WASHINGTON PUBLIC POWER SUPPLY SYSTEM

WNP-2

PROCEDURE

FOR

SOIL BACKFILL TESTING PROGRAM

BURNS AND ROE, INC.
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Supervising Geotechnical Engineer

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1.0 SCOPE

1.1 General

This procedure shall establish a testing program to determine insitu densities in various Quality Class I backfill areas. The insitu test program shall be divided into two phases: the first to develop site dependent correlations between relative density and the various indirect methods used to measure relative density. The second phase shall be to actually measure field densities and other engineering fill properties in areas under question by 50.55(e) Condition 146.

The correlation testing (Phase 1) shall be accomplished by comparing known relative density values in test fills to the following test methods: standard penetration tests (SPT), pressure meter tests (PMT), and downhole nuclear density tests (DNDT) in representative locations. These correlations will establish site specific dependency of material type and depth on test results.

Once initial correlations, acceptable to the geotechnical engineer, have been established, fill testing (Phase 2) will be conducted. The various tests will be performed in selected areas of the service water pipe line, and the remote air intake structures and piping. Correlations will continue to be made as additional data becomes available.

All testing will be done under the direction of a geotechnical engineer.

1.2 Applicable Publications

D 1452	Soil Investigation and Sampling by Auger Borings
D 1556	Density of Soil in Place by Sand-Cone Method
D 1586	Penetration Test and Split-Barrel Sampling of Soils
D 1587	Thin-Walled Tube Sampling of Soils
D 2049	Relative Density of Cohesionless Soils
D 2167	Standard Test Method for Density of Soil in Place by the Rubber-Balloon Method
D 2216	Laboratory Determination of Moisture Content of Soil
D 2487	Classification of Soils for Engineering Purposes
D 2488	Recommended practice for Description of Soils (Visual-Manual Procedure)
D 2850	Unconsolidated, Undrained Strength of Cohesive Soils in Triaxial Compression
STP479	"Suggested Methods of Test for Identification of Soils" by D. M. Burmister, Special Procedures for Testing Soil and Rock for Engineering Purposes, 5th Edition, 1970.

2.0 MATERIALS EFFECTS

2.1 Grain Size

It is expected that occasional gravel sized particles present in the site fill materials will have some effect on test results. To compensate for high blow counts resulting from the occasional gravel size particles, SPT values will not be considered when: A. Greater than approximately trace (0-10%) amounts of gravel size material is found in the spoon, B. A loss of sample occurs, C. Angular gravel fragments are found in the spoon sample indicating (to the geotechcical engineer) the material has been broken during sampling, D. Comparison of SPT values with the other methods indicates SPT values are unusually high due to the presence of gravel.

Gravel sized material is not believed to pose a problem with the PMT or the DNDT.

3.0 BORING AND TESTING REQUIREMENTS

3.1 General Boring Requirements

.1 All borings shall be advanced by means of a drill rig equipped with hollow stem augers.

.2 Soil sampling shall be performed in accordance with ASTM D 1586.

.3 Continuous SPT's shall be taken from the ground surface to the bottom of the boring.

.4 Split-Spoon samples shall not be driven more than 18 inches for any sample interval.

.5 Boring locations shall not deviate more than 0.5 ft. from surveyed locations determined by the geotechnical engineer.

.6 All borings will have their locations referenced to the plant grid system.

.7 At the completion of the boring, all drill holes will be backfilled with insitu material to the satisfaction of the geotechnical engineer.

.8 Representative portions of each split spoon sample shall be preserved in a glass sample jar clearly labeled with the project title, date, number of boring, sample number, depth between which the sample was taken, soil identification, and SPT values.

.9 Boring Contractor shall furnish a driller's logs for each boring.

.10 All field testing shall be monitored by a Geotechnical Engineer

.11 Geotechnical engineer shall maintain a boring log, furnishing the information required on the sample boring log form contained in Appendix A.

