arbor Office and effectively stated corrective actions which are essentially the same as the present program. Without the AAO recommendations, the Problem Alert is truly incomplete. It will not prevent the problem from occurring again once this Problem Alert has been filed. The idea behind the recommended action of the Ann Arbor Office was to perserve these experiences by revising generic specifications and control procedures which govern the placement of backfill.

It is requested that you look into this matter to determine why the San Francisco Power Division Civil Structural Chief rejected the corrective actions proposed by the Ann Arbor Office. Each of those actions, which were proposed, were tied back to problems which were identified during the course of the investigation and were carefully developed to preclude the recurrence of such a situation in the future. Therefore, as the situation now stands, if the office follows through on the Buchert August 27 letter, new projects may fall into the same situation as Midland did when memories dim.

Please respond by 12/12/79. Please advise whether you consider this a matter to be handled by an MCAR.

John Milandin

J. Milandin

JM/le
JM-79-122
File: AAO-QAR-79-66

10-31-80 (afifi)

Bechtel Power Corporation

Inter-office Memorandum

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ANN ARBOR
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Proj Mgr				
Proj Eng				
JOB 7220		FILE		S
REC'D		NOV 30 1979		

To E. A. Rumbaugh

Date November 28, 1979

Subject Problem Alert - Large Settlements Due to Incorrectly Placed Backfill

From J. Milandin

Of Quality Assurance

At Ann Arbor

Copies to
T. E. Johnson
G. A. Tuveson
S. I. Heisler
W. T. Kellermann
S. L. Blue

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Please respond by 12/12/79. Please advise whether you consider this a matter to be handled by an MCAR.

J. Milandin

JM/le
JM-79-122
File: AAO-QAR-79-66

E. Gallagher

Bechtel Associates Professional Corporation

Inter-office Memorandum

To T.E. Johnson

Date December 27, 1979

Subject Problem Alert
Large Settlements Due to
Incorrectly Placed Backfill

From E. Rumbaugh

Of Engineering

Copies to K. Wiedner
J. Milandin

At Ann Arbor

It appears that K. Buchert's TPO Problem Alert will delete a lot of the substance from your draft and may not fully cover us in future backfill operations.

I suggest that we do the following:

1. Try to get the TPO Standard Specs. revised to cover future work similar to your draft problem alert and appropriate new TPO Specs. issued (See Section V of your draft).
2. Use the TPO Problem Alert and your draft problem alert as commentary with the TPO Standard Spec. so anyone in this office will have benefit when using the TPO Specs. in the future.

SB 03001

E Rumbaugh
E. Rumbaugh

ER/emp

CIVIL ENGINEERING - POWER
✓ TJ
✓

See me →
Ted
Maybe its
time for me
to write
Buch. P. A.

JAN 1 4 1981

[illegible]

Consumers Power Company

Internal Correspondence

From DEHorn, Midland

Date October 31, 1978

Subject MIDLAND PROJECT - NRC EXIT
INTERVIEW OF OCTOBER 27, 1978
File: 0.4.2 Serial: 280FQA78

CC	SAfifi, Bechtel - Ann Arbor	JLCorley, Midland
	WRBird, JSC-216B	GSKeeley, P14-403B
	RLCastleberry, Bechtel - Ann Arbor	DBMiller, Midland
	TCCooke, Midland	JFNewgen, Bechtel

The following people were in attendance at the subject exit interview which was conducted at the end of G. J. Gallagher's inspection of October 24-27, 1978:

CPCo	Bechtel	NRC
RCBauman	WLBarclay	RJCook
TCCooke	ABoos	GJGallagher
JLCorley	RLCastleberry	
DEHorn	LADreisbach	
GSKeeley	PAMartinez	
DBMiller		
BHPeck		
RMWheeler		

Mr. Gallagher stated that the visit was a follow-up on 50.55(e) report of the diesel generator settlement and that it was also a fact finding visit. The inspection consisted of a review of past data, activities in progress and planned activities for future work. Inspection was performed by review of the FSAR commitments; Specification C-210; Specification C-211; PQCI/IR C-1.02; Dames and Moore Report of Foundation Investigation and Preliminary Explorations for Borrowed Materials dated June 28, 1968 and supplement to this report dated March 15, 1969; preliminary data on diesel generator settlement problem including boring plan, cross sections of fill, blow count versus the elevation graphs, lab data, settlement data, boring logs, dutch cone logs, weather data and penetrameter readings in test pits; design drawings C-45, C-109, C-[illegible]7 and C-1001; soil tests taken in the diesel generator building area during construction compiled by B. T. Cheek, Bechtel QC; observation of soil testing at the test lab and in the field; and discussions with Bechtel Geo-Tech, Project Engineering, Field Engineering, Quality Control Engineering, U.S. Testing, Consumers Power Company, PMO and QA personnel. Mr. Gallagher stated that he would not handle the findings as noncompliances, however, they could become items of noncompliance when they are reviewed by his management.

[illegible] 7068

His findings/observations were as follows:

1. The FSAR states that during operation, settlement readings will be taken every 90 days. Because of the diesel generator settlement problem, this frequency should be re-evaluated for adequacy.

CPCo.

3a 2. FSAR Table 2.5-14 "Summary of Foundation Supporting Seismic Category I Structures" identifies the supporting soil materials under the diesel generator building as being controlled, compacted cohesive soils. However, construction drawing C-109, Rev. 9 and C-117, Rev. 6 identifies the material in this area as Zone 2 material. Zone 2 material is identified as random fill described as any material free of organic or other deleterious materials. In the field a variety of materials have been used for the diesel generator foundation material, in particular, sands, clay, and lean concrete, silty sands and clayey sands. The apparent conflict is that Table 2.5-14 identifies cohesive soils where, in actuality, cohesionless sands have been utilized. A review of the records indicate that sands have been used between elevation 594'-608', areas of elevation 611'-613' and areas between 616'-268'. This indicates the extent of the variability of the material placed under the diesel generator building foundation. Mr. Gallagher did not feel it was good judgement to use random material under the support of a structure.

3b [illegible] FSAR 3. FSAR Table 2.5-21 "Summary of Compaction Requirements" identify random fill to require a compaction effort of a minimum of 4 passes with the specified equipment in this table. This requirement has not been an imposed requirement of Bechtel Specification C-210 nor an inspection requirement of Bechtel Quality Control Instruction C-1.02 for backfill.

