MAINE YANKEE
FINAL STATUS SURVEY RELEASE RECORD
FR-0110 PAB ALLEYWAY
SURVEY UNIT 3

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A. SURVEY UNIT DESCRIPTION

Survey Unit FR-0110-03 is an excavated area that consists of soil media. The excavation was made in order to remove buried pipes running between the PAB and the Containment Spray Building. The survey unit is located near grid coordinates 407,500 N and 623,800 E using the Maine State Coordinate System (West Zone) NAD 1927, as shown on Map FR0110-00, Attachment 1.

The Alleyway was originally a paved area above the current pipe excavation located within the Restricted Area. It was bordered on the west by the Personnel Hatch, Main Steam Valve House/Reactor Motor Control Center, and the Emergency Feedwater Building, on the east by the Service Building, and by the PAB on the north. Survey Unit 3 is approximately 48 m^2.

B. SURVEY UNIT DESIGN INFORMATION

The area was designated a Class 1 land survey unit per the LTP (Table 5-1C, R0100, RCA Yard West). The Alleyway excavation was begun in late 2002 and the removed soil was spread and surveyed for possible reuse. Nearly all of the removed soil was found to be acceptable for reuse. The soil survey effort was suspended when the ground froze, and upon returning to soil surveying in the spring of 2003, it was determined that radioactivity had migrated into the remaining soil from the open, abandoned pipes within the excavation pit. Consequently, significant soil remediation had to be performed. Since the survey unit was already Class 1, no reassessment of classification was required.

The survey unit design parameters are shown in Table 1. Given a relative shift of 1.2, it was determined that 23 direct measurements were required for the Sign Test, however, the number of samples was increased to improve the area factor. Twenty-eight direct measurements were actually performed. Measurement locations were randomly determined using a fixed grid with a randomly determined start point and are illustrated on the map FR 0110-SS-03 (Attachment 1). All direct measurements consisted of soil samples obtained at the required locations. The samples were analyzed by laboratory gamma spectroscopy.

Ten scan grids of approximately 5 m^2 were established, as indicated on survey map FR 0110-03. A 100% scan coverage of the area was required. The survey instruments used, their MDCs, and alarm setpoints are provided in Attachment 2.

Background values were established for the scan measurements based on local scaler values in the survey area. These background values were used to establish scan alarm setpoints, and to confirm the scan MDCs used were appropriate. Since the design $DCGL_{EMC}$ is greater than the investigation level, no EMC sample size adjustment is required.

TABLE 1

SURVEY UNIT DESIGN PARAMETERS

Survey Unit	Design Criteria	Basis
Area	48 m^2	< Class 1 limit per LTP Rev. 3
Number of Direct Measurements Required	24 (23 required)	Based on an LBGR of 1.6 pCi/g, sigma of 1.33 pCi/g[1] and a relative shift of 1.2, N was adjusted to increase the area factor Type I = Type II = 0.05
Sample Area	2.0 m^2	48m^2/24
Sample Grid Spacing	1.4 m x 1.4 m	
Scan Grid Area	~ 5 m^2	< 10 m^2
Area Factor	6.8	LTP Rev. 3 Table 6-12
Scan Survey Area	48 m^2	Class 1 Area – 100%
Background		
SSPA-3 (scan)	Average background ± 1000 cpm	DI 6-150, LTP Section 5
Scan Investigation Level	3 sigma of background plus BKG	EC-009-01 (MY) (Reference 1), See Table 2-2
DCGL	3.2 pCi/g[2]	LTP, Rev. 3 (Reference 3), and addenda (Reference 4)
Design $DCGL_{EMC}$	21.76	Area factor * DCGL

C. SURVEY RESULTS

Twenty-eight direct soil measurements were made and the results are presented in Table 2. Four of the direct measurements were above the DCGL unity fraction. The maximum direct result (S011) was seven times the DCGL unity fraction. This grid (S002) was remediated, and a subsequent sample was less than the DCGL. This post-remediation sample result is used in Table 2. The original result is used in the Sign Test. The maximum post-remediation result was 1.52 times the DCGL. The mean residual activity is 43% of the unity fraction.

The ten grids were scanned as required. Eight of the ten grids required investigation. Three were due to a low background at the start of the scan, three because the scan setpoint was exceeded, one because the background exceeded the alarm setpoint, and one (S002 as noted above) because the direct soil sample results exceeded the DCGL by a large margin. A discussion of the investigation performed in the survey unit is contained in Section D.

