MAINE YANKEE
FINAL STATUS SURVEY RELEASE RECORD
FA-0100 CONTAINMENT BUILDING
SURVEY UNIT 2

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A. SURVEY UNIT DESCRIPTION

Survey Unit 2 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 2 consisted of the surface of the Containment Building floor (bare steel liner) on the -4 foot elevation. The physical configuration of Survey Unit 2 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 1102.1 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. Given a relative shift of 1.3, it was determined that 21 direct measurements were required for the Sign Test. The design was conservatively based on 30 direct measurements. Thirty-two measurements actually fell in the survey unit. Each sample location was determined using a fixed square grid with a random start point. These locations are presented on survey map FA0100-U2-DIRECTS (Attachment 1). Once the direct readings were completed, removable contamination samples were obtained at each measurement location.

A 100% scan coverage of the area was required. The survey was designed to include 588 scan grids each of approximately 2 m^2 area. Instrument scan setpoints were conservatively set below the $DCGL_{EMC}$, as shown in Table 2-2 (Attachment 2). The location of the scan grids is shown on maps FA 0100-U2-A through FA 0100-U2-J (Attachment 1).

To accommodate measurement geometry requirements for surfaces of non-uniform smoothness (including junctures), the SHP-360 and the 43-68 probes were used to augment the scan survey. First, a 43-37 scan was performed on all surfaces, including those unlikely to meet geometry requirements for that model of probe. Then a repeat scan, using the SHP-360, was performed on areas with surface irregularities that required a smaller probe size. Ninety-degree surface junctures (i.e., wall-pedestal junctures) were scanned using the 43-68 probe with a reduced efficiency.

Background values were established for each particular instrument probe application based on ambient background values in the survey area. No material backgrounds were included because of the minor background contribution from bare steel. The background values, listed in Table 1, were used to establish net activity for direct measurements, scan investigation levels, 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	1,102.1 m^2	Section 5, LTP, Class 1 (Reference 1)
Number of Direct Measurements Required	21	Based on an LBGR of 9,000 dpm/100 cm^2, sigma[1] of 6,853 dpm/100 cm^2, and a relative shift of 1.3. Type I = Type II = 0.05
Sample Area	36.7 m^2	1,102 m^2 / 30 samples[2]
Sample Grid Spacing	6.0 m	$(36.7)^{1/2}$
Scan Grid Area	2 m^2 (approx.)	
Area Factor	1.3	50 m^2/36.7 m^2 per LTP, Rev. 3
Scan Area	1102.1 m^2	Class 1 – 100%
Background		
43-68 Direct and Scan (flat surfaces)	584 dpm/100 cm^2	Ambient only
SHP-360 Scan (surface irregularities)	940 dpm/100 cm^2	Ambient only
43-68 Junctures	1,519 dpm/100 cm^2	Ambient only
43-37 Scans (flat surfaces)	334 dpm/100 cm^2	Ambient only
Scan Investigation Level	DCGL plus background	See Table 2-2 (Attachment 2)
DCGL	18,000 dpm/100 cm^2	LTP, Rev. 3 (Reference 1)
Design $DCGL_{EMC}$	23,400 dpm/100 cm^2	LTP, Rev. 3 (Reference 1)

C. SURVEY RESULTS

Thirty-two direct measurements were made in Survey Unit 2. All direct measurements were less than the DCGL. Direct measurement data are presented in Table 2.

Scanning resulted in four verified alarms. Three alarms occurred while scanning flat surfaces with the 43-37 probe. One alarm was verified while scanning with the SHP-360. No alarms occurred while scanning junctures. The subsequent investigation work is discussed in the following section.

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1 LTP Revision 3, Table 5-1A for Containment El.–2 ft., A0100

2 Number of required measurements increased as a measure of conservatism. This survey unit was initially designed for N = 30 samples. The N = 30 design led to a survey unit map with 32 locations on the systematic grid.

TABLE 2

DIRECT MEASUREMENTS

Sample Location	Gross Activity dpm/100 cm^2	Net Activity (Table 1 Background Subtracted) dpm/100 cm^2
FA0100-2-M001	640	55
FA0100-2-M002	606	22
FA0100-2-M003	914	329
FA0100-2-M004	743	159
FA0100-2-M005	729	144
FA0100-2-M006	688	103
FA0100-2-M007	700	115
FA0100-2-M008	587	2
FA0100-2-M009	637	53
FA0100-2-M010	868	284
FA0100-2-M011	815	231
FA0100-2-M012	719	135
FA0100-2-M013	529	-55
FA0100-2-M014	608	24
FA0100-2-M015	777	192
FA0100-2-M016	661	77
FA0100-2-M017	998	414
FA0100-2-M018	630	46
FA0100-2-M019	671	87
FA0100-2-M020	729	144
FA0100-2-M021	859	274
FA0100-2-M022	832	248
FA0100-2-M023	676	91
FA0100-2-M024	676	91
FA0100-2-M025	681	96
FA0100-2-M026	782	197
FA0100-2-M027	2,744	2,160
FA0100-2-M028	652	67
FA0100-2-M029	709	125
FA0100-2-M030	652	67
FA0100-2-M031	700	115
FA0100-2-M032	760	176
Sample Mean	**780**	**196**
Median	**700**	**115**
Standard Deviation	**372**	**372**
Sample Range	**529 - 2,744**	**-55 – 2,160**

D. SURVEY UNIT INVESTIGATIONS PERFORMED AND RESULTS

The scan process identified 4 locations of potentially elevated activity. An investigation was performed for each location using survey investigation package XA0100-02. The investigation results and assessment 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 range, are provided in Table 2. The direct measurements were all below the DCGL without subtracting background. The maximum result, with background subtracted, is equivalent to 2,160 dpm/100 cm^2. When adjusted for background (ambient background subtracted), the mean residual contamination level is 196 dpm/100 cm^2. For a DCGL of 18,000 dpm/100 cm^2, this is equivalent to an annual dose rate of 0.003 mrem/y.[3]

The four alarms were investigated as shown in Table 3-1 of Attachment 3 and determined to be less than 1.2% of the Elevated Measurement Comparison unity limit, thereby satisfying the EMC criterion.

F. ADDITIONAL DATA EVALUATION

Attachment 4 provides additional data evaluation associated with Survey Unit 2, 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 basement survey unit. It also should be noted that the maximum net activity (2,160 dpm/100 cm^2 at location M027) is well below the DCGL of 18,000 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 log-normal distribution with 1 outlier.

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.

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[3] This annual dose equivalent is based on LTP Table 6-11 which shows the contaminated concrete dose contribution (for surfaces contaminated at the DCGL) to be 0.301 mrem/y.

As mentioned in Section B, removable contamination samples were obtained at each (direct) measurement location. In that this survey unit involved a (backfilled) basement 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 less than MDA values for alpha and beta activity (i.e., $\leq$ 3.8 dpm/100 cm^2). Thus, in comparison with the mean survey unit net activity (Table 2), the removable contamination sampling effort indicated that the 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 and no additional measurements are required.

H. LTP CHANGES SUBSEQUENT TO SURVEY UNIT FSS

The FSS of Survey Unit 2 was designed and performed using the criteria of the approved LTP, Revision 3 Addenda (Reference 1, 2, 3) and the license amendment for activated concrete (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 18,000 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 were 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, 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. Attachment 3 shows the areas identified by verified alarms and provides the results of the investigation actions. The areas under investigation were evaluated using the appropriate area factor. The survey unit was determined to satisfy the elevated measurement comparison unity rule per the LTP methodology.

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 2 meets the release criteria of 10CFR20.1402 and the State of Maine enhanced criteria.

