MAINE YANKEE
FINAL STATUS SURVEY RELEASE RECORD
FA-0100 CONTAINMENT BUILDING
SURVEY UNIT 5

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A. SURVEY UNIT DESCRIPTION

Survey Unit 5 is located in Survey Area FA 0100, the Containment Building interior. The Containment Building is located in the restricted area between the Fuel Building and the Spray Building centered at site coordinates 407,575 N and 623,810 E. The Containment Building is shown in relation to other major site structures in map FA 0100. All maps referenced in this release record are provided in Attachment 1 unless otherwise noted.

Survey Unit 5 consists of the nine pipe penetrations between the Spray Building and the Containment Building located from the -4 foot elevation to the 17 foot elevation as well as the 6 inch I.D. neutron detector transfer chute that went from El. –4 foot to the ICI sump. Some of the steel pipes were removed by coring the penetration and a bare concrete surface was left. The physical configuration of Survey Unit 5 in relation to the remaining survey units in the Containment Building is provided in map FA 0100-UNITS (Attachment 1).

The survey unit has a surface area of approximately 21.4 m^2.

B. SURVEY UNIT DESIGN INFORMATION

The survey unit was known to have been contaminated to levels in excess of the release limits and required an extensive remediation effort prior to FSS. Given the high probability of residual contamination, the area was designated a Class 1 survey unit per the LTP.

The survey unit design parameters are shown in Table 1 below. Given a relative shift of 3.0, it was determined that 14 direct measurements were required for the Sign Test. Each sample location was determined using a fixed square grid with a random start point. Because of the geometry, 16 direct measurement points were specified as shown on map FA 0100-U5-DIRECTS. Once the direct readings were completed, removable contamination samples were obtained at each measurement location.

The survey was also designed to include 12 scan grids which are shown on map FA 0100-U5-SCANS. Each pipe or penetration was designated as a separate grid yielding a total of nine grids. Additionally, there were three more grids assigned to the Neutron Detector Chute. Because of the variability in pipe or penetration diameters, the scan grids varied in size from 0.86 to 3.17 m^2 totaling 21.35 m^2. Instrument scan setpoints were conservatively set below the $DCGL_{EMC}$ as shown in Table 2-2 (Attachment 2).

Background values were established for each particular instrument probe application based on ambient background values in the survey area for the metal penetrations and, in the case of concrete penetrations, previously established ambient and material backgrounds. Material backgrounds for steel contribute little and were thus not included. The background values listed in Table 1 were used to establish net activity for direct measurements, scan alarm setpoints, and to confirm the scan MDCs used were appropriate.

The instruments used in this survey unit 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 also compared to the DCGL, the investigation level, and the $DCGL_{EMC}$. As shown in this table, the scan MDC is less than the investigation criteria in all cases, thus providing high confidence (95% or higher) that an elevated area would be detected in the scanning process. Since the investigation level at the alarm setpoint 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	21.4 m^2	< 2000 m^2, Class 1
Number of Direct Measurements Required	14	Based on an adjusted LBGR of 79,000 dpm/100 cm^2, sigma[1] of 6,853 dpm/100 cm^2, and a relative shift of 3.0. Type I = Type II = 0.05
Sample Area	1.53 m^2	21.4 m^2 / 14 samples[2]
Sample Grid Spacing	1.23 m	$(1.53)^{1/2}$
Scan Grid Area	Varies[3]	No limits
Area Factor	32.6	50 m^2/1.53 m^2 per LTP, Rev. 3[4]
Scan Survey Area	21.4 m^2	Class 1 – 100%
Background		
43-68 23" - 29" Metal Pipe	656 dpm/100 cm^2	Ambient only
43-68 6" - 10" Metal Pipe	1,031 dpm/100 cm^2	Ambient only
43-68 8" Concrete Penetration	3,968 dpm/100 cm^2	Ambient and Material
43-68 24" Concrete Penetration	2,830 dpm/100 cm^2	Ambient and Material
Scan Investigation Level	DCGL	See Table 2-2 (Attachment 2)
DCGL	100,000 dpm/100 cm^2	LTP, Rev. 3
Design $DCGL_{EMC}$	3,260,000 dpm/100 cm^2	LTP, Rev. 3

1 Design sigma is listed in LTP Table 5-1A, Containment El. –2 ft., A0100 (LTP, Revision 3).
2 This survey unit was designed for N=14 samples per MARSSIM Table 5.5.
3 Each pipe or penetration, except the Neutron Detector Chute, has been designated as a scan grid (see Section B). The detector chute was divided into three grids.
4 LTP, Rev. 3 refers to the LTP submitted in October 2002 (Reference 1) as amended by the Maine Yankee Addenda of November 2002 (Reference 2). LTP, Rev. 3 was approved by the NRC in February 2003 (Reference 3).

