MAINE YANKEE
FINAL STATUS SURVEY RELEASE RECORD
FA-1400 PERSONNEL HATCH FOOTPRINT
SURVEY UNIT 1

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SURVEY UNIT 1

A. SURVEY UNIT DESCRIPTION

Survey Unit FA-1400-01 consists of sub-slab soil, concrete and gravel media below the now demolished Personnel Hatch Building, located at grid coordinates 407483N and 623890E using the Maine State Coordinate (West Zone) NAD 1927, as shown on Map FA 1400 SITE, Attachment 1. The survey unit footprint, following building demolition and removal, was approximately 3 feet below grade.

The Personnel Hatch was a concrete block structure with painted, epoxied concrete floor, painted walls and ceiling with some structural steel. The building contained two rooms, with the larger room housing the steel containment access door that served as the primary personnel access point for the Containment Building during plant operation. The smaller room housed ventilation equipment and filter banks. The Personnel Hatch was located within the Restricted Area and encompassed a footprint area of approximately 182 m^2.

B. SURVEY UNIT DESIGN INFORMATION

The area was initially designated a Class 2 land survey unit in accordance with Section 5.2.3 of the LTP, with the excavated foundation footprint classified as one class lower than would have been assigned to the foundation concrete surface. During the performance of the final status survey, radionuclide concentrations were found to exceed the reduced DCGLs for surface soil inside the Restricted Area.[1] When the direct measurement levels exceeded the DCGLs, the survey unit was reclassified and a new survey designed in accordance with Class 1 requirements as provided in Section 5 of the LTP.

The survey unit design parameters for FA-1400 as a Class 1 survey are shown in Table 1. Given a relative shift of 2.0, it was determined that 15 direct measurements were required for the Sign Test. Measurement locations were based on a systematic square grid with a random start point and are illustrated on the map FA 1400-2a (Attachment 1). All direct measurements consisted of soil samples obtained at the required locations. The samples are analyzed with laboratory gamma spectroscopy.

In accordance with the LTP, scans covering 100% of the 182 m^2 area were required for the Class 1 survey unit. This was accomplished by use of an ISOCS detector configured at a 2-meter distance from the surface to obtain approximately 12-m^2 field of view for each scan. Locations of the survey scans are shown on map FA 1400-1b (Attachment 1). The survey instruments used, their MDCs, and scan investigation levels are provided in Attachment 2.

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1 DCGLs for Co-60 and Cs-137 as derived from LTP Rev 3 Table 6-11, taking into account changes in the activated concrete remediation plans, submitted in the September 11, 2003 license amendment (MY Letter to the NRC MN-03-049) and approved by the NRC (letter dated 2/18/2004). The license amendment lowered the surface soil DCGL to 2.39 pCi/g for areas inside the RA.

TABLE 1

SURVEY UNIT DESIGN PARAMETERS

Survey Unit	Design Criteria	Basis
Area	182 m^2	Class 1
Number of Direct Measurements Required	15	Based on LBGR of 1.195, sigma[2] of 0.58 pCi/g, and a relative shift of 2.0. Type I = Type II = 0.05
Sample Area	12.13 m^2	182 m^2 / 15 = 12.13 m^2
Sample Grid Spacing	3.5 m	$(12.13)^{1/2}$
Scan Grid Area	ISOCS scan at 2-meters[3]	Memo TSB 01-07/06/2004
Area Factor	2.4	Class 1 Area, LTP Table 6-12
Scan Survey Area	182 m^2	Class 1 Area – 100%
Scan Investigation Level	2.2 pCi/g Cs-137 0.8 pCi/g Co-60	ISOCS investigation levels with detector at 2-meter height
DCGL	2.39 pCi/g Cs-137 0.86 pCi/g Co-60	LTP Revision 3, Table 6-11, from 09/11/2003 License Amendment (MN-03-049)
Design $DCGL_{EMC}$	5.74 pCi/g Cs-137 2.06 pCi/g Co-60	DCGL x Area Factor for Class 1 survey unit, per LTP Section 5.6.3

C. SURVEY RESULTS

A total of 16 direct volumetric measurements were made and the results are presented in Table 2. All direct measurements were below the DCGL. ISOCS gamma scans were performed at 30 locations using an investigation level of 0.8 pCi/g Co-60 and 2.2 pCi/g Cs-137. The gamma scans were performed for a sufficient count time to achieve a Minimum Detectable Activity of 25% of the DCGL. All identified activity levels were below the investigation scan setpoints. Therefore, no investigations were required.

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2 Sigma was determined using the standard deviation for direct soil sample measurement results obtained during the Class 2 survey of FA-1400.