J. REFERENCES

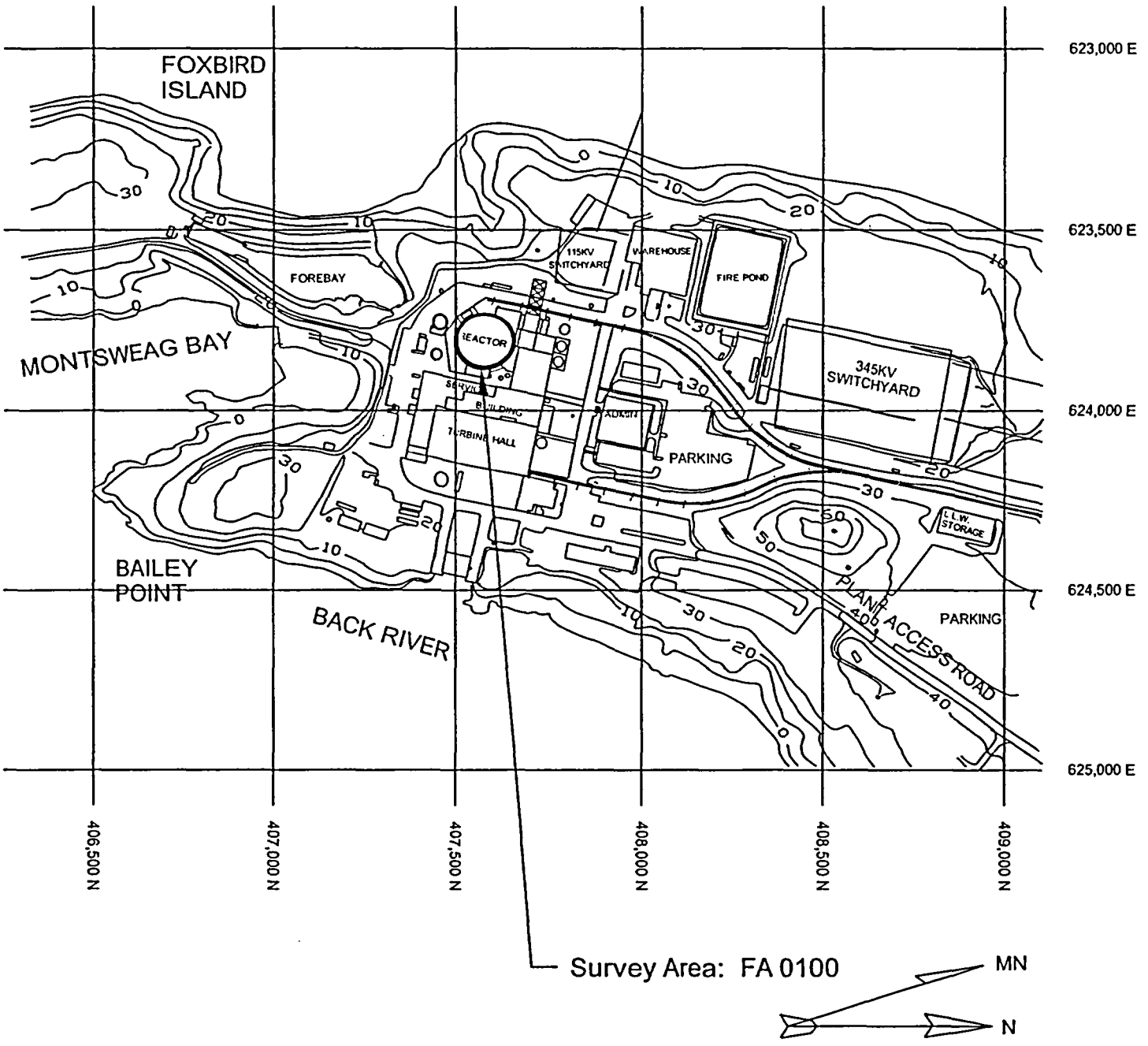
1. Maine Yankee License Termination Plan, Revision 3, October 15, 2002
2. Maine Yankee letter to the NRC, MN-02-061, dated November 26, 2002
3. NRC letter to Maine Yankee, dated February 28, 2003
4. Maine Yankee letter to the NRC, MN-03-049, dated September 11, 2003

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
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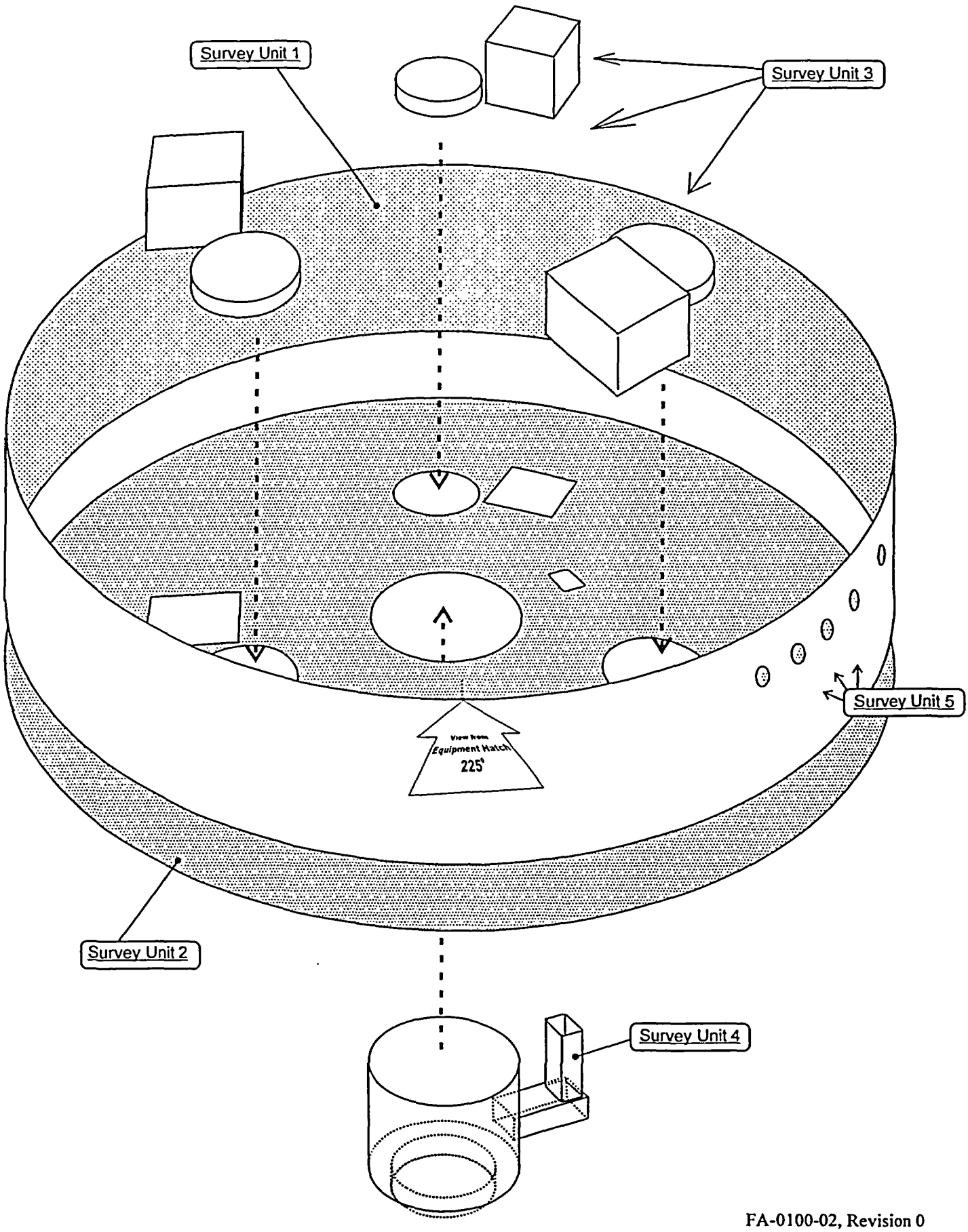