C. SURVEY RESULTS

While 14 direct measurements were required, 16 were made in Survey Unit 5. All direct measurements were less than the DCGL. The resulting data are presented in Table 2 below.

One verified alarm was received during the surface scans using the 43-68 probe. The investigation of verified alarms is discussed in the following section.

TABLE 2

DIRECT MEASUREMENTS

Sample Number	Gross Activity (dpm/100 cm^2)	Net Activity (Table 1 Background Subtracted) (dpm/100 cm^2)
FA0100-5-M001	456	-200
FA0100-5-M002	559	-97
FA0100-5-M003	559	-97
FA0100-5-M004	521	-135
FA0100-5-C005	3,540	711
FA0100-5-C006	3,078	248
FA0100-5-C007	2,374	-455
FA0100-5-C008	2,581	-248
FA0100-5-M009	494	-162
FA0100-5-M010	534	-121
FA0100-5-C011	4,830	861
FA0100-5-M012	637	-19
FA0100-5-C013	3,237	407
FA0100-5-C014	3,423	594
FA0100-5-M015	2,177	1,146
FA0100-5-C016	648	-8
Mean	**1,853**	**151**
Median	**1,413**	**-58**
Standard Deviation	**1,463**	**459**
Range	**456 - 4,830**	**-455 – 1,146**

D. SURVEY UNIT INVESTIGATIONS PERFORMED AND RESULTS

The scan identified one area of potentially elevated activity. Scan grid location M012 in the Neutron Detector Chute alarmed and was determined to be due to high gamma activity associated with activated concrete and not surface activity in the ICI sump. Investigation results are summarized in Attachment 3 (Table 3-1). The investigation is discussed in more detail in Section E to follow.

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. Without subtracting background, all direct measurement results were below the DCGL. The maximum direct sample result with background subtracted was equivalent to 1,146 dpm/100 cm^2. When adjusted for background (Table 1 background subtracted), the mean residual contamination level is 151 dpm/100 cm^2. This is equivalent to an annual dose of 0.00008 mrem/y.[5]

One verified alarm was investigated, as shown in Table 3-1 of Attachment 3. This alarm was at scan grid location M012 (6" diameter steel) in the Neutron Detector Chute. The instrument had an alarm setpoint of 23,500 cpm, and alarmed on a reading of 32,400 cpm. After the alarm was verified, the grid was rescanned with a shielded probe yielding 28,700 cpm. The difference between the shielded and the original measurement was 3,700 cpm which was significantly less than the alarm setpoint of 23,500 cpm. This indicates that high gamma activity associated with activated concrete caused the alarm and not surface contamination. This result was not unexpected because the measurement location is in the ICI sump. The difference of 3,700 cpm is equivalent to 15,703 dpm/100 cm^2 and is significantly less than the DCGL of 100,000 dpm/100 cm^2.

F. ADDITIONAL DATA EVALUATION

Attachment 4 provides additional data evaluation associated with Survey Unit 5, 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 shown in the table, all of the key release criteria were clearly satisfied for FSS of this survey unit.

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. There is no reason to conclude that the data set represents other than random variations in a Class 1 survey unit. It also should be noted that the maximum net activity (1,146 dpm/100 cm^2 at location M015) is well below the DCGL of 100,000 dpm/100 cm^2.

3. A histogram plot was also developed on the direct measurement values. This plot shows that the direct data were essentially a normal distribution.

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[5] This annual dose equivalent is based on LTP Table 6-11 which shows the BOP embedded piping dose contribution (for embedded piping contaminated at the DCGL) to be 0.0511 mrem/y.

4. A Retrospective Power Curve was constructed based on FSS results. The curve shows that the 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.

As mentioned in Section B, removable contamination samples were obtained at each (direct) measurement location. In that this survey unit involved embedded pipe and not a standing building, the removable contamination measurements were not applicable to release decisions for the survey unit. However, the samples were obtained and evaluated, indicating alpha activity less than MDA values (i.e., $\leq$ 3.2 dpm/100 cm^2) and the maximum beta activity at 8.1 dpm/100 cm^2. Thus, in comparison with the mean survey unit net activity (Table 2), the removable contamination sampling effort indicated that the majority of activity is fixed.

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

The survey was designed as a Class 1 area; the results were consistent with that classification. The post-remediation 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 5 was designed and performed using the criteria of the approved LTP, Revision 3 Addenda (References 1, 2, and 3) and the license amendment related to modifications of the activated concrete remediation plan submitted September 11, 2003 (Reference 4).

