MAINE YANKEE
FINAL STATUS SURVEY RELEASE RECORD
FR-0111 YARD WEST EXCAVATIONS
SURVEY UNIT 1

Prepared By:	D. Anderson **FSS Engineer** - Signature D. ANDERSON Printed Name	Date: 12/14/04
Reviewed By:	Larry Dockins **FSS Specialist** - Signature Larry Dockins Printed Name	Date: 12/14/04
Reviewed By:	**Independent Review** - Signature W J Gowar Printed Name	Date: 12/17/04
Approved By:	**Superintendent, FSS** - Signature George Tolbery Printed Name	Date: 12/17/04
Approved By:	**FSS, MOP** - Signature James R. Pocker Printed Name	Date: 12/19/04

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A. SURVEY UNIT DESCRIPTION

At the time Survey Unit 1 of FR 0111 Yard West Excavations Survey Area was initiated, several locations within the Restricted Area back yard had been identified as containing plant-derived activity greater than the DCGL. Due to the extensive characterization survey performed on the Restricted Area soils, remediation efforts were ongoing and in a state of continuous flux. FR 0111 became the all encompassing designator for excavations performed within the Restricted Area. Removal of the storm drain system, other buried piping and component concrete foundations contributed to the size of the excavations. Survey Unit 1 encompassed the first excavation to be completed and prepped for final survey in the February 2004 time frame.

FR 0111 Yard West Excavations Survey Unit 1 consisted of a large excavation located southwest of the Containment Building equipment hatch and adjacent to the northwest boundary of FR-0111 Survey Unit 5. The survey unit was centered at coordinates 407,516 N and 623,621 E using Maine State Coordinate System (West Zone) NAD 1927. The post-remediation surface area of the excavation encompassed 212.6 m^2, with an approximate diameter of 15 meters. The location of Survey Unit 1 in relation to the former Containment Building and the surrounding FR 0111 survey units is shown on map FR0111-01 (Attachment 1).

Survey Unit 1 excavation resembled a large crater, with the outer perimeter walls sloping down to a relatively flat base that averaged 10 meters in diameter and 1.8 meters (6 ft.) to 2.4 meters (8 ft.) in depth. The excavation was created as a result of the removal of contaminated sub-surface soil at location S095 as identified in Characterization Survey Package CR5000.

B. SURVEY UNIT DESIGN INFORMATION

Survey Unit 1 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 1.4, it was determined that 20 direct measurements were required for the Sign Test. Because the measurement locations were based on a systematic square grid with a random start point, the N=20 design led to a survey unit map with 21 locations. The direct point locations are illustrated on map FR0111-03, Direct - Volumetrics (Attachment 1). Direct measurements consisting of soil samples were collected from required locations and analyzed with laboratory gamma spectroscopy instrumentation.

In accordance with the LTP, scans covering 100% of the 212.6 m^2 area were required for the Class 1 survey unit. This was accomplished by use of an *in situ* gamma spectroscopy detector configured at a 4-meter distance from the surface to obtain overlapping 50-m^2 fields of view. At scan location S022, the detector was positioned 4 meters above the surface using the 90° collimator while the remaining locations were scanned with the detector 4 meters above the surface plane. This scan survey ensured there were no unevaluated areas exceeding the $DCGL_{EMC}$ limit. Locations of the 7 survey scans are shown on map FR0111-02, Scans – ISOCS (Attachment 1).

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	212.6 m^2	Class 1, < 2000 m^2
Number of Direct Measurements Required	20	Based on an adjusted LBGR of 0.48 pCi/g, sigma[1] of 1.33 pCi/g, and a relative shift of 1.4. Type I = Type II = 0.05
Sample Area	10.63 m^2	213 m^2 / 20 = 10.63 m^2
Sample Grid Spacing	3.26 m	$(10.63)^{1/2}$
Scan Grid Area	ISOCS scan at 4 m for 50-m^2 field of view	
Area Factor	2.5	Class 1 Area, LTP Table 6-12
Scan Area	212.6 m^2	Class 1 Area – 100%
Scan Investigation Level	2.99 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 $DCGL_{EMC}$	5.98 pCi/g Cs-137	DCGL x Area Factor for Class 1 survey unit, per LTP Section 5.6.3

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

C. SURVEY RESULTS

A total of 21 direct measurements were performed in Survey Unit 1. One of the direct points was above the DCGL, but less than 50% of the $DCGL_{EMC}$ (S008 was 2.72 pCi/g Cs-137). The results are presented in Table 2. The elevated measurement was evaluated in Section E and included in Table 3-1 (Attachment 3).