3C 4. FSAR section 3.8.5.5 states that settlements of shallow spread footings founded on compacted fill are estimated to be on the order of ½" or less. Site Survey Program has identified settlements in the diesel generator building foundation on spread footings to range from 0.55 inches to 2.30 inches and in excess of 3.0 inches for the diesel generator pedestal.

3d FSAR corrected 5. FSAR figure 2.5-47 indicates the foundation of the diesel generator building to be at elevation 634', according to design drawings C-1001, Rev. 5 it is indicated for the diesel generator spread footings and pedestal foundation to be at 628'.

4 [illegible] 6. A. Specification C-210, section 13.7.1 requires all cohesive backfill in the plant area to be compacted to not less than 95% maximum density as determined by ASTM D1557 method D which requires an effective compactive effort of 56,000 foot-pounds of energy per cubic foot of soil. However, section 13.4 Testing requires testing of the materials placed in the plant area to be performed in accordance with tests listed in section 12.4. This section, in particular section 12.4.5.1, "Cohesive Soils," requires maximum lab densities to be determined using ASTM D1557 Method D provided a compactive energy equal to 20,000 foot-pounds per cubmic foot is applied (Bechtel Modified Proctor Density). To date, the Bechtel Modified Proctor Density for determining maximum proctor density versus optimum moisture content has been utilized. This conflict results in an unconservative method of determining the maximum proctor density and method of assuring that the required percent compaction is achieved. In particular, the actual in-place compaction would be less using the Bechtel Modified Proctor Density as a reference than using the standard ASTM D1557 method D. This is due to the fact that the compactive energy exerted using the Bechtel Modified Method is less than the effort exerted by the standard method D - example: 20,000 foot-pounds versus 56,000 foot-pounds.

6. B. Bechtel Quality Control Instruction C-1.02 section 2.4 testing identifies the applicable inspection criteria and includes Specification C-210, section 13.7 and 12.4 which includes the apparent conflict as described in detail in Part A above.

4

C. A further review of the original subsurface investigation performed by Dames and Moore and documented in report supplement dated March 15, 1969 page 16 indicates that the recommended minimum compaction criteria for support of structures be 100% of maximum density using a compactive effort of 20,000 foot-pounds (resulting from Bechtel Modified Proctor determination). However, this 100% of Bechtel Modified Proctor corresponds to 95% compaction according to the standard ASTM D1557 method D and not 95% compaction according to Bechtel Modified Proctor method which has been utilized for the entire plant fill area to date. Furthermore, Dames and Moore Report, page 15 states that all fill and backfill material should be placed at or near the optimum moisture content in near horizontal lifts approximately 6-8" in loose thickness. Bechtel specification permits a maximum of 12 inches which affects the compactability of the material.

4

7. Piping, condensate lines, duct banks, and other utilities under the diesel generator building may also be affected and must be evaluated.

NI

8. Mr. Gallagher stated he was leaving not having seen design calculations and will be discussing design calculations, assumptions made, and conflicts with the FSAR with Licensing.

UP

9. The inspector observed the structural concrete crack that has developed in the east exterior wall. The crack was observed with members from Bechtel Geo-Tech and Consumers Power Company. The crack extended full height of the wall and continued down through the spread footing as seen from the inside of the building. The crack is expected to have been induced flexurally caused by differential settlement. Discussion with Bechtel design staff has indicated that this crack is under study and is currently being evaluated. ACI-318-71 in the commentary section 10.6.4 limits flexural crack exposed to the outside to 0.013". Corrective action may be required if this limit is exceeded.

6

10. The following tests were observed to be performed in accordance with the applicable tests standards by U.S. Testing:

NA

A. Lab Test ASTM D1557-70

B. Field Test ASTM D/1556-64

11. Calculations should be evaluated on the increase and the rate of increase of the pond fill and the effects of the water in other areas.

NP

UP 12. Mr. Gallagher stated that the NRC does not view preloading of the structure to be a fix or resolution of the problem at this time.

UP 13. Seismic loading calculations should be determined for the type of material existing in its present condition.

DRAFT: FOR ENGINEER'S USE IN CORRESPONDENCE WITHIN BECHTEL

Bechtel Associates Professional Corporation

Inter-office Memorandum

To H. W. WAHL

Date

Subject MIDLAND PLANT UNITS 1 & 2
JOB 7220
Plant Area Earthwork.

From ~~R. L. CASTLEBERRY~~ P. A. MARTINEZ

Of ENGINEERING

At ANN ARBOR

Copies to FILE: C-210, C-211, 0294.
R. L. Castleberry.
T. E. Johnson.
K. WIEDNER.

The following is in response to the queries raised by various people regarding the earthwork on Midland proj.

1. Introduction: The present specification for construction of the embankments in the plant area is C-210. Majority of the fill in the plant area was placed using the Spec. C-210 between 1973-74 and 1975-76. The major portion of the embankment was constructed by Canonie Construction Company under field administered Subcontract 7220-C-210. Testing of materials, compaction etc. was conducted under subcontract 7220-C-202.

The origin of Spec. C-210 is C-10 which was prepared during [illegible]. It appears that the Spec. C-10 emphasized more on

RAC/

~~[illegible]~~
P. A. MARTINEZ.

ENCLOSURES (PLEASE INDICATE)

SB 22304

(IF ADDITIONAL SPACE IS REQUIRED, PLEASE ATTACH A SHEET OF LINED PAPER.)

the Construction of cooling pond dikes and railroad embankments. However, certain sections of the specification included the plant area fill also. This is due to the fact that some dikes are located within the plant area limits. ~~P.~~ Testing of embankment materials, compaction etc. was carried out under a separate field administered subcontract 7220-C-8.

Criteria used for embankment construction.

A. Specification C-10:

Foundation Preparation - After clearing and grubbing the acceptability of foundation to be determined by contractor.

Proof rolling on acceptable foundation:

- 4 passes of 50 ton rubber tired roller for dikes and RailRoad embankment
- 2 passes of 50 ton rubber tired roller for plant area.

B. Embankment Construction - R/R, Dikes and areas shown on drawings.

Suitability of materials is to be determined by the Contractor and subcontractor to make necessary tests to determine the acceptability of materials. ~~[illegible]~~ Contract to determine the degree of compaction and other requirements by laboratory tests.

Moisture Content : ASTM D 2216.