1 Design sigma from the LTP Rev. 3, Table 5-1C for R0100, RCA Yard West.

2 Design initially used a DCGL of 3.2 pCi/g Cs-137. The Cs-137 DCGL was later reduced to 2.39 pCi/g (Reference 5).

It should be noted that the Co-60 DCGL is 0.86 pCi/g. This 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 5 and 6). The Co-60 DCGL for surface soil is 1 pCi/g x 10/6.58 mrem/y (from LTP Table 6-7) or 1.5 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 1.5 pCi/g x 5.63/10 mrem/y or 0.86 pCi/g.

TABLE 2

DIRECT MEASUREMENTS

Sample Number	Co-60 (pCi/g)	Uncertainty	Cs-137 (pCi/g)	Uncertainty	Unitized Value of Unity Rule
FR0110-03-S001	5.32E-01	5.73E-02	3.72E-01	5.96E-02	0.77
FR0110-03-S002	4.71E-01	4.35E-02	3.72E-01	5.09E-02	0.70
FR0110-03-S003	3.06E-01	2.98E-02	2.37E-01	3.33E-02	0.45
FR0110-03-S004	1.13E-01	2.38E-02	1.02E-01	2.59E-02	0.17
FR0110-03-S005	7.52E-01	4.98E-02	8.65E-01	7.21E-02	1.24
FR0110-03-S006	7.42E-01	5.63E-02	9.65E-01	8.81E-02	1.27
FR0110-03-S007	5.70E-01	4.52E-02	5.35E-01	5.61E-02	0.89
FR0110-03-S008	4.28E-01	4.22E-02	4.53E-01	5.53E-02	0.69
FR0110-03-S009	5.41E-01	4.45E-02	5.93E-01	6.02E-02	0.88
FR0110-03-S010	2.71E-01	3.26E-02	2.81E-01	4.41E-02	0.43
FR0110-03-S011*	1.74E-01	2.79E-02	1.57E-01	3.29E-02	0.27
FR0110-03-S012	8.72E-01	5.50E-02	1.20E+00	9.29E-02	1.52
FR0110-03-S013	1.55E-01	2.28E-02	1.21E-01	2.73E-02	0.23
FR0110-03-S014	1.41E-01	2.54E-02	8.00E-02	2.54E-02	0.20
FR0110-03-S015	2.02E-01	2.64E-02	2.65E-01	3.55E-02	0.35
FR0110-03-S016	8.33E-02	2.58E-02	6.44E-02	2.37E-02	0.12
FR0110-03-S017	1.11E-01	2.23E-02	5.63E-02	2.12E-02	0.15
FR0110-03-S018	1.77E-01	2.28E-02	1.39E-01	2.65E-02	0.26
FR0110-03-S019	5.87E-02	3.49E-02	7.00E-02	2.78E-02	0.10
FR0110-03-S020	1.66E-01	2.23E-02	1.30E-01	2.68E-02	0.25
FR0110-03-S021	2.02E-01	2.60E-02	2.83E-01	3.79E-02	0.35
FR0110-03-S022	1.48E-01	2.25E-01	2.88E-01	3.49E-02	0.29
FR0110-03-S023	4.53E-02	2.69E-02	4.44E-02	2.11E-02	0.07
FR0110-03-S024	<4.65E-02		3.55E-02	1.86E-02	0.07
FR0110-03-S025	<4.69E-02		<4.43E-02		0.07
FR0110-03-S026	<4.69E-02		<4.03E-02		0.07
FR0110-03-S027	<4.36E-02		<3.86E-02		0.07
FR0110-03-S028	<3.16E-02		6.02E-02	2.27E-02	0.06
Mean	2.67E-01		2.82E-01		0.43
Median	1.70E-01		1.48E-01		0.27
Standard Deviation	2.46E-01		3.04E-01		0.41
Range	0.032 to 0.87		0.036 to 1.20		0.062 to 1.52

* Since the grid for sample S011 was remediated, the post-remediation result is shown. The original results were used for the Sign Test (Attachment 4).

"<" indicates values less than the minimum detectable activity (MDA)

D. SURVEY UNIT INVESTIGATIONS PERFORMED AND RESULTS

Survey Unit 3 was partitioned into 10 grids as shown on map FR 0110-03 (Attachment 1). Of the 10 grids, 8 required investigation due to a low background at the start of the scan (3), elevated direct sample results (1), the background exceeded the alarm setpoint (1), or the alarm setpoint was exceeded (3) during the scan. Four direct measurements exceeded the LTP Addendum revised DCGL (Reference 5). Three of these were in grids that were investigated as noted above. The fourth was not investigated because it did not exceed the DCGLs that were in effect at the time of the survey. This sample has been included in the Elevated Measurement Comparison Test (Table 3-1). One grid with a direct measurement that exceeded the DCGL was remediated and resampled during the investigation process.

