MAINE YANKEE

LTP SECTION 5

FINAL STATUS SURVEY PLAN

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5.0 FINAL STATUS SURVEY PLAN

5.1 Introduction

5.1.1 Purpose

The Final Status Survey (FSS) Plan describes the final survey process used to demonstrate that the MY facility and site comply with radiological criteria for unrestricted use (NRC's annual dose limit of 25 mrem plus ALARA and the enhanced state clean-up levels of 10 mrem/year or less for all pathways and 4 mrem/year or less for groundwater drinking sources).

5.1.2 Overview

The final status survey includes remaining structures, land, and plant systems that are identified as contaminated or potentially contaminated as a result of licensed activities. The majority of the survey effort will be required in the basements of the Containment Building, Fuel Building, Primary Auxiliary Building, Spray Building and the surrounding yard areas. A final status survey of the Independent Spent Fuel Storage Installation (ISFSI) location (land area) was initiated prior to construction of the concrete base.

There are 5 major steps in the final survey process: survey preparation, survey design, data collection, data assessment, and documentation of survey results.

a. Survey Preparation

Survey preparation is the first step in the final survey process and occurs after remediation, if necessary, is completed. In areas where remediation was required, a turnover survey may be performed to confirm that remediation was successful prior to initiating final survey activities. A turnover survey may be performed using the same process and controls as a final survey so that data from a turnover survey may be used as part of the final survey data. In order for turnover survey data to be used for final status survey, it must have been designed and collected in compliance with LTP Sections 5.4 through 5.7 and the area controlled in accordance with Section 5.11. Following the turnover surveys, the final status survey is performed.

The area to be surveyed is isolated and/or controlled to ensure that radioactive material is not reintroduced into the area from ongoing demolition or remediation activities nearby and to maintain the final configuration of the area. Tools, equipment, and materials not needed to support survey activities are removed, unless authorized by the FSS Superintendent. Routine access, material storage, and worker transit through the area are not allowed, unless authorized by the FSS Superintendent. However, survey areas may, with proper approval, be used for staging of materials and equipment providing; 1) the staging does not interfere with performance of surveys, and 2) the external surfaces of the material or equipment are free of loose surface contamination and there is no likelihood that internal or fixed radioactive materials could escape and contaminate the surrounding area or create background concerns, and 3) the safety of survey personnel is not jeopardized.

An inspection of the area is conducted by FSS personnel to ensure that work is complete and the area is ready for final status survey. Control of activities is transferred from the Maine Yankee engineering/construction group to the FSS/RP organizations. Approved procedures provide isolation and control measures until the area is released for unrestricted use.

b. Survey Design

The survey design process establishes the methods and performance criteria used to conduct the survey. Survey design assumptions are documented in "Survey Packages" in accordance with approved procedures. The site land, structures, and systems (embedded and buried piping/conduit are the principal potentially contaminated systems that will remain after decommissioning) are organized into survey areas and classified by contamination potential as Class 1, Class 2, Class 3, or non-impacted in accordance with LTP Section 5.2 and Tables 5-1A, 5-1B, 5-1C, 5-1D, and 5-1E.

Survey unit size is based on the assumptions in the dose assessment models in accordance with the guidance provided in NUREG-1727. The percent coverage for scan surveys is determined in accordance with LTP Section 5.4.1 and Table 5-3. The number and location of structure surface measurements (and structure volumetric samples) and soil samples are established in accordance with LTP Sections 5.4.2 through 5.4.4. Investigation levels are also established in accordance with Section 5.6 and Table 5-7.

Replicate measurements are performed as part of the quality process established to identify, assess, and control errors and uncertainty associated with sampling, survey, or analytical activities. This quality control process, described in LTP Section 5.10, provides assurance that the survey data meets the accuracy and reliability requirements necessary to support the decision to release or not release a survey unit.

c. Survey Data Collection

After preparation of a survey package, the final survey data are collected. Trained and qualified personnel perform the necessary measurements using calibrated instruments in accordance with approved procedures and instructions contained in the survey package.

d. Survey Data Assessment

Survey data assessment is performed to verify that the data are sufficient to demonstrate that the survey unit meets the unrestricted use criterion (i.e., the Null Hypothesis may be rejected.). Statistical analyses are performed on the data and the data are compared to investigation levels. Depending on the results of an investigation, the survey unit may require further remediation, reclassification, and/or resurvey. Graphical representations of the data, such as posting plots or histograms, may be generated to provide qualitative information from the survey and to verify the assumptions in the statistical tests, such as spatial independence, symmetry, data variance and statistical power. The assumptions and requirements in the survey package are reviewed. Additional data needs, if required, are identified during this review.

e. Survey Results

Survey results are documented by Survey Area in “Survey Packages.” Each final survey package may contain the data from the several Survey Units that are contained in a given Survey Area. The data is reviewed, analyzed, and processed and the results documented in a “Release Record.” The Release Record provides the information necessary to support the decision to release the survey units for unrestricted use. A Final Survey Report is prepared that provides the necessary data and analyses from the Survey Packages and Release Records, and is submitted to the NRC.

5.1.3 Implementation

In its submittal to the NRC (MN99-26, dated 8/9/99), MY described the schedule for the phased release of site land. Two large site areas have been determined to be non-impacted (as described in Section 2 of the LTP). Details of the partial release application package are discussed in Section 1.4.2.c. The NRC granted the license amendment allowing the removal of the subject site land from the operating license by letter dated July 30, 2002. The impacted site areas are subject to a final status survey in accordance with this plan.

The final survey will be implemented in phases. The first phase was comprised of the survey of the ISFSI land and a portion of the ISFSI security operations building prior to construction of the ISFSI. The second phase includes: (a) the non-Radiological Restricted Area (RA) lands and any non-RA buildings which will remain standing within the Industrial Area; and (b) the survey of the RA land including the structural concrete which will remain three feet below grade. The third and final phase includes the ISFSI site following fuel removal, facility dismantlement and any required remediation. Survey results will be described in written reports to the NRC. The actual structures and land included in each written report may vary depending on the status of ongoing decommissioning activities.

Maine Yankee anticipates that both the NRC and the State of Maine Department of Human Services (DHS) - Division of Health Engineering (DHE) may choose to conduct confirmatory measurements in accordance with applicable laws and regulations. The NRC may take confirmatory measurements to make a determination in accordance with 10 CFR 50.82(a)(11) that the final radiation survey and associated documentation demonstrate that the facility and site are suitable for release in accordance with the criteria for decommissioning established in 10 CFR Part 20, subpart E. Maine state law requires Maine Yankee to permit monitoring by the Maine State Nuclear Safety Inspectors (22 MRSA 664, sub-§2, as amended by PL 1999, c. 739, §1 and 38 MRSA 1451, sub-§11, as amended by PL 1999, c. 741, §1). This monitoring includes, among other things, taking radiological measurements to verify compliance with applicable state laws (including the enhanced state radiological criteria). Maine Yankee will demonstrate compliance with the 25 mrem/yr criteria of 10 CFR Part 20, Subpart E by demonstrating compliance with the enhanced state radiological criteria. Therefore, the confirmatory measurements taken by the NRC and the State of Maine will be based upon the same criteria, that is, the Derived Concentration Guideline Level (DCGL). Timely and frequent communications with these agencies will ensure that they are afforded sufficient opportunity to perform these confirmatory measurements prior to Maine Yankee implementing any irreversible decommissioning actions (e.g., backfilling basements with fill material.)

5.1.4 Regulatory Requirements and Industry Guidance

This plan has been developed using the guidance contained in the following documents:

a. Appendix E, NUREG 1727, "Demonstrating Compliance With the Radiological Criteria for License Termination" (September 2000).

b. NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)", Revision 1 (June 2001).

c. NUREG-1505, "A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys," Revision 1 (June 1998 draft).

d. NUREG-1507, "Minimum Detectable Concentrations With Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" (June 1998).

e. Regulatory Guide 1.179, "Standard Format and Content of License Termination Plans for Nuclear Power Reactors" (January 1999).

f. NUREG-1700, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans" (April 2000).

g. NUREG-1727, "NMSS Decommissioning Standard Review Plan" (September 2000)

Other documents used in the preparation of this plan are listed in the References Section.

5.2 Classification of Areas

Prior to beginning the final status survey, a thorough characterization of the radiological status and history of the site was completed. The methods and results from site characterization are described in Section 2 of the License Termination Plan. Based on the characterization results, the structures and open land areas were classified following the guidance in Appendix E of NUREG-1727 and Section 4.4 of NUREG 1575. There will be no above grade systems remaining following decommissioning. Contaminated systems will be disposed of as radioactive waste and non-radioactive systems will be disposed of as scrap. Area classification ensures that the number of measurements, and the scan coverage, are commensurate with the potential for residual contamination to exceed the unrestricted use criteria.

Initial classification of site areas is based on historical information and site characterization data. Data from operational surveys performed in support of decommissioning, routine surveillance or any other applicable survey data may be used to change the initial classification of an area up to the time of commencement of the final status survey as long as the classification reflects the levels of residual radioactivity that existed prior to remediation. Once the FSS of a given survey unit begins, the basis for any reclassification will be documented, requiring a redesign of the survey unit package and the initiation of a new survey using the redesigned survey unit package. If during the conduct of a FSS survey sufficient evidence is accumulated to warrant an investigation and reclassification of the survey unit, the survey may be terminated without completing the survey unit package.

5.2.1 Non-Impacted Areas

Non-Impacted areas have no reasonable potential for residual contamination because there was no known impact from site operations. These areas are not required to be surveyed beyond what has already been completed as a part of site characterization to confirm the area's non-impacted classification. Maine Yankee will continue to implement its Radiological Environmental Monitoring Program (REMP) throughout the decommissioning phase of Maine Yankee. The REMP program is focused upon the collection of radiological data from offsite, non-impacted areas. Non-impacted areas are shown on Figure 5-1.

5.2.2 Impacted Areas

Impacted areas may contain residual radioactivity from licensed activities. Based on the levels of residual radioactivity present, impacted areas are further divided into Class 1, Class 2 or Class 3 designations. The definitions provided below are from NUREG-1727, Pages E1 and E2.

a. Class 1 areas are impacted areas that, prior to remediation, are expected to contain residual contamination in excess of the $DCGL_w$.[1]

b. Class 2 areas are impacted areas that, prior to remediation, are not likely to contain residual radioactivity in excess of the DCGLw.

c. Class 3 areas are impacted areas that have a low probability of containing residual radioactivity.

