MAINE YANKEE
FINAL STATUS SURVEY RELEASE RECORD
FB-0500 TURBINE BUILDING FOOTPRINT
SURVEY UNIT 3

Prepared By:	for U. Vanags FSS Engineer - Signature G. Pillsbury Printed Name	Date: 9/23/04
Reviewed By:	Tozzie FSS Specialist - Signature Robert Tozzie Printed Name	Date: 10/31/04
Reviewed By:	Dale Randall Independent Reviewer - Signature Dale Randall Printed Name	Date: 11-9-04
Approved By:	Superintendent, FSS - Signature George Pillsbury Printed Name	Date: 11/9/04
Approved By:	FSS, MOP - Signature James R. Packer Printed Name	Date: 11/17/04

MAINE YANKEE
FINAL STATUS SURVEY RELEASE RECORD
FB-0500 TURBINE BUILDING FOOTPRINT
SURVEY UNIT 3

A. SURVEY UNIT DESCRIPTION

FB-0500 is the survey area located in the footprint of the former Turbine Building shown on site map FB 0500-03 SITE (Attachment 1). The north east corner of the Turbine Building is located at 407685N and 624185E using the Maine State Coordinate System (West Zone) NAD 1927. Survey Unit 3 consisted of sub-slab soil and concrete footing remnants on the Turbine Building's west side. The total area was approximately 1730 m^2. While the survey area was located inside the Industrial Area of the site, it was outside of the plant's radiologically restricted area (RA).

B. SURVEY UNIT DESIGN INFORMATION

The Turbine Building was typically maintained as a clean structure during plant operation. However, radioactive material was present in systems and low levels of contamination were found in building sumps and drains. The area around the PCC/SCC pumps was considered to be a Class 1 area so the sub-slab soil within FB-0500 Survey Unit 3 was designated a Class 2 survey unit per the LTP (Table 5-1B).

During the removal of a service water discharge pipe in this survey unit, soil contamination was found in excess of the DCGL. The area of elevated activity was bounded to 25 m^2 by soil scans and samples. A 50 m^2 area was reclassified to Class 1, removed from the scope of Survey Unit 3, and was designated Survey Unit 4.

The survey unit design parameters are summarized in Table 1. Given a relative shift of 3.0, it was determined that 14 direct soil sample points were required for the Sign Test. The soil measurement locations were generated using a random start, fixed grid and are shown on map FB 0500-03b (Attachment 1). Soil measurements consisted of soil samples that were analyzed with laboratory gamma spectroscopy instrumentation.

A 10-100% scan coverage of the area was required.[1] Approximately 50% scan coverage was obtained by scanning 36 locations each 25 m^2 (totaling 900 m^2). The location of the scan areas are shown on map FB 0500-03a (Attachment 1).

The survey instruments used, their MDC values, and alarm setpoints are provided in Attachment 2.

Background values were established for the scan measurements, based on local scaler values in the survey unit. These background values were used to establish scan alarm setpoints.

[1] LTP Table 5-3

TABLE 1

SURVEY UNIT DESIGN PARAMETERS

Survey Unit	Design Criteria	Basis
Area	1730 m^2	Class 2
Number of Direct Measurements Required	14	Based on an adjusted LBGR of 3.69 pCi/g, sigma[2] of 0.17 pCi/g and a relative shift of 3.0. Type I = Type II = 0.05
Sample Area	123.57 m^2	1730 m^2 / 14
Sample Grid Spacing	11.1 m x 11.1 m	Class 2 Area
Scan Grid Area	5 m x 5 m	Class 2 Area
Area Factor	N/A	Class 2 Area
Scan Survey Area	900 m^2	Class 2 Area – 50%
Background		
SPA-3 (scan)	Average background ± 1000 c/m	DI 6-150, EC-009-01, LTP Section 5
Scan Investigation Level	3 sigma of background See Table 2-2	EC-009-01 (Reference 1)
DCGL	4.2 pCi/g	LTP Revision 3 (Reference 2)
Design $DCGL_{EMC}$	N/A	Class 2 Area

C. SURVEY RESULTS

As required, 14 direct soil measurements were made. Direct measurement data are presented in Table 2. All direct measurements were below the DCGL.