Investigation of the scan grids consisted of a 100% scan with the SSPA-3. The highest reading in the grid was flagged and a sample was collected for laboratory gamma analysis. The results of the investigations are shown in Attachment 3. Detectable concentrations of Co-60 and Cs-137 were found in six of the investigated grids with one sample's activity exceeding the unitized DCGL. Samples from the other two investigated grids did not show positive Co-60 or Cs-137, and so, for purposes of the EMC test, were assumed to be present at the observed MDA. The investigation results, including the positive results from an uninvestigated grid, are summarized in Attachment 3 (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, are provided in Table 2. Of the 28 soil samples, four had concentrations of Co-60 and Cs-137 that exceeded unity. The grid for one of these samples was subsequently remediated and resampled. The results of the post-remediation sampling are used in this data assessment except that the original sample results were used in the Sign Test. The average of the DCGL unity fractions was 0.43 and the maximum unity fraction was 1.52 times the DCGL. The Elevated Measurement Comparison unity test was applied to the investigation data and conservatively includes one direct sample that was in a grid that was not investigated. The EMC test was 74% of unity, passing the EMC test. The final sigma was greater than the design sigma. A review of data indicates that a sufficient number of samples were collected provided the type II error is 0.10. The survey unit passed the Sign Test. Therefore, no additional samples were required.

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 established mean fallout Cs-137 background value[3] (0.19 pCi/g) for disturbed soil from the survey unit sample mean Cs-137 activity (0.282 pCi/g). The result is a net value of 0.092 pCi/g. When the survey unit mean for Co-60 (0.267 pCi/g) is included, this would equate to an annual dose rate of 1.96 mrem/y.[4] 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 soil sample analysis activity values.

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

[4] [(0.276 pCi/g/0.86 pCi/g) + ((0.282 pCi/g – 0.19 pCi/g) / 2.39)] x 5.63 mrem/y = 1.96 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 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, except four samples had activity above the unitized DCGL and the final sigma was greater than the design value, were satisfied for the FSS of this survey unit. The elevated measurements were appropriately evaluated and found acceptable. Similarly, the final sigma was evaluated in Section E and was found to be acceptable.

2. The Quantile Plot was generated from direct measurement data listed in Table 2. The data set and plot are consistent with expectations for a Class 1 survey unit. The survey unit average is well below the DCGLs of 0.86 pCi/g and 2.39 pCi/g for Co-60 and Cs-137 respectively.

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 no 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 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. Since the DCGLs were changed (decreased) by addendum to the LTP to account for the activated containment concrete pathway the design of the survey unit was confirmed and data reviewed against the revised DCGLs. Two of the four direct samples would still be above unity with the previous, higher DCGLs.

H. LTP CHANGES SUBSEQUENT TO SURVEY UNIT FSS

The FSS of Survey Unit 3 was designed and performed per the criteria LTP Rev. 3 with Addenda (Reference 3 and 4). The subsequent LTP change with potential impact to this FSS requiring evaluations was the LTP change related to the activated concrete license amendment (Reference 5 and 6) which reduced the DCGLs for soil inside the RA.

These changes were evaluated and found to have no impact on the FSS results or conclusions for this survey unit. The revised DCGLs were used for the evaluation of the results included herein.

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, the average of the direct measurements was well below the DCGL unity.

A Sign Test Summary analysis was conducted. Using the initial estimated sigma combined with the decreased DCGL, the sign test indicated that an insufficient number of direct samples was collected. By increasing the type II error to 0.10 the Sign Test Summary analysis demonstrated that the Sign Test criteria were satisfied and a sufficient number of samples were obtained.

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 no outliers.

The scan survey design for this survey unit was developed in accordance with the LTP with significant aspects of the design discussed in Section B and Table 1. Verified alarms were investigated and the survey unit meets Elevated Measurement Comparison unity rule per LTP methodology.

It is concluded that FR0110 Survey Unit 3 meets the release criteria of 10CFR20.1402 and the State of Maine enhanced criteria.

J. REFERENCES

1. Maine Yankee Engineering Calculation, EC-009-01

2. Approach for Dealing with Background Radioactivity for Maine Yankee Final Status Surveys, Attachment E to Maine Yankee Procedure PMP 6.7.8, FSS Data Processing and Reporting

3. Maine Yankee License Termination Plan, Revision 3, Maine Yankee letter to the NRC, MN-02-048, dated October 15, 2002

4. Maine Yankee License Termination Plan, Revision 3 Addenda, Maine Yankee letter to the NRC, MN-02-061, dated November 26, 2002

