

MAINE YANKEE
FINAL STATUS SURVEY RELEASE RECORD
FR-0111 YARD WEST EXCAVATIONS
SURVEY UNIT 2

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A. SURVEY UNIT DESCRIPTION

FR 0111 Yard West Excavations Survey Unit 2 consisted of a 32-ft. diameter excavation that was created following the discovery of potentially elevated sub-surface soil activity during characterization activities within the Restricted Area back yard. The excavation was centered at coordinates 407,837 N and 623,930 E using Maine State Coordinate System (West Zone) NAD 1927 and lay northeast of the former Primary Auxiliary Building (PAB). The location of the 114.5 m² survey unit in relation to the former Containment Building and the surrounding FR 0111 survey units is shown on map FR0111 U2-01 (Attachment 1).

During characterization activities, several locations within the Restricted Area back yard were identified as potentially containing plant-derived activity greater than the DCGL. One of the locations (S042 as identified in Characterization Package CR 5000) required extensive excavation, resulting in a large hole with an area of 114.5 m² and an average diameter of 9.75 meters (32 ft). The excavation was slightly elongated and notched around a storm drain manway with vertical walls approximately 1.2 meters (4 ft.) deep. An abandoned concrete duct bank was also discovered during soil removal. The duct bank was approximately 2-ft. 6-in. below grade and penetrated through and across the north edge of the survey unit. The exposed duct bank was surveyed as part of the survey unit direct points.

B. SURVEY UNIT DESIGN INFORMATION

Survey Unit 2 met the LTP Revision 3 definition for a Class 1 survey unit. The survey unit design parameters are shown in Table 1. Given an adjusted relative shift of 1.5, it was determined that 18 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 map FR0111U2-03, Direct - Volumetrics (Attachment 1). Direct measurements consisting of soil samples or concrete samples (taken from direct locations on the abandoned concrete duct bank) were collected from required locations and analyzed with laboratory gamma spectroscopy instrumentation.

In accordance with the LTP, scans covering 100% of the 114.5 m² area were required for the Class 1 survey unit. This was accomplished by use of an *in situ* gamma spectroscopy detector positioned at the surface plane of the excavation using a well geometry to perform the scans (approximate field of view of 100 m² at 2 m height). This scan survey ensured there were no unevaluated areas exceeding the DCGL_{EMC} limit. Locations of the Unit 2 survey scans are shown on map FR0111U2-02.

The survey instruments used 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 the 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. Further, 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	114.5 m ²	Class 1, < 2,000 m ²
Number of Direct Measurements Required	18 ¹	Based on an adjusted LBGR of 0.275 pCi/g, sigma ² of 1.33 pCi/g, and a relative shift of 1.5. Type I = Type II = 0.05
Sample Area	6.36 m ²	114.5 m ² / 18 = 6.36 m ²
Sample Grid Spacing	2.52 m	(6.36) ^{1/2}
Scan Grid Area	ISOCS scan at 2 m (8 m diameter hole) for 100 m ² field of view	
Area Factor	3.1	Class 1 Area, LTP Table 6-12
Scan Area	114.5 m ²	Class 1 Area – 100%
Scan Investigation Level	3.70 pCi/g Cs-137	ISOCS investigation level set at 50% of DCGL _{EMC}
DCGL	2.39 pCi/g Cs-137	LTP Revision 3, Table 6-11 (Reference 4)
Design DCGL _{EMC}	7.40 pCi/g Cs-137	DCGL x Area Factor for Class 1 survey unit, per LTP Section 5.6.3

C. SURVEY RESULTS

As required, a total of 18 direct measurements were performed in Survey Unit 2. All direct measurements were below the DCGL. The results are presented in Table 2.

ISOCS gamma scans were performed at two locations using an investigation level of 3.70 pCi/g Cs-137 (50% of DCGL_{EMC}). Data was subsequently evaluated to 0.5 pCi/g (< DCGL). The gamma scans were performed for a sufficient count time to achieve a Minimum Detectable Activity of approximately 10% of the DCGL. All identified activity levels were below the investigation levels (i.e., < MDA). Therefore, no investigations were required.