Gradation: ASTM D422
Inplace density: ASTM D 1556.
Max. Lab. Density } ASTM D-1557 [illegible]
and optimum moisture content } D provided the Sam
For Cohesive materials. is prepared to Bechte
method.

For Cohesionless Materials - ASTM D 2049.

Placement: Materials to be placed i
layers (loose) not exceeding 12 inch
for clayey, random fill and Sandy
materials. In areas not accessible
to heavy rollers the placement is
limited to 4 inches.

Moisture Content: To be within ±2
percentage points of the optimum

Compaction - for materials described
under placement 4 passes of 50
ton Roller.

SB 22306

It should be noted that there
was no indication of the degree of
compaction to be achieved. In essence
the degree of ~~com~~ required compaction
was to be determined by perform
This type of performance specification

requires constant surveillance by people who are familiar with earthwork operations. There are evidences that the earthwork was constantly supervised by qualified soils engineers during 1965 thru 1970.

C. Specification C-8.

This specification was the basis for determining the adequacy of placing and compacting embankment materials und. Subcontract 7220-C-10.

Specification C-8 required only Proct test to determine max. laboratory density and optimum moisture content although Spec. C-10 required ASTM D1557 method D for cohesive materials. For cohesionless materials ASTM D2049 has been referenced.

Frequency of Testing embankment materials

Lab Compaction — 1/20,000 yds or 1 test/day.
Relative density — 1/20,000 yds "
Field density — 1/20,000 yds "
Moisture Content — 1/10,000 yds.

3. PSAR Commitments:

A. 1967 Dames & Moore report.

- The permanent flood protection fill (dikes) may be constructed from on site materials. Placement to be in 12 inches layers compacted to 85% max. density based on AASHO T-180-57 Spec.
- Fill for support of structures and around to be accomplished by using granular materials placed in 8 inches layers and compacted to 95-100% of max density determined by AASHO spec. T-180-57

Material requirements were modified to use onsite material for support of structures by Amendment 1 to the PSAR.

B. 1968 Dames & Moore Report.

SB 22308

Fill should be placed in layers of 6 to 8 inches and compacted to 95% & 100% of max density determined by ASTM D 1557-66T for cohesive soils and cohesionless soils respectively

⑥

C. 1969 Soils Report by Dames & Moore.

It was recommended that the fill operations be supervised by qualified soils engineer. Fill shall placed in layers of 6 to 8 inches at or near optimum moisture content compacted to 100% of max. density determined by modifie ASTM D-698 method (so called the BECHTEL Modified Proctor TEST) for cohesive soils to support structures. For sand soils the relative density to be 85% per ASTM D2049.

SB 22309

4. Discussion.

It is noted that the PSAR Commitments were not reflected in the specification C-10 for the plant area fill. Review of project files reveal that some plant area fill was constructed during 1968 thru' 1970. Various correspondences discuss the requirement for compaction in the plant area fill viz 6 passes of 50 ton rubber tired roller. These correspondences also indicate that some laboratory testing was conducted to determine the adequacy of fill and there was supervision by qualified.

soils engineers. The project was shutdown during 1970 and reactivated in late 1972.

Project resumed earthwork activities during 1973. Specification C-210 was prepared during this time and the Contract was awarded to Canonie Construction Company.

5. Specification 7220-C-210.

It appears that the basic form of Spec. C-210 followed the original C-10 with several modifications and included the Quality Assurance requirements. Since all the Class-I structures and systems were not situated, the whole plant area was designated as Q-listed and was identified on engineering drawings.

SB 22310

Specification C-210 included the requirements for the construction of dike RIR embankments, construction laydown areas and plant area fill. Areas adjacent to structures (3') and areas where motorized rollers are not accessible, structural backfill [illegible] was specified and the work was [illegible] included in the Subcontract 7220-C-21.

A. Criteria for placing fill in the plant area.
- foundation to be approved by Contractor
- Testing of embankment materials is referenced to the dike section.
- Placement is also referenced to dike section. w/ 12" thick layers
- Moisture Control is tied to the dike section.

- Compaction - for cohesive soils it is 95% of max. density determined per ASTM D1557. Meth. D.

  for cohesionless soils - 80% relative density determined by ASTM D2049 spec.

B. Testing of all materials placed in the embankment was conducted under Spec. 7220-C-208. Specification C-208 was prepared on the lines of Spec. C-8 - with several modifications. This Specification requires that max. lab density for soils shall be determined per ASTM D-1557 Meth. D. or per Bechtel TEST when directed

SB 22311

by Contractor.

Frequency –

Field density & moisture content } – 1/300 yds

Compaction, grain size & specific gravity } – 1/10,000 y

c. Specification 7220-C-211.

This specification was originated to include areas, with in 3 feet of exterior walls of structures and not accessible by motorized rollers. These areas may be used as support for other structures.

Criteria.

Foundation to be approved by Field En.

Placement – max 12 inches layer and to determined by the performan of the Compaction equipment used.

Moisture Control } – No specific limits; but to be conditioned as far as practical

Compaction - 95% max density / ASTM 1557
or Bechtel Test. cohesive soils
[illegible]

- 80% Rel. density - ASTM D2[illegible]
for cohesionless soils

Testing Frequency

Large areas 1/500 yds
Confined areas 1/10 yds to 100 yds
as determined by
the Field Engineer

6. Project Design Criteria.

Project design criteria discusses the requirement of compaction for various conditions. Basically these requirements reflect the commitment of the PSAR - Dames & Moore report of 1969 & includes the supervision of earthwork by qualified soils engineers.

DISCUSSION:

It is seems that the project specifications adhered to the PSAR ~~requi~~ commitments only in certain areas viz. moisture content and material requirements. However, there are some descrepancies with the commitment. The placement of materials does not meet the PSAR requirements because the spec. requires 12 inche layers versus 6 to 8 inches. 12" layers were pretested for adequacy, and may not be a deficiency. The compaction indicated in the spec meets the commitment of 100 % of max density determined by Bechtel test, versus 95 % of ASTM D1557 method D, for cohesive soi [The ASTM D-1557 method D requires 56,000 ft lbs of energy per cubic feet of soil and the Bechtel test requires only 20,000 ft lbs of energy per cubic feet of soil. See attachment A for a graphical comparision various tests]

For cohesionless soils spec. requi 80% relative density versus 85 % committed in the PSAR. This however may not lead to a deficiency because of the characteristics of materials used.