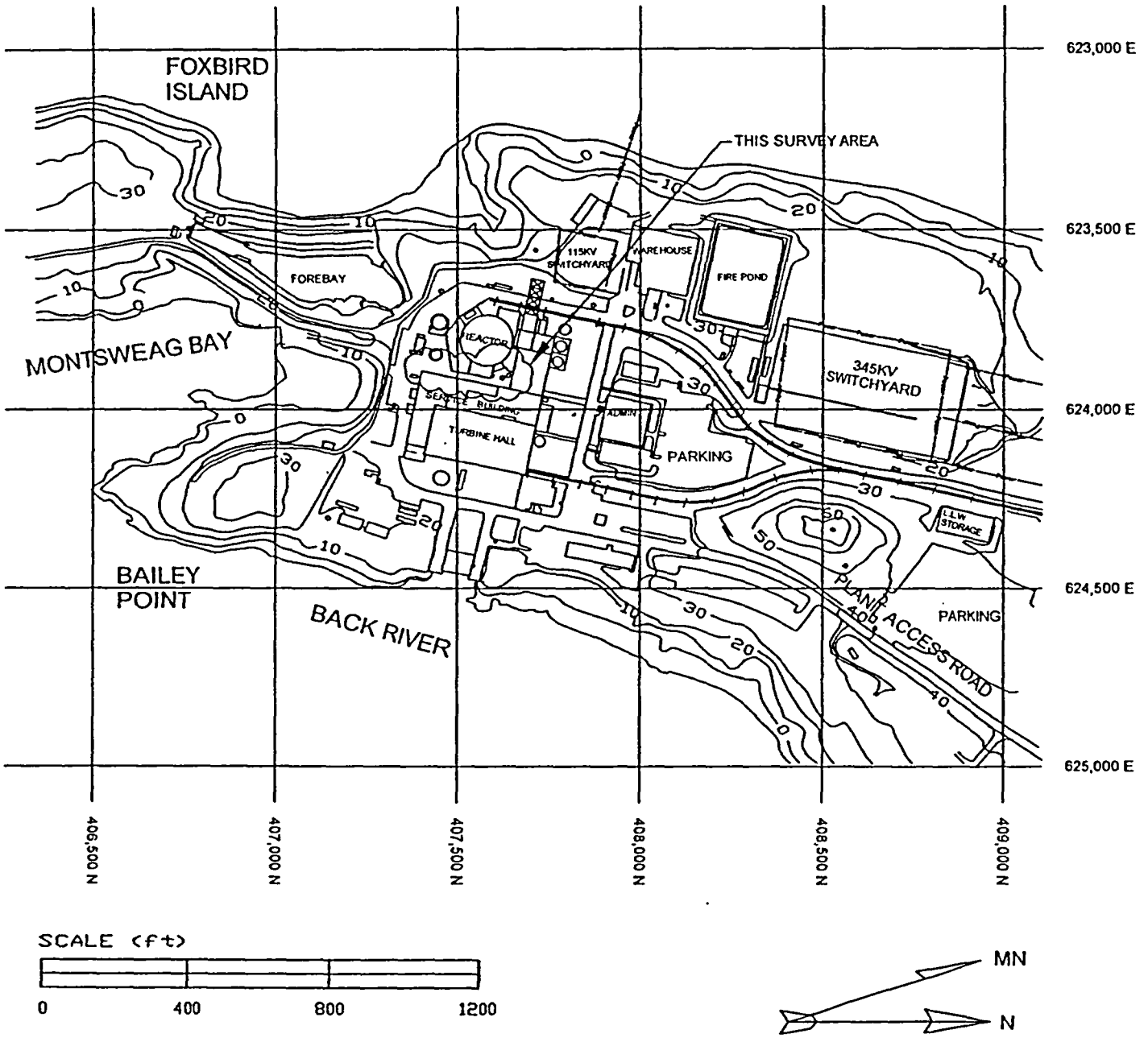
5. Proposed License Amendment Related to Changes in the Activated Concrete Remediation Plans, Maine Yankee letter to the NRC, MN-03-049, dated September 11, 2003

