

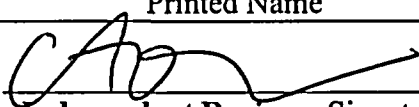




**MAINE YANKEE
FINAL STATUS SURVEY RELEASE RECORD
FR-0900 BALANCE OF PLANT LAND
SURVEY UNIT 4**

Prepared By:	 _____ FSS Engineer - Signature <u>G. Madison</u> Printed Name	Date: <u>JUN 07 2005</u>
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Approved By:	 _____ Superintendent, DSS - Signature <u>George Pillsbury</u> Printed Name	Date: <u>6/8/05</u>
Approved By:	 _____ FSS, MOP - Signature <u>JAMES R. PACKER</u> Printed Name	Date: <u>6/8/05</u>

**MAINE YANKEE
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SURVEY UNIT 4**

A. SURVEY UNIT DESCRIPTION

Survey Unit 4 is located in Survey Area FR-0900. This area was used during decommissioning to pile snow removed from the roadway, and consists of a reclassified portion of Survey Area FR-2900 Survey Unit 2 and Survey Area FR-0900 Survey Unit 1. The survey unit area is 175 m². It is a rectangular shaped area 25 meter by 7 meter located just off of the east end of the east/west access road that runs along the north side of the Restricted Area. The surface is primarily soft sandy soil. As shown on map FR0900U4-SITE, the survey area is located near the northeast corner of the former Protected Area and is approximately centered at coordinates 407,767 N and 624,341 E using the Maine State Coordinate System (West Zone) NAD 1927.

The area is shown in relation to other major site structures in map FR0900U4-SITE. All maps referenced in this release record are provided in Attachment 1 unless otherwise noted.

B. SURVEY UNIT DESIGN INFORMATION

This area was designated a Class 1 land survey unit because it contained a small localized soil area that exceeded the DCGL (refer to the Release Record for FR-2900 Survey Unit 2 for additional information). The snow removal area, including the debris pile, was remediated prior to FSS.

The survey unit design parameters are shown in Table 1. Given an adjusted relative shift of 3.0, it was determined that 14 direct measurements were required for the Sign Test. Fourteen direct measurements were actually performed. The measurement locations were based on a systematic square grid with a random start point, which led to a survey unit map with 14 locations as illustrated on map FR0900U4-DIRT. Direct measurements (soil samples) were collected from required locations and analyzed with laboratory gamma spectroscopy instrumentation.

The survey was also designed to include 31 overlapping scans for soil surfaces, each of approximately 19.6 m² area (see map FR0900U4-SCAN). The High Purity Germanium (HPGe) In Situ Object Characterization System (ISOCS) scan investigation level was conservatively set at approximately 25% of the DCGL, as shown in Table 2-2 (Attachment 2). The survey design called for an open collimation configuration which allows a broad field of view (5 meter diameter), and better efficiency for detection of an elevated area since the detector face is positioned 0.5 meter perpendicular from the surface. The survey design also called for investigation of any scan result with verified positive detection of Co-60, because of previous success at identifying a localized elevated area from FR-2900 Survey Unit 2.

The instruments used in this survey are listed by model and serial number in Attachment 2 (Table 2-1). Scan MDCs are also listed in Attachment 2 (Table 2-2) and are compared to the DCGL, the investigation level, and DCGL_{EMC}. As shown in this table, the scan MDC is less than the scan investigation level in all cases, thus providing high confidence (95% or higher) that an elevated area would be detected in the scanning process. Furthermore, since the investigation level was always less than the design DCGL_{EMC}, no EMC sample size adjustment was necessary.