5.2.3 Initial Classification of Basements, Land, Embedded Piping, and Buried Piping

Based on more than 19,000 measurements made during the site characterization and the information evaluated as part of the Historical Site Assessment, all land areas, basements, structures, and piping to remain after decommissioning were assigned an initial classification. The scope of the final status survey includes land and structures south of the Old Ferry Road. The areas to the north and west have been shown to meet the non-impacted criteria (LTP Section 2, Appendix A). The scope and boundaries of the FSS will be increased if survey data show significant levels of radioactivity above background in peripheral areas. (Initial Class 1 areas south of Ferry Road are shown on Figure 5-2. Additional Class 1 areas may be added as a result of ongoing characterization, remediation or survey activities.)

The primary interfaces between the impacted and non-impacted areas are the public road (Old Ferry Rd.) and the railroad spur. Both sides of the public road will be surveyed for FSS. If residual radioactivity greater than 0.5 DCGL is detected on the road or sides of the road, an investigation will be conducted to determine the extent of contamination and to identify any possible migration into the non-impacted areas. The portion of the railroad spur within the impacted area will be included in the final survey. If residual radioactivity greater than 0.5 DCGL is detected on the last 100 meters prior to exit from the impacted area, an investigation similar to that described above will be conducted.

[1] The "w" in $DCGL_w$ refers to the Wilcoxon Rank Sum test per MARSSIM (NUREG-1575, page 2-3) but generally represents the uniform level of residual contamination that results in the dose limit, regardless of the statistical test used. See also, LTP Section 5.4.2.

Characterization was performed and reported by survey area. The area designations used for characterization were used, for the most part, to delineate and classify areas for final survey. This allowed the characterization data to be efficiently used for final survey area classification and for estimating the sigma value for sample size determination.

Tables 5-1A through 5-1E list the survey areas for basements, structure foundation footprints, land areas possibly augmented by structure footprints, embedded piping, and buried piping. See Attachment 5A for additional detail on embedded and buried piping and related discussions on the basis for the initial MARSSIM classification of the survey units. The major land areas are designated in Figure 5-3. For operational efficiency, each of the final survey areas listed in the tables may be subdivided into multiple areas. Smaller survey areas may be necessary to enhance the efficiency of data collection, processing, and review and serve to better support the decommissioning schedule. The classification of all subdivided survey areas will be the same as indicated in Tables 5-1A through 5-1E, unless reclassified in accordance with this LTP. The sigma values are based on site characterization data. See LTP Section 5.4.2 for the use of these sigma values in sample size determination.

Some survey areas have been assigned more than one classification based on the levels of activity found. During the FSS design process, when these areas are divided into survey units, administrative controls will ensure that each survey unit will have only one classification.

Survey areas for structures that are demolished will either be applied to the remaining footprint (if the foundation is removed) or the building basement. The soil below removed foundations in the RA and Industrial areas will undergo final survey prior to backfill. The need to survey soil in excavated footprints before backfill will be evaluated on a case by case basis and documented in the Final Survey Package. The soil in the excavated footprints of several structures may be combined into a single survey area and/or survey unit if final survey is required prior to backfill. Each survey unit will be comprised of one or more structural foundation footprints, will meet the size constraints for the associated structure or structures (per Table 5-2) and will possess generally uniform characteristics, including:

- Survey unit classification
- Material type and nuclide fraction
- Sigma
- Historical radiological impact of the area

The excavated foundation areas for any building or structure outside of the IA may not be surveyed prior to backfill.

A conservative approach of classifying the excavated foundation footprints will be to classify the footprints as one class lower than would have been assigned to the foundation concrete surface. For example, if contamination below the DCGL were identified on a given foundation surface that would have resulted in the concrete surface being Class 2, the soil remaining after the foundation is removed would be given a Class 3 designation. The intent of classifying the building footprints as one classification lower (than that for the foundation concrete surface) is based on the assumption that there was no evidence of external contamination and that the only potential for soil contamination would be building demolition. If there were any evidence of soil contamination or sub-slab contamination, such information would form the basis for the footprint classification. Absent such information, the footprint would be classified at one classification below the footprint structure. Following the satisfactory performance of FSS on the excavated foundation footprint surface, if required, the excavation area would be backfilled.

The major land areas are designated in Figure 5-3.

Table 5-1A
Survey Area Classification - Building Basements

Package Number	Survey Area-Structures	Interior		Exterior		Mean Direct Beta dpm/100cm²	Maximum Direct Beta dpm/100cm²	Approx. Survey Area Size (Meters²)
		Sigma [g] (dpm/100 cm²)	Class	Sigma (dpm/100 cm²)	Class			
A0100	Containment-El.-2ft	6,853	1	N/A	N/A	81,976	1,970,974	4800
A0400	Fuel Bldg.	3,606	1	N/A	N/A	6,815	312,939	300
A0600	PAB-El.11ft	3,811	2,1	N/A	N/A	1,106	32,328	2200
A1700	Containment Spray Bldg.	6,132	2,1	N/A	N/A	83,249	4,968,088	1700

Table 5-1B
Survey Area Classification-Structural Foundation Footprints

Package Number	Survey Area-Structures	Interior		Exterior		Mean Direct Beta dpm/100cm^2	Maximum Direct Beta dpm/100cm^2	Approx. Survey Area Size (Meters^2)
		Sigma [g] (dpm/100 cm^2)	Class	Sigma (dpm/100 cm^2)	Class			
A0500[a]	DWST (Tk-21)	760	2	N/A	N/A	438	2,659	114
A0900[a]	Service Bld. Hot Side	1,456	2,1	N/A	N/A	699	18,955	885
A1100	LLWSB	3,149	3,1	86	3	852	74,216	980
A1200[a]	RCA Bldg.	4,880	2,1	N/A	N/A	73,939	2,233,580	290
A1300[a]	Equipment Hatch	240	2,1	N/A	N/A	28	721	91
A1400[a]	Personnel Hatch	1,390	2,1	N/A	N/A	350	6,758	47
A1500[a]	Mechanical Penetration	812	3,2	N/A	N/A	215	3,678	134
A1600[a]	Electrical Penetration	319	3	N/A	N/A	-138	557	53
A1800[a]	Aux Feed Pump Rm	247	3,2	N/A	N/A	148	1,278	279
A1900[a]	HV-9 Area	510	2,1	N/A	N/A	131	2,563	186
A2100[a]	RWST (Tk-4)	5,293	1	N/A	N/A	3,602	54,719	148
A2200[a]	BWST	3,865	1	N/A	N/A	7,270	43,189	190
A2300[a]	PWST	1,262	1	N/A	N/A	668	3,258	83
A2400[a]	Test Tanks	778	1	N/A	N/A	956	4,300	180

Table 5-1B
Survey Area Classification-Structural Foundation Footprints

Package Number	Survey Area-Structures	Interior		Exterior		Mean Direct Beta dpm/100cm^2	Maximum Direct Beta dpm/100cm^2	Approx. Survey Area Size (Meters^2)
		Sigma [g] (dpm/100 cm^2)	Class	Sigma (dpm/100 cm^2)	Class			
A2600[a]	LSA Bld Slab	TBD [f]	2,1	N/A	N/A			291
B0200[a]	Control Rm	317	3	N/A	N/A	216	1054	334
B0400[a]	Fire Pump House	317	3	N/A	N/A	10	840	104
B0500[a]	Turbine Building	727	2	N/A	N/A	62	8614	3723
B0700[a]	Service Bld.Cold Side	299	3,2 [d]	N/A	N/A	80	1622	3293
B0800[a]	Fuel Oil Storage Bld.	298	3	N/A	N/A	-83	451	200
B0900[a]	Diesel Generators Rooms	223	3	N/A	N/A	-177	412	Included in Turbine Bldg
B1000[a]	Aux. Boiler Rm.	354	2	N/A	N/A	183	1310	Included in Turbine Bldg
B1100[a]	Circ Water Pump House	319	3	N/A	N/A	-334	673	407
B1200[a]	Administration Bld.	432	3	N/A	N/A	293	1628	784
B1300[a]	WART Bld.	542	3	N/A	N/A	-146	1164	242
B1400[a]	Information Center	313	3	N/A	N/A	295	1929	372
B1500[a]	Warehouse 2	208	3	N/A	N/A	96	539	1900

Table 5-1B
Survey Area Classification-Structural Foundation Footprints

Package Number	Survey Area-Structures	Interior		Exterior		Mean Direct Beta dpm/100cm^2	Maximum Direct Beta dpm/100cm^2	Approx. Survey Area Size (Meters^2)
		Sigma [g] (dpm/100 cm^2)	Class	Sigma (dpm/100 cm^2)	Class			
B1600[a]	Training Annex	144	3	N/A	N/A	-13	708	375
B1700[a]	Staff Bld.	374	3	TBD[b]	3	129	952.9	1431
B1900[a]	Bailey House	327	3	TBD[b]	3	612	6,524	195
B2000[a]	Bailey Barn Slab	245	3	N/A	N/A	-97	307	332
B2400	Staff Bld.-Turbine Tunnel	381	3	N/A	N/A	19	576	116
B2500	Relay House	257	3	N/A	N/A			56
D3400	LLWSB (vent and drain)	1300	3	N/A	N/A	457	3099	N/A

Table 5-1C
Survey Area Classification-Land

Package Number	Survey Area- Land	Sigma [g] (pCi/g) Cs-137	Classification	Mean Cs-137 pCi/g	Max. Cs-137 pCi/g	Approx. Survey Area Size (Meters^2)
R0100	RCA yard West (Expanded to include portions of R0200, R0900 & R1000)	1.33	2,1 [d]	15.95	156.0	17,902
R0200	Yard East (Minus portion incorporated into R0100)	0.17	3	0.17	0.64	28,748
R0300	Roof and Yard Drains	N/A	3	0.33	0.53	Incorporated into R0100
R0400	Forebay (Expanded to include portion of R1000)	TBD [e]	2,1 3 dike surface soil	TBD [e]	TBD [e]	12,191
R0500	Bailey Point	0.28	3,2,1	0.36	1.09	16,046
R0600	Ball Field (Incorporated into R1800)	See R1800	See R1800	See R1800	See R1800	Incorporated into R1800
R0700	Construction Debris Landfill (Incorporated into R1800)	See R1800	See R1800	See R1800	See R1800	Incorporated into R1800