3 Memo TSB 01-07/06/2004, ISOCS Geometries and Investigation Levels

TABLE 2

DIRECT MEASUREMENTS

Sample Number	Cs-137 (pCi/g)	Uncertainty	Co-60 (pCi/g)	Uncertainty	Unitized Value of Unity Rule
FA1400-01-1G001VS	< 5.56E-02		< 6.23E-02		9.57E-02
FA1400-01-1G002VS	1.39E-01	3.33E-02	9.36E-02	2.18E-02	1.67E-01
FA1400-01-1G003VS	7.74E-02	3.45E-02	< 5.71E-02		9.88E-02
FA1400-01-1G004VS	6.78E-02	2.95E-02	< 6.10E-02		9.93E-02
FA1400-01-1G005VS	2.60E-01	3.77E-02	5.73E-02	1.90E-02	1.75E-01
FA1400-01-1G006VS	8.10E-01	8.01E-02	< 6.03E-02		4.09E-01
FA1400-01-1G007VS	2.13E-01	4.54E-02	3.07E-01	3.78E-02	4.46E-01
FA1400-01-1G008VS	1.33E-01	3.52E-02	< 6.58E-02		1.32E-01
FA1400-01-1G009VS	< 5.81E-02		< 5.83E-02		9.21E-02
FA1400-01-1G010VS	< 6.38E-02		< 5.89E-02		9.52E-02
FA1400-01-1G011VS	4.12E-02	2.58E-02	< 5.95E-02		8.64E-02
FA1400-01-1G012VS	< 5.49E-02		< 5.09E-02		8.22E-02
FA1400-01-1G013VS	1.27E-01	3.81E-02	< 5.79E-02		1.21E-01
FA1400-01-1G014VS	1.56E-01	3.50E-02	1.72E-01	3.29E-02	2.66E-01
FA1400-01-1G015VS	< 5.61E-02		< 5.71E-02		8.99E-02
FA1400-01-1G016VS	< 7.11E-02		< 7.78E-02		1.20E-01
Mean	**1.49E-01**		**8.48E-02**		**1.61E-01**
Median	**7.43E-02**		**5.99E-02**		**1.10E-01**
Standard Deviation	**1.87E-01**		**6.60E-02**		**1.14E-01**
Range	**4.12E-02 to 8.10E-01**		**5.09E-02 to 3.07E-01**		**8.22E-02 to 4.46E-01**

"<" indicates MDA value

D. SURVEY UNIT INVESTIGATIONS AND RESULTS

No investigations were required.

E. SURVEY UNIT DATA ASSESSMENT

An analysis of the direct sample measurement results, including the mean, median, standard deviation, and sample result range, is provided in Table 2. Of the 16 volumetric samples collected, 10 identified Cs-137 activity below the DCGL value of 2.39 pCi/g while 4 identified Co-60 activity below the DCGL value of 0.86 pCi/g. All other values were at the MDA. Identified sample activities or Minimum Detectable Activities are listed in Table 2. The mean and median activities were less than the DCGL for both Co-60 and Cs-137. The highest reported values for Co-60 and Cs-137 were less than 50% of the DCGLs.

For illustrative purposes, as indicated in LTP Section 5.9.3, a simplified general retrospective dose estimate can be calculated from the average residual contamination level. The established mean fallout Cs-137 background value[4] (0.19 pCi/g) for disturbed soil is larger than the survey unit mean. Hence the annual dose from Cs-137 is 0.0 mrem/y. However, the mean value of 0.0848 pCi/g Co-60 would equate to an annual dose rate of 0.55 mrem/year[5]. However, for the purposes of demonstrating compliance with the radiological criteria for license termination and the enhanced State Criteria, background activity is not subtracted from the volumetric sample analysis activity values.

F. ADDITIONAL DATA EVALUATION

Attachment 4 provides additional data evaluation associated with this Survey Unit, including relevant statistical information. Based on survey unit direct measurement data, this attachment provides the Sign Test Summary, Quantile Plot, Histogram, and Retrospective Power Curve.

1. The Sign Test Summary provides an overall summary of design input (Table 1) and resulting calculated values used to determine the required number (N) of direct measurements (per LTP Section 5.4.2). The Sign Test Summary is a separate statistical analysis that also calculates the mean, median, and standard deviation of the direct measurements.

   The critical value and the result of the Sign Test are provided in the Sign Test Summary table, as well as a listing of the key release criteria. As is shown in the table, all of the key release criteria were clearly satisfied for the FSS of this survey unit.

2. The Quantile Plot was generated from the unity value data listed in Table 2. The data set and plot are consistent with expectations for a Class 1 survey unit. All of the measurements are well below the DCGL of 2.39 pCi/g for land inside the restricted area.

3. A Histogram Plot was also developed based on the unity values. This plot shows a log-normal distribution with 5 outliers.