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

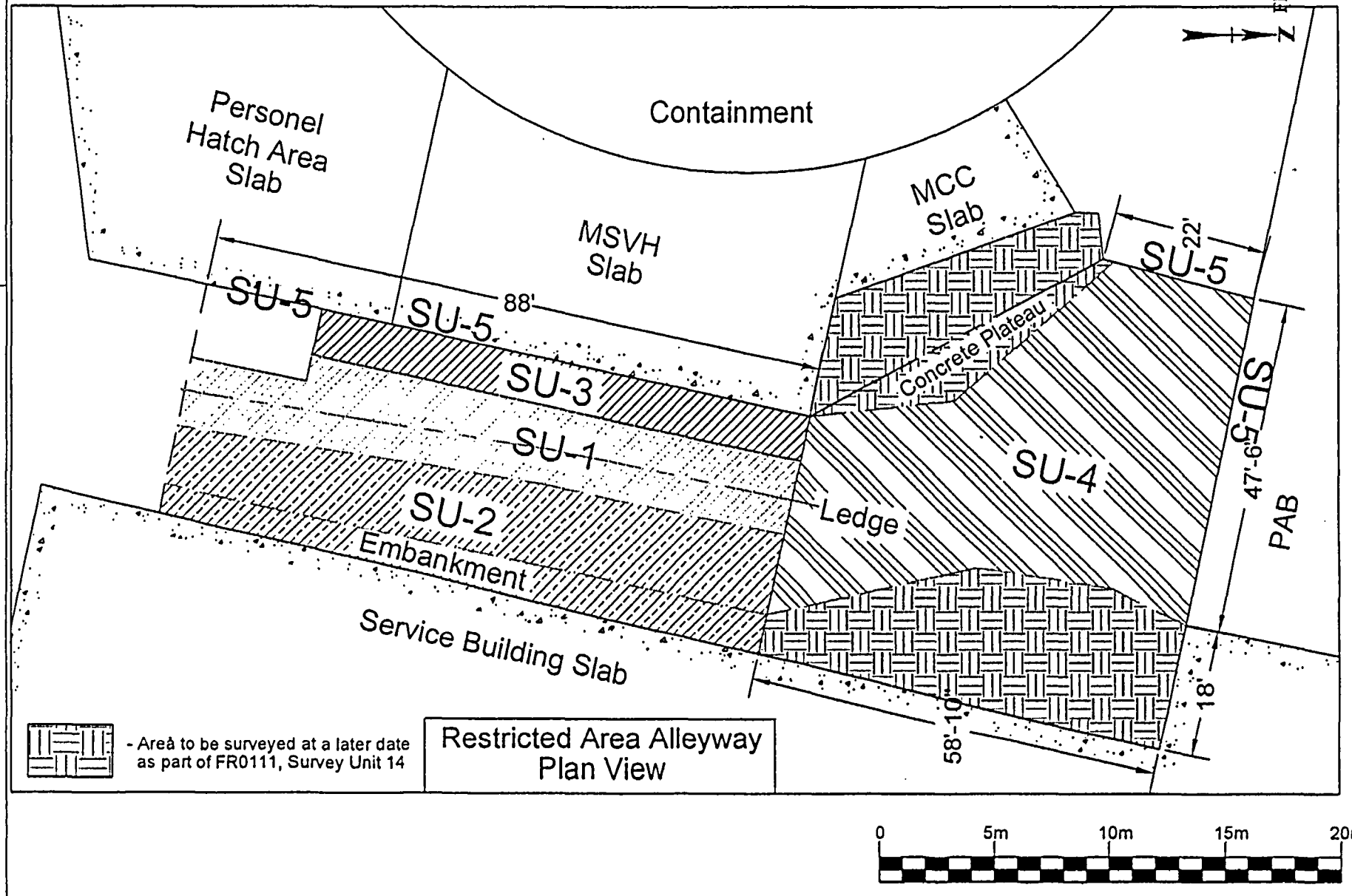
Attachment 1

Survey Unit Maps

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FR 0110-00
Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey	Survey Area Name: Alleyway Excavation	Date: 6-25-03



Final Status Survey Unit Reference Map
Alleyway Piping Excavation Pit



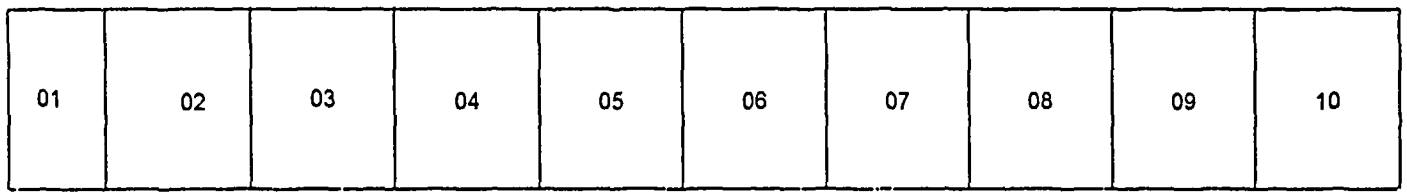
Maine Yankee Decommissioning Team | *Maine Yankee Decommissioning Project Survey Form* | Map ID #: FR 0110-REF

Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey | Survey Area Name: Alleyway Excavation | Date: 6-25-03

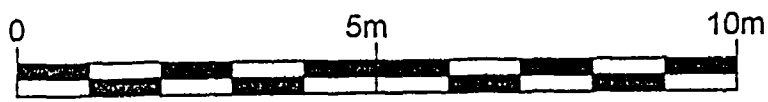
FR 0110-03: Alleyway Piping Excavation Pit
Soil Area West of Ledge Survey Scan 01-10