It is apparent from various correspondence that Field Engineering had doubts about using the right Compaction Criteria. It is also evident that a Soils Engineer was supervising the fill operation during 1973 to 1974. Responsibilities were outlined by the project engineer to the various parties involving fill operations including the Soils Engineer. Soils Engineer was responsible for guiding field construction in areas of testing and selection of materials etc.

Unfortunately, Bechtel field was using the Bechtel test and approving the tests based on 95% using Bechtel test. The basic reason for this confusion is that the testing requirements for plant area fill is referenced to the dike section of the spec. C-210. Field although request for a clarification in writing the letter was left unanswered for unknown reasons.

It is also noticed that the supervision by a qualified soils engineer was only occational for period 1975 to 1977.

It appears that the qualified ~~fn~~ soils engineers realized ~~a~~ that the compaction requirements that are used in the field donot meet the PSAR commitment, but was at a stage major earthwork was done. Ofcourse, this discrepancy was notified to the project in reply to the field's request for clarification on this subject of compaction.

In reality, the compaction was to have been acheived at 95% of max. density determined by ASTM D1557 method D as intended in the plant fill section of the spec. C-210. The determination of max density based on BECHTEL TEST WAS TO HAVE been used only when directed by the field Engineer. However, it would have been alright to use Bechtel test if the acceptance was based on acheiving 100% compaction.

The 80% relative density was

used in the specifications C-211 based on the recommendations by Soils engineers [illegible]

It is also noticed that there are no specific criteria for use of Compaction equipment in the Spec. C-2 The plant area Compaction was mainly intended to be the end result spec. This would mean there would have to be closer supervision and/or control of the fill during placement and compaction

Rac/

BECHTEL

MEMORANDUM

TO Ann Arbor office LOCATION Midland Job #7220
FROM F. Gabrielson DATE 10-4 and 5 , 1978
SUBJECT JOB NO.
FILE

Review of plant site earth work operations also specifications.

First thing that came to my attention in earth work, was the use of two opposite materials for backfil in the same area. (Cohesive & non cohesive

I did not see any evidence that the roller requirements was carried out as referred to in spec. 12.8.1 and could not come up with an appoued method where as we could deviate from it — it is my opinion that a 12" lift of clay is partty tough to handle

F. Gabrielson

ANN ARBOR
1
XL 2
QOW 3
A. Roos XL
XL 1390
7220 3410
OCT 20 1978

MEMORANDUM

TO Ann Arbor office
LOCATION
FROM F Gabrielson
DATE 10-6 (Fri) 1975
SUBJECT EARTH WORK
JOB NO. 7220
FILE

The following Reports are my daily field observation notes.

Trying to aerate ~~cl~~ clay material in the rain?

Not enough values put in foundation preparation.

Supervision seems to be a little weak.

putting too much values on vibrator roller in clay type materials.

Controled lift thickness is important.

Light rain

F Gabrielson

GEOTECH
ANN ARBOR
DIST
XC 2

A. Bous QOW xc 2
xc 7220 1390 3410

SB 04729 OCT 20 1975

MEMORANDUM

TO ANN ARBOR Office LOCATION

FROM F Gabrielson DATE SAT 10-7 1978

SUBJECT EARTH WORK JOB NO. 7220

FILE

STARTED TEST PAD SECTION CONSISTING of 4"-6"-8"-10" AND 12" LIFTS WITH TESTS ON EACH LIFT AT (4) PASSES, (8) PASSES AND (12) PASSES - TEST AREA IS ADJACENT TO FUEL TANK STORAGE - ROLLER SPECIFICATIO ARE ATTACHED.

EXC. SOFT CLAY MATERIAL FROM RAMP AT WELDERS LOADING DOCK - AND BACK FILLING WITH SAND - WHICH EXTENDS OUR WATER PROBLE

SHERIF AFIFI AND JAMES WANZEC ON JOB SITE THIS DAY.

F Gabrielson

MEMORANDUM

TO: Ann Arbor office
LOCATION:
FROM: F Gabrielsen
DATE: Sun 10-8 1978
SUBJECT: Earth work
JOB NO. 7220
FILE:

Continued back fill and test section in fuel storage tank area — U.S. Testing can not give us enough support on test section also Geotech is not representa on second shift — I am not sure of how much control we have on test.

GEOTECH
ANN ARBOR
1
XC 2 88

A. Buos QOW xc 2 — p
xc 1390
7220 - 3410

MEMORANDUM

TO Ann Arbor office LOCATION
FROM F Gabrielson DATE Mon 10-9 1978
SUBJECT Earth work JOB NO. 7220
FILE

The suitability of the materials is to be determinded by the field eng. - in accordance with section 5.6 of spec. C-211 - I dont question the material but will question moisture control in free draining sand material - use of waffle stomper type of tamper is not recommended in clay type materials - leaves a slick plane.

Completed 8" test section on test pad @ 10:00 A.M. - placed 10" lift on at 2:00 p.m. Rolled (4) times and waiting on tests.

problem area - sand backfill in ramp at welders loading dock - no way it could drain.

F Gabrielson

1
XC 2
SB 04730
QOW 3
A. Boos XC
XC 7220 1380 3910

MEMORANDUM

TO Ann Arbor office LOCATION

FROM F Gabrielson DATE Tues 10-10 1978

SUBJECT EARTH WORK JOB NO.

FILE

Light rain last night - dark start up continue with test pad - backfilling tank farm area also sand backfill behind Rad. blg - 2 hr wait this a.m. for test on test section - 24 hrs to run tests on 10" lift - no coverage (Geotech) on second shift.

Length of shank on rollers should be a requirement if sheep foot type is used.

Need a knowledgeable man to call shots on when and where to test - to many times this is left to testing people discretion.

Completed placing 12" lift on test pad @ 3:00 p.m.

F Gabrielson

MEMORANDUM

TO Ann Arbor LOCATION

FROM F Gabrielson DATE Wed 10-11 1978

SUBJECT Earth work JOB NO. 7220

FILE

Slow start up - dark until 7:30 - didn't have a good handle on test section - was completed on night shift

placing clay in Tank farm area - placing sand behind Generator building

I find a very poor work line between Eng - Lab and construction.

Asked Jack Delarm (Const) To hold lifts To max 6" in clay type material.