Table 5-1C
Survey Area Classification-Land

Package Number	Survey Area- Land	Sigma [g] (pCi/g) Cs-137	Classification	Mean Cs-137 pCi/g	Max. Cs-137 pCi/g	Approx. Survey Area Size (Meters^2)
R0800	Admin and Parking Area (Minus portion incorporated into R1800)	0.13	3	0.18	0.37	31,057
R0900	Balance of Plant Areas (Minus portion incorporated into R0100 and R1800)	0.48	3	0.49	1.5	35,975
R1000	Foxbird Island (Minus portion incorporated into R0100 and R0400)	0.23	3	0.26	0.86	56,822
R1100	Roof and Yard Drains	NA	3	0.07	0.09	Incorporated into FR 0200
R1200	LLWSB Yard (Incorporated in R1300)	See R1300	See R1300	See R1300	See R1300	Incorporated into R1300
R1300	ISFSI (Expanded to include R1200 and portion of R2100)	0.07	3,2,1	0.09	0.28	29,240
R1500	Ash Road Area	NA	NI [c]	0.08	0.21	NA
R1600	Area West of Bailey Cove	NA	NI [c]	0.46	1.43	NA
R1700	Area North of Ferry Road	NA	NI [c]	0.47	1.55	NA

Table 5-1C
Survey Area Classification-Land

Package Number	Survey Area- Land	Sigma [g] (pCi/g) Cs-137	Classification	Mean Cs-137 pCi/g	Max. Cs-137 pCi/g	Approx. Survey Area Size (Meters^2)
R1800	Bailey House Land Area	0.23	3	0.25	0.83	367,000
R2000	Diffuser	TBD [e]	3	0.10	0.13	TBD
R2100	Maintenance Yard (Incorporated into R1300 and R1800)	See R1300 & R1800	See R1300 & R1800	See R1300 & R1800	See R1300 & R1800	Incorporated into R1300 & R1800
R2300	SFPI Substation Slab Area (Incorporated into R0100)	See R0100	See R0100	See R0100	See R0100	Incorporated into R0100
R2900	Roads/Railroad Final Verification. [h]	See R1800	See R1800	See R1800	See R1800	1000m^2 roads 500m^2 railroads

Notes for Tables 5-1A, 5-1B and 5-1C:

a. Structural footprint may be incorporated into land area as indicated in Table 5-1C.
b. Exterior characterization will be conducted if buildings selected to remain standing
c. "NI" refers to Non Impacted
d. Contains known sub-surface or sub-slab residual activity
e. To be determined upon opening the system or other pending characterization efforts
f. Current background radiation levels preclude accurate survey. (Radioactive waste is still being packaged and stored in this area). Area will be surveyed when background allows.
g. Sigma values listed were developed using characterization data. Sigmas may be recalculated based on post-remediation survey data.
h. If contamination of 0.5 DCGL is detected in the last 100m prior to exit, an investigation as to source and impact will be conducted.

Table 5-1D
Land Areas Possibly Augmented by Backfilled Structural Footprints

Land Area Package No.	Land Area Description	Structure Package No.	Structure Area Description
R0100	RCA Yard West	A0500	DWST
		A0900	Service Bldg. Hot Side
		A1200	RCA Bldg
		A1300	Equipment Hatch
		A1400	Personnel Hatch
		A1500	Mechanical Penetration
		A1600	Electrical Penetration
		A1800	Aux Feed Pump Rm
		A1900	HV-9 Area
		A2100	RWST (Tk-4)
		A2200	BWST
		A2300	PWST
		A2400	Test Tanks
		A2600	LSA Bld

Table 5-1D
Land Areas Possibly Augmented by Backfilled Structural Footprints

Land Area Package No.	Land Area Description	Structure Package No.	Structure Area Description
R0200	Yard East	B0200	Control Rm
		B0500	Turbine Bldg
		B0700	Service Bldg. Cold Side
		B0800	Fuel Oil Storage Bldg
		B0900	Diesel Generator Rooms
		B1000	Aux. Boiler Rm
		B1100	Circ Water Pump House
		B1200	Administrative Bld. (Front Office)
		B1300	WART Bldg
		B2100	Lube Oil Storage Rm.
		B2200	Cold Machine Shop
R0800	Admin and Parking Area	B1400	Information Center
		B1600	Training Annex
		B1700	Staff Bldg.

Table 5-1D
Land Areas Possibly Augmented by Backfilled Structural Footprints

Land Area Package No.	Land Area Description	Structure Package No.	Structure Area Description
R0900	Balance of Plant Areas	B0400	Fire Pump House
		B2600	Warehouse 5
R1800	Bailey House Land Area	B1900	Bailey House
		B2000	Bailey Barn
R2600	Duct Banks	N/A	Underground Duct Banks

Table 5-1E **Survey Area Classification-Embedded and Buried Pipe**		
Package Number	Description	Classification
C0300	Containment Spray	Class 1
C2000	Containment Foundation Drains	Class 2
D0400	Sanitary Waste [(2)]	Class 3
D0500	Circulating Water	Class 3
D0700	Fire Protection (Water)	Class 3
D3500	Storm Drains	Class 1/3
D3600	Roof Drains [(1)]	Class 1/3
D3700	Containment Building Penetrations	Class 1
D0600	Service Water	Class 1/3

Note 1: Roof Drains will be surveyed as part of D3500 Storm Drains
Note 2: D0400 may require additional characterization surveys (see 5.2.4).

5.2.4 Discussion of Initial Classification

During the initial site characterization of Survey Area D2600, “Bailey House” (Environmental Services Laboratory Systems) some elevated direct readings were identified in sink drains and traps. When these pipes were checked by gamma spectrum analysis, there were no plant derived radionuclides detected. Survey Area R0400 “Forebay,” received limited survey during initial characterization. This area has been subjected to further characterization to support dose modeling, remediation and FSS efforts. (See Section 2.5.3e and Attachment 2H.) Survey Area D0400 “Sewage Treatment Plant” is currently classified as a Class 3. There were some contamination events recorded for this system in the historical site assessment; however, the systems and components affected by these events have since been replaced. Additional characterization may be required to confirm classification.

The classification tables do not show any previously (Rev. 0) classified above grade structural elevations such as A0200 “Containment El. 20 ft.,” A0300 “Containment El. 46 ft.,” A0700 “PAB El. 21 ft.,” A0800 “PAB El. 36 ft.,” B0100 “Turbine Bld El. 61 ft.,” B0300 “Motor Control Center,” B0600 “Turbine Bld El. 39 ft.,” or B2300 “Cable Vault.” These area classifications have been removed since they are associated with upper level elevations of buildings which will be demolished and the resulting debris disposed of offsite.

A detailed discussion of the basis for the classification of the embedded piping and buried piping listed in Table 5-1E is provided in Attachment 5-A.

5.2.5 Changes in Classification

Initial classification of site areas is based on historical information and site characterization data. Data from operational surveys performed in support of decommissioning, routine surveillance and any other applicable survey data may be used to change the initial classification of an area up to the time of commencement of the final status survey as long as the classification reflects the levels of residual radioactivity that existed prior to remediation. Once the FSS of a given survey unit begins, the basis for any reclassification will be documented. If during the conduct of a FSS survey sufficient evidence is accumulated to warrant an investigation and reclassification of the survey unit in accordance with LTP Section 5.6, the survey may be terminated without completing the survey unit package.

5.2.6 Selected Survey Area Boundaries Redefined

During the review of initial and continuing characterization, it was noted that there were some survey areas that contained areas of elevated activity that were adjacent to one another. The boundaries of these survey area have been redrawn for FSS to consolidate the elevated areas into one survey area, where practical. Other survey areas have been combined for efficiency because they have the same classification and characteristics. Table 5-1C and Figure 5-3 reflects the redefinition of these boundaries which are described in further detail below:

R0100 “RCA Yard West” - Portions of land areas formerly belonging to Survey Areas R0200 “Yard East”, R0900 “Balance of Plant Areas”, R1000 “Foxbird Island” and R2300 “Spent Fuel Pool Island (SFPI) Substation Slab Area” have been incorporated into R0100. These areas are adjacent to the previous border line and had some indications of elevated activity. Portions of land areas formerly associated with R0200 and R2300 showed elevated activity adjacent to the Borated Water Storage Tanks (BWST’s), Primary Water Storage Tank (PWST) and the SFPI Pagoda. Portions of land areas formerly associated with R0900 and R1000 showed elevated activity above the north end of the Forebay. This adjustment to R0100 consolidated those adjacent areas of elevated activity into areas with a similar classification.

R0400 “Forebay” - Land areas formerly belonging to Survey Area R1000 “Foxbird Island,” including the entire west bank of the forebay, have been added to R0400. These areas have been added R0400 to consolidate areas associated with the forebay.

R1800 “Bailey House Land Area” - Land areas formerly belonging to Survey Areas R0600 “Ball Field”(entire area), R0700 “Construction Debris Landfill”(entire area), and portions of land areas formerly belonging to Survey Areas R0800 “Admin and Parking Area,” R0900 “Balance of Plant Areas,” and R2100 “Maintenance Yard” have been added to R1800. These areas have been combined for efficiency because they have the same classification and characteristics. Any unique historical or site characterization information associated with these areas is being maintained to support final status surveys, judgmental scanning decisions and any followup investigations.

R1300 “Independent Spent Fuel Storage Installation” (ISFSI) - Land areas formerly belonging to Survey Areas R1200 “Low Level Waste Storage Building Yard” (entire area) and portions of land areas formerly belonging to Survey 2100

"Maintenance Yard" have been added to R1300. These areas were combined for efficiency because they were associated with the ISFSI construction project.

5.3 Establishing Survey Units

5.3.1 Survey Unit

Each survey area listed in Tables 5-1A - 5-1E may be divided into discrete survey units. Survey units are areas that have similar characteristics and contamination levels. Survey units are assigned only one classification. The site and facility are surveyed, evaluated, and released on a survey unit basis.

a. Survey Unit Size

NUREG-1727, Appendix E, provides suggested sizes for survey units. However, as stated in NUREG-1727, page E3, the suggested survey unit sizes were based on a finding of reasonable sample density and consistency with commonly used dose modeling codes. The Basement Fill model described in Section 6 is, by necessity, not generally consistent with the "commonly used codes" because the basic conditions are different, i.e., filled basement versus standing buildings or soil contamination.