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Map*	Map ID# FA 0100-U2-DIRECTS
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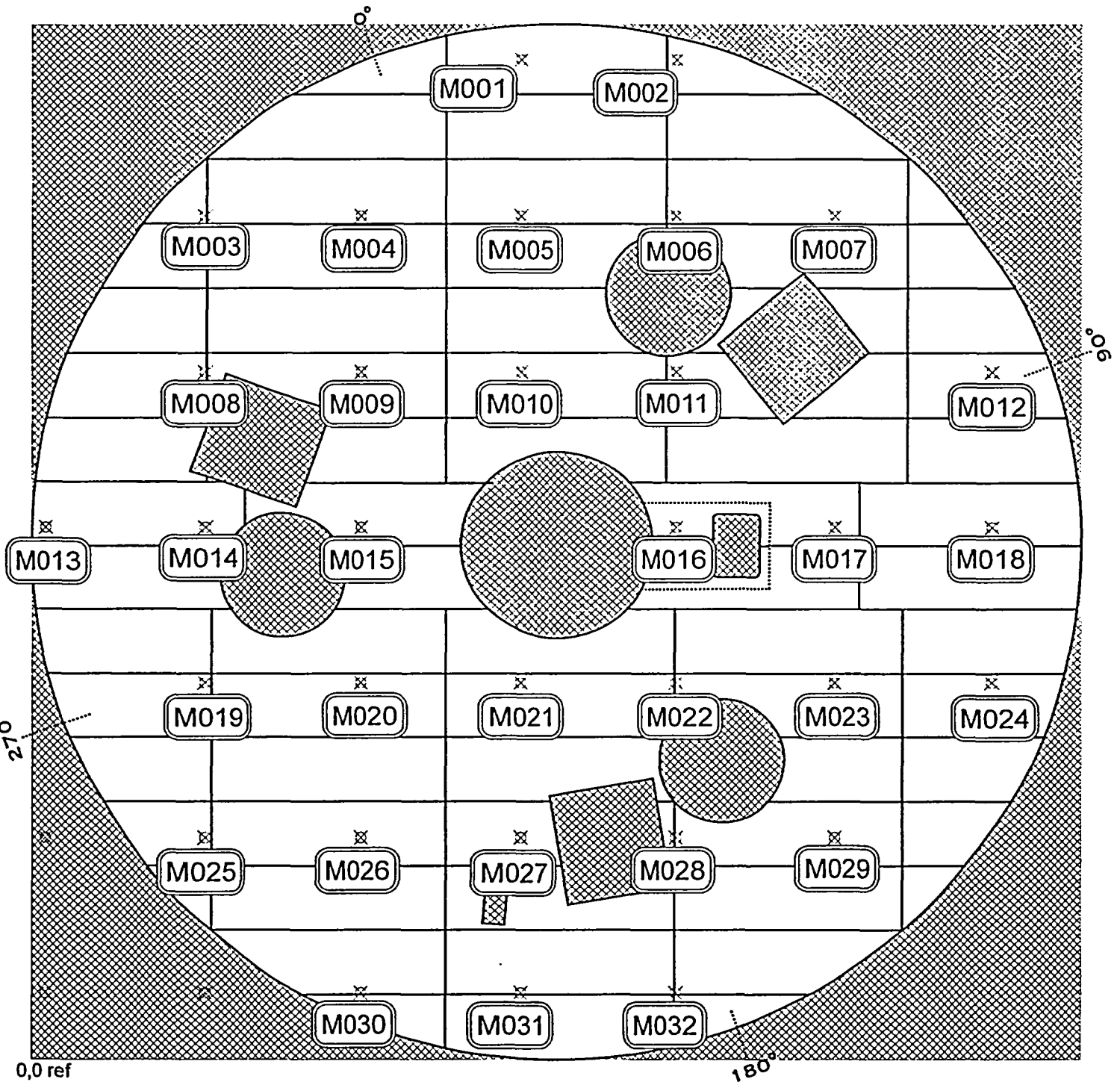

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Map*	Map ID# FA 0100-U2-A
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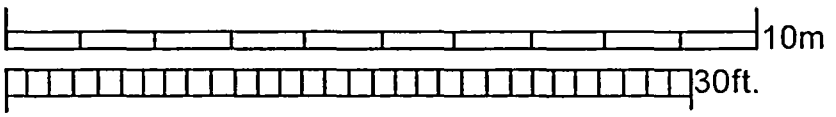

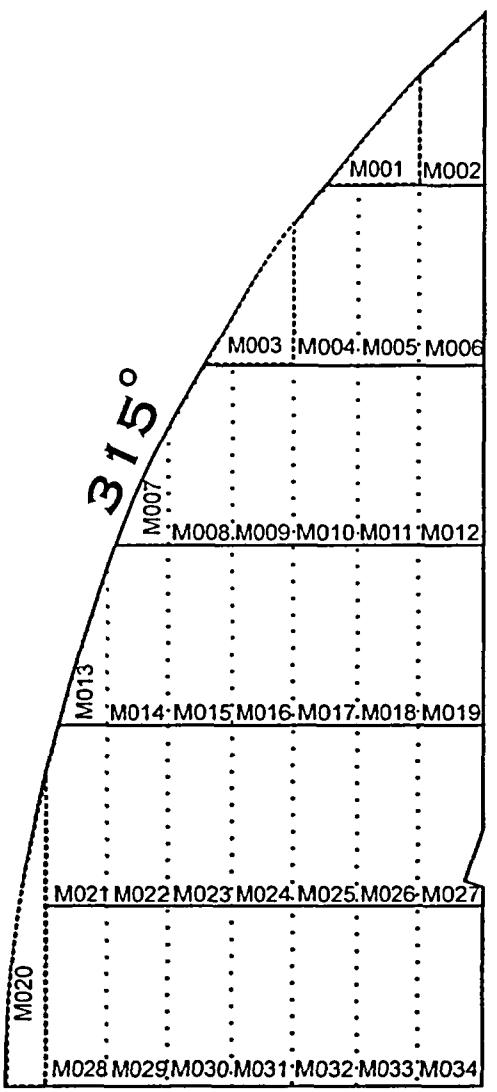

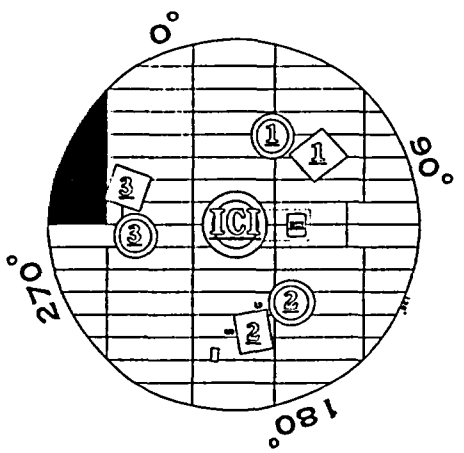

Plates C1-H1

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Map*	Map ID# FA 0100-U2-B
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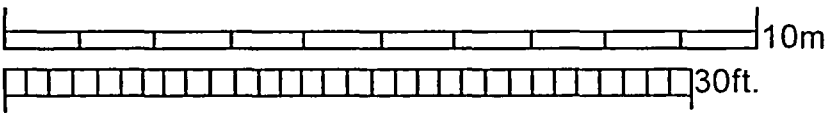