4. A Retrospective Power Curve was constructed, based on FSS results. The curve shows that this survey unit having a mean residual activity at a fraction of the DCGL has a high probability ("power") of meeting the release criteria. Thus, it can be concluded that the direct measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

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4 See Attachment E to Maine Yankee Procedure PMP 6.7.8 (Reference 5).

5 This annual dose equivalent is based on LTP Table 6-11 which shows the contaminated soil in the RA contribution of 5.63 mrem from the 2.39 pCi/g DCGL.

G. CHANGES IN INITIAL SURVEY UNIT ASSUMPTIONS ON EXTENT OF RESIDUAL ACTIVITY

The survey was initially designed for a Class 2 land survey area. Direct measurements determined that residual radioactivity levels exceeded the allowable levels. Following remediation, the survey was designed as a Class 1 area; the FSS results were consistent with that classification. The post-remediation direct measurement sample standard deviation was less than the design sigma. Thus, a sufficient number of sample measurements were taken.

H. LTP CHANGES SUBSEQUENT TO SURVEY UNIT FSS

The FSS of Survey Unit 1 was designed and performed using the criteria of the approved LTP Revision 3 Addenda (Reference 1). The only subsequent LTP changes with the potential for impact to this survey unit were provided in the proposed license amendment related to modifications of the activated concrete remediation plan, submitted September 11, 2003 (Reference 3) and approved by the NRC (Reference 4). Changes represented in this later license amendment were applied during the design and performance of the final status survey of Survey Unit 1.

I. CONCLUSION

The FSS of this survey unit was designed based on a Class 1 designation. The survey design parameters are presented in Table 1. The required number of direct measurements was determined for the Sign Test in accordance with the LTP. As presented in Table 2, all direct measurements were less than the DCGLs of 0.86 pCi/g Co-60 and 2.39 pCi/g Cs-137.

A Sign Test Summary analysis demonstrated that the Sign Test criteria were satisfied. The direct measurement sigma was determined to be less than that used for design, thus indicating that a sufficient number of samples was taken.

The Retrospective Power Curve shown in Attachment 4 confirmed that sufficient samples were taken to support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and the data quality objectives were met. Attachment 4 also revealed that direct measurement data represented essentially a log-normal distribution, with variance consistent with expectations for a Class 1 survey unit.

The scan survey design for this survey unit was developed in accordance with the LTP Revision 3 Addenda (Reference 1) and the LTP Supplement on Activated Concrete (Reference 3 and 4) with significant aspects of the design discussed in Section B and Table 1. Scans conducted with the ISOCS did not identify activity above the scan investigation levels of 0.8 pCi/g Co-60 and 2.2 pCi/g Cs-137. The gamma scans were performed to achieve an MDA of approximately 25% of the DCGLs.

It is concluded that FA-1400 Survey Unit 1 meets the release criteria of 10CFR20.1402 and the State of Maine enhanced criteria.

J. REFERENCES

1. Maine Yankee License Termination Plan, Revision 3, October 15, 2002 and Addenda provided by Maine Yankee letter to the NRC, MN-02-061, dated November 26, 2002