TABLE 1
SURVEY UNIT DESIGN PARAMETERS

Survey Unit	Design Criteria	Basis
Area	175 m ²	Class 1 <2,000 m ²
Number of Direct Measurements Required	14	Based on an adjusted LBGR of 2.76 pCi/g, Cs-137 sigma ¹ of 0.48 pCi/g, and a relative shift of 3.0. Type I = Type II = 0.05
Sample Area	12.5 m ²	(175 m ²)/14=12.5 m ²
Sample Grid Spacing	3.5	(12.5) ^{1/2}
Scan Grid Area	ISOCS scan at 0.5 meter height for 19.6 m ² field of view	See Section B
Area Factor	2.3	Class 1 Area, LTP Table 6-12
Scan Survey Area	175 m ²	Class 1 – 100%
Scan Investigation Level	0.36 pCi/g Co-60 1.0 pCi/g Cs-137	ISOCS investigation levels with detector at 0.5-meter height (Reference 3)
DCGL	1.52 pCi/g Co-60 4.2 pCi/g Cs-137	LTP, Rev. 4 Section 6-7 for Land Areas outside the RA
Design DCGL _{EMC}	3.47 pCi/g Co-60 9.6 pCi/g Cs-137	DCGL x Area Factor for Class 1 survey unit per LTP Section 5.6.3

¹ Design sigma is based on characterization data, listed in LTP Table 5-1C Balance of Plant Land R0900, (LTP, Rev. 4).

C. SURVEY RESULTS

Fourteen direct samples were obtained in Survey Unit 4. All direct measurements were less than the DCGL; therefore, no investigations were required as a result of the direct measurements. Four samples showed detectable Cs-137 and one sample showed Co-60. The resulting data are presented in Table 2 below.

ISOCS scans were performed at 31 locations using investigation levels of 0.36 pCi/g Co-60 and 1.0 pCi/g Cs-137. The gamma scans were designed for an MDA of approximately 6% of the DCGL. Since all the measurement results were less than the investigation setpoints, no investigations were required. Also, the survey design called for investigation of any scan result indicating positive detection of Co-60 greater than MDA. Co-60 was not identified for any scan measurement location.

TABLE 2

DIRECT MEASUREMENTS

Sample Location	Co-60 pCi/g	Uncertainty pCi/g	Cs-137 pCi/g	Uncertainty pCi/g	Unitized Value
FR0900-04-1-S001-SS-DIRT	< 6.16E-02		< 7.64E-02		5.87E-02
FR0900-04-1-S002-SS-DIRT	< 5.04E-02		< 6.50E-02		4.86E-02
FR0900-04-1-S003-SS-DIRT	< 5.81E-02		< 7.27E-02		5.55E-02
FR0900-04-1-S004-SS-DIRT	< 4.73E-02		< 5.33E-02		4.38E-02
FR0900-04-1-S005-SS-DIRT	< 5.32E-02		< 6.13E-02		4.96E-02
FR0900-04-1-S006-SS-DIRT	< 5.36E-02		< 6.03E-02		4.96E-02
FR0900-04-1-S007-SS-DIRT	< 4.76E-02		1.01E-01	2.91E-02	5.54E-02
FR0900-04-1-S008-SS-DIRT	< 4.98E-02		< 5.10E-02		4.49E-02
FR0900-04-1-S009-SS-DIRT	< 6.03E-02		< 6.50E-02		5.51E-02
FR0900-04-1-S010-SS-DIRT	1.96E-01	3.46E-02	< 6.00E-02		1.43E-01
FR0900-04-1-S011-SS-DIRT	< 5.34E-02		1.32E-01	3.23E-02	6.66E-02
FR0900-04-1-S012-SS-DIRT	< 5.64E-02		1.24E-01	3.38E-02	6.66E-02
FR0900-04-1-S013-SS-DIRT	< 6.36E-02		< 6.42E-02		5.71E-02
FR0900-04-1-S014-SS-DIRT	< 6.34E-02		8.30E-02	2.98E-02	6.15E-02
Mean	6.54E-02		7.63E-02		6.12E-02
Median	5.50E-02		6.50E-02		5.54E-02
Standard Deviation	3.81E-02		2.53E-02		2.47E-02
Sample Range	4.73E-02 to 1.96E-01		5.10E-02 to 1.32E-01		4.38E-02 to 1.43E-01

“<” indicates MDA value. Bold indicates positive detection value.

D. SURVEY UNIT INVESTIGATIONS PERFORMED AND RESULTS

No investigations were required based on the direct sample results or the scan results.