.12 Borings shall extend (except as noted below) to which ever depth

is greater: a minimum of 3 feet below the Category I utility, or until two consecutive SPT values are each equal to or greater than 15. However, borings will extend deeper than required above in areas where backfill was placed for circulating water and storm sewer Class II systems that cross under the area of investigation. The deepest extent of this fill is elevation 413.

3.2 Correlation Testing (Phase 1)

3.2.1 Standard Penetration Tests (SPT's)

.1 A minimum of four borings shall be drilled at locations of known relative density; these locations shall be determined by the geotechnical engineer.

.2 SPT samples shall be classified in the field by a geotechnical engineer in accordance with ASTM D 2487. In addition, any unusal occurances shall be reported on the boring log.

3.2.2 Pressure Meter Testing (PMT)

.1 PMT will be done in each boring.

.2 Initially PMT shall be done in representative types of site materials with respect to density and gradation.

3.2.3 Downhole Nuclear Density Testing (DNDT)

.1 DNDT shall be done in each boring.

.2 The DNDT shall be done in three foot increments for the entire depth of the boring.

3.3 Fill Testing (Phase 2)

3.3.1 Standard Penetration Tests

.1 Approximately 40 borings shall be drilled in the area requiring supplementary test data.

.2 Same as in 3.2.1.2

3.3.2 Pressure Meter Testing

.1 PMT shall be performed in each boring.

.2 PMT will be done alongside or immediately below the elevation of the safety related pipe, and at all loose zones (SPT values less than 15).

3.3.3 Downhole Nuclear Density Testing

.1 Same as in 3.2.3.1 and 3.2.3.2.

4.0 FIELD TESTING PROCEDURES

4.1 Pressure Meter Test

A Menard pressure meter shall be used to determine the insitu deformation modulus of the soil; this modulus shall ultimately be compared to relative density by excavating adjacent to the bore hole at PMT locations and measuring relative densities. Generally, a downhole probe which consists of an inner and outer expanding tube shall be lowered to the desired depth for testing; a coaxial cable shall connect the probe to the volume measuring panel board. Nitrogen gas shall be forced under pressure in the outer part of the coaxial cable while water under the same pressure shall be forced down the inner part of the coaxial cable. The water under pressure causes the probe to enlarge and deform the borehole wall, the amount of volume change shall be measured on the panel board. A separate nitrogen system shall keep the water system from expanding beyond the test limits so that a controlled interval 210mm long can be tested.

The pressure meter to be used in the testing shall be manufactured by Menard, Inc. and procedures generally followed shall be those described by Louis Menard in the equipment operation manual. Testing shall be performed in 210mm segments at locations discussed in Section 3.3.2 within the borings.

4.2 Downhole Nuclear Density Test

The wet density of the relatively undisturbed soil in the borehole shall be determined using the DNDT; the nuclear gauge shall be calibrated to be used in thin-walled aluminum casing.

The moisture content of split spoon samples shall be determined in accordance with ASTM D 2216 in order to convert the wet density determined by nuclear methods to dry density. Further, at selected locations, test pits shall be excavated adjacent to the boring locations and the insitu wet and dry densities at the bottom of these test pits shall be determined using a Washington Densometer and/or the sand cone, (ASTM D 1556). These values of inplace density and relative density shall be used to compare the densities determined by nuclear methods at adjacent depths.

The nuclear gauge and probe used in the density testing shall be a Campbell Pacific Nuclear Model 501 calibrated and operated as described in the CPN Operator's Manual dated 1980. Generally, wet and dry densities shall be determined on 3 feet intervals. The density determined at each 3 foot interval is that contained in the volume of influence of a sphere having a diameter of 10 inches.