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 beta direct measurements were less than the DCGL of 100,000 dpm/100 cm^2.

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 normal distribution, 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 with significant aspects of the design discussed in Section B and Table 1. Scanning resulted in one verified alarm (Section C) for evaluation. Attachment 3 shows the area identified by the verified alarm and provides the result of the investigation actions. The area under investigation was determined to be the result of high gamma activity in the activated concrete found in the ICI sump. The elevated measurement comparison was not performed.

In addition, while not part of the release decision criteria, removable contamination sampling confirmed that the majority of remaining activity in this basement survey unit was fixed.

It is concluded that FA0100 Survey Unit 5 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

2. Maine Yankee letter to NRC, MN-02-061, dated November 26, 2002

3. NRC letter to Maine Yankee, dated February 28, 2003

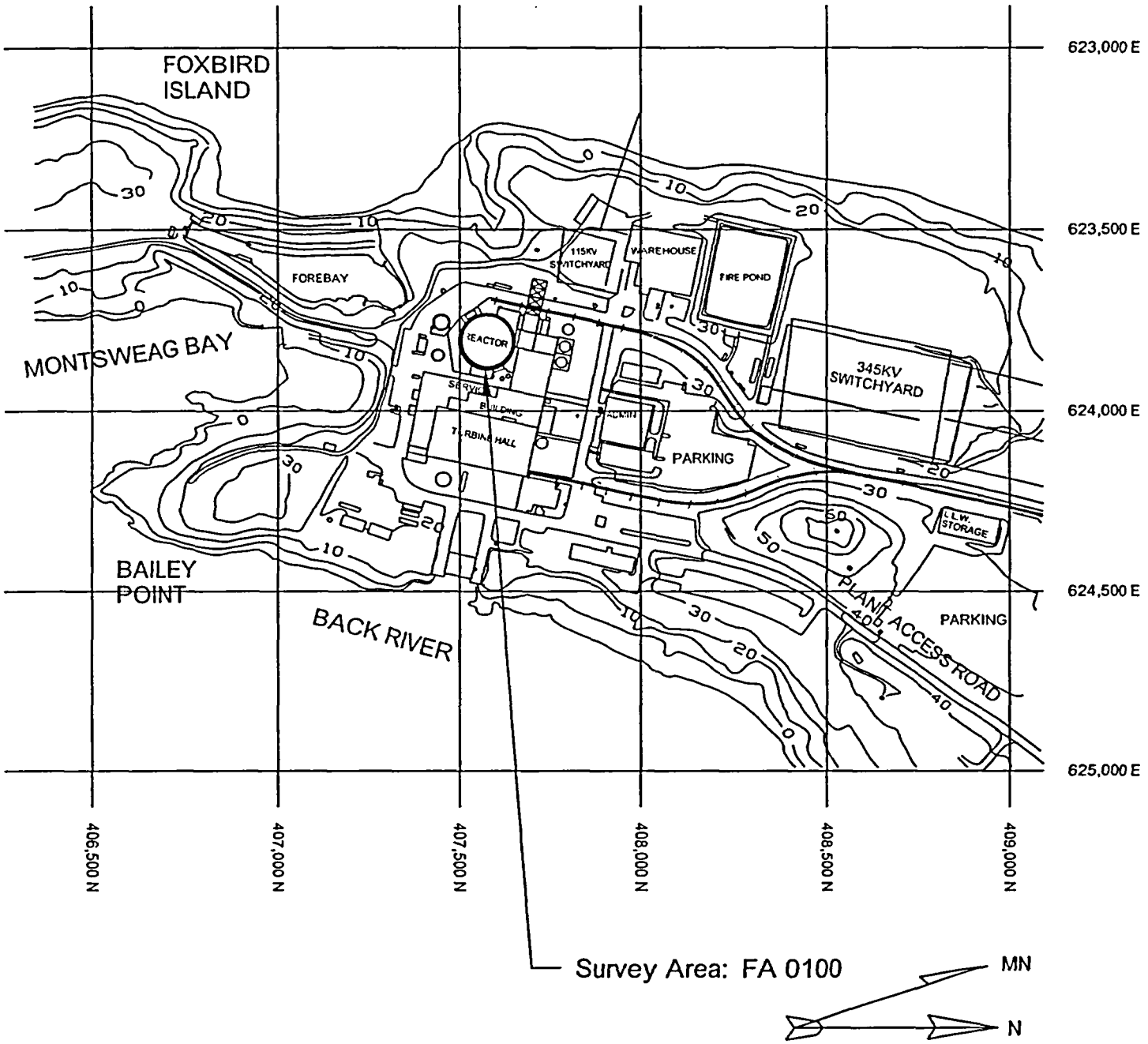
4. Maine Yankee letter to NRC, MN-03-049, dated September 11, 2003