E. SURVEY UNIT DATA ASSESSMENT

An analysis of the direct sample measurement results, including the mean, median, standard deviation and sample result range, are provided in Table 2. All direct measurement results were below the DCGL. Of the 14 soil samples collected, four identified Cs-137 below the DCGL of 4.2 pCi/g, and one sample identified Co-60 below the DCGL of 1.52 pCi/g. All other values were below 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 Co-60 and Cs-137. The average of the unitized values was 0.061 indicating that the direct measurements averaged 6.1% of the DCGL.

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 by subtracting the mean fallout Cs-137 $(0.19 \text{ pCi/g})^2$ for disturbed soil from the survey unit sample mean value (0.076 pCi/g) . This would equate to an annual dose rate of 0.0 mrem/yr. Taking into account the average residual contamination for Co-60, the annual dose rate would be 0.43 mrem/yr³. Also, for the purpose of demonstrating compliance with the radiological criteria for license termination and the enhanced State of Maine criteria, background activity was not subtracted from the sample analysis activity values.

F. ADDITIONAL DATA EVALUATION

Attachment 4 provides additional data evaluation associated with Survey Unit 4, 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. In addition, the sample standard deviation is smaller than the design sigma; therefore, no additional samples were required.

² See Attachment E to Maine Yankee Procedure 6.7.8 (Reference 2).

³ This annual dose is based on LTP Section 6.7, which shows the contaminated soil contribution (for soils contaminated at the DCGL) to be 10 mrem/y. Therefore, the annual Co-60 dose rate (using the Co-60 DCGL of 1.52 pCi/g outside the RA and the mean Co-60 direct activity value of 0.065 pCi/g) would equate

$$\text{to } \textit{Annual Dose Rate} = 10 \times \left(\frac{0.065}{1.52} \right) = 0.43 \textit{ mrem / y}$$

2. The Quantile Plot was generated from direct measurement data listed in Table 2 and indicates general symmetry about the median. The data set and plot are consistent with expectations for a Class 1 survey unit. All of the measurements are below the DCGLs of 4.2 pCi/g (Cs-137) and 1.52 pCi/g (Co-60) for land outside the Restricted Area.
3. A Histogram Plot was also developed based on the direct measurement values. This plot shows that the direct data were essentially a log-normal distribution with a single outlier.
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 small 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.

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

The survey was designed as a Class 1 area; the FSS results were consistent with that classification. The 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 4 was designed, performed, and evaluated in the May 2005-June 2005 time frame using the criteria of the LTP Revision 4 (Reference 1). No subsequent LTP changes with potential impact to this survey unit need to be evaluated.

I. CONCLUSION

The FSS of this survey unit was designed based on the designation as a Class 1 area. 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 1.52 Co-60 pCi/g and 4.2 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 one outlier, 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 4 (Reference 1) with significant aspects of the design discussed in Section B and Table 1. ISOCS scans performed at a height of 0.5 meter in a systematic grid pattern throughout the survey unit did not identify any areas exceeding the scan investigation levels. Therefore, no investigations were required.

It is concluded that FR-0900 Survey Unit 4 meets the release criteria of 10CFR20.1402 and the State of Maine enhanced criteria.