ISOCS gamma scans were performed at 7 locations using an investigation level of 2.99 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 20% of the DCGL. All identified activity levels were below the investigation levels. Therefore, no scan investigations were required.

TABLE 2

DIRECT MEASUREMENTS

Sample Number	Cs-137 (pCi/g)	Uncertainty (pCi/g)	Co-60 (pCi/g)	Uncertainty (pCi/g)	Unitized Value of Unity Rule
FR0111011S001	< 2.42E-02		< 2.49E-02		3.91E-02
FR0111011S002	1.40E-01	1.84E-02	< 2.23E-02		8.47E-02
FR0111011S003	2.41E-01	2.61E-02	< 2.49E-02		1.30E-01
FR0111011S004	< 1.57E-02		< 2.28E-02		3.31E-02
FR0111011S005	4.23E-02	2.20E-02	< 2.47E-02		4.64E-02
FR0111011S006	1.28E-01	1.61E-02	< 3.55E-02		9.50E-02
FR0111011S007	6.93E-02	1.86E-02	< 2.82E-02		6.18E-02
FR0111011S008	2.72E+00	1.68E-01	5.87E-02	1.36E-02	1.21E+00
FR0111011S009	< 2.38E-02		< 2.35E-02		3.73E-02
FR0111011S010	< 3.22E-02		< 3.23E-02		5.10E-02
FR0111011S011	4.94E-02	2.87E-02	< 3.70E-02		6.37E-02
FR0111011S012	3.63E-02	4.01E-02	< 3.41E-02		5.49E-02
FR0111011S013	4.34E-01	3.83E-02	< 3.18E-02		2.18E-01
FR0111011S014	2.33E-02	1.09E-02	< 2.67E-02		4.08E-02
FR0111011S015	< 3.09E-02		< 2.99E-02		4.77E-02
FR0111011S016	< 4.13E-02		< 4.15E-02		6.55E-02
FR0111011S017	8.72E-02	1.24E-02	< 2.98E-02		7.12E-02
FR0111011S018	5.53E-01	4.57E-02	< 2.33E-02		2.59E-01
FR0111011S019	3.74E-01	5.21E-02	3.49E-02	1.66E-02	1.97E-01
FR0111011S020	1.72E-01	2.36E-02	3.91E-02	1.45E-02	1.17E-01
FR0111011S021	4.48E-01	3.65E-02	< 3.22E-02		2.25E-01
Mean	**2.71E-01**		**3.13E-02**		**1.50E-01**
Median	**6.93E-02**		**2.99E-02**		**6.55E-02**
Standard Deviation	**5.85E-01**		**8.45E-03**		**2.52E-01**
Range	**1.57E-02 to 2.72E+00**		**2.23E-02 to 5.87E-02**		**3.31E-02 to 1.21E+00**

"<" indicates MDA value.

It should be noted that the Co-60 DCGL of 0.86 pCi/g is an "adjusted DCGL" and can be derived from the unitized dose for surface soil, LTP Table 6-7 and the updated dose model in the activated concrete related license amendment (References 3 and 4). The Co-60 DCGL for surface soil is 1 pCi/g x 10/6.58 mrem/y (from LTP Table 6-7) or 1.52 pCi/g Co-60. This DCGL is further limited by the dose contribution allowed for surface soil only in the basement fill model per LTP Section 6 Attachment IX (revised LTP Table 6-11) in the activated concrete license amendment. Thus, the Co-60 adjusted DCGL is 1.52 pCi/g x 5.63/10 mrem/yr or 0.86 pCi/g.