2. NRC letter to Maine Yankee, dated February 28, 2003

3. Maine Yankee letter to the NRC, MN-03-049, dated September 11, 2003 (LTP Supplement to LTP Revision 3)

4. Issuance of License Amendment No. 170, NRC letter to Maine Yankee, dated February 18, 2004

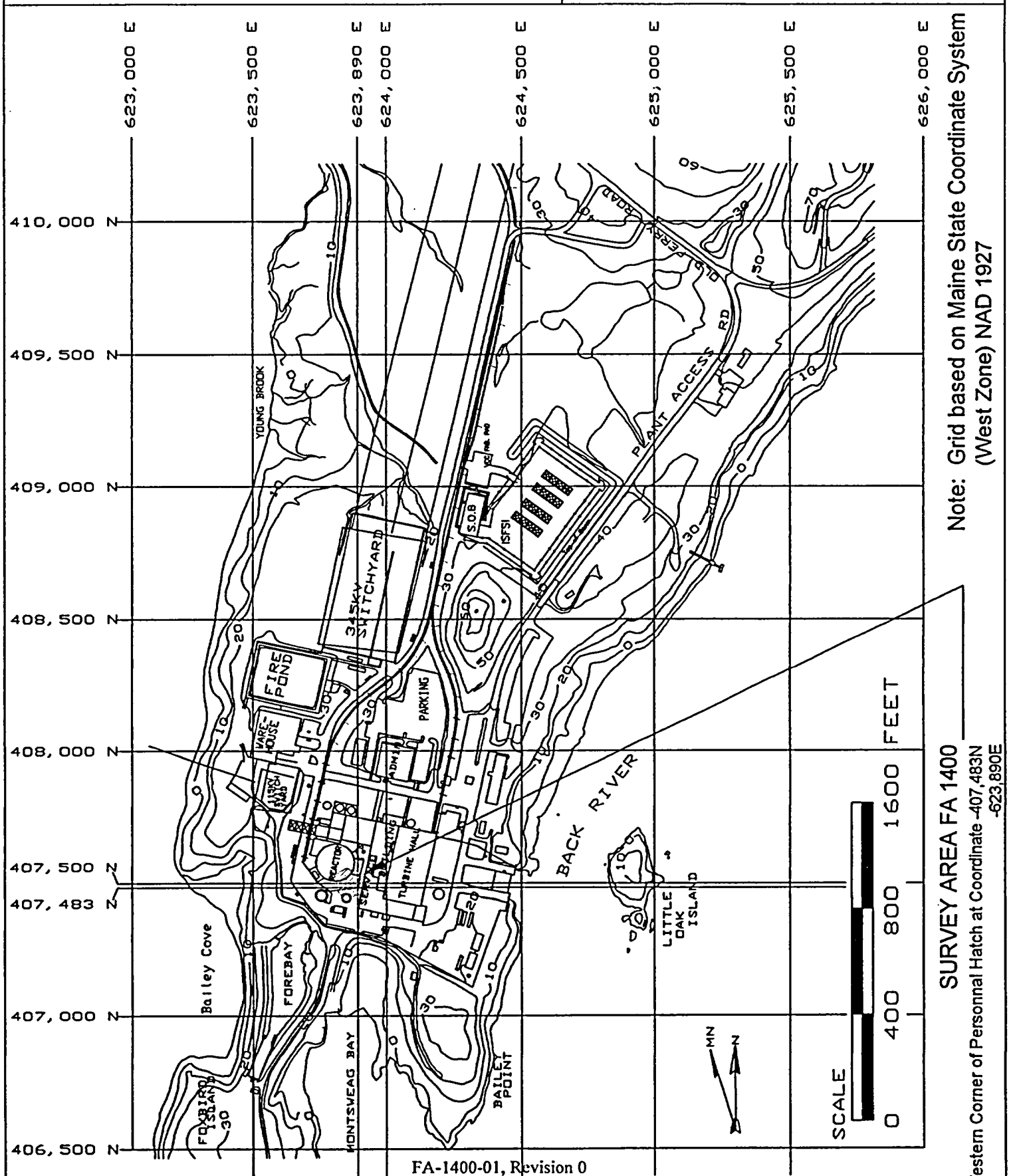
5. Maine Yankee PMP 6.7.8, FSS Data Processing and Reporting, Attachment E, Approach for Dealing With Background Radioactivity for Maine Yankee Final Status Surveys