For standing buildings, the MARSSIM recommends a survey unit size of 100 m^2 floor area in a Class 1 area based on the dose model assumption that a 100 m^2 office would be occupied. The source term in this case is essentially the 100 m^2 floor surface; 180 m^2 if the lower walls are included. For soil, the recommended survey unit size for a Class 1 area was conservatively based on the dose model assumption of a 2,000 m^2 resident farm. The source term area in this case is 2,000 m^2. For basement surfaces, the non-containment basement fill model assumes an area of 4182 m^2. Therefore, the source term, and survey unit size, for basements should be based on an area of 4182 m^2. For containment, the model assumes an area of 1130 m^2, so the survey unit size would be limited to 1130 m^2.

However, using a 4182 m^2 Class 1 survey unit size may not result in a "reasonable sample density" per MARRSIM. This is somewhat difficult to evaluate since MARSSIM provides no explanation for the statement and the statement is somewhat inconsistent with the MARSSIM premise that sample size is determined using DQO's and a statistically based method. To provide a rationale for a "reasonable sample density" finding, the recommended sample densities for standing building and soil surveys were evaluated.

Using the recommended survey unit sizes for standing buildings and soil, and assuming a sample size of 14 per survey unit (for the sign test with an α and β = 0.05 and relative shift = 3 as presented in Section 5.2), sample densities of 1/13 m^2 for standing buildings and 1/143 m^2 for soil would be required. The primary reason for the difference in sample densities for standing buildings and soil is the source term assumptions in the dose model as described previously. Both sample densities are considered reasonable in MARSSIM. In accordance with the same logic, a sample density of 1/298 m^2 would be called for in a 4182 m^2 survey unit (14/4182).

However Maine Yankee proposes to use a much higher sample density 1/50 m^2 for the Class 1 basement surfaces. There is no sample density limitation for Class 2 or Class 3 basement surfaces. This value satisfies the MARSSIM "reasonable sample density" criteria since it is at the low end of the range of the recommended sample densities for standing building and soil and is consistent with the dose model assumptions. The number of samples in a survey unit will, in all cases, meet or exceed the minimum number required per survey unit in MARSSIM. For example, if a survey unit size is 280 m^2, the sample density will be 1/20 m^2 to maintain the minimum 14 samples per survey unit. On the other hand, if a survey unit size is 1000 m^2, 20 samples will be collected as opposed to the 14 that are statistically required, to maintain the minimum 1/50 m^2density. In addition, if sample size adjustments are required because of scan survey MDA, the required higher sample number will be used, regardless of the sample density. The non-containment Basement surface survey unit size will be limited to 2000 m^2. The containment Basement surface survey unit size will be limited to 1130 m^2.

It is important to recognize that 100% scan survey of accessible areas is required in a Class 1 area. This provides a high level of confidence that no significant contamination will be missed. The fixed point measurements or samples are used in the statistical analysis, assuming a random distribution. For the statistical analysis, a sample density of 1/50 m^2 that meets or exceeds the required MARSSIM minimum number is considered sufficient.

The actual survey unit areas and location designated within a survey area, particularly in the building basements, will be based on decommissioning operations and schedule as well as the physical configuration of the areas. Basement survey units will, in most cases be on the order 1000 m^2 or less. Scale drawings of building or land areas, and walkdowns, will be used to calculate the surface area of the basement surfaces or soil within a survey area.

The survey unit sizes are related to the dose models described in Section 6. Therefore, the standing structure survey units are based on the building occupant scenario pathways and the basement structure survey units are based on the basement fill scenario pathways. The typical survey unit sizes for building basements, soil, and standing buildings are listed in Table 5-2.

Table 5-2
Survey Unit Areas

Class	**Suggested Survey Unit Area**		
	Standing Structures	**Basement Structures**	**Land**
1	180 m^2*	2000 m^2 **	2000 m^2
2	180 to 1000 m^2	2000 m^2 **	2000 to 10^4 m^2
3	No Limit	No Limit	No Limit

*   includes floor and lower walls
** 1130 m^2 for containment basement structure

Table 5-2 lists the survey unit size for basement structures as 2,000 m^2 surface area. Note that for embedded piping, this size is also justified since the dose model for residual radioactivity in embedded piping is identical to that used for basement structure contamination. Therefore, the same survey unit size of 2,000 m^2 is appropriate. For buried piping, the 2,000 m^2 survey is not appropriate. In fact, all of the buried pipe could be considered as one survey unit based on dose modeling assumptions. The dose model for buried piping assumes that the entire inventory of residual radioactivity in all buried piping expected to remain is instantaneously removed from the pipe surface and mixed into a volume of soil equal to the 141 m^3, which is the volume of all the buried pipe. Under the assumption that this 141 m^3 of soil is excavated and uniformly spread over a 15 cm layer on the ground surface, it would cover an area of 940 m^2. This is less than the 2,000 m^2 that would be allowed for surface soil. Therefore, all of the buried piping could be included in one survey unit. In actuality, as listed in Table 5-1, the buried piping will be surveyed as several distinct survey units based on physical and system considerations.

b. Site Reference Coordinate System (Reference Grid)

A reference coordinate system is used for impacted areas to facilitate the identification of survey units within the survey area. The reference coordinate system is basically an X-Y plot of the site area referenced to the state of Maine mercator projections as shown in Figures 5-4 and 5-5. Once the reference point is established, grids may be overlaid parallel to lines of latitude and longitude.

5.4 Survey Design

This section describes the methods and data required to determine the number and location of measurements or samples in each survey unit, the coverage fraction for scan surveys, and requirements for measurements in background reference areas. The design activities described in this section will be documented in a survey package for each survey unit. Survey design includes the following:

a. Scan Survey Coverage

b. Sample Size Determination

c. Background Reference Areas as necessary

d. Reference Grid and Sample Location

LTP Section 5.4.5 describes the process for designing, developing and reviewing survey packages.

5.4.1 Scan Survey Coverage

The area covered by scan measurement is based on the survey unit classification as described in NUREG 1727 and as shown in Table 5-3 below. A 100% accessible area scan of Class 1 survey units will be required. The emphasis will be placed on scanning the higher risk areas of Class 2 survey units such as soils, floors and lower walls. Scanning percentage of Class 3 survey units will be performed on likely areas of contamination based on the judgement of the FSS engineer.

Table 5-3
Scan Measurements

	Class 1	**Class 2 ***	**Class 3**
Scan Coverage	100%	10-100%	1 to 10%

* For Class 2 Survey Units, the amount of scan coverage will be proportional to the potential for finding areas of elevated activity or areas close to the release criterion in accordance with MARSSIM Section 5.5.3. Accordingly, Maine Yankee will use the results of individual measurements collected during characterization to correlate this activity potential to scan coverage levels.

5.4.2 Sample Size Determination

NUREG-1727 describes the process for determining the number of survey measurements necessary to ensure a data set sufficient for statistical analysis. Sample size is based on the relative shift, the Type I and II errors, sigma, and the specific statistical test used to evaluate the data.

Alternate processes may be used if such gain NRC and industry acceptance between the time this plan is adopted and the commencement of final survey activities. However, any new technologies must still meet the applicable requirements of this plan for calibration, detection limit, areal coverage, operator qualification, etc.

a. Determining Which Test Will Be Used

Appropriate tests will be used for the statistical evaluation of survey data. Tests such as the Sign test and Wilcoxon Rank Sum (WRS) test will be implemented using unity rules, surrogate methodologies, or combinations of unity rules and surrogate methodologies, as described in MARSSIM and NUREG-1505 chapters 11 and 12.

If the contaminant is not in the background or constitutes a small fraction of the DCGL, the Sign test will be used. If background is a significant fraction of the DCGL, the Wilcoxon Rank Sum (WRS) test will be used.

b. Establish Decision Errors

The probability of making decision errors is controlled by hypothesis testing. The survey results will be used to select between one condition of the environment (the null hypothesis) and an alternate condition (the alternative hypothesis). These hypotheses, chosen for MARSSIM Scenario A, are defined as follows:

Null Hypothesis (H_0): The survey unit does not meet the release criteria.
Alternate Hypothesis (H_a): The survey unit does meet the release criteria.

A Type I decision error would result in the release of a survey unit containing residual radioactivity above the release criteria. It occurs when the null hypothesis is rejected when it is true. The probability of making this error is designated as “"”. A Type II decision error would result in the failure to release a survey unit when the residual radioactivity is below the release criteria. This occurs when the Null Hypothesis is accepted when it is not true. The probability of making this error is designated as “$”.

Appendix E of NUREG 1727 recommends using a Type I error probability (") of 0.05 and states that any value for the Type II error probability ($) is acceptable. Following the NUREG 1727 guidance, " will be set at 0.05. A $ of 0.05 will initially be selected based on site specific considerations. The $ may be modified, as necessary, after weighing the resulting change in the number of required survey measurements against the risk of unnecessarily investigating and/or remediating survey units that are truly below the release criteria.

c. Relative Shift

The relative shift () / F) is calculated. Delta ())) is equal to the DCGL_w minus the Lower Boundary of the Gray Region (LBGR). Calculation of sigmas has been discussed in Section 5.2.3 and values are provided in Tables 5-1A-C. The sigmas used for the relative shift calculation may be recalculated based on the most current data obtained from post-remediation or post-demolition surveys; or from background reference areas, as appropriate The LBGR is initially set at 0.5 times the DCGL_w, but may be adjusted to obtain an optimal value, of normally between 1 and

3 for the relative shift.

Lower Boundary of the Gray Region

The Lower Boundary of the Gray Region (LBGR) is the point at which the Type II ($) error applies. The default value of the LBGR is set initially at 0.5 times the DCGL. If the relative shift is greater than 3, then the number of data points, N, listed for the relative shift values of 3 from Table 5-5 or Table 5-3 in NUREG -1575 will normally be used as the minimum sample size. Use of a relative shift greater than 3 requires approval by an FSS Engineer. If the minimum sample size results in a sample density less than the required minimum density (see Section 5.3.1), the sample size will be increased accordingly.

Sigma

Sigma values (estimate of the standard deviation of the measured values in a survey unit, and/or reference area) were initially calculated from characterization data. These sigma values can be used in FSS design or more current post-remediation sigma values can be used. The use of the sigma values from the characterization data will be conservative for the sample size determination since the recalculated post-remediation sigmas are expected to be smaller. The sigma values for survey areas listed in Table 5-1 which contain survey units with two different classifications, will be evaluated to ensure that the sigma conservatively represents the contaminant distribution of each associated survey unit; otherwise a specific sigma value will be developed.