4.3 General Drilling and Testing Procedure for SPT, PMT, & DNDT

Initially at each boring location, a SPT sample shall be taken from the surface and extend to a depth of 18 inches. The split spoon sampler shall then be removed to obtain the sample and the sampler shall be relowered to the bottom of that hole. A second SPT sample shall be taken to create a hole extending to a total depth of 3 feet. Subsequently, an aluminum casing (2" O.D. and 1.9" I.D.) shall be inserted in the open hole created during the SPT sampling in preparation for the nuclear downhole density testing. The nuclear probe shall then be lowered down the casing to determine the wet density of the soil.

After the nuclear density testing of the upper level soils is completed, the hole shall be augered to the depth of 3 feet (to the bottom of the zone previously tested) and two consecutive SPT samples will be taken below the augers, (creating a hole with a bottom depth of 6' beneath the surface). Similarly, as before, the aluminum casing will be placed in the open hole created beneath the augers so that the nuclear density testing can again be performed. This procedure of continuous SPT sampling and nuclear density testing will be followed throughout the borings.

At selected depth intervals within each borehole, the aluminum cases will be removed after the density testing is completed, and BX-Size Steel casing (2 7/8" O.D., 2 3/8" I.D.) shall be driven to the bottom of the hole. The BX casing shall be used to enlarge the hole 3 feet beneath the augers for insertion of the pressure meter probe and subsequent pressure meter testing.

4.4 Disturbance Effects

The procedures described will be followed in a manner that minimizes soil disturbance. This results because the soil displaced during the SPT sampling is forced into the split spoon sampler and removed leaving a zone relatively undisturbed for DNDT testing . A further factor which tends to decrease soil disturbance effects is that the nuclear probe used in the DNDT records the average density in approximately a 10 inch diameter sphere of influence around the probe. Since this zone of influence extends well beyond the limits of any significant disturbance, an averaging effect results tending to decrease any disturbance effects in the DNDT value.

For the pressure meter testing, the BX casing used to create the test section interval is driven down the 2" diameter hole created by the SPT sampling displacing the soil into the BX casing and removed with the BX casing leaving a zone relatively undisturbed for PMT. Furthermore, the results of the pressure meter testing shall be plotted in the form of volume change verses pressure curve that allows soil disturbance to be detected and taken into account in the data calculations. This results because the disturbed zone appears as non-linear on the volume change versus pressure curve and the deformation modulus is calculated based only on the straight line portion of that curve.

4.5 Loose Zones

In the event loose zones (SPT values less than 15) are encountered in any boring, additional borings will be placed such that they are offset approximately 20 feet from first boring in each direction along the edge of the underground utility

If the additional boring(s) encounter loose zones another boring(s) will be placed approximately 20 feet from the last boring until the extent of the loose zone has been defined in horizontal and vertical extent.

5.0 REPORTS

5.1 Final Backfill Testing Report

The geotechnical engineer shall prepare a report summarizing all field test results. The report will include a geotechnical evaluation of the test program and will include recommendations for resolution of the 50.55(e) condition 146.

APPENDIX A

BURNS AND ROE INC. | BORING NO.

	GRND. WATER	DATE	TIME	DEPTH	CASING	
PROJECT						SHEET NO.: 1 OF
OWNER						PROJECT NO:
CONTRACTOR						ELEVATION:

METHOD OF ADVANC. BORING	DEPTH		CAS.	SAMP.	CORE	TUBE	DATUM:
POWER AUGER	TO	TYPE					DATE START:
HAND CHOP. W/MUD: W/WATER	TO	DIA.					DATE FINISHED
ROT. DRILL: W/MUD: W/WATER	TO	WT.					DRILLER:
DIAMOND CORE	TO	FALL					INSPECTOR:

DEPTH FT.	CASING BLOWS	SAMPLE NO.	SAMPLES RECOV. TOT.	SAMPLES RECOV. RQD.	SAMPLES PENETR. RESIST. BL./6 IN.	SYMBOL	MOIST.	IDENTIFICATION	DEPTH	REMARKS
1										
2										
3										
4										
5									5	
6										
7										
8										
9										
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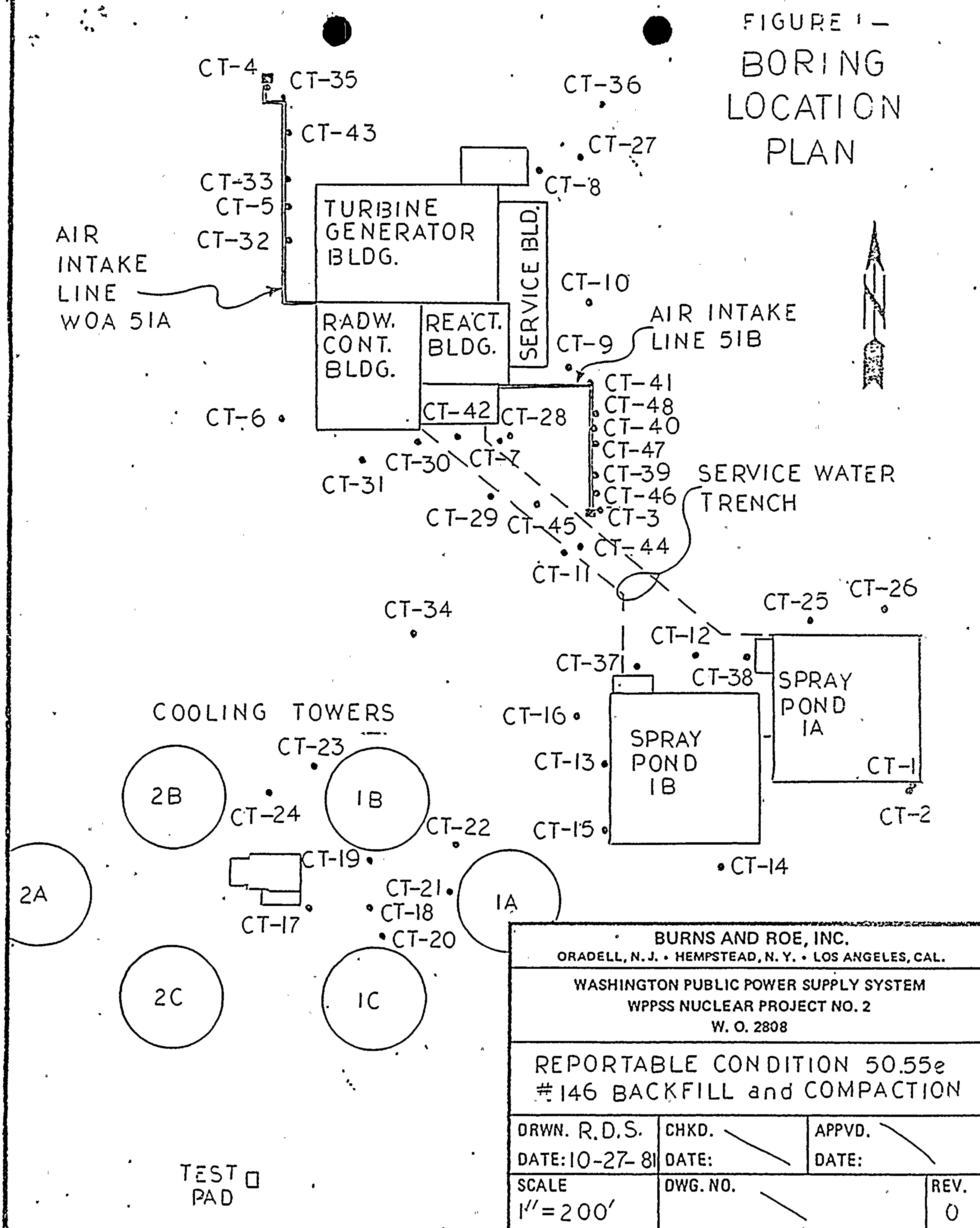
APPENDIX B

FIGURE 1 — BORING LOCATION PLAN



BURNS AND ROE, INC.
ORADELL, N.J. • HEMPSTEAD, N.Y. • LOS ANGELES, CAL.