Of the 36 grids scanned, 8 grids had verified alarms. One additional grid (S030) was investigated after receiving a false positive indication. The investigation results are discussed in Section D.

[2] LTP Table 5-1C, footnote a, R0200 yard east

TABLE 2

SOIL SAMPLE RESULTS

Soil Sample ID Number	Cs-137 (pCi/g)	Uncertainty pCi/g	Co-60 (pCi/g)	Uncertainty pCi/g	Application of Unity Rule
FB0500-03-2-S001SS	<3.08E-02	NA	<3.31E-02	NA	2.94E-02
FB0500-03-2-S002SS	<2.96E-02	NA	<3.11E-02	NA	2.78E-02
FB0500-03-2-S003SS	<3.01E-02	NA	<3.52E-02	NA	3.06E-02
FB0500-03-2-S004SS	<3.03E-02	NA	<3.39E-02	NA	2.98E-02
FB0500-03-2-S005SS	<3.17E-02	NA	<3.10E-02	NA	2.82E-02
FB0500-03-2-S006SS	<2.10E-02	NA	<2.84E-02	NA	2.39E-02
FB0500-03-2-S007SS	<3.16E-02	NA	<3.18E-02	NA	2.87E-02
FB0500-03-2-S008SS	<2.73E-02	NA	<3.09E-02	NA	2.71E-02
FB0500-03-2-S009SS	**6.88E-02**	**1.94E-02**	**2.82E-01**	**2.46E-02**	2.04E-01
FB0500-03-2-S010SS	<2.75E-02	NA	<2.89E-02	NA	2.58E-02
FB0500-03-2-S011SS	<2.84E-02	NA	<3.00E-02	NA	2.67E-02
FB0500-03-2-S012SS	<2.76E-02	NA	<2.86E-02	NA	2.56E-02
FB0500-03-2-S013SS	<2.94E-02	NA	<3.18E-02	NA	2.82E-02
FB0500-03-2-S014SS	**3.56E-02**	**1.56E-02**	<2.07E-02	NA	2.23E-02
Sample Mean	**3.21E-02**		**4.84E-02**		**3.99E-02**
Sample Median	**2.99E-02**		**3.11E-02**		**2.80E-02**
Standard Deviation	**1.10E-02**		**6.73E-02**		**4.73E-02**
Range	**0.021 – 0.069**		**0.021 – 0.282**		**0.022 – 0.204**

NOTES

1. The Co-60 DCGL of 1.5 pCi/g is an "adjusted DCGL" and can be derived from the unitized dose for surface soil, LTP Table 6-7. The resulting DCGL for Co-60 alone is 1 pCi/g x 10/6.58 mrem/y or 1.5 pCi/g. This relationship is not impacted by the updated dose model in the activated concrete related license amendment (References 3 and 4).
2. "<" indicates MDC value.

D. SURVEY UNIT INVESTIGATIONS PERFORMED AND THEIR RESULTS

The nine investigations consisted of re-scanning the grid and taking a soil sample at the highest count-rate location. The soil samples were analyzed by gamma spectroscopy. All soil sample results were at the MDC except a concentration of 0.986 pCi/g of Co-60 was detected in one sample (S033). This sample did not exceed the DCGL of 1.5 pCi/g for Co-60. The results of the investigation measurements are tabulated in Attachment 3 (Table 3-1).

E. SURVEY UNIT DATA ASSESSMENT

An analysis of the direct sample measurement results, including mean, median, standard deviation, and sample result range, are provided in Table 2. The mean and median activities were less than the DCGL for both Co-60 and Cs-137. The soil sampling results yielded a positive indication of plant-derived nuclides in two direct samples and one investigated grid.