D. SURVEY UNIT INVESTIGATIONS PERFORMED AND RESULTS

Based on the scan results, no investigations were required. However, one direct sample exceeded the DCGL and is included in Table 3-1.

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 21 soil samples collected, 14 identified Cs-137 activity below the DCGL value of 2.39 pCi/g, 1 identified Cs-137 activity above the DCGL but below the $DCGL_{EMC}$ value of 5.98 pCi/g, and 3 samples identified Co-60 activity below the DCGL value of 0.86 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 both Co-60 and Cs-137. The average of the DCGL unity fractions was 0.150 and the maximum unity fraction was 1.21 times the DCGL. The Elevated Measurement Comparison unity test conservatively includes the one direct sample that was in a grid that was not investigated. The EMC test was 54% of unity, passing the EMC test. The sample standard deviation was smaller than the design sigma; therefore, no additional measurements were needed.

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)[2] for disturbed soil from the survey unit sample mean activity (0.271 pCi/g). Taking into account the average residual contamination level for Co-60, the annual dose rate would equate to 0.40 mrem/year[3]. 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.

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[2] See Attachment E to Maine Yankee Procedure PMP 6.7.8 (Reference 5).

[3] 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:

$$Annual\ Dose\ Rate = 5.63x\left(\frac{0.271 - 0.19}{2.39} + \frac{.0313}{0.86}\right) = 0.40\,mrem/y$$

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. All of the key criteria were found acceptable except one value exceeded the DCGL. This value was evaluated and found acceptable. The sample standard deviation is smaller than the design sigma; therefore, no additional measurements are required.

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. Only one measurement exceeds the DCGL value of 2.39 pCi/g and all of the measurements are well below the $DCGL_{EMC}$ of 5.98 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 one 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 land survey area; the FSS results were consistent with that classification. The direct measurement sample standard deviation was less than the design sigma so no additional measurements were required.

H. LTP CHANGES SUBSEQUENT TO SURVEY UNIT FSS

The FSS of Survey Unit 1 was designed, performed and evaluated in early 2004. The design was performed to the criteria of the LTP Revision 3 (References 2 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 design $DCGL_{EMC}$ of 5.98 pCi/g Cs-137. The survey unit mean is less than the DCGL.

A Sign Test Summary analysis demonstrated that the Sign Test criteria were satisfied. The direct measurement sigma was less than the design sigma; therefore, no additional measurements were required.

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.

The scan survey design for this survey unit was developed in accordance with the LTP Revision 3 Addenda (References 2 and 4) with significant aspects of the design discussed in Section B and Table 1. ISOCS scans did not identify activity above the scan investigation level of 0.5 pCi/g Cs-137 (< DCGL). Thus, no investigations were warranted.

It is concluded that FR 0111 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 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