¹ This survey unit was initially designed for N=40 samples. The design LBGR was developed by dividing the excavation area (A_e) by the maximum Class 1 area (A₁) and applying a correction factor of 2 to determine the LBGR as a percentage of the DCGL.

² LTP Revision 3, Table 5-1C for RCA Yard West, R0100.

TABLE 2

DIRECT MEASUREMENTS

Sample Number	Cs-137 (pCi/g)
FR0111021S001	< 2.22E-02
FR0111021S002	< 2.11E-02
FR0111021S003	< 2.48E-02
FR0111021S004	< 2.27E-02
FR0111021S005	< 2.53E-02
FR0111021S006	< 2.08E-02
FR0111021S007	< 2.50E-02
FR0111021S008	< 2.49E-02
FR0111021S009	< 2.13E-02
FR0111021S010	< 2.91E-02
FR0111021S011	< 2.28E-02
FR0111021S012	< 2.42E-02
FR0111021S013	< 2.21E-02
FR0111021S014	< 2.39E-02
FR0111021S015 Concrete	< 1.14E-01
FR0111021S016 Concrete	< 1.25E-01
FR0111021S017 Concrete	< 9.94E-02
FR0111021S018	< 2.11E-02
Mean	3.83E-02
Median	2.41E-02
Standard Deviation	3.46E-02
Range	2.08E-02 to 1.25E-01

“<” indicates MDA value. Samples were also analyzed for Co-60. All were less than MDA.

D. SURVEY UNIT INVESTIGATIONS PERFORMED 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. Cs-137 and Co-60 were not present above the MDA in any of the 18 soil samples collected.

As noted in Table 1, the initial survey design required 40 samples with a density of 1 sample/2.9 m². Due to the expected levels of contamination, 40 samples was deemed excessive and the LBGR was lowered to raise the relative shift. As shown in Table 2, the actual survey unit mean is much less than the design LBGR. In addition, the final standard deviation was much less than the design sigma. Thus, the design relative shift remains valid, indicating a sufficient number of samples were taken.

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 value (0.19 pCi/g)³ for disturbed soil from the survey unit sample mean activity (0.0383 pCi/g). This would equate to an annual dose rate of 0.0 mrem/year⁴. However, for purposes of demonstrating compliance with the radiological criteria for license termination and the enhanced State criteria, background activity was not subtracted from the soil 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 See Attachment E to Maine Yankee Procedure PMP 6.7.8 (Reference 5).

⁴ This annual dose equivalent is based on LTP Table 6-11 which shows the RA contaminated soil contribution (for soils contaminated at the DCGL) to be 5.63 mrem/y. Therefore, the annual dose rate would equate to

$$\text{Annual Dose Rate} = 5.63 \times \left(\frac{0.0383 - 0.19}{2.39} \right) = 0.0 \text{ mrem / y}$$

3. A Histogram Plot was also developed based on the unity values. This plot shows a distribution skewed by the three concrete measurements.
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 land survey 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 and no additional measurements were required.

H. LTP CHANGES SUBSEQUENT TO SURVEY UNIT FSS

The FSS of Survey Unit 2 was designed, performed and evaluated in March 2004. The design was performed to the criteria of the LTP Revision 3 (References 3 and 4). 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 LTP 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 DCGL of 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 skewed distribution with three outliers.

The scan survey design for this survey unit was developed in accordance with the LTP Revision 3 Addenda (Reference 1) with significant aspects of the design discussed in Section B and Table 1. ISOCS scans performed using a well geometry did not identify activity above the scan investigation level of 0.5 pCi/g Cs-137 (< DCGL).

It is concluded that FR 0111 Survey Unit 2 meets the release criteria of 10CFR20.1402 and the State of Maine enhanced criteria.