F Gabrielson

GEOTECH

1

XC 2

A. Boos QOW 3

XC

7220 5418

MEMORANDUM

TO Ann Arbor LOCATION

FROM F Gabrielson DATE 10-12- Thur 1978

SUBJECT Earth Work JOB NO. 7220

FILE

Lab test results are slow - Not that much support on small fill area. Reviewed log on compaction tests and found too many density failures - Tells me contractor was running a border line job an' should have been leaned on.

F Gabrielson

GEOTECH
DISTRIBUTION
[illegible] 1
[illegible] 2
A. Ross [illegible] 3
XC 1388
7220 13410
REC'D OCT 20 1978

BECHTEL

MEMORANDUM

TO Ann Arbor LOCATION

FROM F Gabrielsen DATE Fri 10-13 19 78

SUBJECT Earth Work JOB NO. 7220

FILE

Met with Eng and Testing people to solve current slow and corrective action on test failures — continue to backfill over failing test areas could be trouble — recomended to cont. to try different type of compactor for structural backfill (clay type materials)

F Gabrielsen

GEOTECH
ANN ARBOR
DISTRIBUTION
DISC UNIT
SUPV 1
ADMIN
DRAFT
ENGINEER KC 2
GEOL
FLD
EVP
A. Roots GDW 3
PROJ ENG KC
SAL KC 1398
JOB 7220 F.P. 5918
REC'D OCT 2? 1978

MEMORANDUM

TO Ann Arbor LOCATION

FROM F. Gabrielson DATE SAT 10-14 19 78

SUBJECT JOB NO. 7220

FILE

Correct location and elev. is a must on structural back fill testing, have found errors where it would be impossible to relocate to make correction.

Asked Jack DeLaire (Const) if we couldn't cut down on test frequency on sand materials - also to try and improve application of clay type materials. We can not live with as many failures as we have

F. Gabrielson

GEOTECH
ANN ARBOR
DISTRIBUTION
1
KW 2 SAT
GOW 3
A. Boos
7220
OCT 20 1978

SB 01737

ANN ARBOR

MEMORANDUM

Page 1 of 2

TO S. BLUE (GEOTECH) LOCATION ANN ARBOR.

FROM G.A. TUVESON (CIVIL) DATE June 14, 19 79

SUBJECT CPCo Midland Plant Units 1 & 2 JOB NO 7220

Earthwork FILE C-0294, ~~C-211~~

Copies to 1. R.L. CASTLEBERRY 2. B. DHAR.
3. J. Hook.

Project engineering has completed the review of Dames and Moore report. The purpose of this review was to find out if the project specifications for earthwork (C-211) complies with recommendations made by Dames & Moore.

The following is the outcome of our review

1. We have disregarded Dames & Moore recommendations for materials and compaction contained in their 1967 & 1968 reports.

2. The 1967 Dames & Moore Report (Pg. 13) indicates that the degree of compaction should be based on strength & compressibility properties of the compacted materials and type of structures to be supported.

3. The 1969 Dames & Moore report recommends compaction criteria to be 100% BMP and 85% relative density for cohesive and cohesionless soils respectively, for support of structures.

0-521

ANN ARBOR

MEMORANDUM

Page 2 of 2.

TO S. BLUE (Geotech) LOCATION

FROM G.A. TUVESON (CIVIL) DATE June 14, 19 79

SUBJECT

JOB NO.

FILE

Contd...

Please advise us of any provision to be included in the technical specificatio in regards to item 2 indicated above.

We also would like to know if the present compaction criteria included in spec. C-211 (rev. 6) is compatible with the Dames & Moore recommendation.

Please advise us of the outcome of your review of the Dames & Moore reports and other comments if any, by June 22, 1979.

Reo

G A Tuveson

(G.A. TUVESON)

Bechtel Power Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

Mail Address: P.O. Box 1000, Ann Arbor, Michigan 48106

002359

November 9, 1979

Job 7220-QA-Received 11-13-7			
Log No. 1267 File No. ____			
Response Req'd NO Date ____			
QA Action Item No. ____			
Route	Info	Act	Comments
PQAE	BD		
Resp. Cor.			
Elect (1)			
Elect (2)			
Lovo/LWS			
[illegible]			
[illegible]			
[illegible]			
[illegible]			

BLC-8438

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

Midland Units 1 & 2
Consumers Power Company
Bechtel Job 7220
<u>SMOOTH COPY - RESPONSE TO</u>
<u>50.54(f) QUESTION 23</u>

Dear Mr. Keeley:

In response to Ben Marguglio's request of November 8, 1979, three copies of the enclosed November 8, 1979, draft were delivered to Ben Marguglio for Consumers Power review today. This draft represents the results of a review of the October 26, 1979, draft at Consumers Power on November 6, 1979, with Messrs. Marguglio, Bird, Horn, Milandin, and Rixford.

Status and comments for each part are summarized as follows:

<u>Part (1)</u> reflects all comments of Consumers Power and Bechtel through November 8, 1979.
<u>Part (2)</u> reflects all comments of Consumers Power and Bechtel through November 8, 1979.
<u>Part (3)</u> is essentially a new rewrite prepared by Ben Marguglio during the November 6, 1979, review. It provides a logic tenor different than recommended in Bechtel's draft of October 26, 1979. This Bechtel response, which was a combined response to parts (3) and (4), said:

- the program was effective
- it had continual assesment and improvement
- we recognize NRC's concern for needing added confidence
- we will report the results of all our actions to NRC
- we will provide rationale as to why these actions provide confidence
- we will look at previous actions in retrospect which were taken on 50.55e and NRC I&E reports (This item was not a firm recommendation.)

The Consumers Power November 6, 1979, version:

- does not say the program is effective - rather says we have confidence based on several reasons, therefore, it is recognized that a response to part (4), program effectiveness, is still necessary
- the program had continued improvement and itemizes those improvements by year
- makes no commitments for further reporting

Both drafts do respond to part (3) which requests more information for material reported in the original report.

Part (3) Consumers draft has not been reviewed by Bechtel Management. The attachment to part (3) reporting the status of action items is not included in the November 8, 1979, draft since it is repeat material and because of the extensive rewrite of format, it could not be readied for today's transmittal. The attachment does not require further review and will be ready for the final transmittal to NRC.
Part (4) to be prepared by Consumers Power as agreed to by Ben Marguglio.

I understand Steve Howell and Ben Marguglio already have the benefit of your general comments.