The highest reported value for Cesium-137 was 1.6 % of the DCGL (4.2 pCi/g), and the highest reported value for Co-60 was 65.7% of the DCGL (1.5 pCi/g). The combined concentrations of Cs-137 and Co-60 do not exceed the unity rule value of 1. A trace amount (0.15 pCi/g) of Sb-125 was detected in soil sample S009. This is consistent with contamination from the service water pipe where high Co-60 activity is sometimes accompanied by lower levels of Sb-125. Compared to the NUREG-1727 soil value, the Sb-125 activity would equal a unitized value of 0.015.

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. Cs-137 activity results in a non-positive value of activity once the established mean fallout Cs-137 background value (0.19 pCi/g) is subtracted from the survey unit mean (0.03 pCi/g), and does not contribute to the annual dose rate. However, the mean value of 0.048 pCi/g of Co-60 equates to a dose rate of 0.32 mrem/year[3]. However, for the purposes of demonstrating compliance with the radiological criteria for license termination and the enhanced State Criteria, background Cs-137 activity is 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 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 that the design sigma was less than actual unitized sigma, were clearly satisfied for the FSS of this survey unit. Refer to Section G for a discussion on the sigma values.

---

[3] (0.048 pCi/g/1.5 pCi/g) x 10 mrem/year = 0.32 mrem/year

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 2 survey unit. All of the measurements are well below the DCGL of 4.2 pCi/g.

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 due to the presence of 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 2 area; the FSS results were consistent with that classification. The direct measurement sample unitized standard deviation exceeded the design sigma. However, the increase in sigma would not have affected the relative shift. Therefore, the survey design had sufficient power to reject the null hypothesis so no additional measurements were required.

H. LTP CHANGES SUBSEQUENT TO SURVEY UNIT FSS

The FSS of Survey Unit 3 was designed and performed using the criteria of the approved LTP Revision 3 Addenda (Reference 2). The only subsequent LTP changes were provided in the proposed license amendment related to modifications of the activated concrete remediation plan submitted September 11, 2003 (References 3 and 4). Changes represented in this later proposed license amendment have been evaluated and have no impact on the design, conduct, or assessment on the final status survey on Survey Unit 3.

I. CONCLUSION

The FSS of this survey unit was designed based on the LTP designation as a Class 2 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. The presence of Sb-125 was detected at a low level. Even though Sb-125 is not a typical soil nuclide, its unitized activity was evaluated and found to still meet the unity rule.

A Sign Test Summary analysis demonstrated that the Sign Test criteria were satisfied. The direct measurement sigma was determined to be greater than that used for design, however, 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, due to the presence of one outlier.

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. Scanning resulted in eight verified alarms and one additional grid investigated. Investigations were conducted and no soil concentrations exceeded the DCGL.

It is concluded that FB-0500 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. 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

3. MY letter to the NRC, MN-03-049, dated September 11, 2003, "Proposed Change: Revised Activated Concrete DCGL and More Realistic Activated Concrete Dose Modeling"