The sigma values for structure surfaces were calculated using the GTS characterization data measurements on concrete that were less than 20,000 dpm/100 cm^2,which was a preliminary estimate of the $DCGL_w$. This assumes that areas above 20,000 dpm/100 cm^2 will be remediated. Using a lower concentration should lower the sigma estimate. This method should be conservative since many contaminated areas that are near the $DCGL_w$ or near other remediated areas will likely also be remediated which would serve to reduce the higher values and the resulting sigma. The characterization measurements above 20,000 dpm/100 cm^2 were not truncated to 20,000 dpm/100 cm^2 and included since it is likely that any area remediated will be well below the $DCGL_w$. The sigmas for soil areas were calculated using the GTS characterization data on measurements greater than MDA, and less than 8 pCi/g Cs-137. This should provide a conservative estimate of sigma for any Cs-137 $DCGL_w$ at 8 pCi/g or less.

The number of structure surface measurements taken to support the calculation of sigmas indicated in Tables 5-1A and 5-1B ranged from 7 to 98 per survey area. The number of soil measurements taken to support the calculation of sigmas indicated in Table 5-1C ranged from 5 to 73 per survey area. The structure sigmas calculated in Tables 5-1A and 5-1B represent the total gross beta activity measured down to the beta energy of C-14. If nuclides are present that have beta energies greater than that associated with C-14 they would be included in the gross measurement. The method for determining the average energy of the beta emitters is described in a supporting engineering calculation. Table 5-3a shows that the calibration sources with average beta-particle energies of $\leq$ 0.107 MeV are conservative with respect to the energy spectrum presented in the table.

The soil sigmas calculated in Table 5-1B are based upon distributed Cs-137. Sigmas may be recalculated based upon data obtained from post-remediation or post-demolition surveys.

There are some areas in containment, RCA, Fuel and Spray buildings that presently show large sigma values. After these areas are remediated, the sigma values are expected to be significantly lower. Where areas are remediated or changed, new sigma values may be calculated by taking measurements in the survey area at about 5 to 20 locations as recommended in Section 5.5.2.2. of NUREG 1575.

Table 5-3a
Contaminated Media Beta Energy (KeV)

Nuclide	**Fraction 2004**	**Average Beta Energy (KeV)**	**Average Beta Energy Contribution (KeV)**
H-3	2.36E-02	5.68	0.134
Fe-55	4.81E-03	0	0
Co-57	3.06E-04	0	0

Table 5-3a Contaminated Media Beta Energy (KeV)			
Nuclide	**Fraction 2004**	**Average Beta Energy (KeV)**	**Average Beta Energy Contribution (KeV)**
Co-60	5.84E-02	95.79	5.59
Ni-63	3.55E-01	17.13	6.08
Sr-90	2.80E-03	195.80	0.55
Cs-134	4.55E-03	156.80	0.71
Cs-137	5.50E-01	170.80	93.94
Total			107.01

d. Wilcoxon Rank Sum (WRS) Test Sample Size

The number of data points, N, to be obtained from each reference area or survey unit are determined using Table 5-3 in NUREG-1575. The table includes the recommended 20% adjustment to ensure an adequate sample size.

e. Sign Test Sample Size

The number of data points is determined from Table 5-5 in NUREG-1575 for application of the Sign Test. This table includes the recommended 20% adjustment to ensure an adequate sample size.

f. Elevated Measurement Comparison (EMC) Sample Size Adjustment

If the scan MDC is greater than the $DCGL_W$, the sample size will be calculated using the equation provided below. If N_{EMC} exceeds the statistically determined sample size (N), N_{EMC} will replace N.

$$N_{EMC} = A/A_{EMC}$$

Where: N_{EMC} is the elevated measurement comparison sample size
A is the survey unit area
A_{EMC} is the area corresponding to the area factor calculated using the MDC_{scan} concentration.

5.4.3 Background Reference Areas

Background reference area measurements are required when the WRS test is used, and background subtraction may be used with the Sign test, under certain conditions such as those described in Chapter 12 of NUREG 1505. The reference area measurements will be collected using the methods and procedures required for Class 3 final survey units. For soil, reference areas will have a soil type as similar to the soil type in the survey unit as possible. When there is a reasonable choice of possible soil reference areas with similar soil types, consideration will be given to selecting reference areas that are most similar in terms of other physical, chemical, geological, and biological characteristics. For structure survey units that contain a variety of materials with markedly different backgrounds, a reference area will be selected that has similar materials. If one material is predominant or if there is not too great a variation in background among materials, a background from a reference area containing only a single material is appropriate when it is demonstrated that the selected reference area will not result in underestimating the residual radioactivity in the survey unit.

It is understood that background reference areas should have physical characteristics (including soil type and rock formation) similar to the site and shall not be contaminated by site activities. In general, Maine Yankee commits to using background reference areas, when possible, that are offsite. If non-contaminated onsite areas are to be used, then Maine Yankee will verify and justify its use by appropriate comparison with samples from appropriate off-site locations. A White Paper (technical basis document) was developed for dealing with background (Reference 5.12.35). Information from the White Paper has been included in the appropriate FSS procedure (Reference 5.12.27).

Should significant variations in background reference areas be encountered, appropriate evaluations will be performed to define the background concentration. As noted in NUREG 1727, Appendix E, Section 3.4, the Kruskal-Wallis test can be conducted in such circumstances to determine that there are no significant differences in the mean background concentrations among potential reference areas. Maine Yankee will consider this and other statistical guidance in the evaluation of apparent significant variations in background reference areas.

If material background subtraction is performed , the sigma value used will take into account the variability of material background.

5.4.4 Sample Grid and Sample Location

Sample location is a function of the number of measurements required, the survey unit classification, and the contaminant variability.

a. Sample Grid

The reference grid is primarily used for reference purposes and is illustrated on sample maps. Physical marking of the reference grid lines in the survey unit will only be performed when necessary. For the sample grid in Class 1 and 2 survey units, a randomly selected sample start point will be identified and sample locations will be laid out in a square grid pattern[2] at distance, L, from the start point in both the horizontal and vertical directions. The sample and reference grids are illustrated on sample maps and may be physically marked in the field. For Class 3 survey units, all sample locations are randomly selected, based on the reference grid. An example is shown in Figures 5-4 and 5-5. Global Positioning System (GPS) instruments may be used in open land areas to determine reference or sample grid locations within the survey area. The manufacturer's specifications indicate a horizontal accuracy of 21 feet to 45 feet for the GPS system. Digital cameras may be employed to provide a lasting record of survey location within the survey unit. When used, these photographic records will be linked to landmark and directional information to ensure reproducibility.

Note that GPS is only one method that could be used to locate land survey points. Maine Yankee is currently using a site reference grid based on the Maine mercator system and distances and angles from fixed reference points to locate survey points. If GPS is to be the sole method used to locate survey points, a more accurate system will be obtained.

b. Measurement Locations

Measurement locations within the survey unit are clearly identified and documented for purposes of reproducibility. Actual measurement locations are identified by tags, labels, flags, stakes, paint marks, geopositioning units or photographic record. An identification code matches a survey location to a particular survey unit.

Sample points for Class 1 and Class 2 survey units are positioned in a systematic pattern or grid throughout the survey unit by first randomly selecting a start point coordinate. A random number generator is used to

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[2] Note that both NUREG 1575 and 1505 recognize both the rectangular and the triangular grid pattern grid method as acceptable.

determine the start point of the square grid pattern. The grid spacing, L, is a function of the area of the survey unit as shown below:

$$L = \sqrt{\frac{A}{n}} \qquad \text{for a square grid}$$

where:

A = the area of the survey unit,

n = the number of sample points in the survey unit.

Sample points are located, L, distance from the random start point in both the X and Y directions.

Random measurement patterns are used for Class 3 survey units. Sample location coordinates are randomly picked using a random number generator.

Measurement locations selected using either a random selection process or a randomly-started systematic pattern that do not fall within the survey unit or that cannot be surveyed due to site conditions are replaced with other measurement locations as determined by the FSS Specialist or FSS Engineer.

5.4.5 Survey Package Design Process

A Final Status Survey Package is produced for each survey area. The survey package is a collection of documentation detailing survey design, survey implementation and data evaluation for a Final Status Survey of a survey area.

Maine Yankee applies the 10CFR50, App. B requirements for field and laboratory counting equipment, as well as the corrective action process to address data or programmatic discrepancies. Using the existing Part 50, App. B program precludes developing redundant measures for FSS activities. (See also Section 5.10.5.)

a. Survey Package Initiation

Each survey area and package is assigned a unique identification number. To allow continuity of area identification, the protocol used for identifying survey areas during the characterization survey is used, as appropriate.

Numbers dissimilar to those used for characterization survey may be necessary if survey boundaries are modified.

b. Review of HSA, Characterization Surveys

The FSS Specialist gathers and reviews historical data applicable to the survey area. Historical information that will be used for survey design is filed in the survey package. Sources of historical data include:

1. Historical Site Assessment
2. Characterization Survey (Initial and Continuing)[3]
3. Classification basis
4. 50.75(g) files
5. Operational Survey Records

c. Survey Area Walkdown

The FSS Specialist performs a walkdown to gather information about the physical characteristics of the survey area. The walkdown provides the Specialist an opportunity to determine if any physical or safety related interferences are present that may affect survey design or survey implementation, and to determine any support activities necessary to implement surveys. The walkdown is documented and filed in the survey package.

Following the walkdown, representative maps of the survey area are prepared.

d. Survey Design

Survey Design is the process of determining the number, type and location of survey measurements or samples required for each survey unit within a survey area. The various aspects of survey design are documented and filed in the survey package. The survey unit design process is controlled by approved procedures.

The size and number of survey units for a survey area is determined based on area classification, modeling assumptions used to develop DCGL's and the layout of the survey area. The FSS Specialist will divide the area into discrete survey units as appropriate. Each survey unit is numbered

[3] For additional explanation of initial and continuing characterization surveys, see Section 2.1.

sequentially. The FSS Specialist provides a description of each survey unit including survey unit size, classification and location. The types of material (i.e. soil, concrete, etc.) found in the survey unit and survey measurement and/or sampling methods are identified.

The FSS Engineer calculates the number of measurements or samples required for each survey unit in accordance with NUREG-1575. The FSS Engineer also calculates required investigation setpoints for survey measurements.