Very truly yours,

John A. Rutgers
Project Manager

JAR/JM/js

Attachment

cc: P. Becnel
W. Bird w/o Att.
J. Clements
L. Curtis
[redacted]
S. Heisler
D. Horn w/o Att.
S. Howell
B. Marguglio
J. Milandin
F. Porter
R. Rixford
E. Rumbaugh
R. Simanek

double space

9/20/78
DRAFT

NRC INVESTIGATION OF DIESEL GENERATOR BUILDING

The Nuclear Regulatory Commission, Region III conducted a special investigation to gather facts relating to the previously reported condition where the Diesel Generator Building has settled more than the amount anticipated and described in the FSAR. This problem has been describe in MCAR 24 and has been reported as a 50.55e item.

The inspectors were J. Phillips and G. Gallagher. The inspection consisted of interviewing personnel at Midland site and Ann Arbor Office. These interviews were carried out as closed interviews with the two inspectors interviewing one person at a time. No other persons were allowed to observe or hear the interviews. Mr Phillips indicated at the Ann Arbor Office that this method of gathering information is allowed by their operating rules. A list of all personnel interviewed is attached. The interviews were conducted at the Midland site on December 12 and 13, 1978 and at the Ann Arbor Office on December 18, 19 and 20, 1978. No exit meeting was held. The inspectors ~~[illegible]~~ indicated an exit will be held at a later date after they have evaluated the information obtained.

The inspectors seemed to be interested in specification 7220-C-210 (placement of embankments) as related to PSAR commitments and implementation, the relationship of Geotechnical Services with Project Design and the history of ~~[illegible]~~ the decision to report the problem under 50.55e.

Summary

1. Specification 7220-C-210

The PSAR required soils to be placed under the Diesel Generator Building to a minimum compaction of 100% BMP. per J. Clement

Specification 7220-C-210 was interpreted by the field (F.E., QC, QA) to require a minimum density of 95% BMP. This interpretation has been repeatedly backed up by reference to 95% BMP on NCR dispositions, in FCR C-302 and telecons dated 10/77.

In the Ann Arbor Office the following points were made

- Geo Tech has always felt the intent of spec C-210, para 13.7 was to use 95% of ASTM 1557 as a minimum - this was also backed up by some Engineering personnel.
- Engineering personnel were aware that the field was using 95% of BMP and chose not to take any action to change the practice

Specification 7220-C-210 was the subject of communication and clarification questions but was not revised by Engineering to provide clearer direction to the field

The FSAR was written to clearly describe that the minimum compaction requirement used was 95% BMP.

2. F.S.A.R.

During review of the calculations made by Geo Tech to determine the anticipated settlements the NRC noted that the calculations for the DGB were made assuming a mat foundation. The actual design is for a spread footing. This calculation is to anticipate the settlement and has no bearing on the design but could raise the question of accuracy of the FSAR and design change control methods related to off project design

Summary - Con't.

3. 50.55e reporting.

The NRC seemed interested in the timing of the 50.55e report. Specific pertinent facts known to NRC:

- July 1, 1978 - Survey Chief first suspected settlement may be more than normal - reported to PFE. PFE decided to observe building settlement for a couple of weeks to see if there is a problem. FSAR figures not exceeded at this time

check date - July 23, 1978 - BCBE ______ identifies potential settlement problem To Project Engineering and transmits settlement data

How? Aug 9, 1978 Project Engineering acts upon IOM.

Aug 21, 1978 NCR 1482 written

Aug __, 1978 Agreement made with Consumers power company to observe settlement for two more weeks and then make 50.55e decision

Sept 7, 1978 MCAR 24 issued - NRC notified by CPCo on ______

Summary Con'T

4 Based on the above it is anticipated the NRC will decide to issue one or more items of noncompliance. These could be based on any of the following:

- Failure to clearly translate into the specifications the requirements of the Dames - Moore report attached to amendment 3 to the PSAR - Criterion III
- Failure of construction to properly interpret specification 7220-C-210 and failure of inspection to identify the intent of this specification in that a control minimum of 95% BMP was used in lieu of 95% of ASTM D-1557. Criterion V and X
- Failure to revise specification 7220-C-210 even though a conflict in this specification had been identified and confusion as to the intent of the specification was apparent Criterion III and XI
- Utilization of incorrect design bases for the calculation of anticipated settlement figures. Criteria III
- Failure to report a 10CFR 50.55e condition within the 24 hour time limit.
- Failure to properly coordinate technical requirement in the PSAR with appropriate off project support groups - specifically Geo. tech for specification 7220-C-210. Criterion III

PERSONNEL INTERVUID

NAME	POSITION	COMPANY	WHERE INTEVIEL
A. BOOS	PFE	BECTEL	Site
J. BETTS	Lead Civil Eng	"	"
C. Williams	Super of Surveys	"	"
B. Chrek	LQCE (Civil)	"	"
T. Lieb	QCE (Test Lab)	"	"
G. Richardson	QA-Staff	"	"
L. Driesback	PQAE	"	"
A. Marshall	Geo. Tech. Eng	"	"
J. Speltz	Lab Super	U.S. Testing Co.	"
D. Horn	QAE	Consumers Power Co	"
S. Afifi	Geo Tech. Eng	Bechtel	Ann Arbor Office
P. Chen	"	"	"
S. Rao	Civil Eng	"	"
G. Tuveson	Civil Group Super	"	"
J. Hink	Ass't Proj. Eng.	"	"
J. Hook	Civil Eng	"	"
B. Dahr	Civil Eng	"	"
S. Sobkonski			
J. Clements			
J. Wanzeck	Geo. Tech Eng	"	"

Bechtel Associates Professional Corporation
Inter-office Memorandum

To	S. S. Afifi	Date	23 October 1978
Subject	Midland Units 1 & 2-Job 7220-001 Backfill Study Trip Report August 26 - October 11, 1978	From	A. S. Marshall
		Of	Geotechnical Services
Copies to	S. L. Blue R. L. Castleberry w/a H. H. Burke/W. R. Ferris w/a T. E. Johnson w/a P. Martinez w/a J. O. Wanzeck w/a K. Wiedner w/a 1310, [redacted] xc: [redacted], J. F. Newgen J. Betts	At	Ann Arbor 10(D)5

RECEIVED
NOV 17 1978
BECHTEL POWER CORP
JOB 7220
PER [illegible]

Transmitted with this memo is a trip report summarizing my activities at the Midland site during August 26 through October 11, 1978.