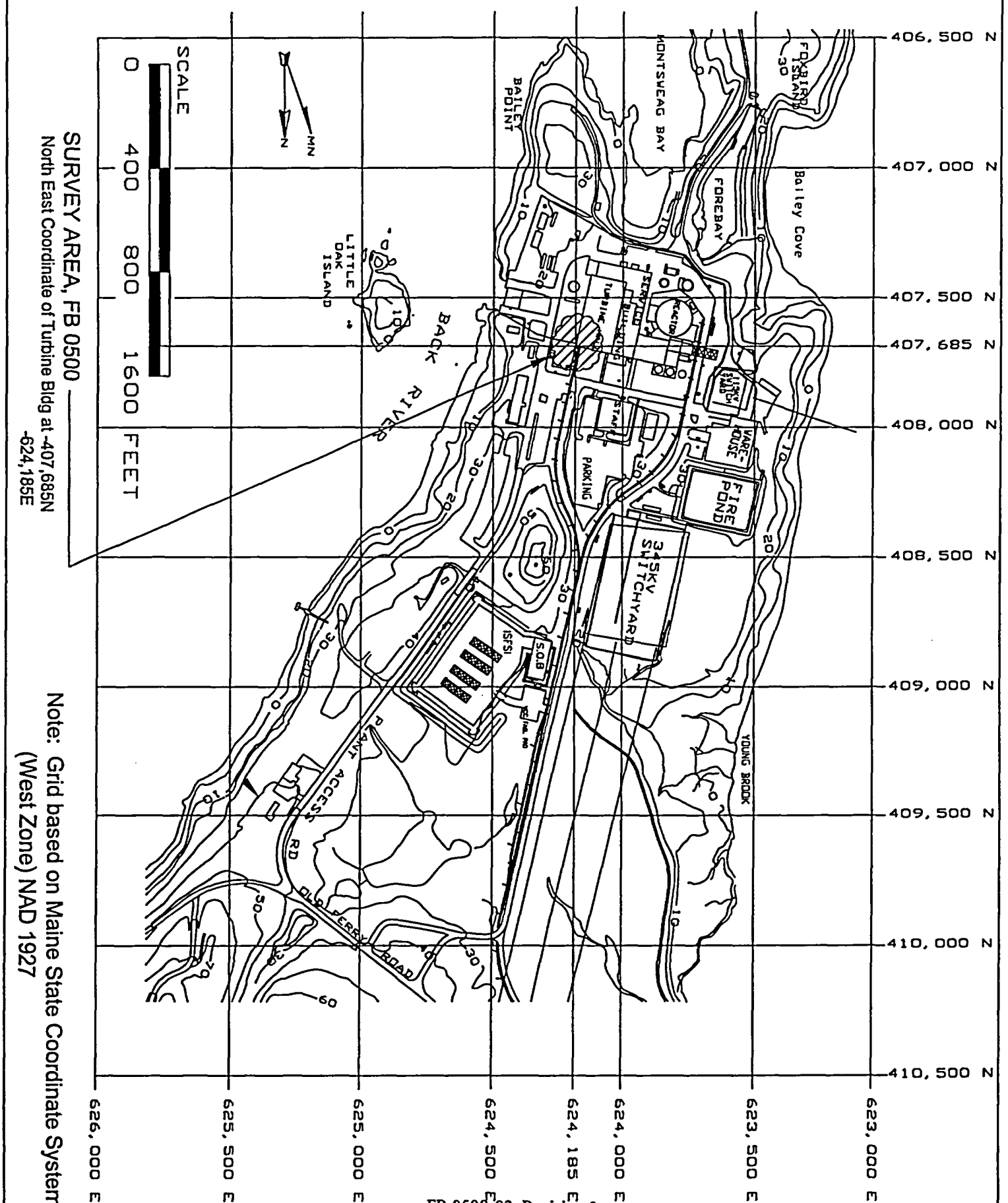
4. NRC Letter to Maine Yankee dated February 18, 2004, Approval of Activated Concrete Amendment