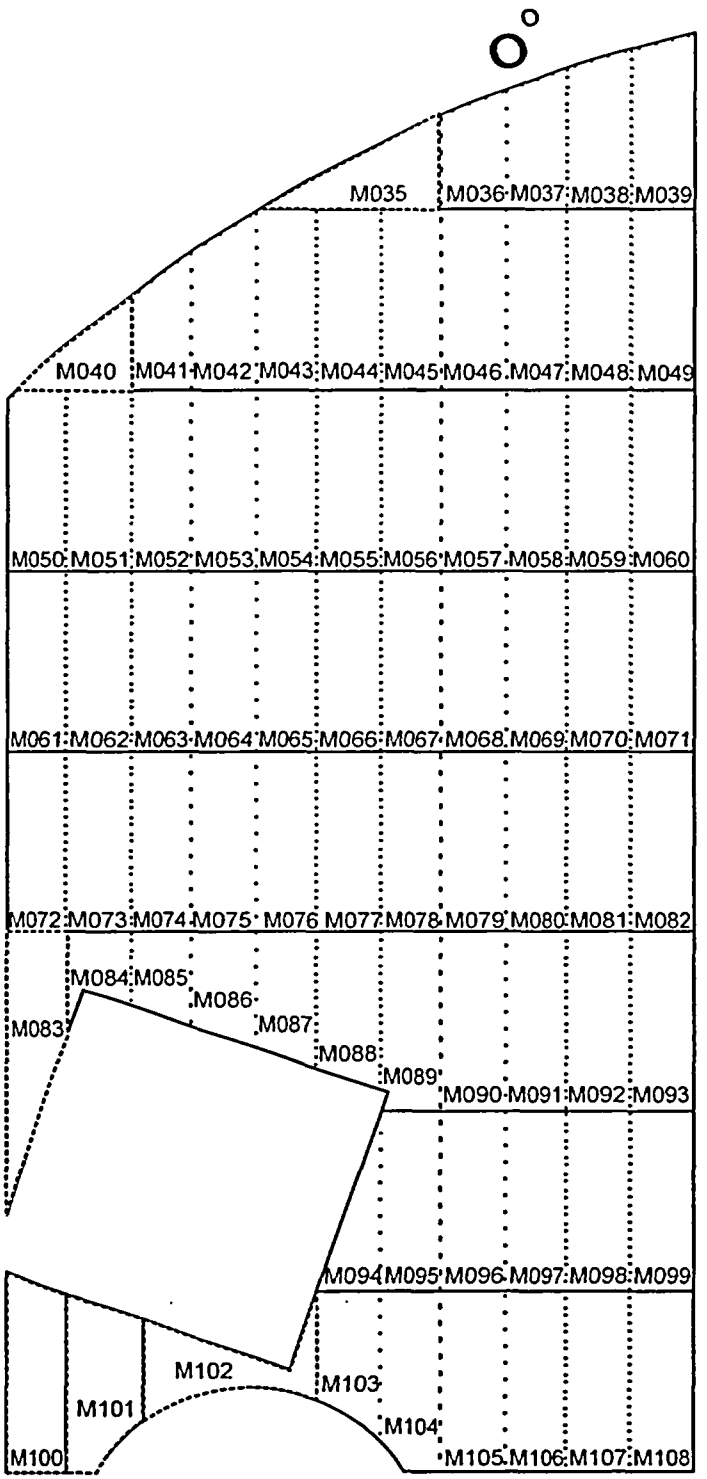

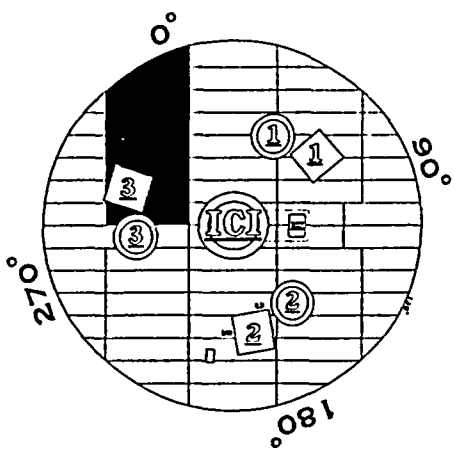

Plates A2-H2

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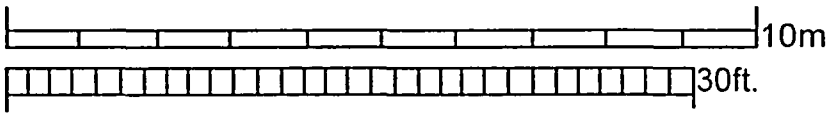

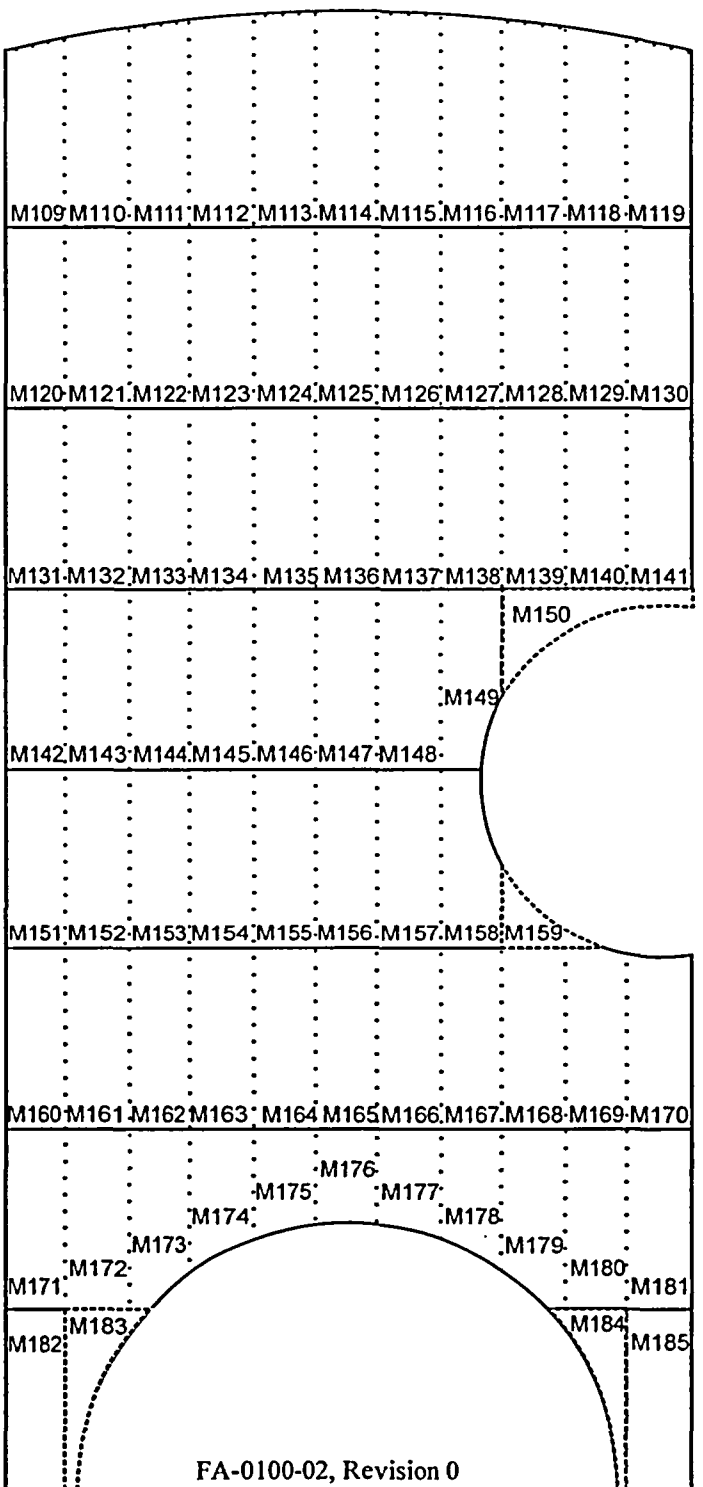

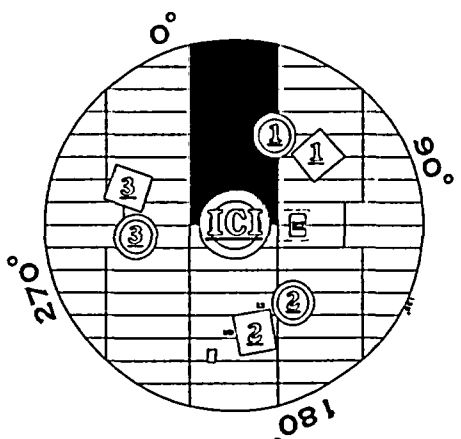

Plates A3-H3

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Map*	Map ID# FA 0100-U2-D
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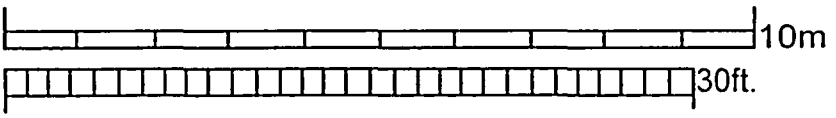