Maine Yankee Decommissioning Team

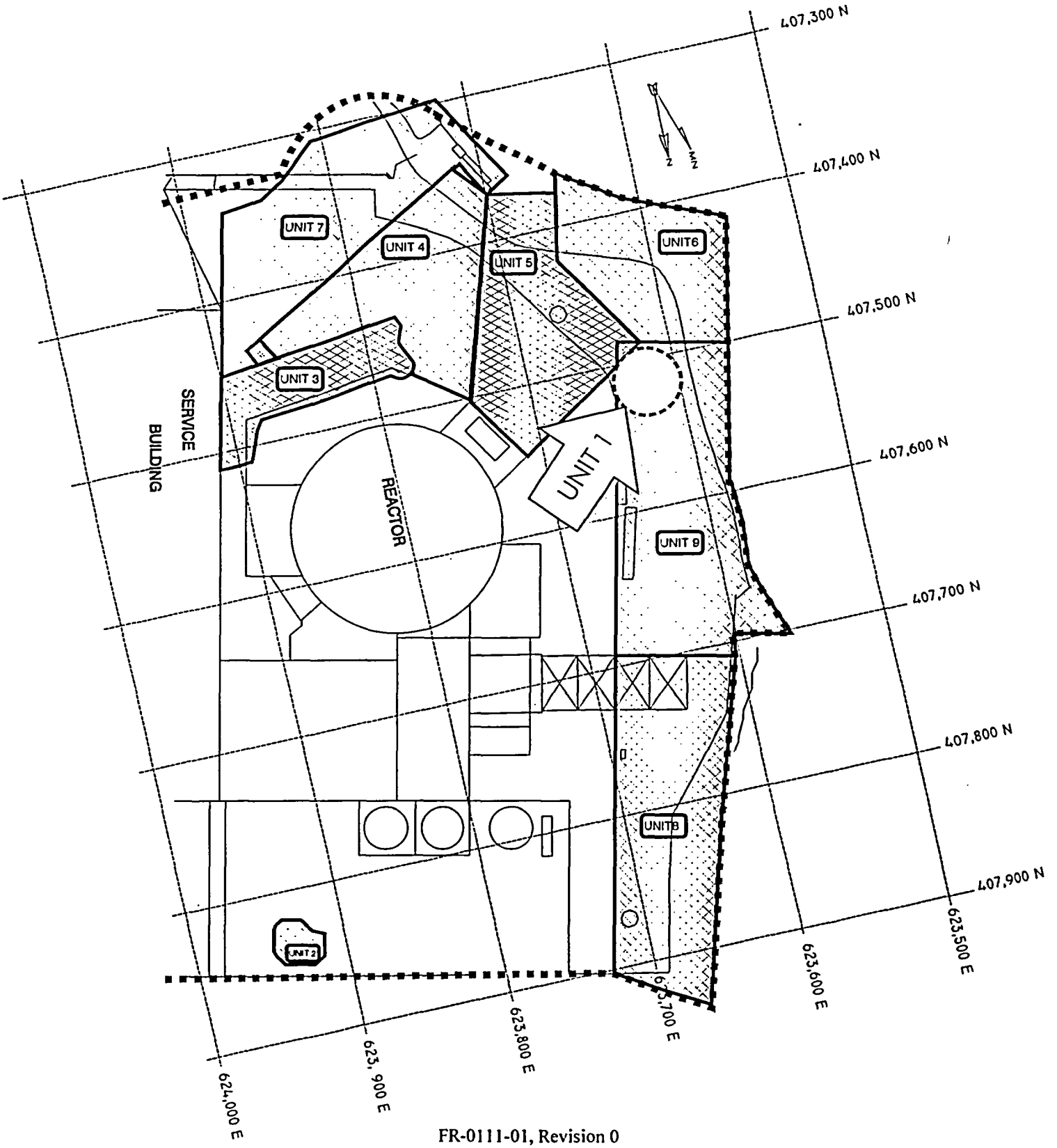
Maine Yankee Decommissioning Project Survey Map

Map ID# FR0111-01

Survey Type: Characterization Turnover ■ Final Status Survey

Survey Area Name: SUB-SURFACE EXCAVATION AREA 1 (Site Location)