5. Maine Yankee Procedure PMP 6.7.8, Attachment E

Attachment 1

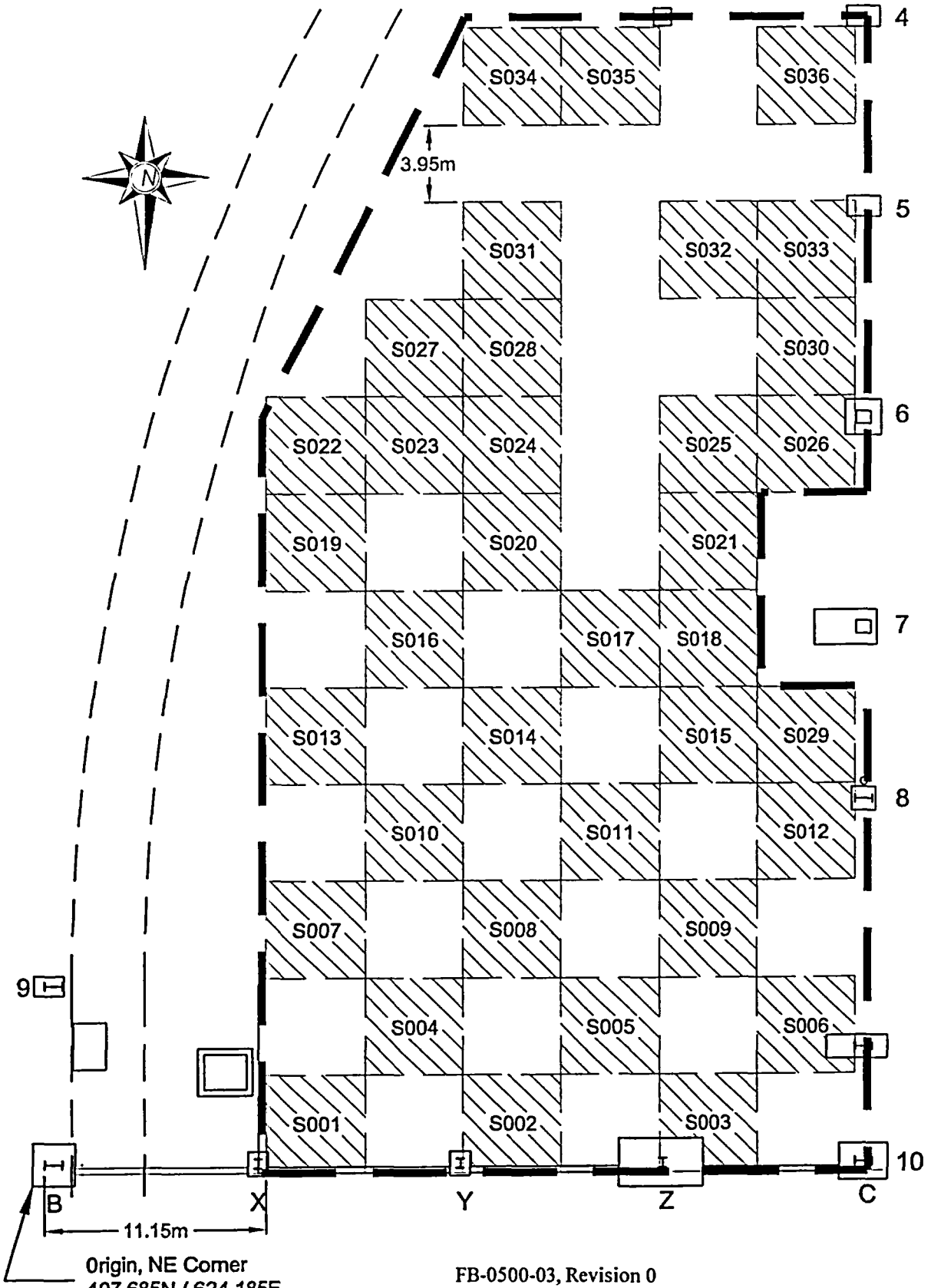
Survey Unit Maps

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FB 0500-03 SITE Revised: 12-09-03
Survey Type: ☐ Characterization ☐ Turnover ■ Final Status Survey	Survey Area Name: Turbine Building Phase II	



