## MAINE YANKEE FINAL STATUS SURVEY RELEASE RECORD FR-0900 BALANCE OF PLANT AREAS SURVEY UNIT 2

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Revision 0

### MAINE YANKEE FINAL STATUS SURVEY RELEASE RECORD FR-0900 BALANCE OF PLANT AREAS SURVEY UNIT 2

### A. SURVEY UNIT DESCRIPTION

FR-0900 Survey Unit 2, Balance of Plant Areas, consists of the land area inclusive and adjacent to scan grid S103 of FR-0900 Survey Unit 1, which was a Class 3 survey unit. Scan grid S103 was a 1m by 10m area and was initially a bias scan location. The scan of grid S103 resulted in a verified alarm. The follow-up investigation determined that the cause of the scan alarm was a small volume of contaminated soil media. This contaminated media was completely collected into a 1-liter sample. The contaminated portion was subsequently segregated to a 100 g aliquot of soil media that was found to contain Co-60 with a specific activity of 1,030 pCi/g. In accordance with the License Termination Plan (LTP), (Reference 3) the subject area was reclassified into a Class 1 survey unit.

The bias selection of grid S103 in Survey Unit 1 was based primarily on the topology and drainage of the surrounding area and the fact that it lay in close proximity to an exterior staircase walkway and a paved roadway. Since the adjacent roadway was crowned and will be surveyed as a separate survey area (FR-2900; Roads/Railroad), 100% of the down gradient ditch, and a portion of the lower hillside adjacent to the ditch, was selected for reclassification.

Since the contaminated area was isolated to a small portion of a  $10 \text{ m}^2$  scan grid of FR-0900 Survey Unit 1, the 104 m<sup>2</sup> area of FR-0900 Survey Unit 2 was deemed adequate to achieve the design objectives of both the Class 1 survey unit and a Class 2 buffer unit, which would typically surround a Class 1 survey unit. Survey Unit 2 grids S036 through S045 approximate the location of Survey Unit 1 grid S103.

FR-0900 Survey Unit 2 is located at the approximate coordinates of 407,900 N and 623,920 E using the Maine State Coordinate System (West Zone), NAD 1927. The survey unit area is shown in relation to other major site structures in map FR0900-02-Site. All maps referenced in this release record are provided in Attachment 1, unless otherwise noted. The survey unit's total area is approximately  $104 \text{ m}^2$ .

#### **B. SURVEY UNIT DESIGN INFORMATION**

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FR-0900 Survey Unit 2 was designated a Class 1 survey unit. The survey unit design parameters are summarized in Table 1. Given a relative shift of 3.0, it was determined that 14 direct measurements were required for the Sign Test. Measurement locations were determined using the fixed grid with a random start point and are illustrated on the map FR0900-02-Directs (Attachment 1). All direct measurements consisted of soil samples obtained at the required locations. The samples are analyzed with laboratory gamma spectroscopy.

Scan grids of nominal 1 m x 1 m size were established as indicated on survey maps. A 100% scan coverage of the area was required. Scan areas are indicated on map FR0900-02-Scan (Attachment 1). One meter by one-meter scan grids were made to provide a total of  $104 \text{ m}^2$ (100% of the survey unit area coverage).

The instruments used in this survey 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<sub>EMC</sub>. Further, since the investigation level at the alarm setpoint was always less than the design DCGL<sub>EMC</sub>, no EMC sample size : adjustment was necessary.

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 and to confirm the scan MDCs used were appropriate. Due to variability in background within the survey unit, the grids were divided into two different background groups based on the location. These are specified in Table 1 and shown on map FR0900-02-Scan.