Austin S. Marshall

A. S. Marshall

ASM/lap
Attachment

Midland Units 1 & 2
Job 7220-001

TRIP REPORT

PERIOD: August 26 through October 11, 1978

LOCATION: Midland Power Plant
Midland, Michigan

SUBJECT: Backfill Study

ATTENDEE: A. S. Marshall - Geotech/Soils

Backfill Study

During the backfill study, borings were drilled in the following areas:

1. Diesel Generator Building
2. Condensate Water Tanks
3. Unit 1, Unit 2 and Startup Transformers
4. Category I Water Lines
5. Retaining Walls
6. Service Water Buildings
7. Tank Farm
8. Radwaste Building
9. Administration Building
10. Cooling Tower
11. Evaporator Building
12. Chlorination Building
13. Discharge Structures
14. Diesel Fuel Tanks
15. Guard House
16. Proposed Bullock Creek Bridge

Split spoon, shelby tube, and Osterberg tube samples were taken from the borings. Dutch cone penetrations were made in the diesel generator building area. Test pits were excavated in which sand cone density tests were taken and a bulk sample was taken from one pit. Test pit locations included the north end of the east bay of the diesel generator building, just east of the condensate water tanks, and along the north side of the tank farm.

Samples were transported and tested by Goldberg-Zoino-Dunnicliff and Associates, Inc.

Observations on Backfill Placement

The following observations were made on backfill placement during the period:

1. Materials were placed and compacted in lift thicknesses exceeding those specified.
2. Heavier equipment appeared to be required to achieve compaction on clays.
3. Clays compacted in confined areas with vibratory plate compactors were often only compacted in the upper few inches of each lift.
4. Areas were being backfilled as "temporary" without field engineering's awareness.
5. Clay backfill materials were not being disced to breakdown the large "clumps" that did not appear to breakdown during compaction.
6. Field inspection of backfill operations by engineering personnel was very limited.
7. Materials observed 20 feet northwest of the primary water makeup tank indicated soft materials might underlie this area.

Upon discussion of the above mentioned observations with Al Boos and Jim Betts the following actions were taken:

1. Materials were to be compacted within limits specified for sands and in 6-inch loose lifts for clays.
2. A procedure was implemented through which "temporary" fill would be located and documented for later removal and replacement.
3. A disc was brought on-site and was used to breakdown the size of the clay "clumps" at the stockpile.
4. Field inspection was increased by field engineering by placing a field engineer over backfill, and only backfill.
5. Soft materials observed at Elev. 628 just northwest of the primary water makeup tank were excavated to about Elev. 617 and replaced with compacted materials.

Dike Inspection

Mr. Don Sibbald of Consumers Power Company and A. S. Marshall made a detailed dike inspection on October 11, 1978. The upstream and downstream slopes and off-dike areas were inspected for seepage, riprap problems, erosion, animal burrow holes, cracks and other potential signs of distress. The inspection did not indicate any signs of distress.

Proposed Pipe Bridge Study

One boring was drilled on each side of Bullock Creek. The slopes on which the abutments are to be constructed are very steep and are covered with tall grass. The creek bottom area appeared to be faced off with soil-cement.

Copies of boring and dutch cone logs will be presented later.

A. S. Marshall

A. S. Marshall

ASM/lap
Attachment

Bechtel Associates Professional Corporation

Inter-office Memorandum

BEBC - 531

To	E. E. Felton	Date	September 12, 1974
Subject	Midland Plant Units 1 & 2 Job 7220 Plant Area Backfill File: C-210, C-1140, 0274	From	R. L. Castleberry
		Of	Engineering
Copies to	J. H. Allen S. S. Afifi R. A. Grote R. L. Rixford	At	Ann Arbor

Reference: a) BCBE-370, 7-25-74
b) BEBC-456, 8-1-74

This letter is to confirm a verbal discussion between R. A. Grote of Field Engineering and R. L. Rixford of Project Engineering on 9-5-74. It will also provide a temporary course of action to be followed with regard to item 3 of reference a (95% of Bechtel Modified vs ASTM 1557, Method D). This letter will provide an interim response to be used until a final position is forthcoming from Geotech as mentioned in reference b.

Spec. 7220-C-210 covers "Backfilling around the structures in the Plant Area..." (Sect. 1.1.15) with Sect. 13.2 excluding "...1) backfill materials to be placed within three feet of any plant area structure, or 2) backfill areas inaccessible to motorized rollers will be considered structural backfill. Structural backfill will not be placed by the Subcontractor." It is the remainder of the "backfilling around the structures" (i.e., not structural backfill) which is the subject of this letter.

The verbal discussion referenced above in the 1st paragraph was to determine the compaction criteria for the backfilling around the structures in the plant area. Section 13.4 states, "Testing of all materials placed in the plant area...will be performed in accordance with the tests listed in Section 12.4." This requirement was not meant to include the compaction criteria given in Section 12.4.5; the compaction criteria for material placed in the plant area are given in Section 13.7. However, a misinterpretation of these sections of the specification led to the usage of Section 12.4.5 criteria (95% of Bechtel Modified) in lieu of the specified Section 13.7 criteria (95% of ASTM 1557, Method D).

Until a complete evaluation of this problem can be made by Geotech (reference b), Engineering hereby approves the use of the Bechtel Modified Proctor as the standard for determining the degree of compaction of the backfill, not covered by Spec. C-211, around plant area structures.

This approval is based upon:

1) Dames & Moore's "Supplement to Report - Foundation Investigation and Preliminary Explorations for Borrow Materials, Proposed Nuclear Power Plant, Midland, Michigan," dated March 15, 1969, which uses the Bechtel Modified Proctor (pg A-76) to define the compaction criteria.

2) Use of Bechtel Modified is consistent with all the material already in place in the plant area. To place material with a compactive effort equal to 1557, Method D over material compacted to Bechtel Modified (as would be the case on the excavation slopes), would be of doubtful value.

3) If Geotech's evaluation of this matter (reference b) should indicate that ASTM 1557, Method D is necessary in some areas and a correction program is then established, setting up the program, administrating it, and obtaining the samples would be facilitated by having a fill of uniform characteristics (i.e., all placed to meet one criteria).