Note: Grid based on Maine State Coordinate System (West Zone) NAD 1927

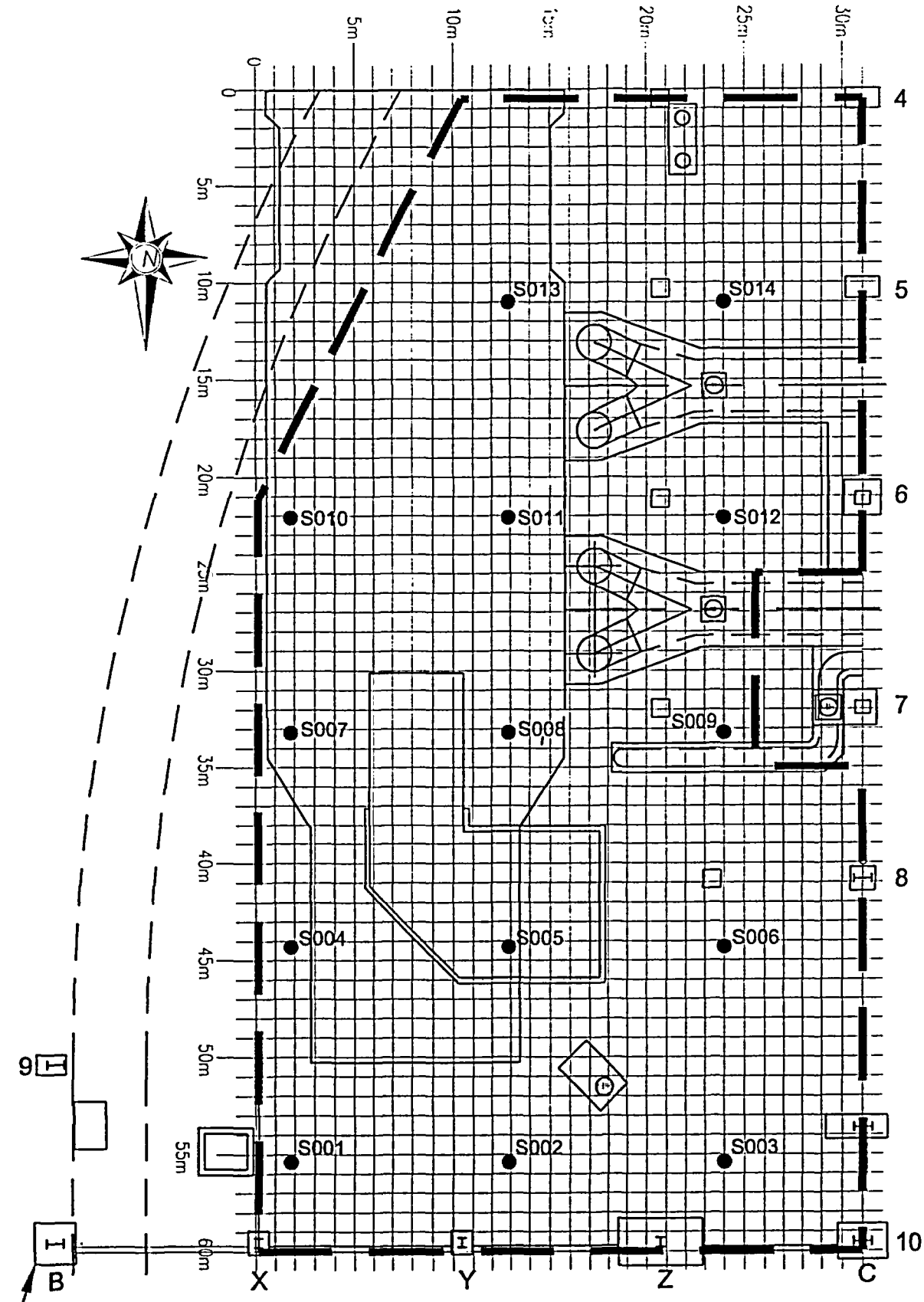
Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FB 0500-03a Revised: 12-9-03
Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey	Survey Area Name: Turbine Building Phase II	



Turbine Building Phase II
Footprint Final Status Survey
Survey Scans S001 - S036

Scan Grids are 5m x 5m Total Area = 1730 sq-m

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FB 0500-03b Revised: 12-9-03
Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey	Survey Area Name: Turbine Building Phase II	



Turbine Building Phase II
Footprint Final Status Survey
Direct Points S001-S014

407,685N / 624,185E

L= 11.1 N=14 Total Area = 1730 sq-m

Attachment 2

Survey Unit Instrumentation

TABLE 2-1

INSTRUMENTATION INFORMATION

E-600 S/N	Probe S/N (type)
1933	725332 (SPA-3)
2620	726560 (SPA-3)

HPGe Detectors for Lab Analysis of Volumetric Samples

Detector Number	MDC (pCi/g)
FSS-1	0.02 – 0.11
FSS-2	0.02 – 0.11
DET2	< 0.15
DET3	< 0.15