6. Memo TSB 01-07/06/2004, ISOCS Geometries and Investigation Levels

Attachment 1

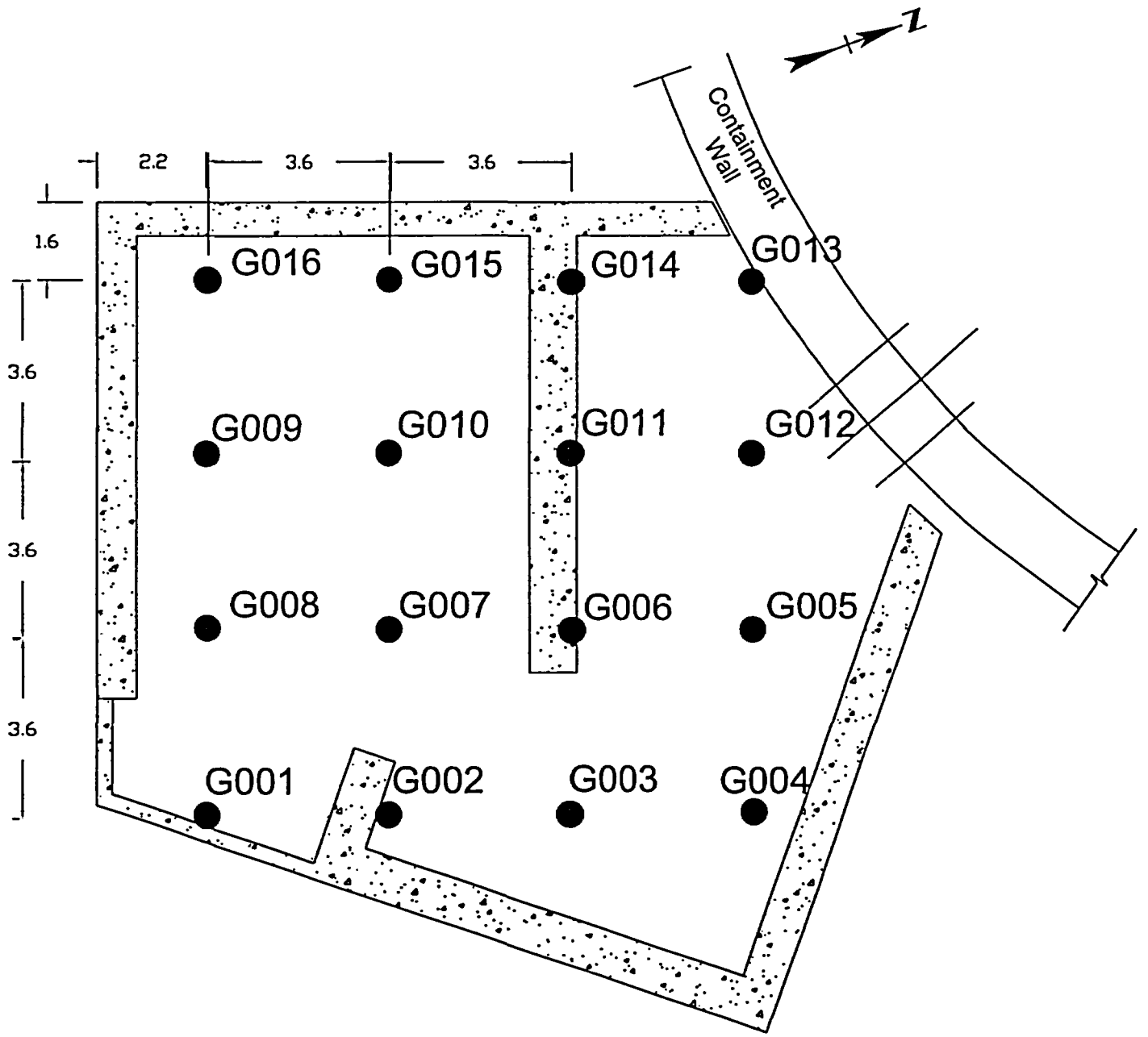
Survey Unit Maps

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FA 1400 SITE Revised: 3-22-04
Survey Type: ☐ Characterization ☐ Turnover ■ Final Status Survey	Survey Area Name: Personnel Hatch Building	



Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FA 1400-2a Revised: 7-15-04
Survey Type: ☐ Characterization ☐ Turnover ■ Final Status Survey	Survey Area Name: Personnel Hatch Building	