J. REFERENCES

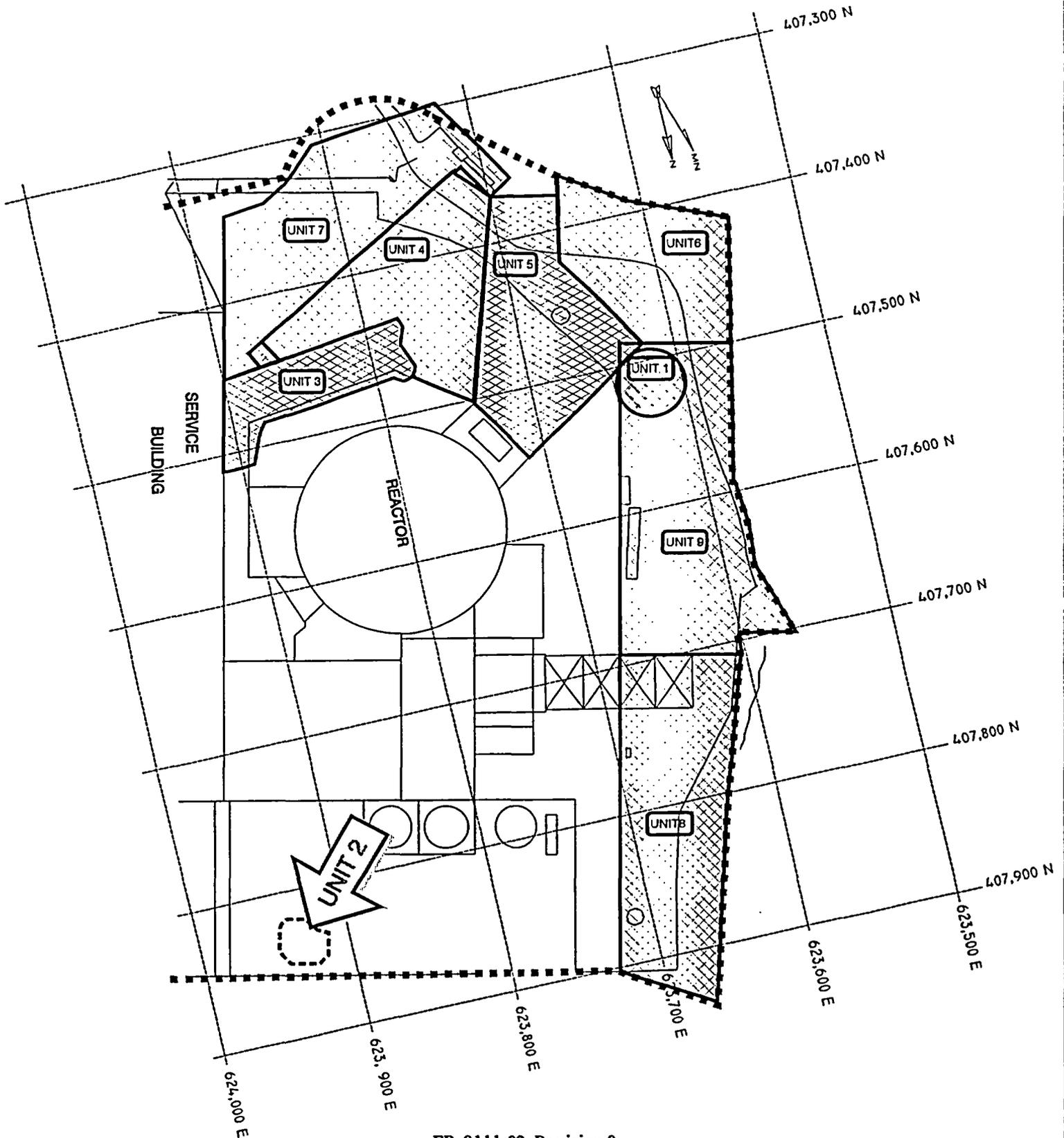
1. Maine Yankee License Termination Plan, Revision 3, October 15, 2002 and Addenda provided by Maine Yankee letter to the NRC, MN-02-061, dated November 26, 2002
2. NRC letter to Maine Yankee, dated February 28, 2003
3. Maine Yankee letter to the NRC, MN-03-049, dated September 11, 2003 (LTP Supplement to LTP Revision 3)
4. Issuance of License Amendment No. 170, NRC letter to Maine Yankee, dated February 18, 2004
5. Maine Yankee Procedure PMP 6.7.8, FSS Data Processing and Reporting, Attachment E, Approach for Dealing With Background Radioactivity for Maine Yankee Final Status Surveys