Attachment 1

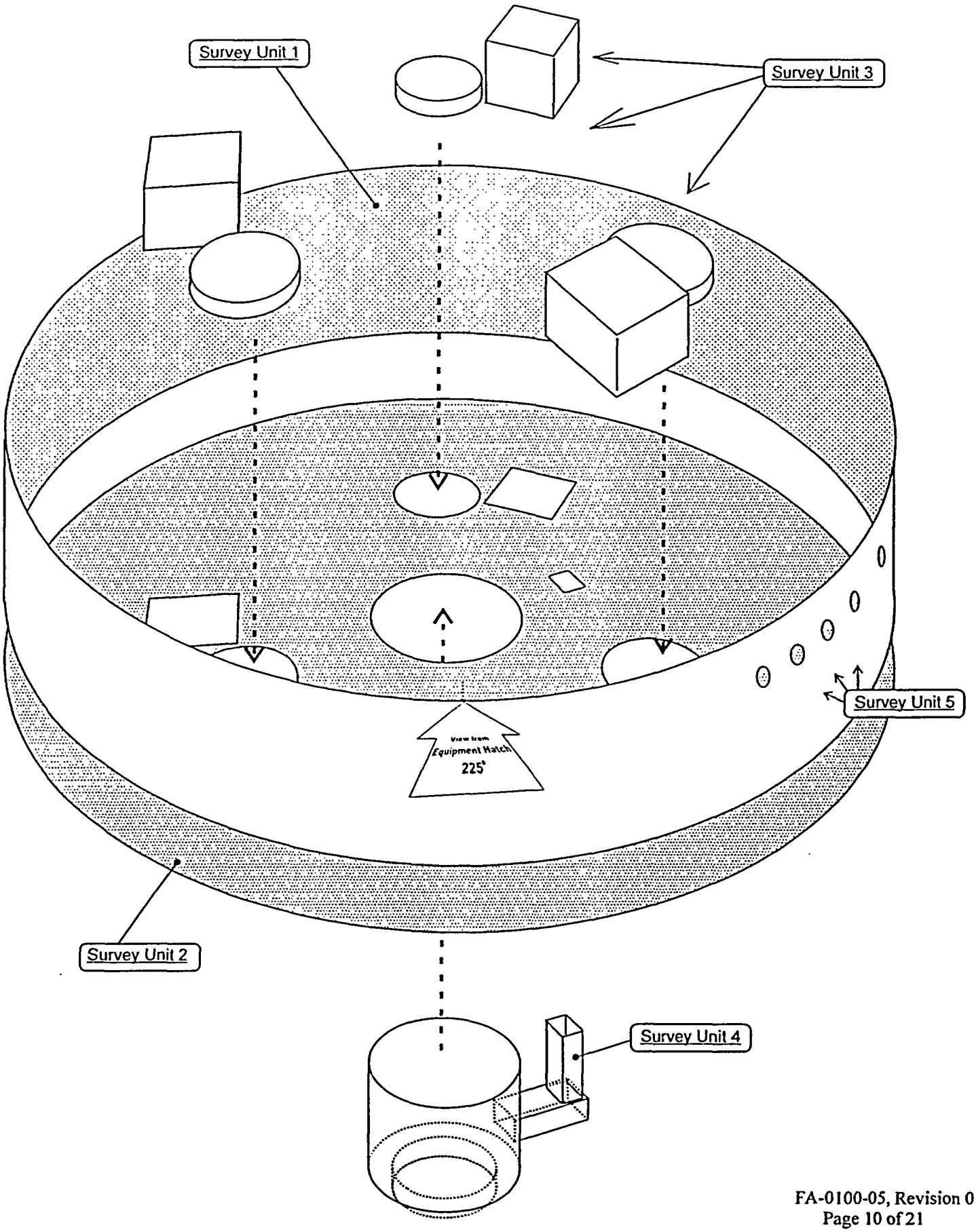
Survey Unit Maps

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Form*	Map ID #: FA 0100
Survey Type: ☐ Characterization ☐ Turnover ■ Final Status Survey	Survey Area Name: Reactor Containment Building	