Personnel Hatch Building Footprint
Final Status Survey
Direct Points G001-G016

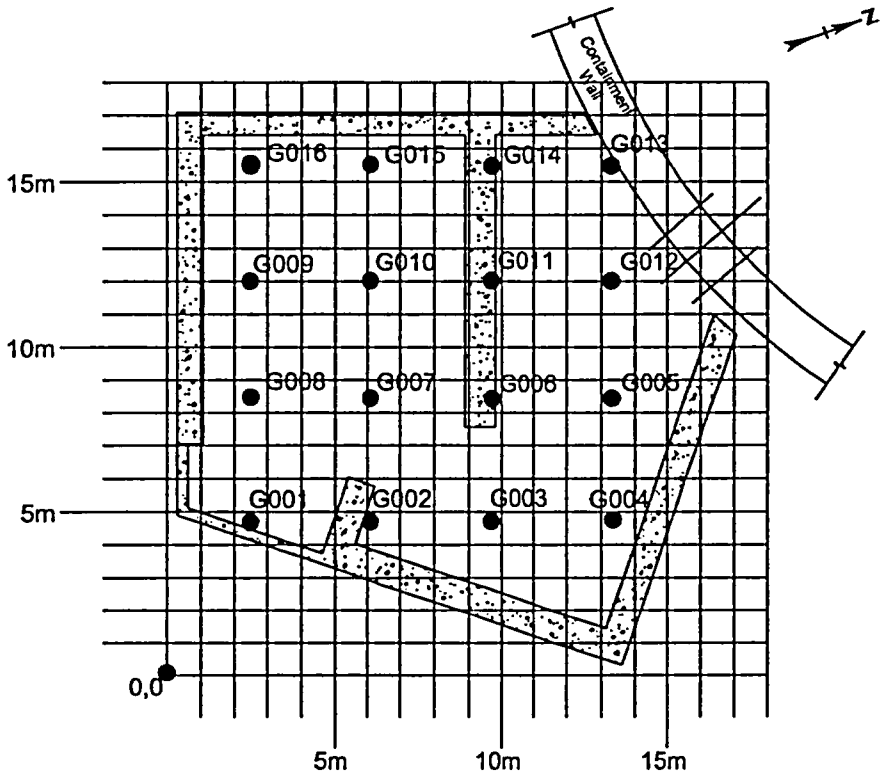


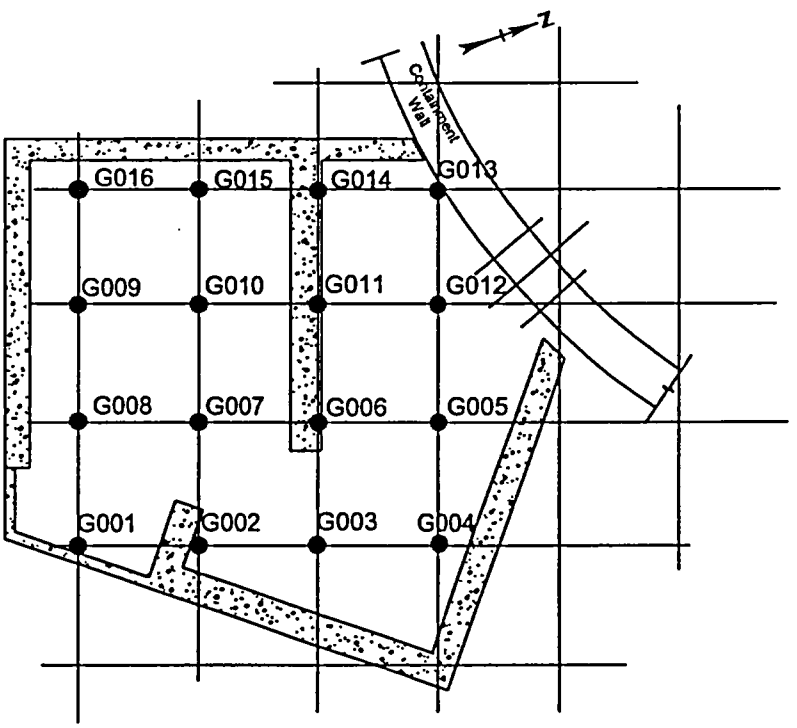
N = 15, L = 3.6

Soil Footprint Total Area - 182 sq-m

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FA 1400 DP Ref A Revised: 7-15-04
Survey Type: ☐ Characterization ☐ Turnover ■ Final Status Survey	Survey Area Name: Personnel Hatch Building	

Personnel Hatch Building Footprint
Final Status Survey
Direct Points Reference Map