Maine Yankee Decommissioning Team | *Maine Yankee Decommissioning Project Survey Form* | Map ID #: FR 0110-03

Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey | Survey Area Name: Alleyway Excavation | Date: 7-18-03



MSVH & PH/V Concrete Walls



This survey area unit is approximately 48 square meters

FR 0110-SS-03, Direct Point Survey, Soil
Survey Unit 03
Alleyway Piping Excavation Pit
Soil Area West of Ledge to Wall

Maine Yankee Decommissioning Team

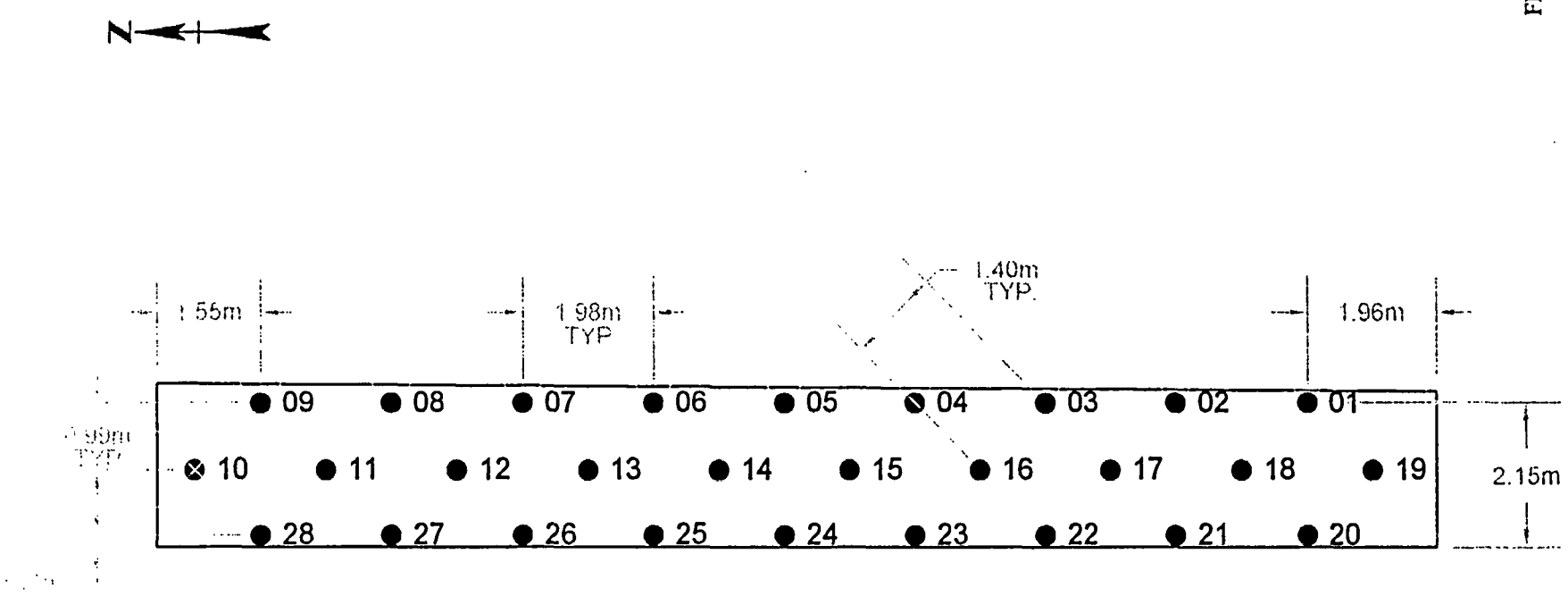
Maine Yankee Decommissioning Project Survey Form

Map ID #: FR 0110-SS-03 Survey Unit 03

Survey Area Name: Alleyway Excavation

Date: 6-25-03

Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey



L=1.4, N=24

This survey area unit is approximately 48 square meters

Attachment 2

Survey Unit Instrumentation

TABLE 2-1

INSTRUMENT INFORMATION

E-600 S/N	Probe S/N (type)
1929	725890 (SSPA-3)
2489	726560 (SSPA-3)

HPGe Detectors for Lab Analysis of Volumetric Samples

Detector Number	MDC (pCi/g)
FSS-1	0.04 – 0.10
FSS-2	0.04 – 0.10
DET2	0.10 (nominal)
DET3	0.10 (nominal)

TABLE 2-2

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

Detector	SSPA-3	Comments
Scan MDC (pCi/g)	5.9	Design Scan MDC, LTP Table 5-6 (Reference 4)
DCGL (pCi/g)	2.39 Cs-137 0.86 Co-60	Reference 5
Investigation Level (Alarm Setpoint) cpm	21,110	3 sigma of Background plus BKG
Design $DCGL_{EMC}$ (pCi/g)	16.3 Cs-137 5.8 Co-60	DCGL * AF (6.8)