TABLE 2-2

INSTRUMENT SCAN MDC, DCGL, AND INVESITGATION LEVEL

Detector	SPA-3	Comments
DCGL (pCi/g)	4.2 Cs-137 1.5 Co-60	DCGL for land areas outside the Restricted Area applied (LTP Revision 3 Addenda, Reference 2)
Scan MDC (pCi/g)	5.9	LTP Table 5-6, Design Scan MDC (LTP Revision 3 Addenda, Reference 2)
Investigation Level (Alarm Setpoint) (cpm)	12,860	3.0 sigma of Background - EC-009-01 (Reference 1)

Attachment 3

Investigation Table

TABLE 3-1

INVESTIGATION TABLE

XB0500 SU#3 INVESTIGATED GRIDS

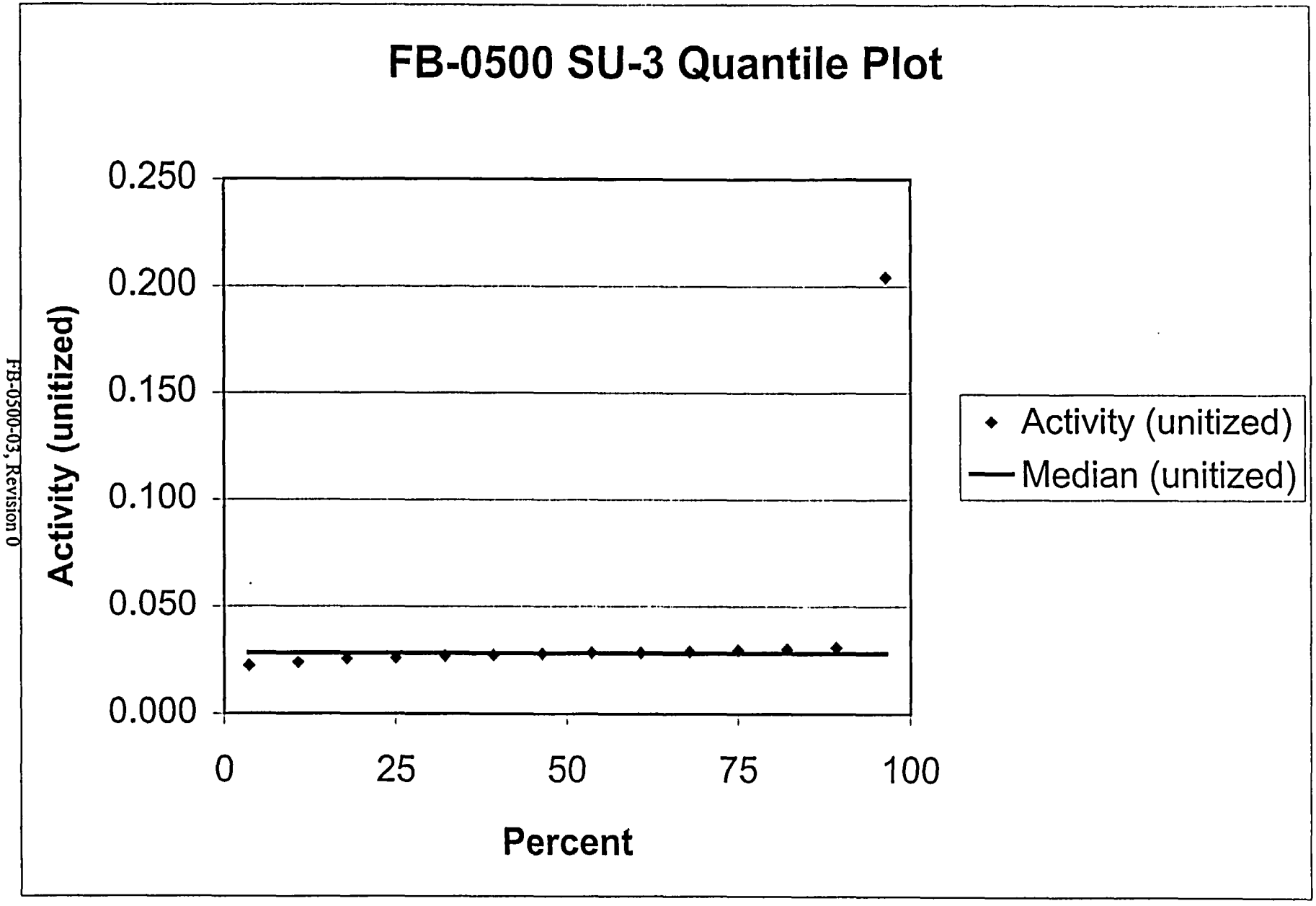
Original Survey Results				Investigation Results						
Investigated Grids	Investigation Reason	Alarm Setpoint (cpm)	Scan Value (cpm)	Investigation Scan Measurement (cpm)	Sample ID #		Co-60 (pCi/g)		Cs-137 (pCi/g)	Unity DCGL
S001	ALARM	12,860	13,700	15,200	XB0500-03-2-S001-RS000	<	1.24E-01	<	9.34E-02	0.10
S004	ALARM	12,860	14,980	12,090	XB0500-03-2-S004-SS000	<	3.38E-02	<	3.22E-02	0.03
S018	ALARM	12,860	13,150	13,440	XB0500-03-2-S018-RS000	<	1.24E-01	<	1.14E-01	0.11
S026	ALARM	12,860	13,630	13,410	XB0500-03-2-S026-SS000	<	3.66E-02	<	3.67E-02	0.03
S029	ALARM	12,860	13,620	13,670	XB0500-03-2-S029-SS000	<	3.23E-02	<	2.94E-02	0.03
S030	Professional	12,860	12,310	12,390	XB0500-03-2-S030-SS000	<	3.40E-02	<	3.05E-02	0.03
	Judgement									
S033	ALARM	12,860	13,860	12,760	XB0500-03-2-S033-SS000		**9.86E-01**	<	4.25E-02	0.67
S035	ALARM	12,860	14,000	13,470	XB0500-03-2-S035-SS000	<	3.37E-02	<	3.17E-02	0.03
S036	ALARM	12,860	14,760	13,470	XB0500-03-2-S036-SS000	<	3.09E-02	<	3.02E-02	0.03
"<" indicates MDA value										