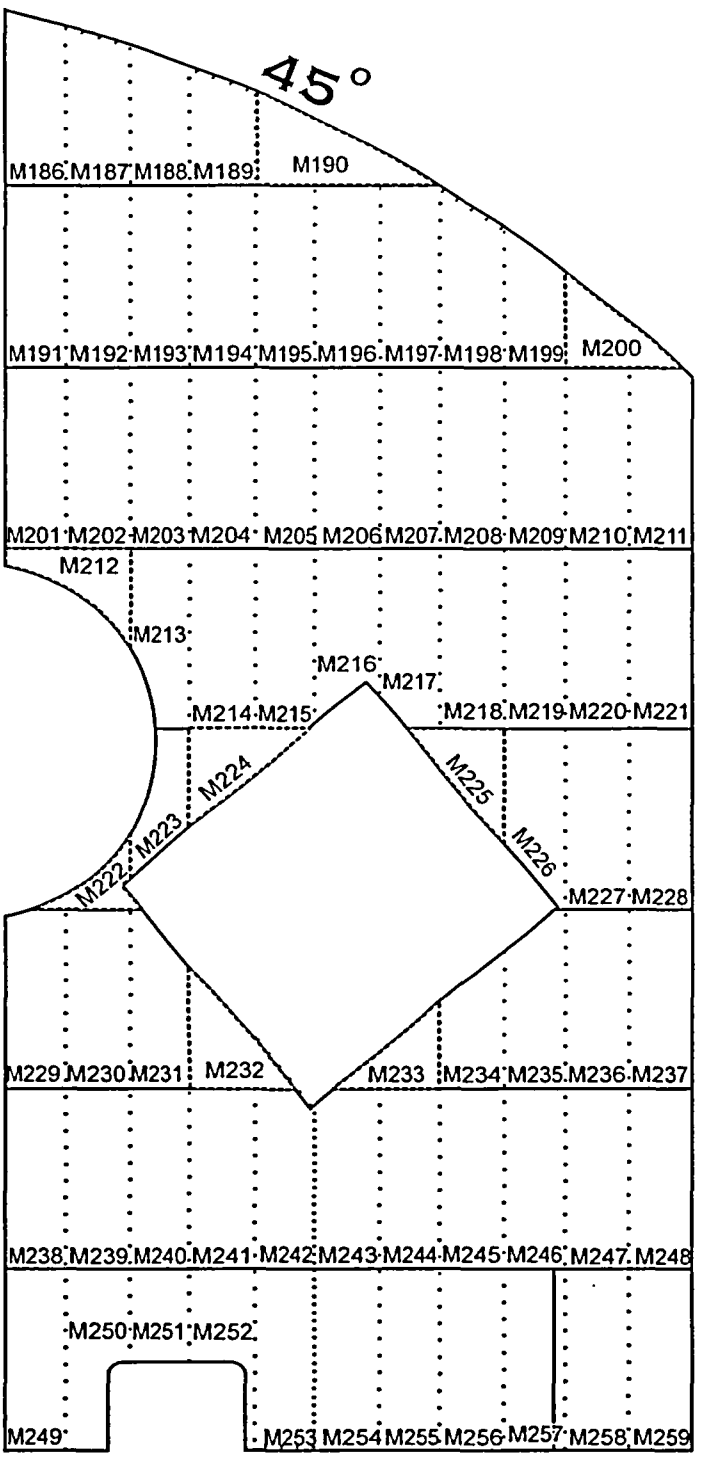

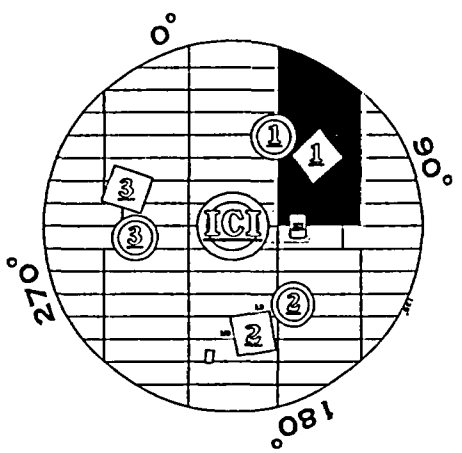

Plates A4-H4

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Map*	Map ID# FA 0100-U2-E
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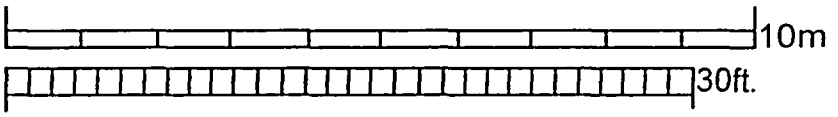

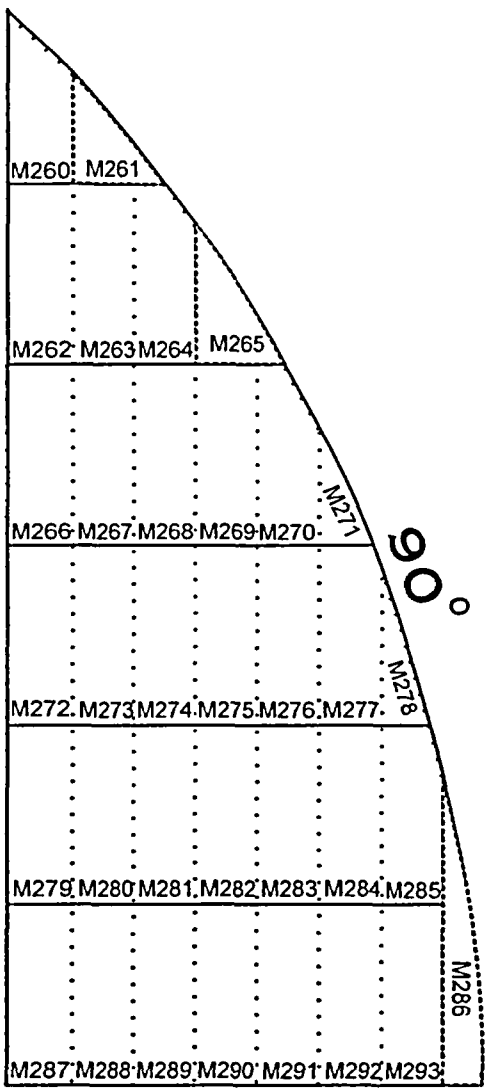

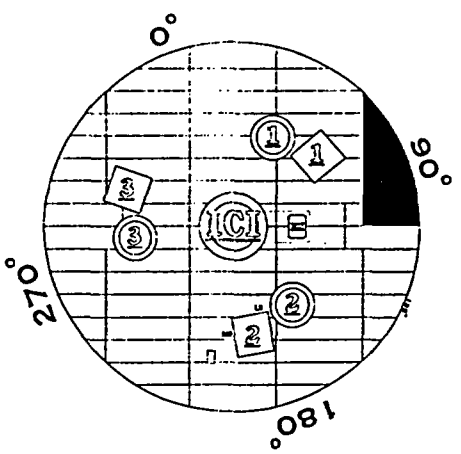

Plates C5-H5

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Map*	Map ID# FA 0100-U2-F
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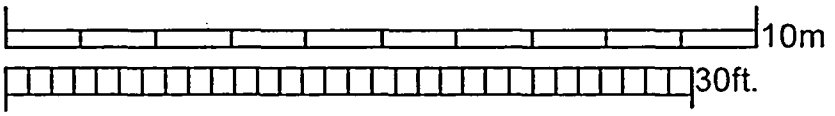

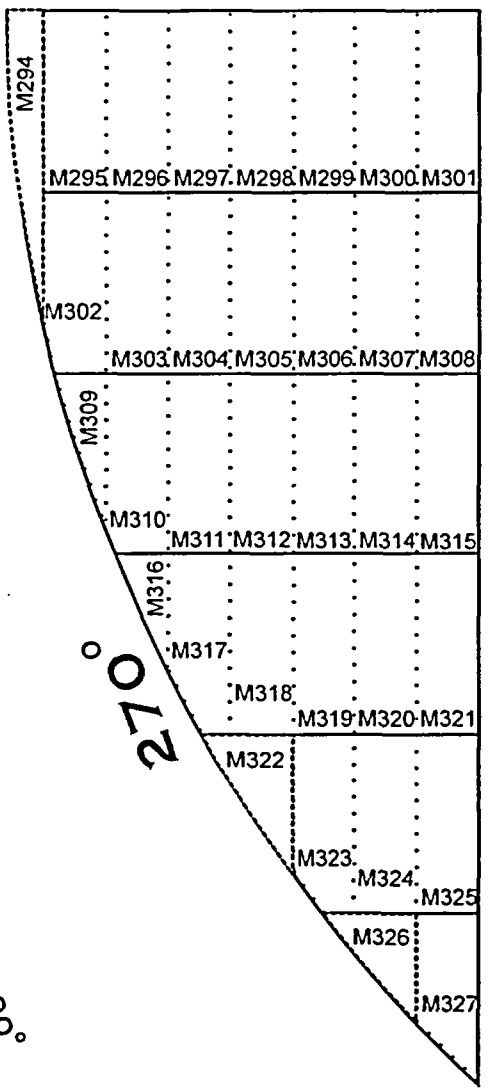

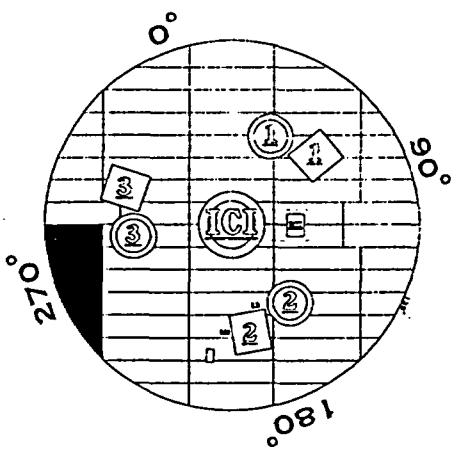

Plates I1-N1

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Map*	Map ID# FA 0100-U2-G
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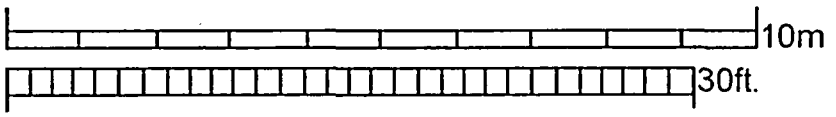