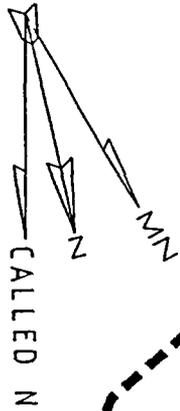
Attachment 1
Survey Unit Maps

Survey Type: Characterization Turnover Final Status Survey

Survey Area Name: Site Locator

Prepared By: Larry N. Dockins Date: 12/13/04





Storm Drain Manway Cover



10 ft.

10 ft.

S019

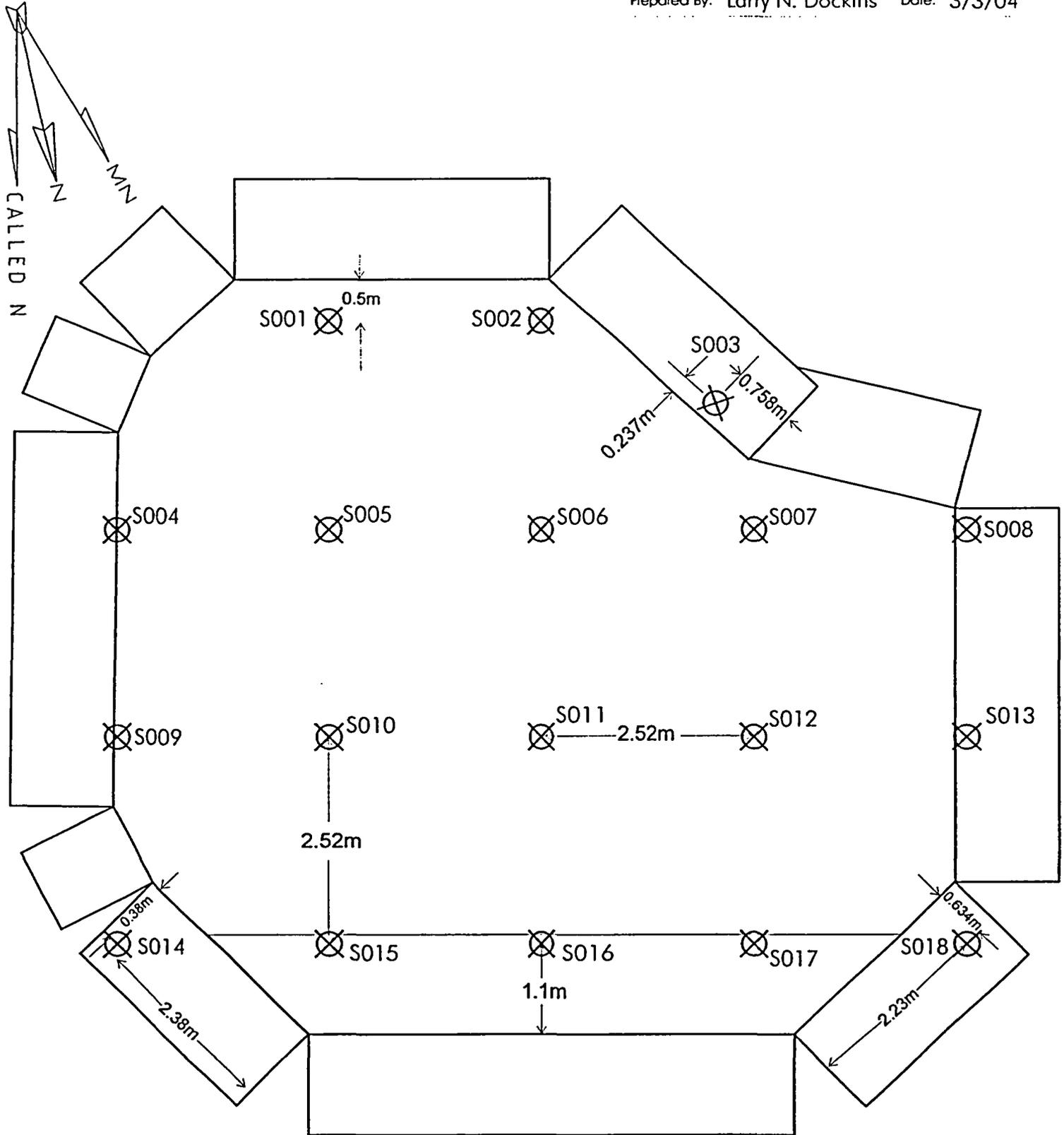
S020

10 ft.

10 ft.

Abandoned
Construction Phase
Duct Bank
(2' 6" below grade)





Attachment 2
Survey Unit Instrumentation

TABLE 2-1

INSTRUMENT INFORMATION

ISOCS Detectors (Field Measurements)

Detector Number	MDC (pCi/g)
7722	0.1 to 0.2

HPGe Detectors (Laboratory Analysis)

Detector Number	MDC (pCi/g)
FSS1	0.02 to 0.03
FSS2	0.02 to 0.03
DET3	0.10 to 0.15

TABLE 2-2

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

Detector	Instrument	Comments
Scan MDC	ISOCS: 0.1 to 0.2 pCi/g	~ 10% DCGL
DCGL	2.39 pCi/g Cs-137 0.86 pCi/g Co-60	Approved DCGL for land areas inside the Restricted Area, (Reference 4)
Investigation Level (ISOCS well geometry @ 2 m)	0.5 pCi/g Cs-137	< DCGL
Design DCGL _{EMC}	7.40 pCi/g Cs-137 2.67 pCi/g Co-60	DCGL x Area Factor for Class 1 survey unit, per LTP Section 5.6.3