Attachment 4

Statistical Data

Survey Package FB-0500 Unit 3 UNITY Soil Sign Test Summary

Evaluation Input Values		Comments
Survey Package:	FB-0500	Turbine Bld Footprint
Survey Unit:	03	
Evaluator:	GP	
$DCGL_w$:	4.20E+00	
$DCGL_{emc}$:	N/A	
LBGR:	3.69E+00	
Sigma:	4.00E-02	Unitized
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:	0.99865	
Calculated Relative Shift:	12.7	
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:	2.80E-02	
Mean:	3.99E-02	
Net Sample Standard Deviation:	4.73E-02	
Total Standard Deviation:	4.73E-02	SRSS
Maximum:	2.04E-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:	Investigate	See Section G of the Release Record
Criteria comparison results:	Investigate	See Section G of the Release Record
Final Status		**Comments**
The survey unit passes all conditions:	Investigate	The Survey Unit passes


FB-0500 SU-3 Quantile Plot
Activity (unitized)
0.250
0.200
0.150
0.100
0.050
0.000
0
25
50
75
100
Percent
Activity (unitized)
Median (unitized)

One-Sample T-Test Report

Page/Date/Time	2 11/9/04 4:49:38 AM
Database	C:\Program Files\NCSS97\FB0500SU3.S0
Variable	C2

Plots Section

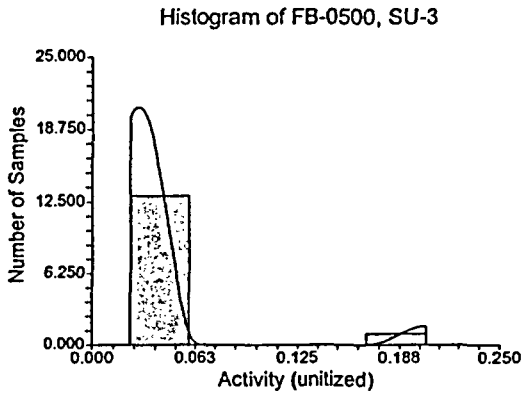


Chart Section