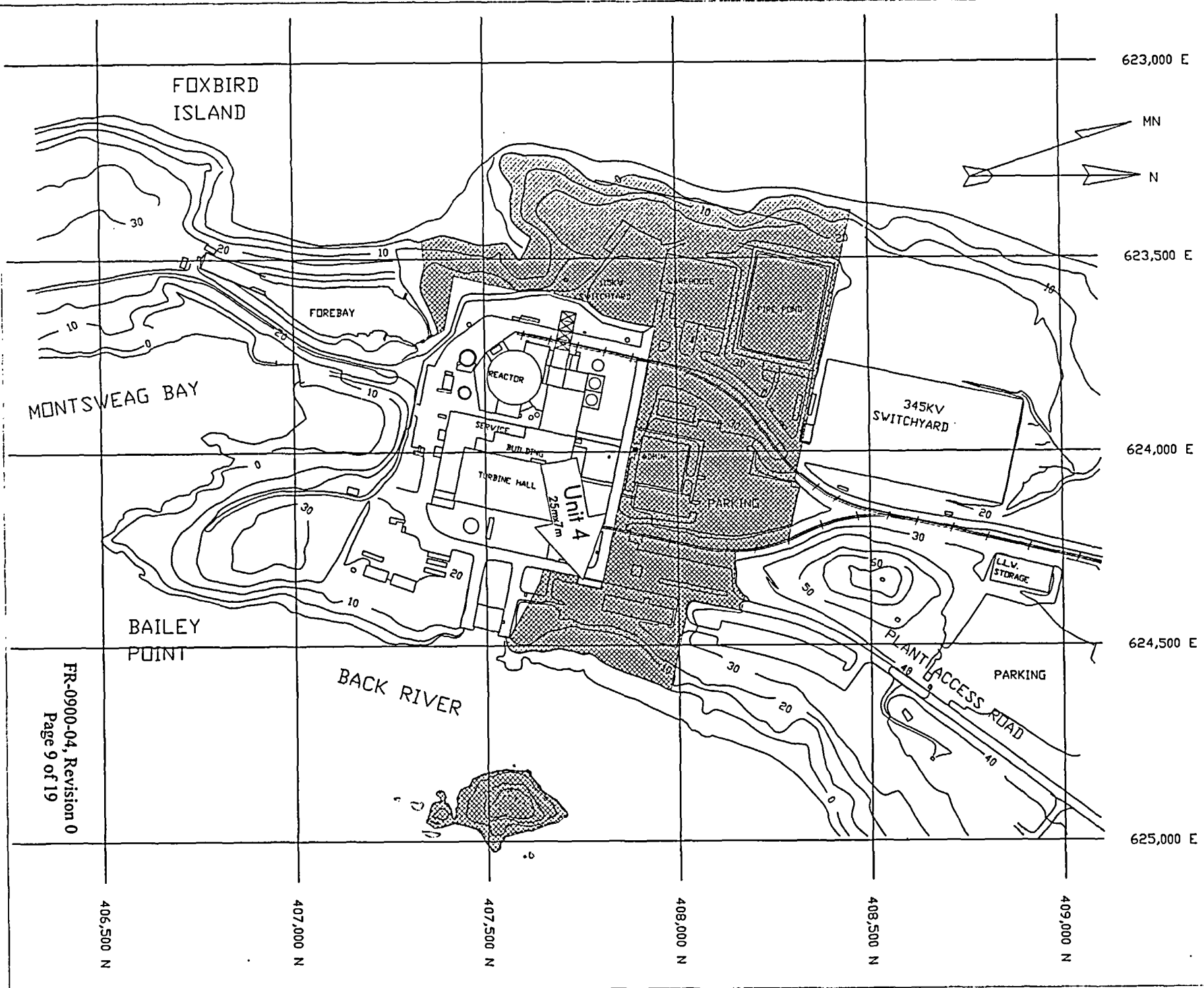
J. REFERENCES

1. Maine Yankee License Termination Plan, Revision 4, February 28, 2005 provided by Maine Yankee letter to the NRC, MN-05-010
2. Maine Yankee Procedure PMP 6.7.8, FSS Data Processing and Reporting, Attachment E, Approach for Dealing With Background Radioactivity for Maine Yankee Final Status Surveys
3. Maine Yankee Calculation No. EC-003-04, Use of Canberra In Situ Object Counting System (ISOCS) for FSS Surveys

Attachment 4

Statistical Data

Maine Yankee Decommissioning Project Survey Map



Survey Type: Characterization

Turnover

Final Status Survey

Survey Area Name:

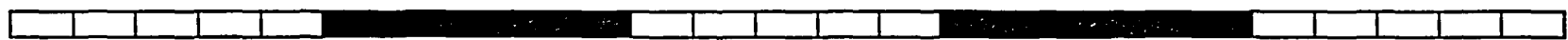
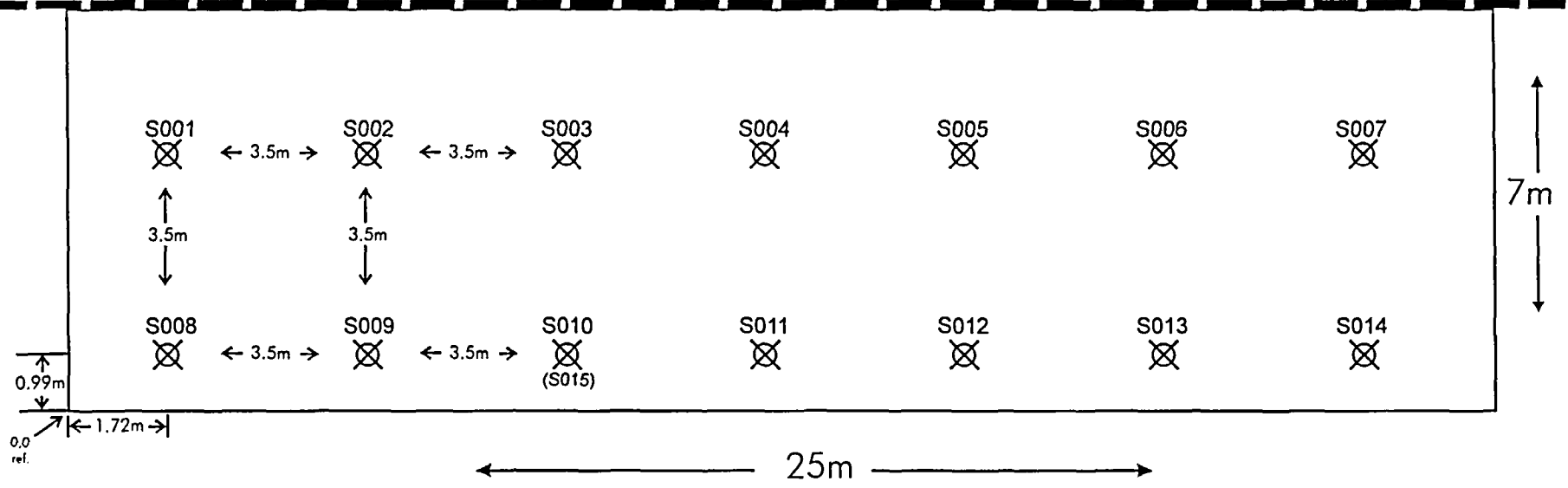
Direct Sample Locations