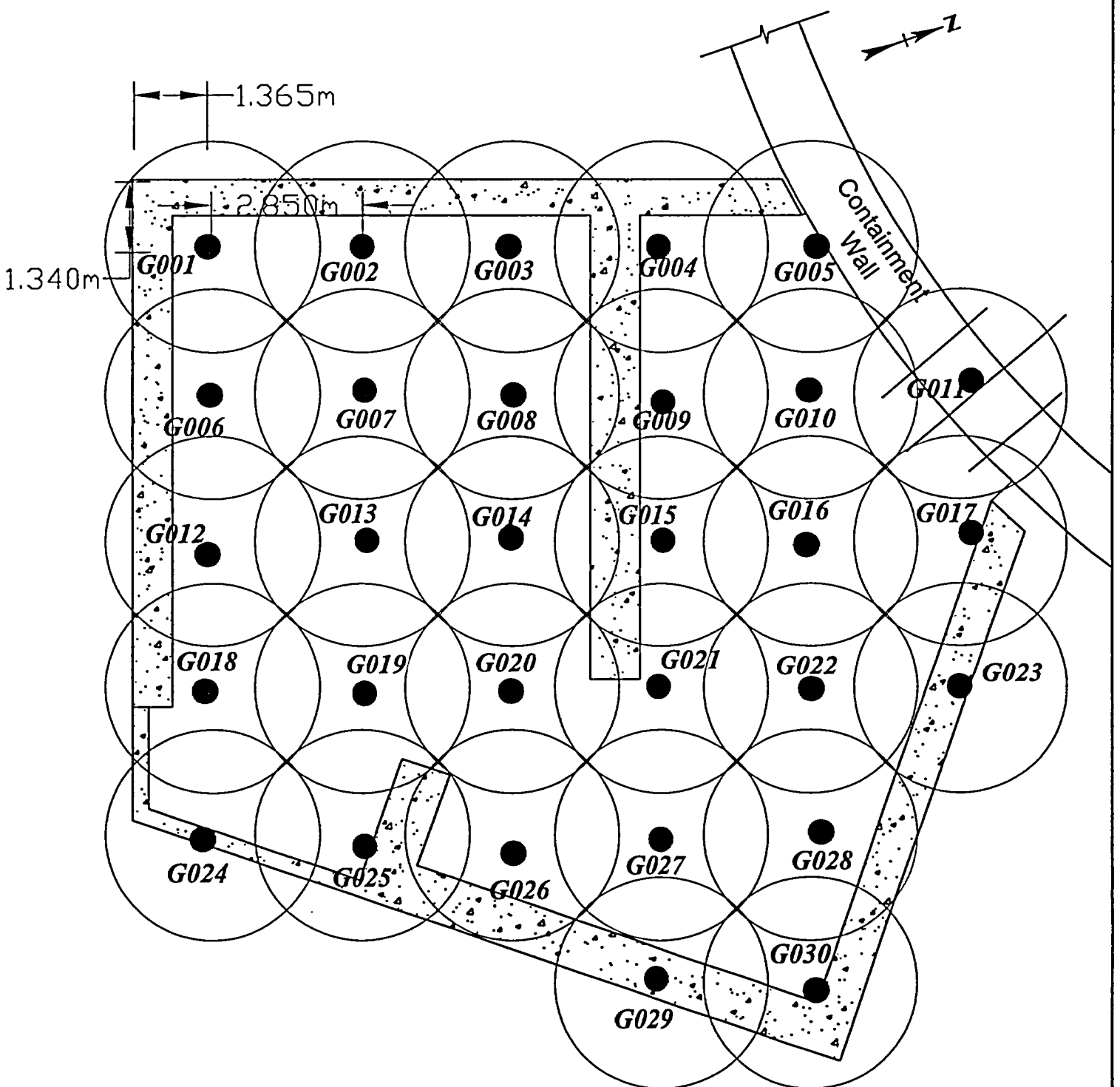


N = 15, L = 3.6

Soil Footprint Total Area - 182 sq-m

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FA 1400-1b Revised: 7-14-04
Survey Type: ☐ Characterization ☐ Turnover ■ Final Status Survey	Survey Area Name: Personnel Hatch Building	

Personnel Hatch Building Footprint
Final Status Survey
ISOCS Scans G001 - G030



The ISOCS scans are 4.0m Ø circles.

Soil Footprint Total Area - 182 sq-m

Attachment 2

Survey Unit Instrumentation

TABLE 2-1

INSTRUMENT INFORMATION

ISOCS Detector S/N	Scan MDC (pCi/g)
7607	0.10 to 0.35

HPGe Detectors for Lab Analysis of Volumetric Samples

Detector Number	MDC (pCi/g)
FSS-1	3.5E-02 to 8.0E-02
FSS-2	3.5E-02 to 8.0E-02

TABLE 2-2

INSTRUMENT SCAN MDC, DCGL, INVESTIGATION LEVEL, AND DESIGN $DCGL_{EMC}$

Detector	ISOCS	Comments
Scan MDC (pCi/g)	7.75E-02 to 2.05E-01 Co-60 1.53E-01 to 3.49E-01 Cs-137	Approximately 25% of DCGL
DCGL (pCi/g)	8.60E-01 pCi/g Co-60 2.39E+00 pCi/g Cs-137	Revised Activated Concrete DCGL (MN-03-049) and Amendment No. 170 (Reference 3 and 4)
Investigation Level	8.00E-01 pCi/g Co-60 2.20E+00 pCi/g Cs-137	Memo TSB 01-07/06/2004, ISOCS Geometries and Investigation Levels
Design $DCGL_{EMC}$ (pCi/g) from Release Record Table 1	2.06E+00 pCi/g Co-60 5.74E+00 pCi/g Cs-137	DCGL x Area Factor for Class 1 survey unit, per LTP Section 5.6.3