The FSS Specialist determines measurement/sample locations based on the classification of the survey unit and in accordance with NUREG-1575. A survey map is prepared of each survey unit. A sample and/or reference grid is superimposed on the map to provide an (x,y) coordinate system. The FSS Specialist generates random numbers, between 0 and 1, which are multiplied by the maximum x and y axis values of the sample grid. This provides coordinates for each sample location, or a random start location for systematic grid, as appropriate. The measurement/sample locations are plotted on the map. Each measurement/sample location is assigned a unique identification code which identifies the measurement/sample by Survey Area, Survey Unit, Material and sequential number.

The FSS Specialist determines the appropriate instruments and detectors, instrument operating modes and survey methods to be used to collect and analyze data.

The FSS Specialist prepares written survey instructions that incorporate the requirements set forth in the survey design. Direction is provided for selection of instruments, count times, instrument modes, survey methods, required documentation, alarm/investigation setpoints, alarm actions, background requirements and other appropriate instructions. The instructions also direct the appropriate instrument set up to ensure collected survey data is saved and downloaded to the appropriate files. In conjunction with the survey instructions, survey data forms, indicating desired measurements, are prepared to assist in survey documentation.

The FSS Engineer reviews the survey design and instructions and verifies, or has a competent person verify, all calculations. The FSS Engineer ensures that appropriate instruments, survey methods and sample locations have been properly identified. Once approved, the survey design and instructions are filed in the survey package.

The Superintendent of FSS reviews the survey package and authorizes survey implementation.

e. Survey Area Turnover

Prior to performing Final Status Surveys, the FSS Superintendent coordinates with appropriate site superintendents to ensure decommissioning activities, area remediation and housekeeping are complete. The FSS Superintendent may direct Radiation Protection to perform surveys to verify that the area meets the radiological criteria for performance of the Final Status Survey. When satisfied, the FSS Superintendent will direct the area to be posted, as appropriate, to indicate that the area is controlled for the performance of Final Status Surveys. Access controls are implemented to prevent contamination of areas during and following Final Status Surveys.

f. Survey Implementation

Survey areas and/or locations are identified by gridding, markings, or flags as appropriate. The FSS Supervisor performs a pre survey briefing with the survey technicians during which the survey instructions are reviewed. The technicians gather instruments and equipment as indicated and perform surveys in accordance with the appropriate procedures. Technicians are responsible for documenting survey results and maintaining custody of samples and instrumentation. At the completion of surveys, technicians return instruments for downloading and prepare samples for analysis.

Survey instruments provided to the technicians are prepared in accordance with appropriate procedures and the survey instructions. Instruments are performance checked prior to and following surveys. Any data collected in data logging instruments is downloaded and a hard copy printed out. The download hard copies, surveyor’s data sheets and sample counting reports are reviewed and forwarded for inclusion in the survey package. The FSS Supervisor is notified of any data that exceeds investigation criteria so that appropriate investigation surveys and remediation can be performed as necessary. The downloaded data file is backed up to the system server and to appropriate storage media on a routine basis.

Several quality control measures and features have been developed for the implementation phase of the final status survey program. These elements typically include:

- Pre-implementation briefings between FSS design and implementation personnel,
- Pre-implementation area walkdowns,
- Survey location verification,
- Daily survey area background measurements,
- Instrument source checks before and after survey activities and
- Conduct of surveys in the peak trap mode, thereby providing a record of the maximum scan value for any scan grid.

g. Data Evaluation

The FSS Specialist reviews survey data, data downloads and counting reports to verify completeness, legibility and compliance with survey design. As directed by the FSS Engineer, the FSS Specialist performs the following:

1. Converts data to reporting units
2. Calculates mean, median and range of the data set
3. Reviews the data for outliers
4. Calculates the standard deviation of the data set
5. Calculates MDC for each survey type performed
6. Creates posting, frequency or quantile plots for visual interpretation of data.

The FSS Engineer reviews and verifies the statistical calculations, verifies the integrity and usefulness of the data set and determines the need for further data. The FSS Engineer will direct investigation as necessary. Once satisfied that the data are valid, the FSS Engineer will perform the appropriate statistical test and make a decision on the radiological status of each survey unit.

The data evaluation process is documented and filed in the survey package.

h. Quality Control Surveys

Following completion of Final Status Survey, the need for QC surveys (replicate surveys, sample recounts, etc.) is determined. If necessary, a QC survey package is developed and modeled after the original survey. QC measurement results are compared to the original measurement results. If QC results do not agree with the original survey, an investigation is performed. Following investigation, the FSS Engineer will decide data validity.

i. Release Record

Following data evaluation, The FSS Engineer prepares a Release Record. The Release Record describes the survey area, survey design, survey units, surveys performed and instruments used. The Release Record summarizes survey results and data evaluation. The Release Record is reviewed and approved by the FSS Superintendent and the Manager of Projects - FSS.

5.5 Survey Methods and Instrumentation

5.5.1 Survey Measurement Methods

Survey measurements and sample collection are performed by personnel trained and qualified in accordance with the applicable procedure. The techniques for performing survey measurements or collecting samples are specified in approved procedures. Final site survey measurements include surface scans, direct surface measurements, and gamma spectroscopy of volumetric materials. In situ gamma spectroscopy or other methods not specifically described may also be used for final status surveys. If so, Maine Yankee will give the NRC 30 days notice to provide an opportunity to review the associated basis document[4] as described in LTP Section 5.3.1.

On-site lab facilities are used for gamma spectroscopy, liquid scintillation and gas proportional counting in accordance with applicable procedures. Off-site facilities are used, as necessary. No matter which facilities are used, analytical methods will be administratively established to detect levels of radioactivity at 10% to 50% of the DCGL value or below the ALARA Remediation Level, if applicable.

a. Structures

Structures will receive scan surveys, direct measurements and, when necessary, volumetric sampling.

Scan Surveys

Scanning is performed in order to locate small areas of residual activity above the investigation level. Structures are scanned for beta-gamma radiation with appropriate instruments such as those listed in Table 5-4.

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4 A Technical Basis Document was submitted for: "Forebay FSS Survey Measurement Methods (In-Situ Gamma Spectroscopy" - References 5.12.37 and 5.12.38

The measurements will typically be performed at a distance of 1 cm or less from the surface and at a scan speed of 5 cm/sec for hand-held instruments. Adjustments to scan speed and distance may be made in accordance with approved procedures. Sodium iodide detectors may be used for scanning of concrete surfaces when surface conditions would result in increased surface to detector distance (typically within 3 inches) and when the static measurement sample size is adjusted for the corresponding MDC, if necessary. In situ gamma spectroscopy may be effectively substituted for scanning surveys if technically justified following the 30 day NRC notice and opportunity to review as described previously.

Direct Measurements

Direct measurements are performed to detect surface activity levels. Direct measurements are conducted by placing the detector on or very near the surface to be counted and acquiring data over a pre-determined count time. A count time of one minute is typically used for surface measurements and generally provides detection levels well below the DCGL. (The count time may be varied provided the required detection level is achieved).

Concrete With Activated Radionuclides

Residual radioactivity within activated building materials was conservatively estimated by performing gamma spectroscopy on core slices taken from long concrete cores located in selectively higher that average neutron fluence locations for the concrete volumes represented by the cores. This activity inventory was established as the DCGL and was evaluated for dose consequences using realistic release assumptions as described in Reference 6.10.7. Because of the low dose consequences, no other final status survey requirements were established to measure the activated concrete activity. However, measurements of total activated activity were estimated using in-situ gamma spectroscopy to provide verification within the bounds of uncertainty.

Volumetric Concrete Measurements

Volumetric sampling of contaminated concrete, as opposed to direct measurements may be necessary if the efficiency or uncertainty of the gross beta measurements are too high. Volumetric concrete samples will be analyzed by gamma spectroscopy. The results will either be evaluated by

1) calculating the derived total gross beta cpm/100 cm^2 in the sample and comparing the gross beta results directly to the gross beta DCGL or 2) by using the radionuclide specific results to derive the surface activity equivalent and determine compliance using the unity rule. Use of the unity rule will require the use of a surrogate calculation to account for the radionuclides in the mixture not identified by gamma spectroscopy. This will be accomplished using the nuclide mixture listed in Tables 2-7 or 2-8 as appropriate.

Volumetric samples analyzed by gamma spectroscopy will detect the presence of radioactivity below the surface. Such sampling is typically performed following removal of paint and other surface coatings during remediation. After analysis, the data may be converted to equivalent surface activity for crack analysis.

Removable Contamination Surveys

Based on current decommissioning planning, there will be no standing buildings remaining with in the Restricted Area and only one building remaining outside the Restricted Area, namely, the switchyard relay house (per LTP Sections 3.2.4 and 6.9.1). Removable contamination surveys will be collected at discreet locations in the switchyard relay house.

b. Soil

Soil will receive scan surveys at the coverage level described in Table 5-3 and volumetric samples will be taken at designated locations. Surface soil samples will normally be taken at a depth of 0 to15 cm. Areas of sub-surface soil contamination may require sampling at a depth exceeding 15 cm. The possibility of sub-surface contamination will be considered during the survey design process and the survey design package will contain requirements for sampling soil below 15 cm. Samples will be collected and prepared in accordance with approved procedures.

Scans

Open land areas are scanned for gamma emitting nuclides. The gamma emitters are used as surrogates for the HTD radionuclides. Sodium iodide detectors are typically used for scanning. For detectors such as the SPA-3, the detector is held within a few centimeters of the ground surface and is moved at a speed of 0.25 m/sec, traversing each square meter 5 times. The area covered by scan measurements is based on the survey unit classification as described in Section 5.4.1.

Volumetric Samples

Soil materials are analyzed by gamma spectroscopy. Soil samples of approximately 1500 grams are normally collected from the surface layer (top 15 cm). If contamination below 15 cm is suspected, split spoon sampling or other methods, will be used for the final survey unless the area has already been excavated and remediated to the deep soil DCGL. If an area containing subsurface contamination has been remediated, the excavated area will be treated as a surface soil.

The areas around the RWST and Fuel Building are two of the areas that will require remediation and possibly sub-surface sampling. Subsurface sampling will be performed in accordance with the guidance in NUREG-1727, page E18, Section 11.1. The sample size for subsurface samples will be determined using the same methods described for surface soil. Per NUREG-1727, scanning is not applicable. Samples will be composited over each 1 m of depth and collected to depths at which there is high confidence that deeper samples will not result in higher concentrations. The area factors derived for surface soil will be applied to subsurface soil in Class 1 areas.

Sample preparation includes removing extraneous material and homogenizing and drying the soil for analysis. Separate containers are used for each sample and each container is tracked through the analysis process using a chain-of-custody record. Samples are split when required by the applicable FSS Quality Control procedure.