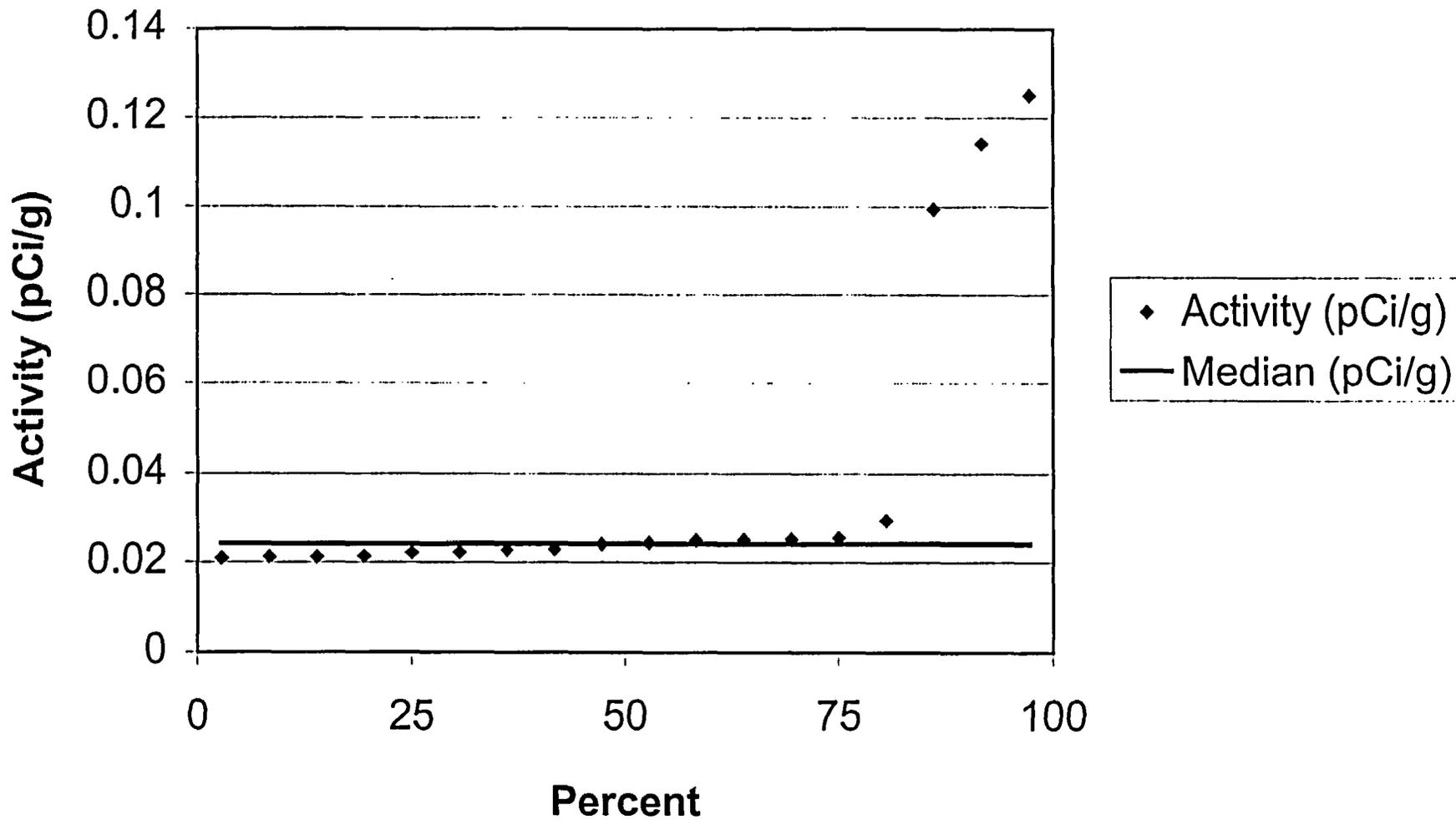
Attachment 3
Investigation Table
(No Investigations Performed)

Attachment 4
Statistical Data

Survey Package FR 0111 Unit 2 Soil Sign Test Summary

Evaluation Input Values		Comments
Survey Package:	FR 0111	
Survey Unit:	02	
Evaluator:	DA	
DCGL _w :	2.39E+00	
DCGL _{emc} :	7.40E+00	
LBGR:	2.75E-01	
Sigma:	1.33E+00	
Type I error:	0.05	
Type II error:	0.05	
Nuclide:	CS-137	
Soil Type:	N/A	
Calculated Values		Comments
Z _{1-α} :	1.645	
Z _{1-β} :	1.645	
Sign p:	0.933193	
Calculated Relative Shift:	1.5	