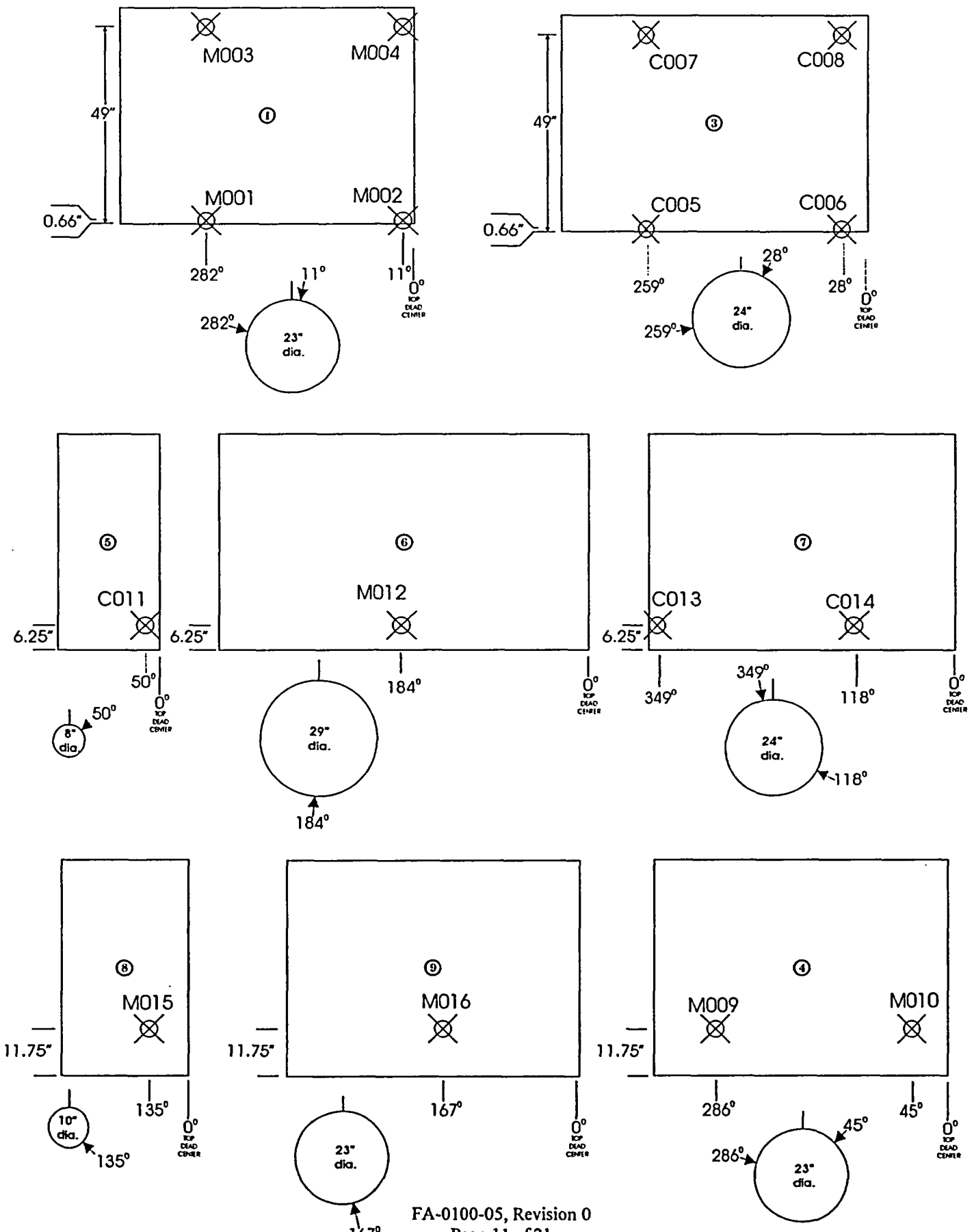
Note: Grid based on Maine State Coordinate System (West Zone) NAD 1927