Sub-Slab Soils

Grade level foundation slabs will be removed during demolition which will afford the opportunity to sample the soil underneath the slab. The floor slabs or foundations remaining in place after demolition (at elevations less than 3 feet below grade) may be evaluated by taking samples immediately adjacent to the slab using a split spoon or core sampler depending on the contamination potential. Factors that will be evaluated to determine the need for split spoon sampling include: (1) existence of soil under the slab; (2) acceptability of alternate means of identifying the potential for sub-slab contamination, e.g., groundwater sampling; and (3) operational history.

Stored Excavated Soil

Several piles of soil have been stored on-site that were excavated from Class 3 areas. Prior to placing any soil into a pile for storage and possible future use, survey measurements are made. Scan surveys are conducted over approximately 10% of the area to be excavated using methods equivalent to FSS. Soil samples are also collected and analyzed to ensure that there is no indication of previously undetected soil contamination. Once these measurements are completed, the soil is excavated and placed into storage. The Maine Yankee soil control procedure is used to track the origin, storage location, and final disposition location of the soil. Prior to any stored soil being placed in any location on site, the sampling techniques described in Section 5.5.1.b are employed to further assure that the soil met the requirements of the area in which it was being used. This stored soil could be used for backfilling the soil excavation areas after additional volumetric sampling. Stored soil will not be used for RA basement fill. The following strategy will be followed.

Assuming the WRS test will be used, $\alpha = \beta = 0.05$, and a Δ/σ value of 3, the sample size would be 10. Based on the soil sigma data in Table 5-1C, it is likely that the Δ/σ value will be equal or greater than 3. For a Class 3 surface soil survey unit of 10,000 m^2, the equivalent volumetric sample density would be 10 samples per 1,500 m^3 (10,000 m^2 x 0.15 m depth of soil sample) or 1/150 m^3.

Using the WRS test sample size to determine a volumetric sampling frequency is consistent with the methods recommended for subsurface soil in NUREG-1727, Appendix E, Section 11.1. Regardless of the soil pile volume, a minimum of 10 samples will be collected. If the soil pile volume exceeds 1500 m^3, additional samples will be collected to ensure the 1/150 m^3 sample frequency is maintained. Soil piles from various class 3 areas may be combined prior to sampling. The origin, storage and final use of soil is controlled by an approved soil control procedure.

Soil excavated from Class 1 and 2 areas may be reused for backfill of excavated areas of the same or higher classification (eg. Class 2 stored soil may be used to backfill Class 1 or 2 excavated areas; Class 1 stored soil may be used only to backfill Class 1 excavated areas). The survey and sampling protocols will be the same or equivalent to that described above for Class 3 stored soil with the following exceptions:

1. The pre-excavation surface scan or equivalent technique will provide 100% coverage
2. The soil pile volumetric sample density will be calculated based upon a surface survey unit size of 2000 m^2 and a Δ/σ value of 0.9. Thus, the equivalent volumetric sample density would be 40 samples per 300 m^3 (2000 m^2 x 0.15 m depth of soil sample) or 1 sample per 7.5 m^3.

In-Situ Gamma Spectroscopy may be employed, as appropriate, in lieu of pre-excavation sampling and scanning. Soil routinely excavated for non-remediation purposes from areas which have been successfully FSS'ed may be used to backfill the excavation without additional survey.

c. Embedded Piping and Buried Piping

The only systems to remain after decommissioning are embedded piping and buried piping. The piping expected to remain was described in detail in the Section 2. A detailed description of the final survey methods is provided in Attachment 5A.

d. Specific Areas and Conditions

Cracks, Crevices, Wall-Floor Interfaces and Small Holes

Surface contamination on irregular structure surfaces (e.g., cracks, crevices, and holes) are difficult to survey directly. Where no remediation has occurred and residual activity has not been detected above background, these surface blemishes may be assumed to have the same level of residual activity as that found on adjacent surfaces. The accessible surfaces are surveyed in the same manner as other structural surfaces and no special corrections or adjustments have to be made.

In situations where remediation has taken place or where residual activity has been detected above background, a representative sample of the contamination within the crack or crevice may be obtained or an adjustment for instrument efficiency may be made if justifiable. If an instrument efficiency adjustment cannot be justified based on the depth of contamination or other geometry factors, volumetric samples will be collected. The total dpm/100 cm^2 contained in the volumetric sample that is attributable to the beta emitting radionuclides used to determine the DCGL will be compared directly to the concrete gross beta DCGL. As an alternative, radionuclide specific analysis, coupled with application of the unity rule may be used.

Volumetric samples analyzed by gamma spectroscopy will detect the presence of radioactivity below the surface. Such sampling is typically performed following removal of paint and other surface coatings during remediation. After analysis, the data may be converted to equivalent surface activity for crack analysis.

The accessible surfaces are surveyed in the same manner as other structure surfaces except that they are included in areas receiving judgmental scans when scanning is performed over less than 100% of the area.

Paint Covered Surfaces

Final status surveys will consider the effect of painted surfaces. Gross measurements will not be used in areas covered by thick painted surfaces that are not remediated. The surfaces will be volumetrically sampled or the coating will be removed prior to survey. No special consideration must be given to wall or ceiling areas painted before plant startup and which have not been subjected to repeated exposure to materials that would have penetrated the painted surface.

Pavement-Covered Areas

The survey design of parking lots, roads and other paved areas will be based on soil survey unit sizes since they are outdoor areas where the exposure scenario is most similar to direct radiation to surface soil. The DCGL applied to these areas will be equal to the buried piping DCGL. Scan and static gamma and beta-gamma surveys are made as determined by the survey unit design. If sub-surface contamination is possible under paved or other covered areas, sub-surface volumetric samples will be collected. Paved areas may be separate survey units or they may be incorporated into other, larger survey open land units. Surveys of paved areas will include the area within road right-of-ways to check for radioactivity relocated due to water runoff. The right-of-ways may be separate survey units.

The buried pipe model, as described in Section 6.6.8, is based on the release of surface contamination (inside piping) into soil. The potential dose from paved areas is also from the release of surface contamination into soil. The soil concentration calculated in the buried pipe model was determined assuming a surface area to soil volume ratio that was higher than would likely occur in the case of paved surfaces. This would lead to higher soil concentrations from release of contamination from the buried piping than was calculated for the paved surfaces. In addition, the buried piping DCGL was limited to ensure that the resulting hypothetical soil concentrations would be below the surface soil DCGL's. The combination of conservative assumptions included in the buried piping dose model and the similarity of the ultimate dose pathways make it suitable for application to the paved surfaces.

Forebay Sediment

The forebay is designated as a stand alone survey area. The survey area may be split into multiple survey units, i.e, the rip-rap area, the "bare rock" bottom area, and soil. The forebay area will be designated as Class 1 and sample size will be determined consistent with a Class 1 soil area. Scan survey coverage will be specific to the various media within the area because of the unique geometry considerations. The Survey Package will describe in detail the rationale for the location and percent coverage of the scan surveys.

5.5.2 Instrumentation

Radiation detection and measurement instrumentation for the final status survey is selected to provide both reliable operation and adequate sensitivity to detect the radionuclides identified at the site at levels sufficiently below the DCGL. Detector selection is based on detection sensitivity, operating characteristics and expected performance in the field. The instrumentation will, to the extent practicable, use data logging with bar code scanning capability.

Commercially available portable and laboratory instruments and detectors are typically used to perform the three basic survey measurements: 1) surface scanning; 2) direct surface contamination measurements; and 3) spectroscopy of soil and other bulk materials, such as concrete. The Instrumentation Program Procedure controls the issuance, use, and calibration of instrumentation. Records supporting the Instrumentation Program are maintained by Document Control.

a. Selection

Radiation detection and measurement instrumentation is selected based on the type and quantity of radiation to be measured. (The instruments used for direct measurements are capable of detecting the radiation of concern to a Minimum Detectable Concentration (MDC) of between 10% and 50% of the applicable DCGL. The use of 10% to 50% of the DCGL is an administrative limit only. Any value below the DCGL is acceptable in Class 1 or 2 survey units. MDCs of less than 50% of the DCGL allow detection of residual activity in Class 3 survey units at an investigation level of 0.5 times the DCGL. Instruments used for scan measurements in Class 1 areas are required to be capable of detecting radioactive material at the $DCGL_{EMC}$.

Instrument MDCs are discussed in Section 5.5.2 (d) and nominal MDC values are listed in Table 5-6. Instrumentation currently proposed for used in the final status survey is listed in Table 5-4. Maine Yankee follows instrument manufacturers recommendations and/or supporting basis documents for considerations such as temperature dependency.

As the project proceeds, other measurement instruments or technologies, such as in-situ gamma spectroscopy or continuous data collection scan devices, may be found to be more efficient than the survey instruments proposed in this plan. The acceptability of such an instrument or technology for use in the final survey program would be justified in a technical basis document. The technical basis document would include among other things the following: (1) a description of the conditions under which the method would be used; (2) a description of the measurement method, instrumentation and criteria; (3) justification that the technique would provide equivalent scan coverage for the given survey unit classification and that the scan MDC is adequate when compared to the $DCGL_{EMC}$; and (4) a demonstration that the method provides data that has a Type 1 error (falsely concluding that the survey unit is acceptable) equivalent to 5% or less and provides sufficient confidence that $DCGL_{EMC}$ criteria is satisfied.

b. Calibration And Maintenance

Instruments and detectors are calibrated for the radiation types and energies of interest at the site. The calibration sources for beta survey instruments are Tc-99, Cs-137, or Co-60 because the average beta energy (100 keV) approximates the beta energy of the radionuclides found on surfaces or in piping on site (85-94 keV). The alpha calibration sources when used are Am-241or Th-230 which have an appropriate alpha energy for plant-specific alpha emitting nuclides. Gamma scintillation detectors are calibrated using Cs-137, but the energy response to Co-60 has also been determined since discrete areas of Co-60 contamination have been found by soil surface scans.