Attachment 3

Investigation Table

TABLE 3-1

INVESTIGATION

INITIAL SURVEY			INVESTIGATION RESULTS									
Grid	Alarm Setpoint cpm	Alarm Value cpm	Max. Scan Value cpm	Scan Area m^2	Area Factor	$DCGL_{EMC}$ Unity Times AF	Sample Number	Co-60 (pCi/g)	+ / -	Cs-137 (pCi/g)	+ / -	$DCGL_{EMC}$ Unity
S001	21110	21100	19140	5	3.6	3.6	XR0110-03-S001	6.26E-01	4.81E-02	5.93E-01	6.23E-02	<DCGL
S002	21110	20300	21400	5	3.6	3.6	XR0110-03-S006	1.74E-01	2.79E-02	1.57E-01	2.79E-02	<DCGL
S003	21110	22100	18300	5	3.6	3.6	XR0110-03-S002	9.01E-01	5.60E-02	8.87E-01	7.37E-02	0.30
S004	21110	hb	20600	5	3.6	3.6	XR0110-03-R001	< 1.48E-01		< 1.30E-01		<DCGL
S005	21110	21300	21500	5	3.6	3.6	XR0110-03-R002	< 1.26E-01		< 9.62E-02		<DCGL
S008	21110	lb	17120	5	3.6	3.6	XR0110-03-S003	1.38E-01	2.70E-02	6.08E-02	2.63E-02	<DCGL
S009	21110	lb	16280	5	3.6	3.6	XR0110-03-S004	4.29E-01	3.88E-02	2.65E-01	4.01E-02	<DCGL
S010	21110	lb	15790	5	3.6	3.6	XR0110-03-S005	3.86E-01	4.05E-02	2.77E-01	4.39E-02	<DCGL
S006*	N/A	N/A	N/A	1.7	8.3	8.3	FR0110-03-S005	7.52E-01	4.98E-02	8.65E-01	7.21E-02	0.11
							Unit mean	2.06E-01		1.96E-01		0.32
										EMC Unity Sum		0.74

NOTES

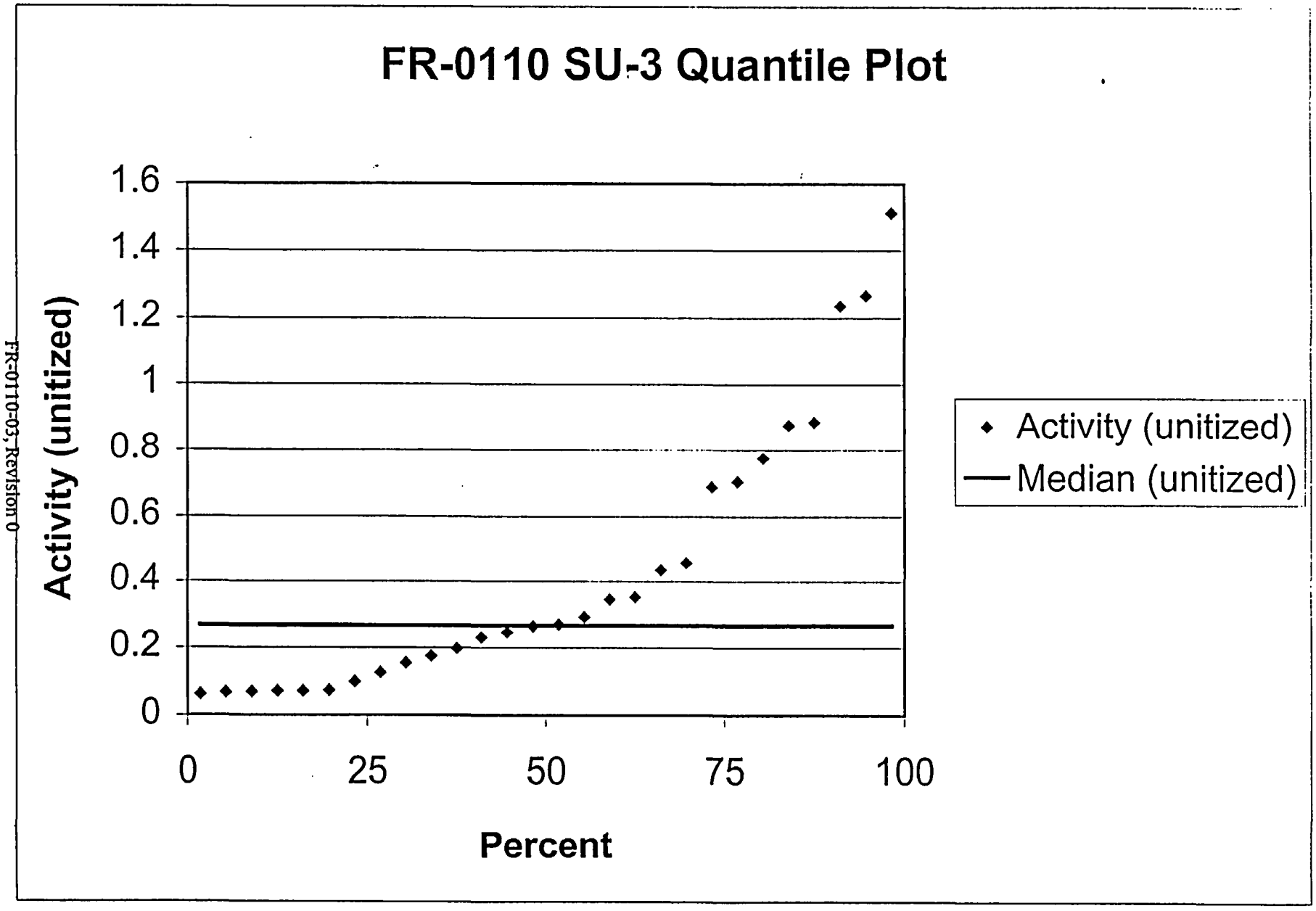
1. lb – investigated due to low background in the grid
2. hb – investigated due to high background in the grid
3. * - S006 is the value from the direct sampling, included because the direct value was >DCGL but there was no alarm in the grid
4. "<" indicates values less than the minimum detectable activity (MDA)
5. Scan area used for S006 was based on grid area of 5 m^2 with three samples (5/3 = 1.7).