Prepared By: Larry N. Dockins Date: 5/25/05



-----ROADWAY-----

Fr2900 UNIT2 BOUNDARY



25m

Survey Type: Characterization

Turnover

Final Status Survey

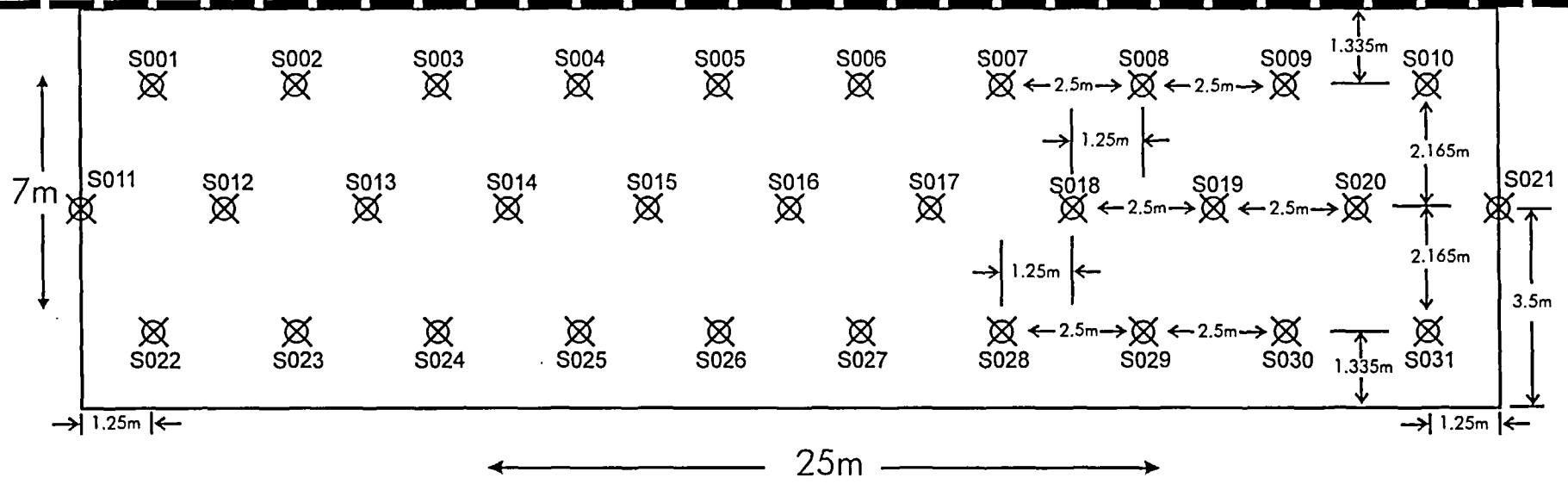
Survey Area Name: ISOCS Scan Locations

Prepared By: Larry N. Dockins Date: 5/25/05



-----ROADWAY-----

Fr2900 UNIT2 BOUNDARY



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0

25m

Attachment 2
Survey Unit Instrumentation

TABLE 2-1

INSTRUMENT INFORMATION

(Laboratory Sample Analysis)

Detector No.	MDC
FSS1	0.04 to 0.07 (pCi/g)
FSS2	0.04 to 0.08 (pCi/g)

ISOCS Detector (Field Measurements)

Detector No.	MDC
7605	0.06 to 0.13 pCi/g

TABLE 2-2

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

Parameter	Instrument: ISOCS	Comments
Scan MDC	0.06 to 0.08 pCi/g Co-60 0.06 to 0.13 pCi/g Cs-137	~ 6% of the DCGL
DCGL	1.52 pCi/g Co-60 4.2 pCi/g Cs-137	Approved DCGL for land areas outside the Restricted Area (Reference 1)
Investigation Level (ISOCS @ 0.5 m)	0.36 pCi/g Co-60 1.0 pCi/g Cs-137	Reference 3
Design DCGL _{EMC}	3.47 pCi/g Co-60 9.6 pCi/g Cs-137	DCGL x Area Factor for Class 1 survey unit, per LTP Section 5.6.3

Note 1: ISOCS Detector 7605 used for 180-degree open collimation at 50cm perpendicular from surface for a 19.6 m² field of view. Any positive detection of Co-60 was investigated.