### TABLE 1

### SURVEY UNIT DESIGN PARAMETERS

| Survey Unit                               | Design Criteria   | Basis  |  |  |
|---|---|--|--|--|
| Area                                      | 104 m <sup>2</sup>  | See discussion Section A   |  |  |
| Number of Direct<br>Measurements Required | 14  | Based on an adjusted LBGR of<br>2.76 pCi/g, sigma <sup>1</sup> of 0.48<br>pCi/g, and a relative shift of 3.0.<br>Type I = Type II = 0.05 |  |  |
| Sample Area                               | 7.43 m <sup>2</sup>   | 104 m <sup>2</sup> / 14 samples  |  |  |
| Sample Grid Spacing                       | 2.72 m  | $(7.43 \text{ m}^2)^{\frac{1}{2}}$   |  |  |
| Scan Grid Area                            | 1m x 1m   |  |  |  |
| Area Factor                               | 2.8   | LTP Table 6-12   |  |  |
| Scan Survey Area 104 m <sup>2</sup>       |   | Class 1 area-100%  |  |  |
| Background                                |   |  |  |  |
| SPA-3 (scan)                              | 11,800 cpm         Group 1           12,900 cpm         Group 2 |  |  |  |
| Scan Investigation Level                  | 3 sigma of background<br>plus BKG                               | EC-009-01 (MY) (Reference 1)<br>See Table 2-2 (Attachment 2)   |  |  |
| DCGL                                      | 4.2 pCi/g   | LTP Revision 3 (Reference 2)   |  |  |
| Design DCGL <sub>EMC</sub>                | 11.76 pCi/g   | Area Factor x DCGL   |  |  |

### C. SURVEY RESULTS

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> Fourteen direct measurements were required, 20 direct soil measurement locations fit within the survey unit. Twenty samples were collected and the results are presented in Table 2. All direct measurements were below the DCGL. Fourteen verified alarms were received during the soil scans. The investigation of verified alarms is discussed below.

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<sup>&</sup>lt;sup>1</sup> Design sigma based on LTP Revision 3, Table 5-1C, Balance of Plant Areas, FR-0900.

## TABLE 2

## DIRECT MEASUREMENTS

| Sample Number             | Cs-137 pCi/g*             |
|---------------------------|---------------------------|
| FR-0900-02-S001           | < 5.91E-02                |
| FR-0900-02-S002           | < 4.40E-02                |
| FR-0900-02-S003           | < 6.93E-02                |
| FR-0900-02-S004           | < 5.53E-02                |
| FR-0900-02-S005           | < 6.12E-02                |
| FR-0900-02-S006           | < 5.81E-02                |
| FR-0900-02-S007           | < 6.03E-02                |
| FR-0900-02-S008           | < 5.43E-02                |
| FR-0900-02-S009           | · <5.04E-02               |
| FR-0900-02-S010           | € 6.31E-02                |
| FR-0900-02-S011           | <pre> &lt; 5.26E-02</pre> |
| FR-0900-02-S012           | < 5.48E-02                |
| FR-0900-02-S013           | <4.77E-02                 |
| FR-0900-02-S014           | <4.78E-02                 |
| FR-0900-02-S015           | <4.73E-02                 |
| FR-0900-02-S016           | <4.68E-02                 |
| FR-0900-02-S017           | < 5.12E-02                |
| FR-0900-02-S018           | < 5.24E-02                |
| FR-0900-02-S019           | < 5.45E-02                |
| FR-0900-02-S020           | <4.77E-02                 |
| Mean                      | 5.39E-02                  |
| Median                    | 5.35E-02                  |
| <b>Standard Deviation</b> | 6.46E-03                  |
| Range                     | 4.40E-02 - 6.93E-02       |

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"<" indicates value less than MDA, MDA value is reported</p>
\* Samples were also analyzed for Co-60; all were less than an MDA of 0.10 pCi/g

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### D. SURVEY UNIT INVESTIGATIONS PERFORMED AND RESULTS

The 14 scan grids that had verified alarms were investigated by taking a soil sample at the highest SPA-3 count rate location for each grid. The soil sample results are presented in Table 3-1. All samples collected were less than the MDA. Consequently, they add no contribution to the DCGL<sub>FMC</sub> unity fraction.

### 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. Both the mean and median activities were less than the DCGL for Cs-137. All results were less than the MDA. The maximum direct measurement MDA was approximately 1.65% of the Cs-137 DCGL. The level of activity is consistent with disturbed soil.