Attachment 3

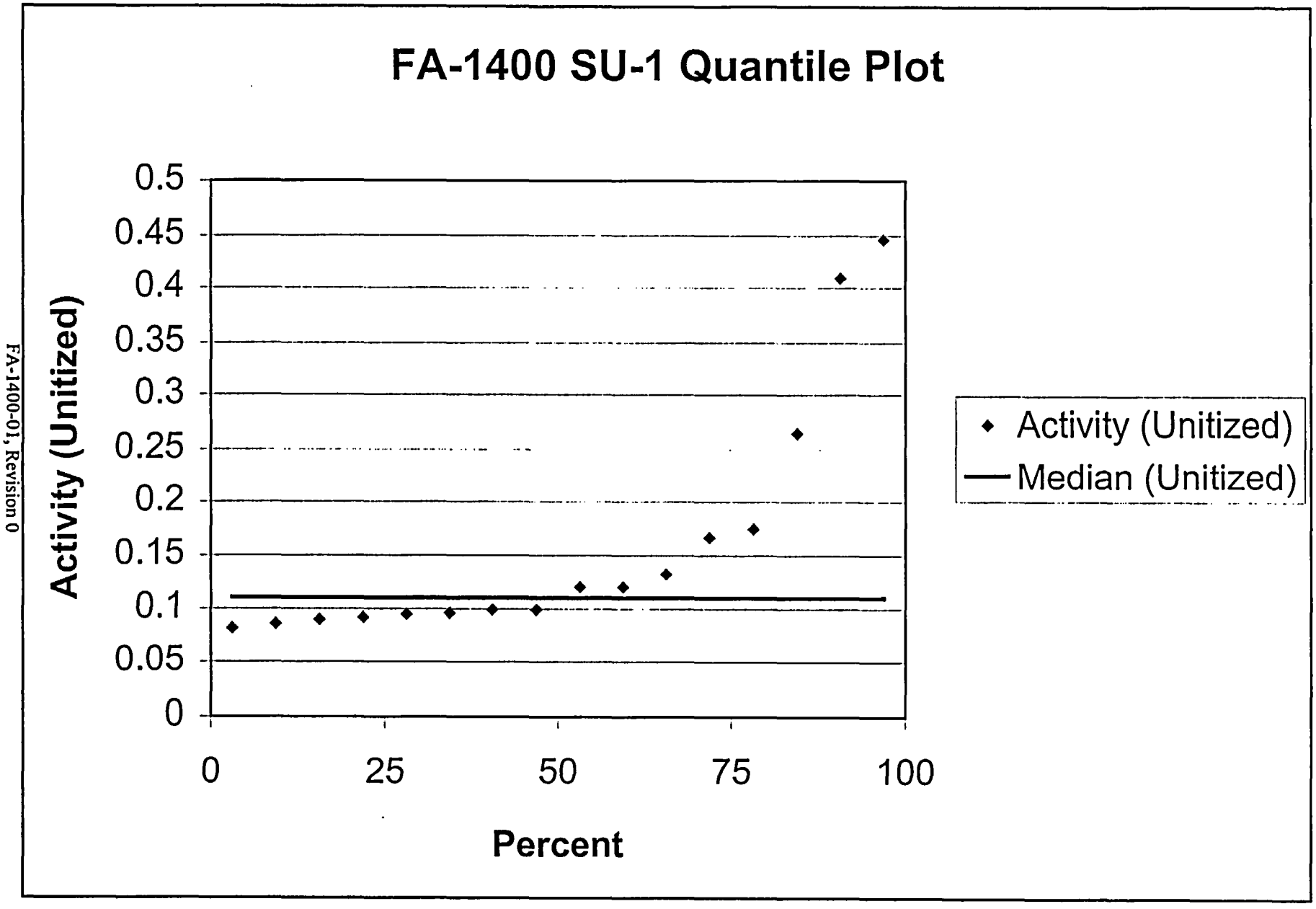
Investigation Tables
(None Required)

Attachment 4

Statistical Data

Survey Package FA-1400 Unit 1 Soil Sign Test Summary

Evaluation Input Values		Comments
Survey Package:	FA-1400	
Survey Unit:	01	
Evaluator:	Anderson	
$DCGL_w$:	2.39E+00	
$DCGL_{emc}$:	5.74E+00	
LBGR:	1.20E+00	
Sigma:	5.80E-01	
Type I error:	0.05	
Type II error:	0.05	
Nuclide:	UNITY	
Soil Type:	N/A	
Calculated Values		**Comments**
$Z_{1-\alpha}$:	1.645	
$Z_{1-\beta}$:	1.645	
Sign p:	0.97725	
Calculated Relative Shift:	2.0	
Relative Shift Used:	2.0	Uses 3.0 if Relative Shift is >3
N-Value:	12	
N-Value+20%:	15	
Sample Data Values		**Comments**
Number of Samples:	16	
Median:	1.10E-01	
Mean:	1.61E-01	
Net Sample Standard Deviation:	1.14E-01	
Total Standard Deviation:	1.14E-01	SRSS
Maximum:	4.46E-01	
Sign Test Results		**Comments**
Adjusted N Value:	16	
S+ Value:	16	
Critical Value:	11	
Sign test results:	Pass	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_w$:	Pass	
Median value <$DCGL_w$:	Pass	
Mean value <$DCGL_w$:	Pass	
Maximum value <$DCGL_{emc}$:	Pass	
Total Standard Deviation <=Sigma:	Pass	
Criteria comparison results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	


FA-1400 SU-1 Quantile Plot
Activity (Unitized)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
25
50
75
100
Percent
Activity (Unitized)
Median (Unitized)

Page/Date/Time 2 10/14/04 3:59:44 PM
Database
Variable C2

Plots Section

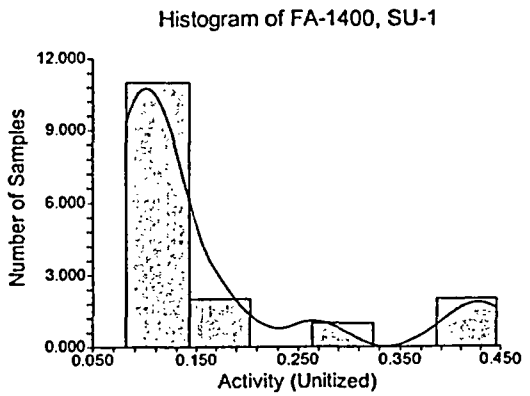


Chart Section