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



Maine Yankee Decommissioning Team

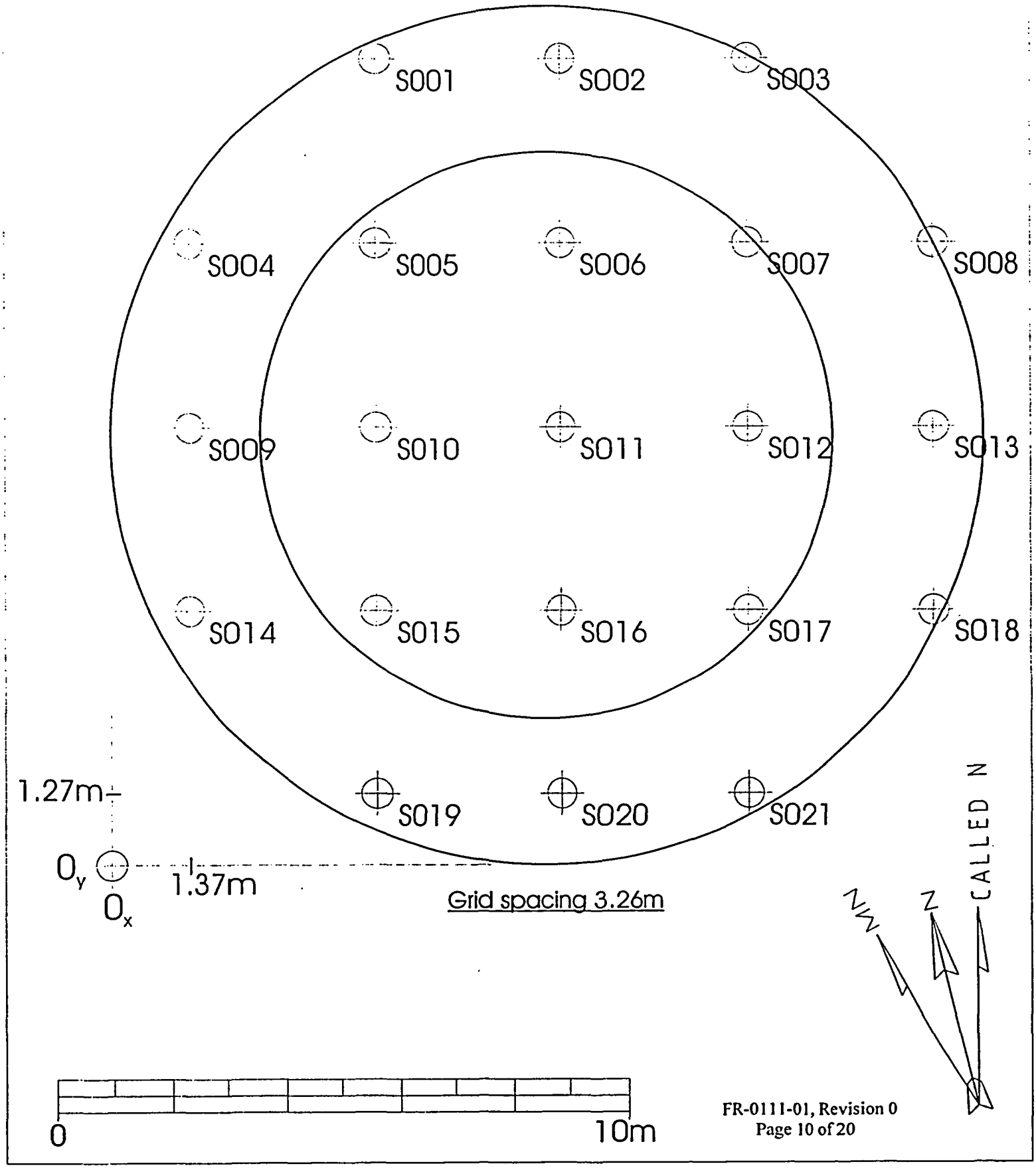
Maine Yankee Decommissioning Project Survey Map

Map ID# FR0111-03

Survey Type: Characterization Turnover ■ Final Status Survey

Survey Area Name: Direct - Volumetrics

Prepared By: Larry N. Dockins Date: 2/19/04



Maine Yankee
Decommissioning Team

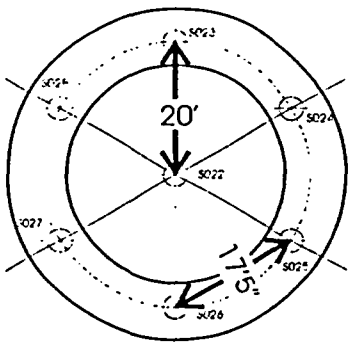
Maine Yankee Decommissioning Project Survey Map