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 for disturbed soil from the survey unit that we desample mean activity. When the background value of 0.19 pCi/g (Reference 4) is subtracted from the sample results for the survey unit, the result is a negative. This would be equivalent to an annual dose rate of 0 mrem/y. However, for purposes of demonstrating compliance with the radiological criteria for license termination and the enhanced State criteria, Andrew Constants background activity is not subtracted from the soil sample analysis activity values. 

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## 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. As is shown in the table, all of the key release criteria were clearly satisfied for the FSS of this survey unit.

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 sample population whose results were all less than MDA. 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 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 THE EXTENT OF RESIDUAL ACTIVITY

The survey was designed as a Class 1 area; the FSS results met the requirements for that classification. The direct measurement sample standard deviation was less than the design sigma. Thus, no additional measurements were required.

#### H. LTP CHANGES SUBSEQUENT TO SURVEY UNIT FSS

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The FSS of Survey Unit 2 was designed, performed and evaluated in mid 2004. The design was performed to the criteria of the LTP, Revision 3 and Addenda (Reference 3). No subsequent LTP, changes with potential impact to this survey unit needed to be evaluated.

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I. CONCLUSION

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The FSS of this survey unit was designed based on the LTP based reclassification 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 DCGL of 4.2 pCi/g.

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 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. All verified alarms were investigated and determined not to add to the DCGL<sub>EMC</sub> unity fraction.

It is concluded that FR0900 Survey Unit 2 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 Addenda, Maine Yankee letter to the NRC, MN-02-061, dated November 26, 2002

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- 3. NRC letter to Maine Yankee, dated February 28, 2003, Approval of LTP Rev. 3 and Addenda
- 4. Approach for Dealing with Background Radioactivity for Final Status Surveys, Attachment E to Maine Yankee Procedure PMP 6.7.8, FSS Data Processing and Reporting

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Survey Unit Maps

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| Maine Yankee<br>Decommissioning Team   | Maine Yanl                  | kee Decommis            | ssioning         | Projec    | t Surve   | у Мар     | Map ID#F  | R0900-0     | 2-Scan |
|--|-----------------------------|-------------------------|------------------|-----------|-----------|-----------|-----------|-------------|--------|
| Survey Type: Characterization Turnover Final Status Survey Survey Area Name: Scan Grids  |                             |                         |                  |           |           |           |           |             |        |
| Prepared By: Larry N. Dockins Date: 7/20/04  |                             |                         |                  |           |           |           |           |             |        |
|  |                             |                         |                  | on<br>Rom |           |           |           |             |        |
| 5001 5002 5003 5004 5005   | 5006 5007 5008 5009         | 5010 5011 5012 5013     | 3 5014 5015      | 5016 5017 | 5018 5019 | 5020 5021 | 5022 5023 | 5024 5025   | 5026   |
| 5027 S028 5029 S030 5031   | 5032 5033 5034 5035         | \$036 \$037 \$038 \$035 | 5040 <b>5041</b> | 5042 5043 | 5044 5045 | 5046 5047 | 5048 5049 | 5050 5051   | 5052   |
| 5053 5054 5055 5056 5057   | 5058 5059 5060 S061         | 5062 5063 5064 5065     | 5 5066 5067      | 5068 5069 | 5070 5071 | 5072 5073 | 5074 S075 | 5076 5077   | S078   |
| 5079 S080 S081 S082 S083   | 5084 5085 5086 5087         | 5088 5089 5090 5091     | 5091 5093        | 5094 5095 | 5096 5097 | 5098 5099 | S100 S101 | \$102 \$103 | \$104  |
|  | 20m<br>Scan Grids (1m x 1m) |                         |                  |           |           |           |           |             |        |
| Group 1 Grids: S027, S053, S087, and S099 through S103<br>Group 2 Grids: S001 through S026, S028 through S052<br>S054 through S086, S088 through S098<br>and S104<br>FR-0900-02, Revision 0<br>Page 11 of 21 |                             |                         |                  |           |           |           |           |             |        |