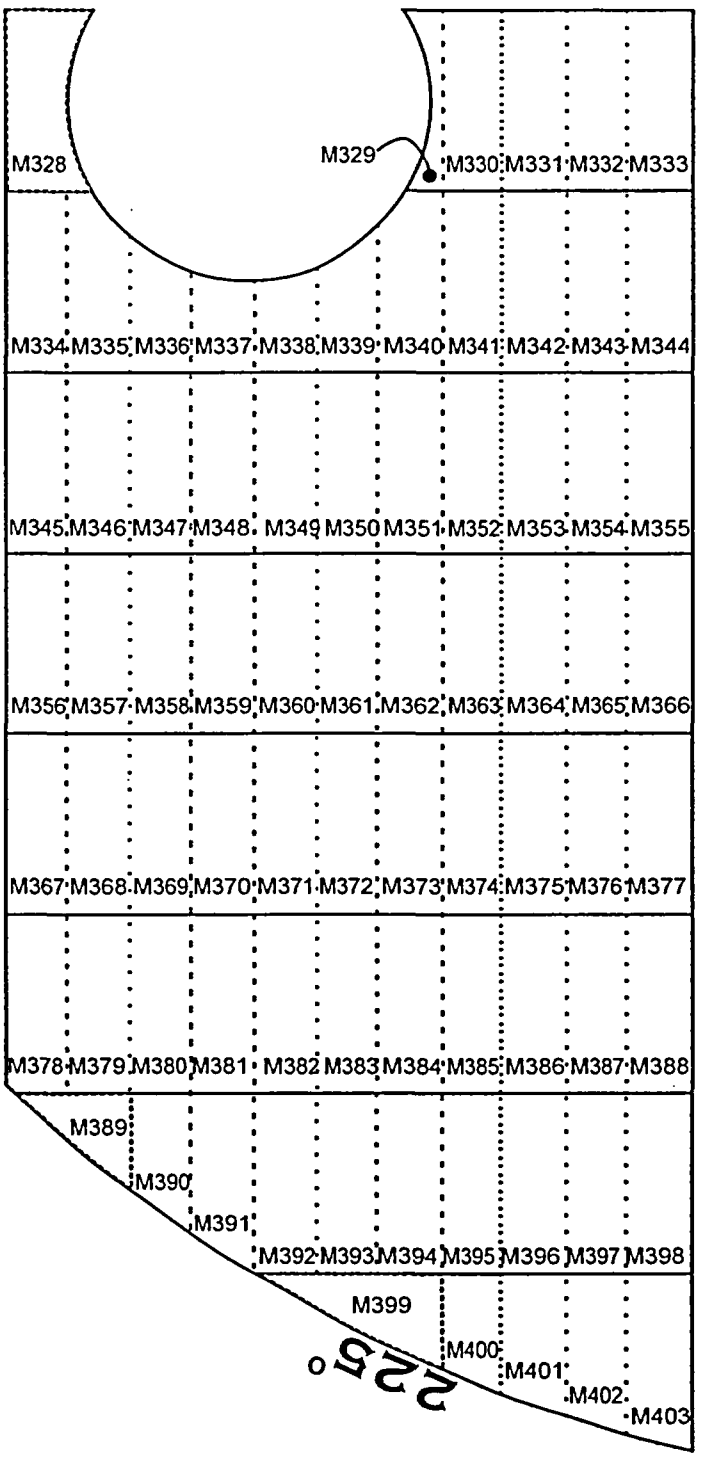

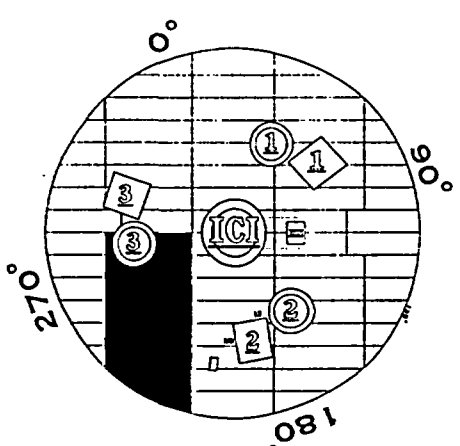

Plates I2-P2

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Map*	Map ID# FA 0100-U2-H
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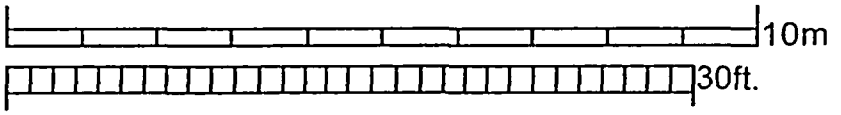
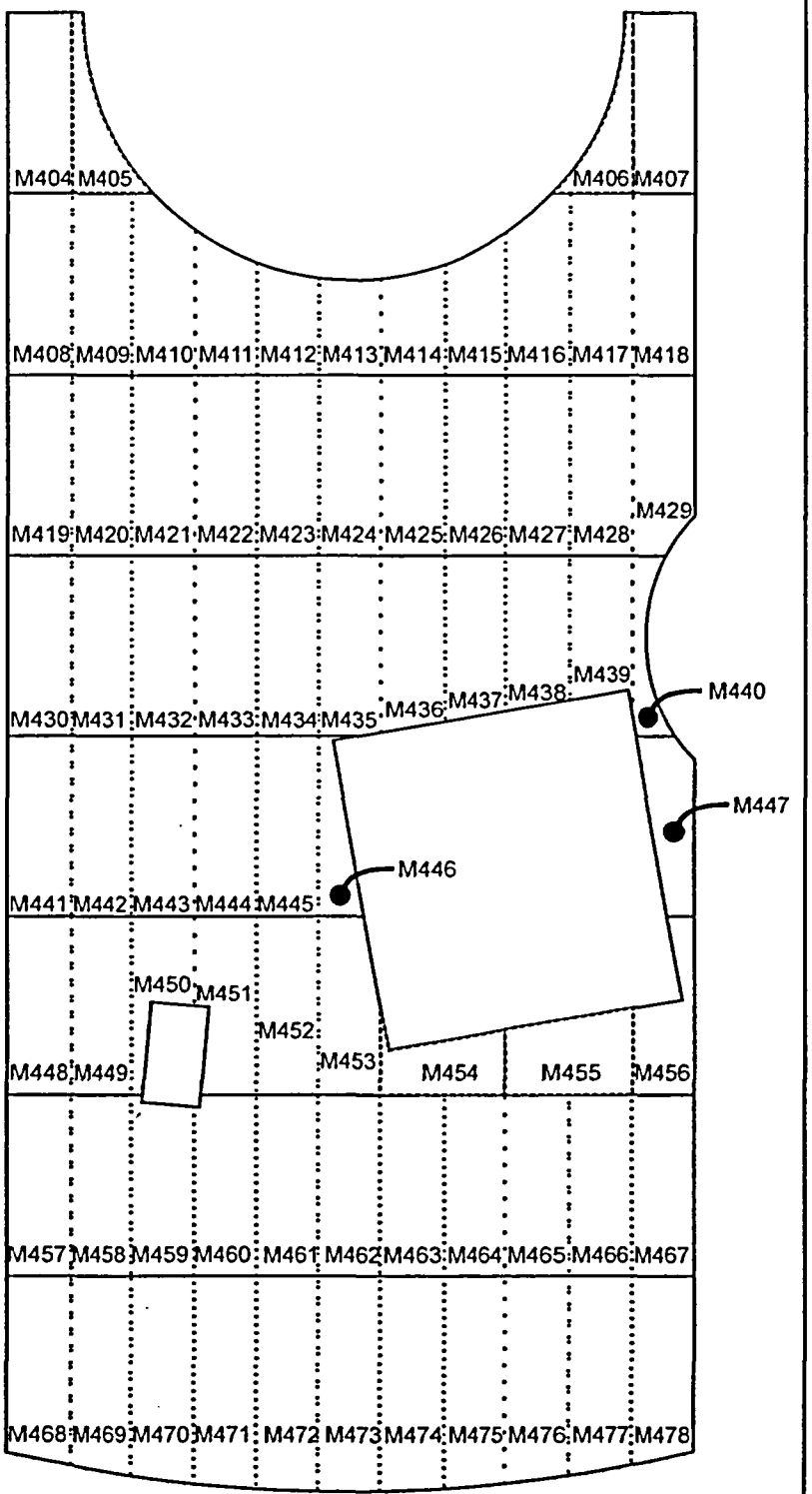
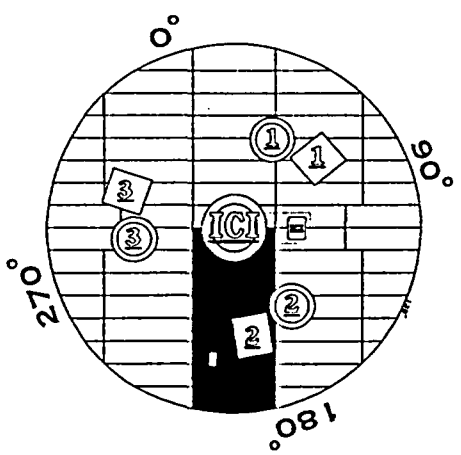
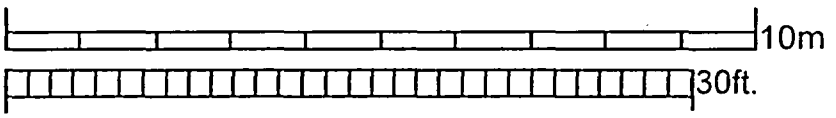