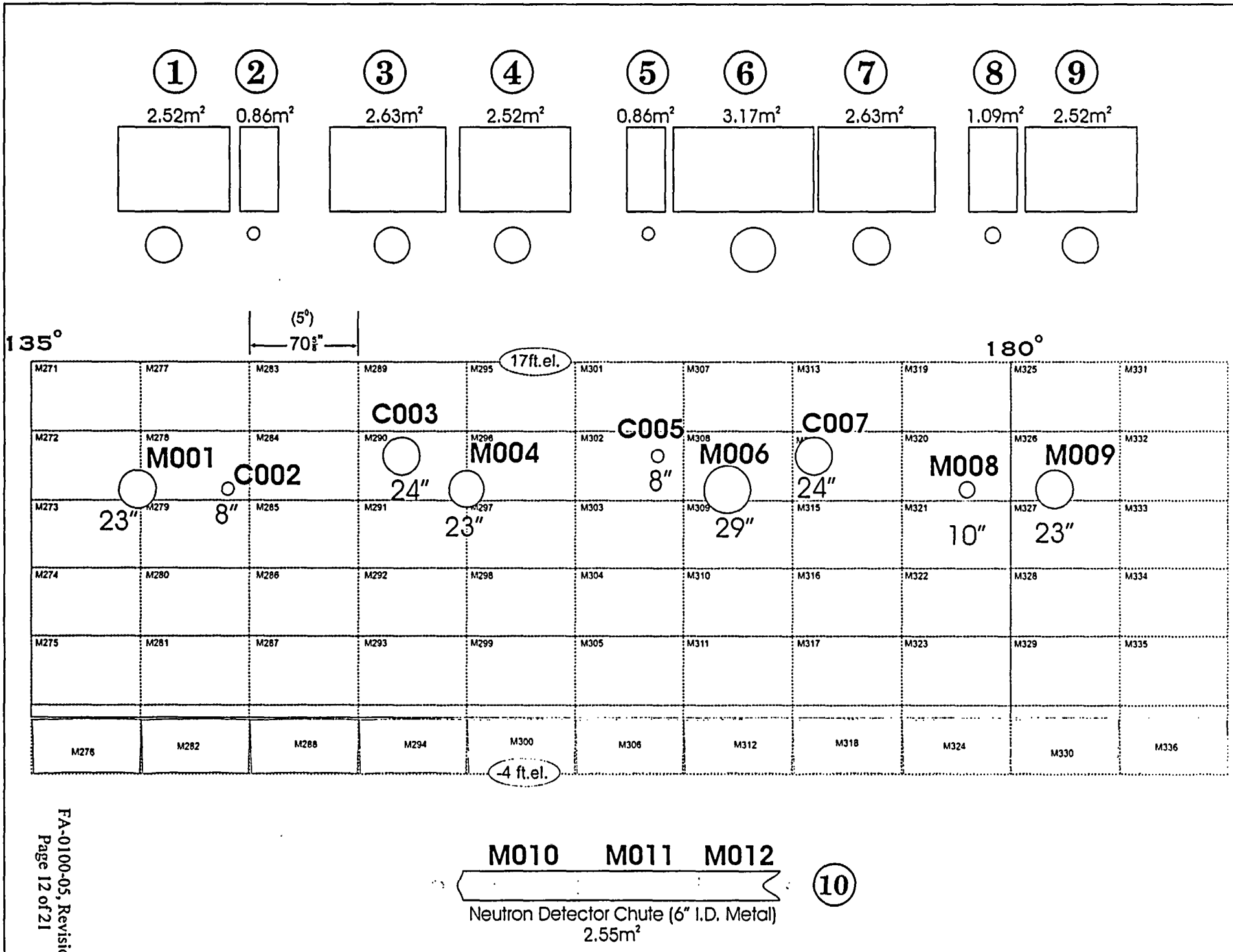


Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Map*	Map ID# FA 0100-UNITS
Survey Type: ☐ Verification ☐ Turnover ☒ Final Status Survey		Area Name: Containment Bldg. (Internal) 17' el. & below



Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Map*	Map ID# FA 0100-U5-DIRECTS
Survey Type: ☐ Verification ☐ Turnover ☒ Final Status Survey		Survey Area Name: Containment Bldg. Survey Unit 5





Maine Yankee Decommissioning Team

Survey Type: ☐ Verification ☐ Turnover ☒ Final Status Survey

Maine Yankee Decommissioning Project Survey Map

Survey Area Name: Containment Bldg. Survey Unit 5

Map ID# FA 0100-U5-SCANS

Attachment 2

Survey Unit Instrumentation

TABLE 2-1

INSTRUMENT INFORMATION

E-600 S/N	Probe S/N (type)
1933	177992 (43-68-5)
1929	177991 (43-68-5)

TABLE 2-2

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

Detector	43-68 Metal Pipe		43-68 Concrete Penetration	
	23" – 29"	6" - 10"	8"	24"
Scan MDC[6] (dpm/100 cm^2)	810	1,274	2,904	2,071
DCGL (dpm/100 cm^2)	100,000	100,000	100,000	100,000
Investigation Level (Alarm Setpoint) (dpm/100 cm^2)	99,989 (DCGL)	99,992 (DCGL)	99,981 (DCGL)	100,000 (DCGL)
Design $DCGL_{EMC}$ (dpm/100 cm^2) (from Release Record Table 1)	3.26E+6	3.26E+6	3.26E+6	3.26E+6

[6] Scan MDCs taken from LTP Table 5-6 and corrected for changes in efficiencies due to penetration geometry and materials.