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## Survey Unit Instrumentation

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## <u>TABLE 2-1</u>

### **INSTRUMENT INFORMATION**

| E-600 S/N | Probe S/N (type) |  |  |
|-----------|------------------|--|--|
| 2618      | 725328 (SPA-3)   |  |  |
| 1648      | 2055 (SPA3)      |  |  |
| 2490      | 2254(SPA-3)      |  |  |
| 2490      | 725328 (SPA-3)   |  |  |
| 2621      | 2055 (SPA3)      |  |  |
| 1622      | 725328 (SPA-3)   |  |  |
| 2617      | 2055 (SPA3)      |  |  |

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 |  |  |

## **TABLE 2-2**

## INSTRUMENT SCAN MDC, DCGL, INVESTIGATION LEVEL, AND DCGL<sub>EMC</sub>

| Detector   | SPA-3  | Comments  |
|--|--------|---|
| DCGL<br>(pCi/g)  | 4.2    | Approved DCGL for land areas<br>outside the Restricted Area,<br>LTP Section 6.7 (Reference 2) |
| Scan MDC<br>(pCi/g)  | 5.9    | Design Scan MDC,<br>LTP Table 5-6 (Reference 2)   |
| Investigation Level  | 14,300 | Group 1   |
| (Alarm Setpoint)<br>(cpm)  | 15,500 | Group 2   |
| Design DCGL <sub>EMC</sub><br>(pCi/g)<br>(from Release Record Table 1) | 11.76  |   |

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## Investigation Table

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### **TABLE 3-1**

| FSS SURVEY RESULTS |        |                            | INVESTIGATION RESULTS        |                                |                     |                   |                       |
|--------------------|--------|----------------------------|------------------------------|--------------------------------|---------------------|-------------------|-----------------------|
| Grid               | Reason | Alarm<br>Setpoint<br>(cpm) | Scan<br>Measurement<br>(cpm) | Scaler<br>Measurement<br>(cpm) | Sample ID           | Cs-137<br>(pCi/g) | DCGL<br>Comparison    |
| S015               | ALARM  | 14,300                     | 14,770                       | 13,920                         | XR0900021S015SS     | <5.66E-02         | <dcgl< td=""></dcgl<> |
| S027               | ALARM  | 15,500                     | 16,540                       | 15,430                         | XR0900021S027SS     | <4.87E-02         | <dcgl< td=""></dcgl<> |
| S028               | ALARM  | 14,300                     | 14,630                       | 13,960                         | XR0900021S028SS     | <4.80E-02         | <dcgl< td=""></dcgl<> |
| S053               | ALARM  | 15,500                     | 16,200                       | 15,190 ·                       | XR0900021S053SS     | <6.10E-02         | <dcgl< td=""></dcgl<> |
| S055               | ALARM  | 14,300                     | 14,350                       | 13,430                         | XR0900021S055SS     | <6.18E-02         | <dcgl< td=""></dcgl<> |
| S073               | ALARM  | 14,300                     | 14,470                       | 15,310                         | XR0900021S073SS     | <5.22E-02         | <dcgl< td=""></dcgl<> |
| S076               | ALARM  | 14,300                     | 14,400                       | 13,420                         | XR0900021S076SS     | <5.23E-02         | <dcgl< td=""></dcgl<> |
| S078               | ALARM  | 14,300                     | 15,260                       | 12,980                         | XR0900021S078SS     | <5.80E-02         | <dcgl< td=""></dcgl<> |
| S090               | ALARM  | 14,300                     | 14,490                       | 13,430                         | XR0900021S090SS     | <4.91E-02         | <dcgl< td=""></dcgl<> |
| S095               | ALARM  | 14,300                     | 14,360                       | 12,700                         | XR0900021S095SS     | <5.61E-02         | <dcgl< td=""></dcgl<> |
| S096               | ALARM  | 14,300                     | 14,920                       | 12,430                         | XR0900021S096SS     | <5.33E-02         | <dcgl< td=""></dcgl<> |
| S097               | ALARM  | 14,300                     | 15,420                       | 12,520                         | XR0900021S097SS     | <6.05E-02         | <dcgl< td=""></dcgl<> |
| S098               | ALARM  | 14,300                     | 14,890                       | 12,970                         | XR0900021S098SS     | <5.84E-02         | <dcgl< td=""></dcgl<> |
| S104               | ALARM  | 14,300                     | 16,000                       | 14,580                         | XR0900021S104SS     | <5.93E-02         | <dcgl< td=""></dcgl<> |
|                    |        |                            |                              |                                | SU Mean / DCGL 0.01 |                   | 0.013                 |
| L                  |        | l                          |                              |                                | Total               |                   | 0.013                 |