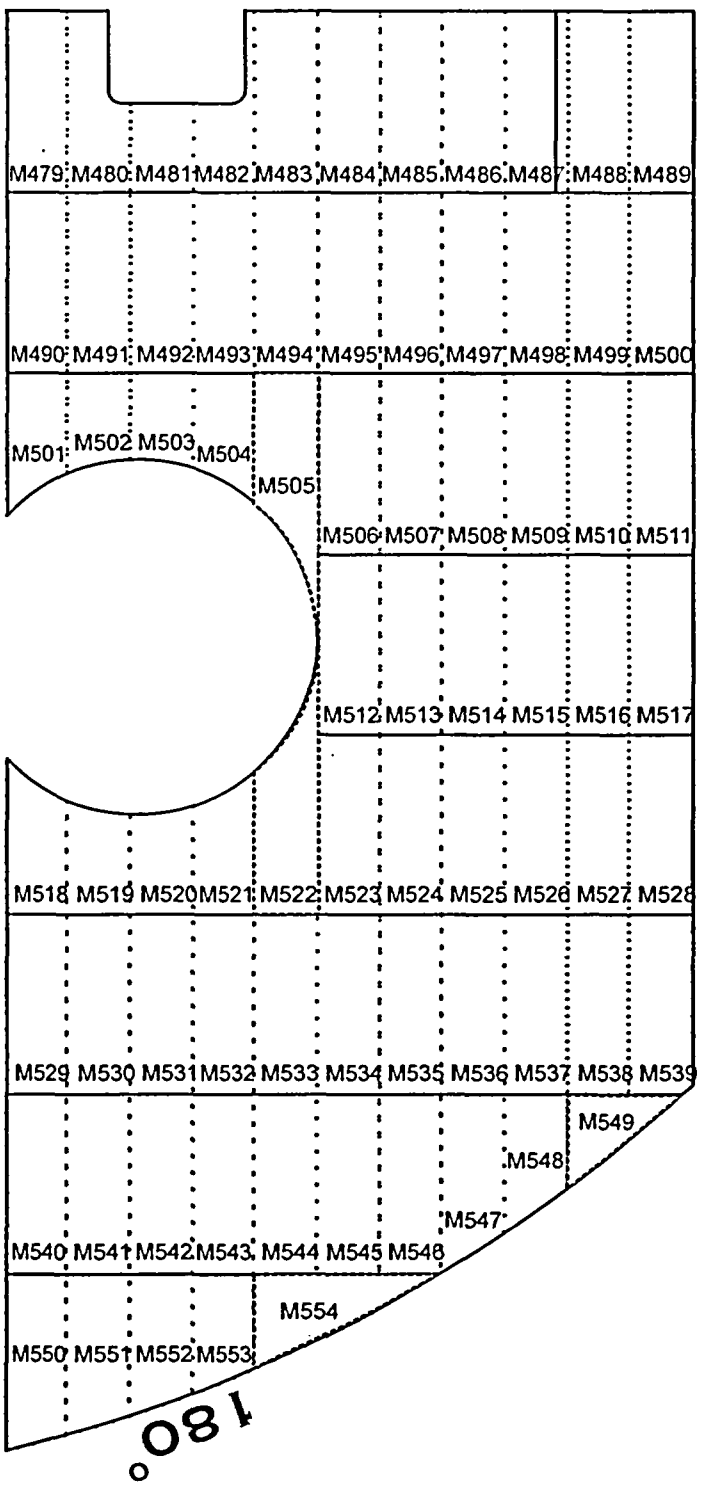


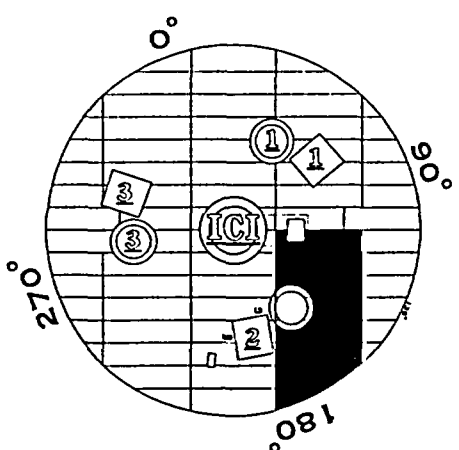


Plates I3-P3

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Map*	Map ID# FA 0100-U2-I
Survey Type: ☐ Verification ☐ Turnover ☒ Final Status Survey	Survey Area Name: Containment Bldg. Survey Unit 2	

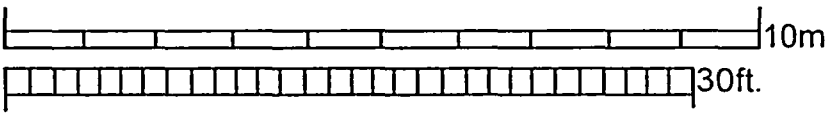


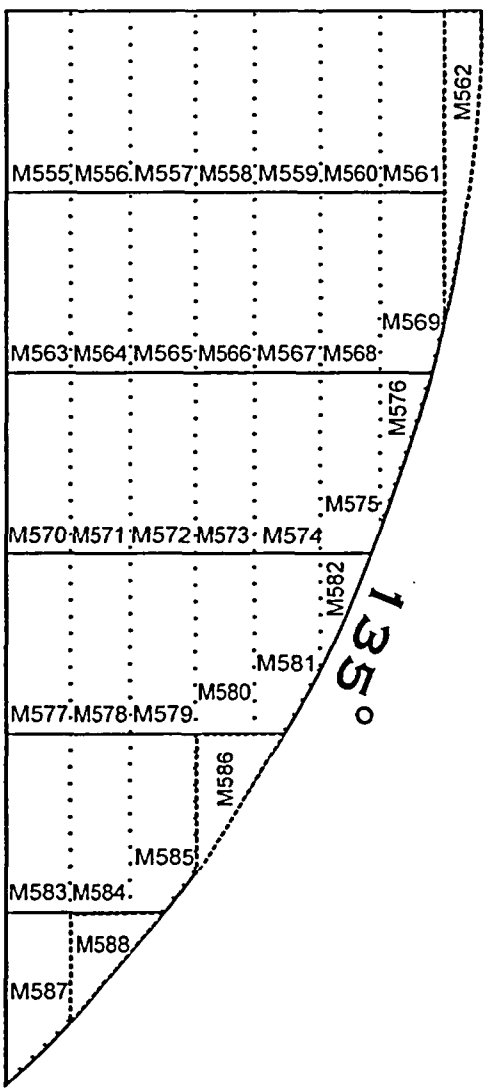


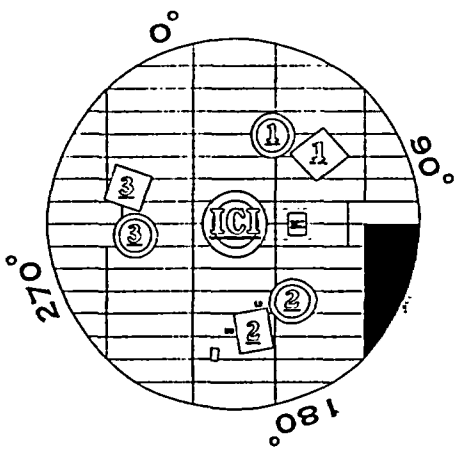


Plates I4-P4

Maine Yankee Decommissioning Team	*Maine Yankee Decommissioning Project Survey Map*	Map ID# FA 0100-U2-J
Survey Type: ☐ Verification ☐ Turnover ☒ Final Status Survey	Survey Area Name: Containment Bldg. Survey Unit 2	







Plates I5-N5

Attachment 2

Survey Unit Instrumentation

TABLE 2-1
INSTRUMENT INFORMATION

E-600 S/N	Probe S/N (type)
1625	190329 (43-37)
1648	168748 (43-37)
2488	190327 (43-37)
2489	190327 (43-37)
2618	190752 (43-37)
1929	148934 (43-68)
1933	149075 (43-68)
1648	148937 (43-68)
2489	148932 (43-68)
1625	459 (SHP-360)
2618	453 (SHP-360)
2618	464 (SHP-360)
2618	461 (SHP-360)

TABLE 2-2

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

Detector	43-68 Flats	43-68 Junctures	SHP-360 Surface Irregularities	43-37 Flats
Scan MDC ($dpm/100\ cm^2$)	722 (Note 1)	1,875 (Note 1)	2,247 (Note 1)	1,404 (Note 1)
DCGL ($dpm/100\ cm^2$)	18,000	18,000	18,000	18,000
Investigation Level (Alarm Setpoint) ($dpm/100\ cm^2$) (Reference 2)	18,579 ~ DCGL plus Background	19,498 ~ DCGL plus Background	18,797 ~ DCGL plus Background	19,400 ~ DCGL plus Background (Note 2)
Design $DCGL_{EMC}$ ($dpm/100\ cm^2$) (from RR Table 1)	23,400	23,400	23,400	23,400

NOTES:
1. Scan MDC from LTP, Revision 3, Table 5-6, was adjusted for a change in efficiency due to different material and/or geometry.
2. Investigation level was calculated for only 126 cm^2 of detection surface area.