4) Moreover, if Geotech's evaluation indicates a corrective program must be initiated, it will affect only a part of the backfill in question and the cost of including this additional amount of material in the corrective program will be small relative to the need to expedite the placement of this material.

Thus any backfill material in question, placed prior to the completion of Geotech's evaluation, should be placed in accordance with the compaction requirements utilized for the placement of the plant area fill under C-210.

R. L. Castleberry

RLR/rsm

Bechtel Associates Professional Corporation

Inter-office Memorandum

To R. L. Castleberry

Subject Plant Area Fill
Midland Units 1 & 2
Job 7220-001

Copies to J. H. Allen
H. H. Burke/W. R. Ferris
J. C. Hink
[redacted]
J. O. Wanzeck
1320,3410

Date 13 September 1974

From S. S. Afifi

Of Geotechnical Services

At Ann Arbor - E

1 This memo is intended to assist in preparing your formal response to Item 3 of BCBE-370 regarding compaction requirements for the plant area. Herein, we address recommendations given in the soils reports prepared by Dames & Moore for the Midland project and compare them with our earthwork specifications. The material in this memo confirms our previous discussions with your group.

2 The evaluation here pertains to plant area fill supporting and surrounding structures, any Category I slopes in the plant area, and the berm fill.

In-Situ Clays

3 Tables 1 & 2 attached (taken from Dames & Moore's soils report of June 28, 1968, Page 15 and its supplement of March 15, 1969, Page 16) present compaction recommendations for fill and backfill. In the June 28, 1968 report, the minimum clay compaction is recommended to be 95% for support of critical structures, 90% for support of non-critical structures, and 90% adjacent to structures, respectively; all percent compaction values are according to ASTM D 1557 Method D (about 56,000 ft-lb compaction energy). In the March 15, 1969 report, the minimum clay compaction is recommended to be 100% for support of structures, 95% adjacent to structures, and 90% for area fill (not supporting or adjacent to structures); all percent compaction values are according to Bechtel Modified Compaction (BMC: 20,000 ft-lb compaction energy).

4 Specification 7220-C-210 (Section 13.7) requires 95% of ASTM D 1557 Method D for in-situ clay in the plant area and berm.

5 In comparing the reports with the specification for in-situ clay supporting structures, it is seen that the specification and the 1968 Dames & Moore report are identical. Also, the specification and the 1969 report are consistent since 95% of ASTM D 1557 Method D is approximately equivalent to 100% BMC in some soils. However,

the requirement of 95% of ASTM D 1557 Method D given in the specification is the applicable criteria for compacting clay to support structures. Further assurance by conducting shear strength tests is required (see Section 12.4.8, Specification 7220-C-210). Compressibility tests may also be required.

6 The berm fill must be compacted to 95% of ASTM D 1557 Method D to insure adequate seepage protection and stability.

7 Category I fill placed within the failure zone of a slip circle may require a degree of compaction higher than 95% of BMC, because of design for the full SSE. However, it is conceivable that in-place fill compacted to 95% of the BMC will be adequate if strength and permeability properties are shown to be adequate.

8 Similarly, in-place fill supporting light structures may be adequate at 95% of BMC provided its strength and compressiblity are shown to be adequate.

9 Fill in the plant area which will not support structures or pipes or be placed within the failure zone of Category I slopes may be compacted to a lesser degree than 95% of ASTM D 1557 Method D (e.g. 95% of BMC). This agrees with Dames & Moore's 1969 report and is consistent with their 1968 report which requires only 90% of ASTM D 1557 Method D.

In-Situ Sands

10 The Dames & Moore June 1968 report presents recommendations for compacting sand in terms of maximum density while their March 1969 report presents recommendations in terms of relative density. The later report is considered more applicable for sands since relative density is one of the basic parameters required to control liquefaction. Therefore, in-situ sands supporting structures must be compacted to a relative density of 85% (ASTM D-2049). For well-graded sands around structures, the 80% relative density specified in 7220-C-211 is adequate.

11 Accordingly, any in-situ clay which will be supporting structures or be involved in Category I slopes and the berm must be compacted to 95% of ASTM D 1557 Method D.

12 If the fill is already in place according to BMC, it may be adequate for some structures, pipes, or slopes, provided it is shown by sufficient testing that its strength, compressibility and seepage

characteristics are adequate. This requires sampling and laboratory shear strength and consolidation testing. Section 12.4.8 of the earthwork specification addresses this issue for any in-place fill. Compaction curves using both ASTM D 1557 Method D and Bechtel Modified Method must also be developed and correlated with shear strength and consolidation test results on the compacted soil to evaluate the compressibility and shear strength achieved from both methods of compaction for the in-place fill.

This information will allow a complete evaluation of any in-place fill for its proposed function, in addition to providing information which will be needed for the FSAR. It should also clear up any questions as to how fill should be placed in the future.

We will be happy to discuss this matter further with you at your convenience.

Sherif S. Afifi
S. S. Afifi

SSA:lab

Attachments

TABLE 1

Minimum Compaction Criteria from Dames & Moore

June 1968 Report**

	Recommended Minimum Compaction Criteria Percent of Maximum Density*	
Purpose of Fill	On-Site Cohesive Soils	On-Site Granular Soils
Support of Critical Structures	95	100
Support of Non-Critical Structures	90	95
Adjacent to Structures	90	95

* Maximum density and optimum moisture content should be determined by the ASTM Test Designation D 1557 Method D.

** Report, Foundation Investigation and Preliminary Explorations for Borrow Materials Proposed Nuclear Power Plant, Midland, Michigan, June 28, 1968.

TABLE 2

Minimum Compaction Criteria from Dames & Moore
March 15, 1969 Report***

	Recommended Minimum Compaction Criteria	
Purpose of Fill	On-Site Sand Soils Percent Relative Density*	On-Site Clay Soils Percent of Maximum Density**
Support of Structures	85	100
Adjacent to Structures	75	95
Area Fill (not supporting or adjacent to structures)	70	90

* Maximum and minimum density of sand soils should be determined in accordance with ASTM Test Designation D-2049.

** Maximum dry density and optimum moisture content should be determined in accordance with ASTM Test Designation D-698, modified to require 20,000 foot-pounds of compactive energy per cubic foot of soil.

*** Supplement to Report, Foundation Investigation and Preliminary Explorations for Borrow Materials, Proposed Nuclear Plant, Midland, Michigan, March 15, 1969.