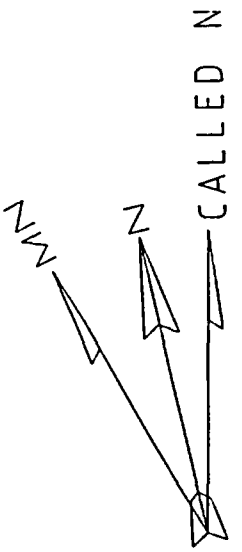
Map ID# FR0111-02

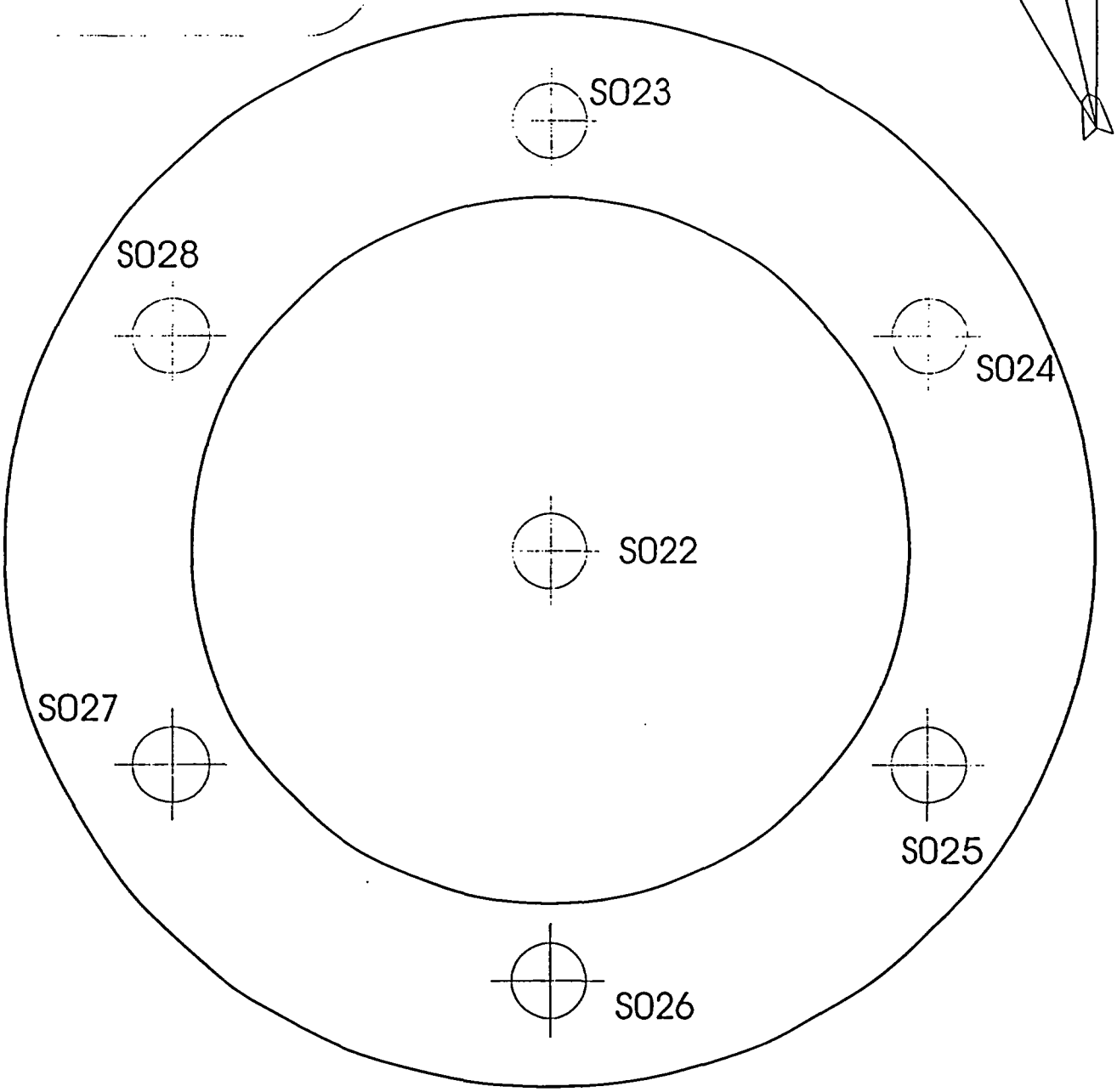
Survey Type: Characterization Turnover ■ Final Status Survey

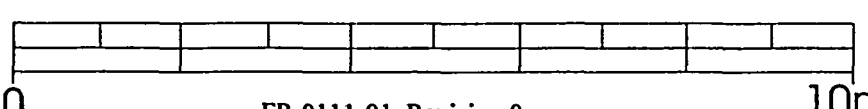
Survey Area Name: Scans - ISOCS

Prepared By: Larry N. Dockins Date: 2/19/04









Attachment 2

Survey Unit Instrumentation

TABLE 2-1

INSTRUMENT INFORMATION

ISOCS Detectors (Field Measurements)