Attachment 3

Investigation Table

TABLE 3-1

INVESTIGATION TABLE

Scan Alarm			Scan Investigation		$DCGL_{EMC}$ Comparison			
Elevated Area Grid No.	Alarm Setpoint (cpm)	Initial Scan Value (cpm)	Maximum Scaler Value (cpm)[4]	Area (cm^2)	Area Factor (AF)[5]	$DCGL_{EMC}$ (dpm/100 cm^2)	Elevated Area Activity (dpm/100 cm^2)[6]	$DCGL_{EMC}$ Comparison Factor
M151 (43-37)	8,800	18,110	6,420	N/A	N/A	N/A	< DCGL	0.00E+00
M165 (43-37)	8,800	9,720	2,070	N/A	N/A	N/A	< DCGL	0.00E+00
M169 (43-37)	8,800	13,300	2,030	N/A	N/A	N/A	< DCGL	0.00E+00
M483 (SHP-360)	800[7]	2,790	1,994	200	2,500	4.50E+07	46,852	0.0010
Survey Unit Remainder		N/A	N/A	N/A	N/A	DCGL = 18,000	Survey Unit Mean = 196	0.0109
							Total	0.0119

4 Scan alarms occurring with the 43-37 were investigated with the 43-68 detector.

5 For investigation purposes, consistent with LTP dose modeling for basement concrete surfaces and LTP Section 6.8.1, a conservative area factor was determined by the formula of AF = 50 m^2/actual size of the elevated area.

6 As an additional conservatism, the background and survey unit mean activity have not been subtracted in calculating the elevated area activity.

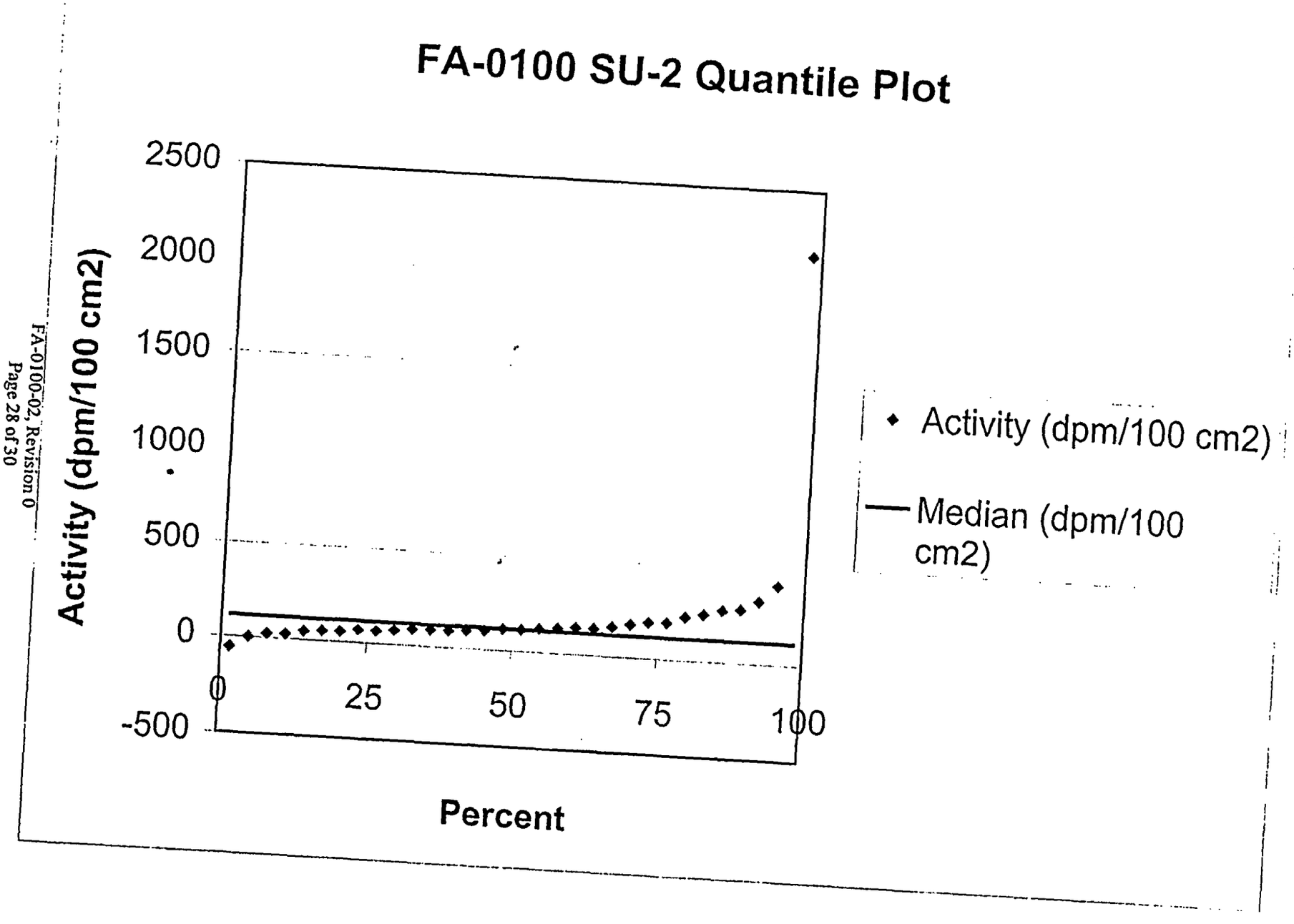
7 The original SHP-360 alarm setpoint was 1000 cpm. The data was evaluated using a revised setpoint of 800 cpm.

Attachment 4

Statistical Data

Survey Package FA-0100 Unit 2 Surface Sign Test Summary

Evaluation Input Values		Comments
Survey Package:	FA-0100	Containment Building
Survey Unit:	02	
Evaluator:	GP	
$DCGL_w$:	18,000	
$DCGL_{emc}$:	23,400	
LBGR:	9,000	
Sigma:	6,853	
Type I error:	0.05	
Type II error:	0.05	
Total Instrument Efficiency:	33.0%	
Detector Area (cm^2):	126	
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:	0.903199	
Calculated Relative Shift:	1.3	
Relative Shift Used:	1.3	Uses 3.0 if Relative Shift >3
N-Value:	17	
N-Value+20%:	21	
Static Data Values		**Comments**
Number of Samples:	32	
Median:	116	
Mean:	196	
Net Static Data Standard Deviation:	372	
Total Standard Deviation:	372	SRSS
Maximum:	2,160	
Sign Test Results		**Comments**
Adjusted N Value:	32	
S+ Value:	32	
Critical Value:	21	
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	


FA-0100 SU-2 Quantile Plot
Activity (dpm/100 cm2)
2500
2000
1500
1000
500
0
-500
0
25
50
75
100
Percent
Activity (dpm/100 cm2)
Median (dpm/100 cm2)

Page/Date/Time 2 11/22/04 10:13:11 AM
Database C:\Program Files\NCSS97\FA0100SU-2.S0
Variable C2

Plots Section

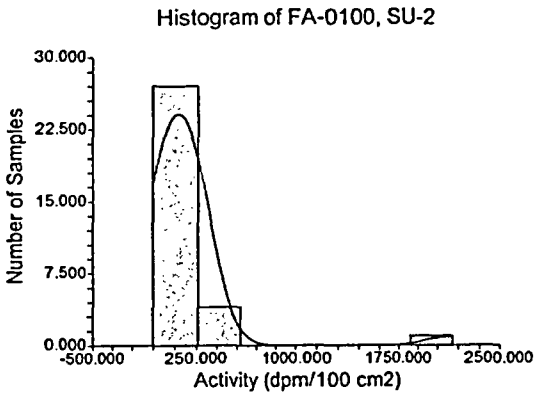


Chart Section