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
WPPSS NUCLEAR PROJECT NO. 2
W. O. 2808

REPORTABLE CONDITION 50.55e
#146 BACKFILL and COMPACTION

DRWN. R.D.S.	CHKD.	APPVD.
DATE: 10-27-81	DATE:	DATE:
SCALE 1" = 200'	DWG. NO.	REV. 0

WPPSS Hanford No. 2
50.55(e) Concern No. 146

TABLE I - BORING LOCATION AND TESTING TABULATION

Burns and Roe, Inc.
See page _____ for notes

Correlation Tests (CT)	Hanford Area Coordinates North	West	Type, Depth & Number of Tests STP	PMT Depth of Tests	DNDT Number of Tests	Subject of Testing
CT-3	11,565	1,020	Continuous	---	--	Class I fill for Class I Air Intake Structure (51B).
CT-4	12,281	1,596	Nearly Continuous	--	--	Class I fill for Class I Air Intake Structure (51A).
CT-5	12,072	1,562	Nearly Continuous	--	--	Class I fill outside of Air Intake Line (WOA51A) trench.
CT-7	11,679	1,191	Nearly Continuous	--	--	Class I fill for Class I Service Water.
CT-11	11,485	1,075	Continuous	---	--	Class I fill for Class I Service Water and Class II Circulating Water.
CT-12	11,317	867	Continuous	--	--	Class I fill for Class I Service Water.
CT-28	11,689	1,178	Nearly Continuous	13.4' 14.1'	10	Class I fill for Class I Service Water and Class II Storm Sewer.
CT-29	11,574	1,182	Continuous*	7.0'*	6*	Class I fill for Service Water.

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Correlation Tests (CT)	Hanford Area Coordinates North	Hanford Area Coordinates West	Type, Depth & Number of Tests: STP	PMT Depth of Tests	DNDT Number of Tests	Subject of Testing
CT-32	12,017	1,565	Continuous	5.0'	4	Class I fill for Class I Air Intake Line (WOA51A).
CT-33	12,121	1,565	Continuous	4.7'	--	Class I fill for Class I Air Intake Line WOA51A).
CT-35	12,286	1,565	Continuous	4.8'	--	Class I fill for Class I Air Intake Line (WOA51A).
CT-37	11,292	956	Continuous	7.7 14.0	6	Class I fill for Class I Service Water.
CT-38	11,319	769	Continuous	4.9	3	Class I fill for Class I Service Water.
CT-39	11,623	1,031	Nearly	4.4	6	Class I fill for Class I Air Intake Line (WOA51B).
CT-40	11,698	1,031	Nearly Continuous	4.7 11.7 26.0	14	Class I fill for Class I Air Intake Line (WOA51B) and Class II Storm Sewer.
CT-41	11,771	1,031	Nearly Continuous	6.6	7	Class I fill for Class I Air Intake Line (WOA51B) and Class II Storm Sewer.

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See page ____ for notes

Correlation Tests (CT)	Hanford Area Coordinates North	West	Type, Depth & Number of Tests STP	PMT Depth of Tests	DNDT Number of Tests	Subject of Testing
CT-42	11,681	1,264	Continuous	10.0*	5*	Class I fill for Class I Service Water and Class II Storm Sewer.
CT-43	12,200	1,565	Continuous	9.0*	4*	Class I fill for Class I Air Intake Line (WOA51A).
CT-44	11,509	1,057	Continuous	9.0*	4*	Class I fill for Class I Service Water Pipe Ln.
CT-45	11,563	1,120	Continuous	7.0*	5*	Class I fill for Class I Service Water Pipe Ln.

* Planned location and number of tests.