Relative Shift Used:	1.5	Uses 3.0 if Relative Shift is >3
N-Value:	15	
N-Value+20%:	18	
Sample Data Values		Comments
Number of Samples:	18	
Median:	2.41E-02	
Mean:	3.83E-02	
Net Sample Standard Deviation:	3.46E-02	
Total Standard Deviation:	3.46E-02	
Maximum:	1.25E-01	
Sign Test Results		Comments
Adjusted N Value:	18	
S+ Value:	18	
Critical Value:	12	
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	

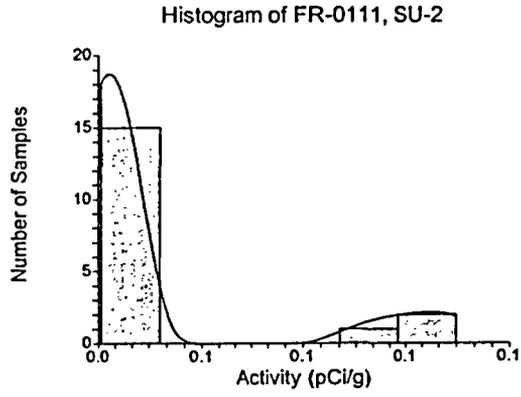
FR-0111 SU-2 Quantile Plot



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