Detector Number	MDC (pCi/g)
7607	0.2 to 0.5

HPGe Detectors (Laboratory Analysis)

Detector Number	MDC (pCi/g)
FSS1	0.02 to 0.11
FSS2	0.02 to 0.11

TABLE 2-2

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

Detector	Instrument	Comments
Scan MDC	ISOCS: 0.2 to 0.5 pCi/g	~ 20% 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 @ 4 m)	0.5 pCi/g Cs-137	< DCGL
Design $DCGL_{EMC}$	5.98 pCi/g Cs-137 2.15 pCi/g Co-60	DCGL x Area Factor for Class 1 survey unit, per LTP Section 5.6.3

Attachment 3

Investigation Table

TABLE 3-1

INVESTIGATION TABLE

INITIAL SURVEY			INVESTIGATION RESULTS							
Scan Grid[4]	Investigation Setpoint pCi/g	Scan Value pCi/g	Max Scan Value	Elevated Area m^2	Area Factor	$DCGL_{EMC}$ Unity AF	Sample Number	Cs-137 pCi/g	Co-60 pCi/g	$DCGL_{EMC}$ [5] Unity
S024	0.5	4.33E-01	N/A	10.63	2.5	2.5	FR0111011S008	2.72E+00	5.87E-02	0.440
							Unit Mean	1.48E-01	3.00E-02	0.096
									EMC Unity Sum	0.540

[4] S008 is the value from the direct sampling, included because the direct value was > DCGL but there was no alarm in the grid.

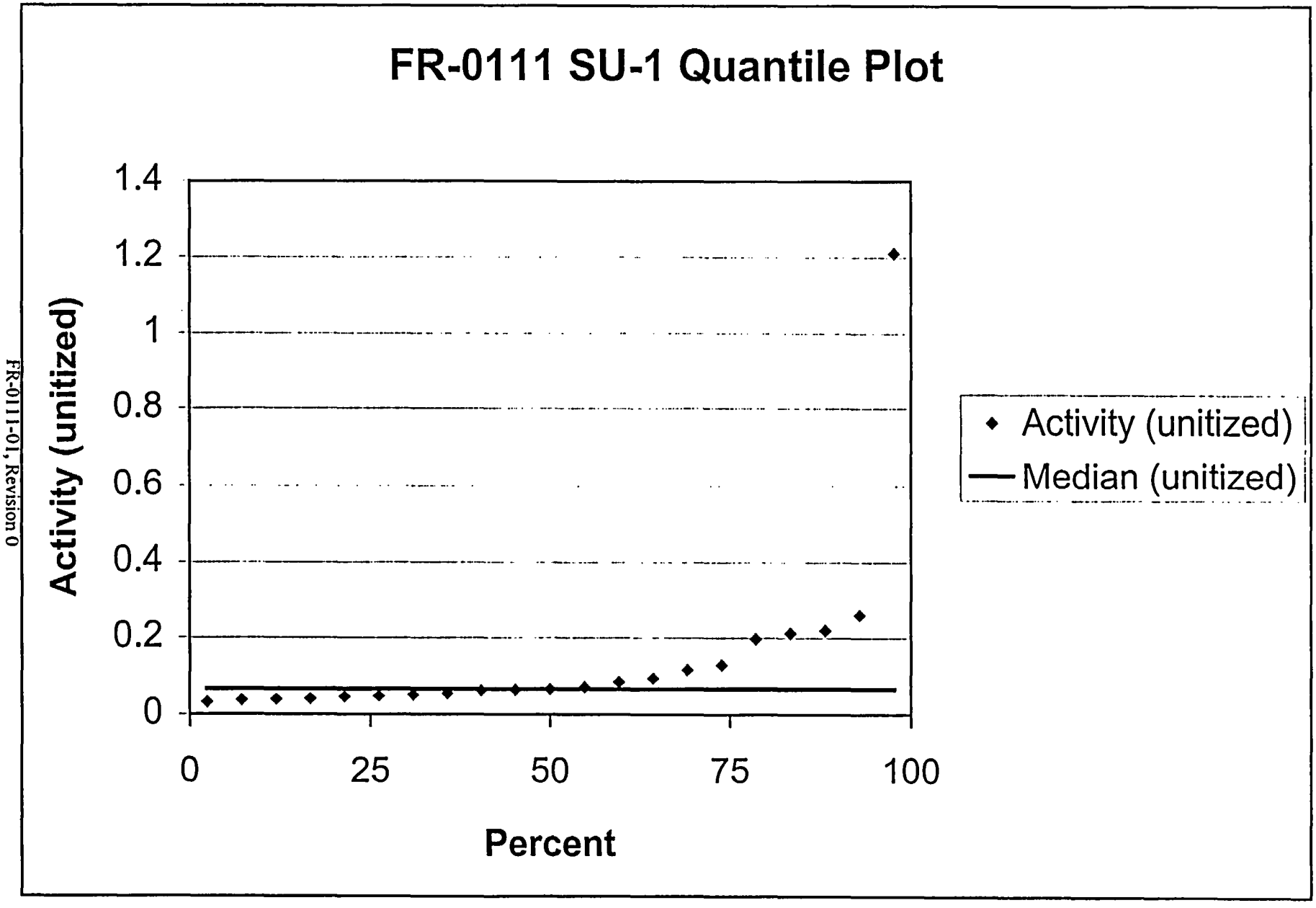
[5] The $DCGL_{EMC}$ unity value was calculated by subtracting the survey unit mean from the sample results. The survey unit mean was calculated using the data shown in Table 2, except that the results for S008 were excluded.