Attachment 4

Statistical Data

Survey Package FR0110 Unit 3 UNITY Soil Sign Test Summary

Evaluation Input Values		Comments
Survey Package:	FR0110	
Survey Unit:	03	
Evaluator:	WJC	
$DCGL_w$:	1.00E+00	using 2.39 pCi/gm DCGL
$DCGL_{emc}$:	6.80E+00	
LBGR:	5.00E-01	
Sigma:	5.66E-01	
Type I error:	0.05	
Type II error:	0.1	Type II error changed to 0.1
Nuclide:	UNITY	
Soil Type:	N/A	
Calculated Values		**Comments**
$Z_{1-\alpha}$:	1.645	
$Z_{1-\beta}$:	1.282	
Sign p:	0.788145	
Calculated Relative Shift:	0.8	
Relative Shift Used:	0.8	Uses 3.0 if Relative Shift is >3
N-Value:	26	
N-Value+20%:	32	
Sample Data Values		**Comments**
Number of Samples:	28	
Median:	2.78E-01	
Mean:	6.69E-01	
Net Sample Standard Deviation:	1.31E+00	
Total Standard Deviation:	1.31E+00	
Maximum:	7.01E+00	
Sign Test Results		**Comments**
Adjusted N Value:	28	
S+ Value:	24	
Critical Value:	18	
Sign test results:	Pass	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Pass	
Maximum value <$DCGL_w$:	Investigate	Mean and Sign tests pass
Median value <$DCGL_w$:	Pass	
Mean value <$DCGL_w$:	Pass	
Maximum value <$DCGL_{emc}$:	Fail	Remediated
Total Standard Deviation <=Sigma:	Investigate	Sign test passes
Criteria comparison results:	Fail	Remediated,mean and sign pass
Final Status		**Comments**
The survey unit passes all conditions:	Fail	Remediated, Sign Passes- SUpasses


FR-0110 SU-3 Quantile Plot
Activity (unitized)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
25
50
75
100
Percent
Activity (unitized)
Median (unitized)

One-Sample T-Test Report

Page/Date/Time	2 12/7/04 12:16:28 PM
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Variable	C2

Plots Section

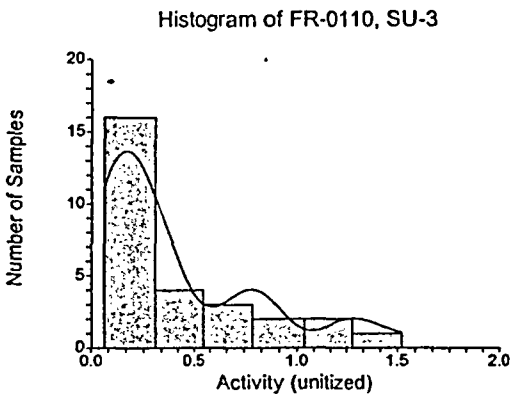

Chart Section