Attachment 3

Investigation Table

TABLE 3-1

INVESTIGATION TABLE

Scan Alarm			Scan Investigation		$DCGL_{EMC}$ Comparison			
Elevated Area Grid No. (Instrument Used)	Alarm Setpoint (cpm)	Alarm Value (cpm)	Scaler (cpm)	Area (cm^2)	AF	$DCGL_{EMC}$ (dpm/100 cm^2)	Elevated Area Activity (dpm/100 cm^2)	$DCGL_{EMC}$ Comparison Fraction
M012 (43-68-5)	23,500	32,400	28,700[7] (Shielded)	N/A	N/A	N/A	< DCGL	N/A
Survey Unit Remainder	N/A	N/A	N/A	N/A	N/A	DCGL = 100,000	Survey Unit Mean = 151	0.00151
							Total	0.00151

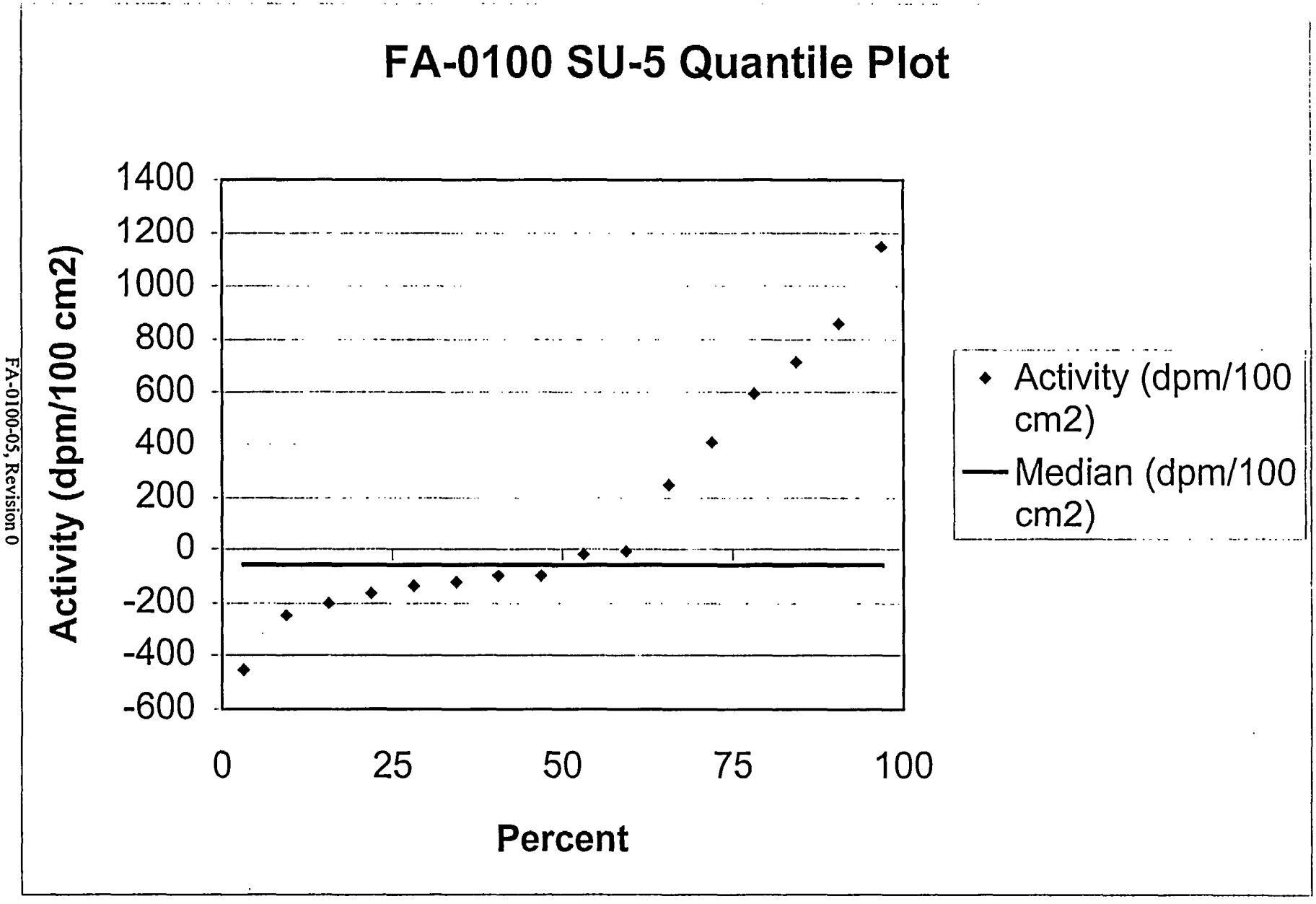
[7] This scan was conducted on the far end of the neutron detector chute which was influenced by the high gamma field created by the activated concrete surrounding the ICI sump into which the chute penetrates. The scan was repeated using a beta-shielded detector and the scan value was 28,700 c/m. The net beta response between the two readings was 3,700 c/m which was similar to the scan values taken above the activated portion of the chute (i.e., 4,200 c/m and 2,750 c/m). The neutron detector chute was determined not to have surface contamination above the DCGL.