Attachment 4

Statistical Data

Survey Package FR 0111 Unit 1 Soil Sign Test Summary

Evaluation Input Values		Comments
Survey Package:	FR 0111	Yard West Excavations
Survey Unit:	01	
Evaluator:	DA	
$DCGL_w$:	1.00E+00	Unity
$DCGL_{emc}$:	2.50E+00	AF x Unity
LBGR:	2.00E-01	20% of DCGL
Sigma:	5.56E-01	Unitized (1.33 pCi/g / 2.39 pCi/g)
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:	0.919243	
Calculated Relative Shift:	1.4	
Relative Shift Used:	1.4	Uses 3.0 if Relative Shift is >3
N-Value:	16	
N-Value+20%:	20	
Sample Data Values		**Comments**
Number of Samples:	21	
Median:	6.55E-02	
Mean:	1.50E-01	
Net Sample Standard Deviation:	2.52E-01	
Total Standard Deviation:	2.52E-01	
Maximum:	1.21E+00	
Sign Test Results		**Comments**
Adjusted N Value:	21	
S+ Value:	20	
Critical Value:	14	
Sign test results:	Pass	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_w$:	Investigate	See Section E of Release Record
Median value <$DCGL_w$:	Pass	
Mean value <$DCGL_w$:	Pass	
Maximum value <$DCGL_{emc}$:	Pass	
Total Standard Deviation <=Sigma:	Pass	
Criteria comparison results:	Investigate	See Section I of Release Record
Final Status		**Comments**
The survey unit passes all conditions:	Investigate	Survey Unit Passes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0.8
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75
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Percent
Activity (unitized)
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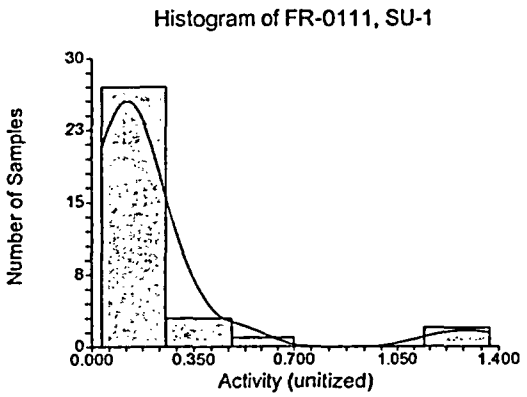

Chart Section