### **INVESTIGATION TABLE**

**NOTES:** 1. "<" indicates value less than MDA, MDA value is reported.

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2. The samples were also analyzed for Co-60; all were less than MDA with MDA of 0.1 pCi/g or less. :

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## **Statistical Data**

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| Evaluation Input Valu                  | es           | Comments                         |
|--|--------------|----------------------------------|
| Survey Package:                        | FR0900       | Balance of Plant Areas           |
| Survey Unit:                           | 02           |                                  |
| Evaluator:                             | DR           |                                  |
| DCGL <sub>w</sub> :                    | 4.20E+00     |                                  |
| DCGL <sub>emc</sub> :                  | 1.18E+01     |                                  |
| LBGR:                                  | 2.76E+00     |                                  |
| Sigma:                                 | 4.80E-01     |                                  |
| Type I error:                          | 0.05         |                                  |
| Type II error:                         | 0.05         |                                  |
| Nuclide:                               | CS-137       |                                  |
| Soil Type:                             | N/A          |                                  |
| Calculated Values                      |              | Comments                         |
| Z <sub>1-a</sub> :                     | 1.645        |                                  |
| Z <sub>1-β</sub> :                     | 1.645        |                                  |
| Sign p:                                | 0.99865      |                                  |
| Calculated Relative Shift:             | 3.0          |                                  |
| Relative Shift Used:                   | 3.0          | Uses 3.0 if Relative Shift is >3 |
| N-Value:                               | Page 11      |                                  |
| N-Value+20%:                           | 14 <b>14</b> |                                  |
| Sample Data Values                     |              | Comments To                      |
| Number of Samples:                     | 20           |                                  |
| Median:                                | 5.35E-02     |                                  |
| Mean:                                  | 5.39E-02     |                                  |
| Net Sample Standard Deviation:         | 6.46E-03     |                                  |
| Total Standard Deviation:              | 6.46E-03     | SRSS                             |
| Maximum:                               | 6.93E-02     |                                  |
| Sign.Test Results                      | 的编辑中国行动      | Comments                         |
| Adjusted N Value:                      | .20          |                                  |
| S+ Value:                              | 20           |                                  |
| Critical Value:                        | 14           |                                  |
| Sign test results:                     | Pass         |                                  |
| Criteria Satisfaction                  |              | Comments Assessments             |
| Sufficient samples collected:          | Pass         |                                  |
| Maximum value <dcgl<sub>w:</dcgl<sub>  | Pass         |                                  |
| Median value <dcgl<sub>w:</dcgl<sub>   | Pass         |                                  |
| Mean value <dcgl<sub>w:</dcgl<sub>     | Pass         |                                  |
| Maximum value < DCGL <sub>emc</sub> :  | Pass         |                                  |
| Total Standard Deviation <= Sigma:     | "Pass        |                                  |
| Criteria comparison results:           | Pass         |                                  |
| Final Status                           |              | Comments - 92 Comments           |
| The survey unit passes all conditions: | Pass         | SU Passes                        |

## Survey Package FR0900 Unit 2 CS-137 Soil Sign Test Summary

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#### One-Sample T-Test Report

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#### **Plots Section**



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**Chart Section** 



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