Attachment 4

Statistical Data

Survey Package FA-0100 Unit 5 Surface Sign Test Summary

Evaluation Input Values		Comments
Survey Package:	FA-0100	Containment Building
Survey Unit:	05	
Evaluator:	GP	
$DCGL_w$:	100,000	
$DCGL_{emc}$:	3,260,000	
LBGR:	79,000	
Sigma:	6,853	
Type I error:	0.05	
Type II error:	0.05	The following efficiencies were used:
Total Instrument Efficiency:	29.4%	, 18.7%,8.2%,11.5%
Detector Area (cm^2):	126	based on pipe size & material
Material Type:	N/A	Choosing 'N/A' sets material background to "0"
Calculated Values		**Comments**
$Z_{1-\alpha}$:	1.645	
$Z_{1-\beta}$:	1.645	
Sign p:	0.99865	
Calculated Relative Shift:	3.0	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift >3
N-Value:	11	
N-Value+20%:	14	
Static Data Values		**Comments**
Number of Samples:	16	
Median:	-58	
Mean:	151	
Net Static Data Standard Deviation:	459	
Total Standard Deviation:	459	SRSS
Maximum:	1,147	
Sign Test Results		**Comments**
Adjusted N Value:	16	
S+ Value:	16	
Critical Value:	11	
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	
Sign test results:	Pass	
Final Status		**Comments**
The survey unit passes all conditions:	Pass	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400
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0
-200
-400
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25
50
75
100
Percent
Activity (dpm/100 cm2)
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One-Sample T-Test Report

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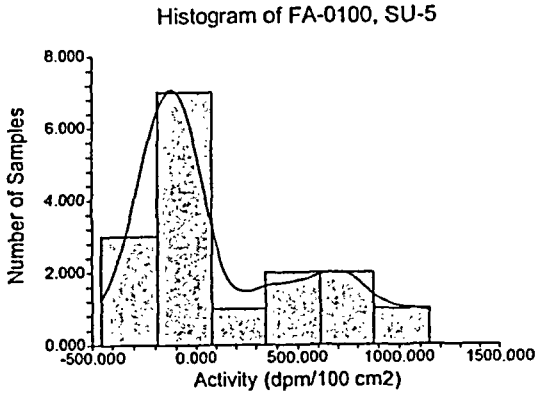
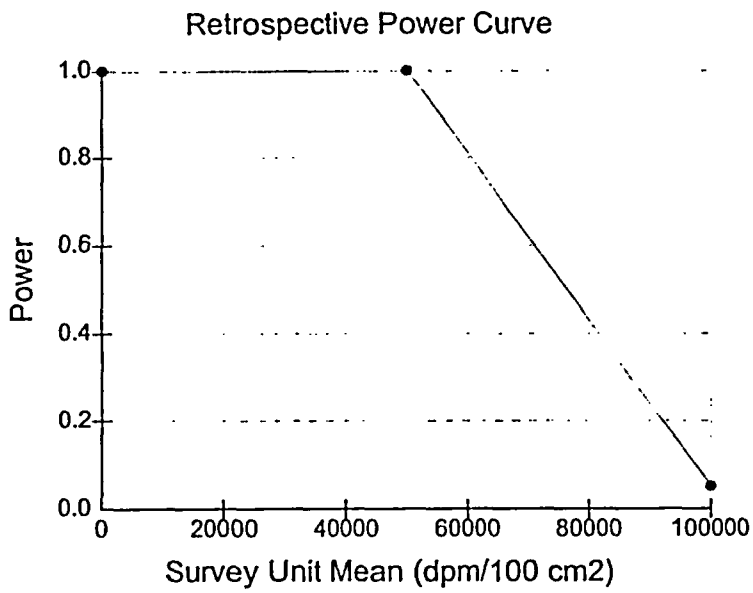
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