Attachment 3

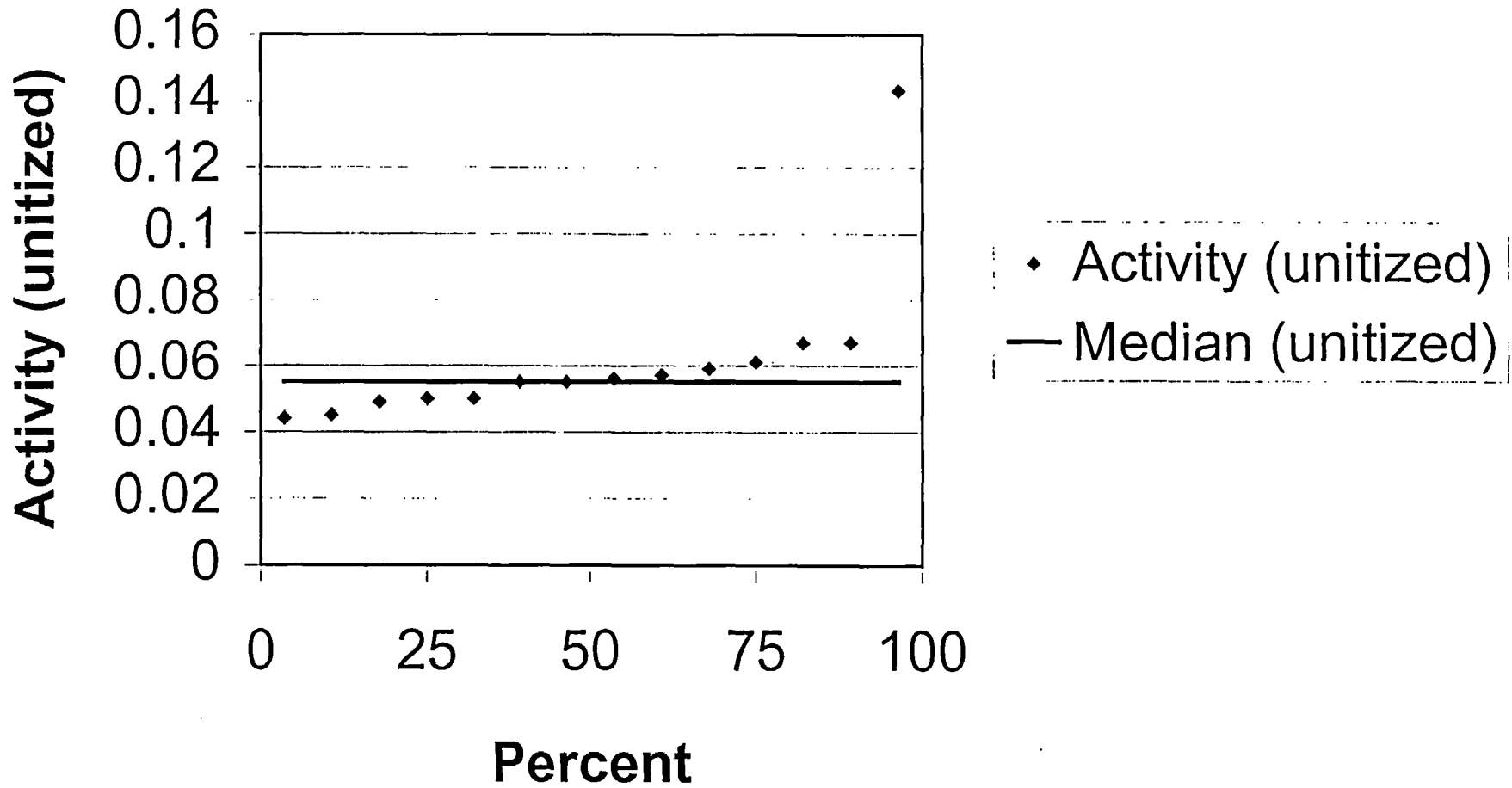
**Investigation Table
(None Required)**

Attachment 4
Statistical Data

Survey Package FR0900 Unit 4 UNITY Soil Sign Test Summary

Evaluation Input Values		Comments
Survey Package:	FR0900	
Survey Unit:	04	
Evaluator:	G. Madison	
DCGL _w :	1.00E+00	Unity
DCGL _{emc} :	2.30E+00	AF = 2.3
LBGR:	5.00E-01	
Sigma:	1.14E-01	(0.48 pCi/g /4.2 pCi/g)
Type I error:	0.05	
Type II error:	0.05	
Nuclide:	UNITY	
Soil Type:	N/A	
Calculated Values		Comments
Z _{1-α} :	1.645	
Z _{1-β} :	1.645	
Sign p:	0.99865	
Calculated Relative Shift:	4.3	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift is >3
N-Value:	11	
N-Value+20%:	14	
Sample Data Values		Comments
Number of Samples:	14	
Median:	5.54E-02	
Mean:	6.12E-02	
Net Sample Standard Deviation:	2.47E-02	
Total Standard Deviation:	2.47E-02	Sum of samples and reference
Maximum:	1.43E-01	
Sign Test Results		Comments
Adjusted N Value:	14	
S+ Value:	14	
Critical Value:	10	
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	Survey Unit Passes

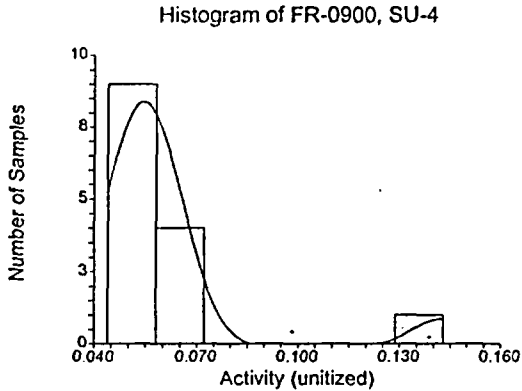
FR0900 SU-4 Quantile Plot



One-Sample T-Test Report

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Database
Variable C2

Plots Section



One-Sample T-Test Power Analysis

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Chart Section