Table 5-4
Final Status Survey Instruments

Measurement Type	**Detector Type**	**Detector Total Area/ Density**	**Typical Manufacturer & Model #**	**Units**
Surface Alpha/Beta-Gamma	Gas Flow Proportional	126 cm^2 0.8 mg/ cm^2	Ludlum 43-68	cpm
Surface Alpha/Beta-Gamma	Large Area Gas Flow Proportional	584 cm^2 821 cm^2 (both 0.8 mg/cm^2)	Ludlum 43-37 43-37-1	cpm
Surface Beta -Gamma	G-M	15.5 cm^2 2mg/ cm^2	LND, TGM Eberline SHP-360	cpm
Gamma Scan	NaI(Tl)	2"x2"	Eberline SPA-3	cpm
Liquid Beta	Scintillation	N/A	Beckman	µCi
Smear Beta-Gamma	Gas Proportional	15.5 cm^2 0.8 mg/ cm^2	Tennelec	dpm
Gamma Spectroscopy	HP Ge	N/A	Canberra	pCi

Instrumentation used for final status survey will be calibrated and maintained in accordance with the Instrumentation Program procedure. Radioactive sources used for calibration are traceable to the National Institute of Standards and Technology (NIST) and have been obtained in standard geometries to match the type of samples being counted. If vendor services are used, these will be obtained in accordance with purchasing requirements for quality related services, to ensure the same level of quality.

c. Response Checks

Instrumentation response checks are conducted to assure proper instrument response and operation. An acceptable response for field instrumentation is an instrument reading within +/- 10% of the established check source value. Laboratory instrumentation standards will be within +/- 3 sigma as documented on a control chart. Response checks are performed daily before instrument use and again at the end of use. Check sources contain the same type of radiation as that being measured in the field and are held in fixed-geometry jigs for reproducibility. If an instrument fails a response check, it is labeled "Do Not Use" and is removed from service until the problem is corrected in accordance with applicable procedures. Measurements made between the last acceptable check and the failed check are evaluated to determine if they should remain in the data set.

d. Minimum Detectable Concentration (MDC)

The MDC is determined for the instruments and techniques used for final status surveys (Table 5-6). The MDC is the concentration of radioactivity that an instrument can be expected to detect 95 percent of the time.

Static MDC For Structure Surfaces

For static (direct) surface measurements, with conventional detectors, such as those listed in Table 5-4, the MDC is calculated as follows:

$$\text{MDCstatic} = \frac{3 + 4.65\sqrt{B}}{(K)(t)}$$

where:

MDC_{static} = minimum detectable concentration for direct counting (dpm/100 cm^2),

B = background counts during the count interval t (counts),

t = count interval (for paired observations of sample and blank, usually 1 minute),

K = calibration constant (counts/min per dpm/100 cm^2),

The value of K includes correction factors for efficiency (e_i and e_s). The value of e_s is dependent on the material type.

Corrections for radionuclide absorption have been made.

Open Land Area and Structure Scan MDC Using Alarm Set Point

The MDC formulae described in NUREG-1507 rely on the audible response of the meter. Maine Yankee proposes to use the E-600 instrument, a so called "smart meter," coupled to an appropriate detector for performing scan surveys for both structures and soil. This allows data logging and a more objective evaluation of scan MDC based on an alarm set point. The probability of alarm was calculated through simulation of instrument performance and compared to the $DCGL_{EMC}$, which was calculated using the area factors established in Sections 6.8 and 6.9. The extent of scan coverage is commensurate with the radiological conditions and classification of the survey unit in accordance with Table 5-3.

The determination of the alarm set-points and the DQO Type I error rate of 0.05 are based on using a 2 X 2 NaI detector moving at 0.25 m/sec at a distance of 2 inches from the soil surface. The error rate was calculated, and determined to be acceptable, using an E-600 instrument with a weighting factor of 5. The FSS procedures require a weighting factor of 5 to be applied during FSS scan surveys.

Prior to beginning the scan survey on an area, the local area background for a given survey unit or portion of a survey unit is determined. The FSS survey designer walks down the area and determines the number of potentially different background areas or materials. The designer then determines the number of measurements that need to be taken within the area in order to establish the local background. The technician collects the required number of measurements as well as soil samples and in situ gamma spectroscopy readings to ensure that the background values are not influenced by plant-derived radioactive materials. The average background reading is used to calculate the alarm set-point. This process ensures the appropriate determination and application of background characteristics in survey units with multiple media.

Before entering the survey unit grid[5] to begin a scan, the technician takes a one minute background count to ensure the background has not changed. If the background reading meets the expectation value, the technician performs the scan survey of the grid. The technician verifies the local area background is within plus or minus 1000 cpm of the expected value. If the background exceeds +/-1000 cpm or the instrument repeatedly alarms, the technician stops the survey and requests the FSS engineer to re-evaluate background and adjust the alarm set-point as necessary. Using the conversion factor derived in Maine Yankee's technical basis document (Reference 5.12.32), 1000 cpm is equivalent to about 2.2 pCi/g. Maine Yankee will add 2.2 pCi/g to the scan MDC for open land areas to account for the possibility that the background in a scan grid could decrease by up to 1000 cpm before the alarm set-point is readjusted.

The scan MDC's for open land areas using the E-600 instrument with an alarm set point are listed in Table 5-4a. The listed MDC's were selected to ensure a Type I error rate less than 0.05. The 0.05 Type I error rate is achieved by apportioning a 0.025 error rate to the first stage scan and a 0.025 error rate to the second stage scan.

[5] The scan grid size is limited to no greater than 10 square meters so that background fluctuation is not a concern (Reference 5.12.36)

The MDC calculation and results are described in a Maine Yankee technical basis document (Reference 5.12.32). Maine Yankee will multiply the MDC by a factor of 1.15 which accounts for uncertainty due to variability in scan speed and detector distance from the soil surface. The *a priori* $DCGL_{EMC}$ used for survey planning for soil survey units will be based on the scan MDC associated with a 2 m^2 land area at a 0.025 Type 1 error rate, corrected by a factor of 1.15 to account for variable scan speed and distance and increased by 2.2 pCi/g, i.e., 5.9 pCi/g Cs-137. Table 5-4a lists the DCGL for areas outside the RA. The DCGL for areas inside the RA is 2.39 pCi/g Cs-137. (See Section 6.7.2 for the determination of the DCGL and application of surrogates.)

The survey is performed in the peak trap mode and the highest value obtained in the survey grid is logged.

The beta-gamma scan MDC for structures using the E-600 instrument with an alarm set point are listed in Table 5-4b. The listed MDC's were selected to ensure a Type 1 error rate less than 0.05. The MDC calculation and results are described in a Maine Yankee technical basis document (Ref. 5.12.32). Survey planning for structure survey units will be based on the scan MDC associated with a 0.5 m^2 surface area, i.e., 1832 dpm/100 cm^2 for a 600 c/m background. Table 5-4b lists the DCGL for areas of 600 and 2000 c/m background. The DCGL for structures is 18,000 dpm/100 cm^2. (See Section 6.7.2 for the determination of the DCGL and the application of surrogates). The gamma scan MDC's for concrete structures using the E-600 instrument with an alarm set point are described using the Maine Yankee gamma scan technical basis document (Ref. 5.12.34).

The structure beta-gamma scan survey is performed using a gas flow proportional detector moving at 5 cm/sec at a distance of 1.0 cm from the structure surface. The survey is performed in the peak trap mode with the highest value obtained in the survey grid logged. The concrete structure gamma scan may be performed using sodium iodide detectors when surface conditions would result in increased surface to detector distance (typically within 3 inches) and when the static measurement sample size is adjusted for the corresponding MDC, if necessary.

Table 5-4a Land Area Scan MDC for E-600 Instrument (Outside Restricted Area - DCGL = 4.2 pCi/g)*								
	Scan Area (m^2)							
	0.5	1	2	4	6	8	16	25
Area Factor	22.3	12.0	6.8	4.1	3.2	2.8	2.0	1.7
$DCGL_{EMC}$	93.7	50.4	28.6	17.2	13.4	11.8	8.4	7.1
MDC_{5s} (pCi/g) Type 1 = 0.05	4.5	3.6	3.2	3.0	2.5	2.5	2.5	2.0

*See Section 6.7 for explanation of DCGL calculated for areas outside the Restricted Area

Table 5-4b Structure Beta-Gamma Scan MDC for E-600 Instrument						
	Scan Area (m^2)					
	0.03	0.06	0.10	0.20	0.50	1.00
Area Factor	1667	847	500	250	100	50
MDC (with 600 c/m bkg) dpm/100 cm^2	4884	3663	3053	2442	1832	1221
MDC (with 2000 c/m bkg) dpm/100 cm^2	9157	6720	5490	4270	3660	3053

e. Detection Sensitivity

The nominal detection sensitivity of some of the detectors that may be used for surface contamination surveys has been determined and is provided in Table 5-6.

Count times are instrument-specific and are selected to ensure that the measurements are sufficiently sensitive for the DCGL. For example, the count times associated with surface activity surveys (1 minute) and gamma spectroscopy of volumetric materials (17 minutes) are administratively established to achieve MDCs less than the DCGL. The MDC_{scan} values are also below the DCGL shown in Table 5-6. The MDC_{scan} values may not always be less than the $DCGL_W$, but will be less than $DCGL_{EMC}$.

A technique for performing land scans with a SPA-3 detector coupled to the E-600 has been developed which is capable of detecting discrete Co-60 particles of 1 uCi activity buried at a depth of six inches in soil. This capability has been confirmed by actual field testing using this detector with the E600, as documented in a technical basis document (Reference 5.12.32).

Cs-137 sensitivity was determined to be 3 pCi/g Cs-137 in a 2m^2 area. This is based on modeling the SPA-3/E600 combination, as documented in Reference 5.12.32 and confirmed by field testing.

The E600 instrument will be operated in the single channel analyzer mode when used in scan surveys to optimize the instrument's energy spectrum sensitivity.

f. Total Efficiency (E_t) and Source Efficiency (E_s) for Concrete Contamination

Section 6.6 provides a detailed description of the dose assessment for contaminated basement concrete. The source term input to the groundwater calculations is the total inventory within the basement concrete. This inventory appears to be primarily located within the first mm of the concrete surface. Various fixed point measurement alternatives for determining the source term were evaluated including gross beta measurements on the surfaces, volumetric concrete sampling and in-situ gamma spectroscopy. Gross beta fixed point measurements were determined to be cost-effective and technically defensible under the assumption that the instrument efficiencies for concrete could be satisfactorily calculated using the methods recommended in NUREG-1507.

For scan surveys, gross beta measurements appear to be the only practical method. Under certain conditions, in-situ gamma spectroscopy may be a reasonable method for replacing beta scan surveys. If in-situ gamma spectroscopy is used, a technical basis document will be developed demonstrating its suitability for final survey measurements and NRC will be notified 30 days prior to its first use.

The methods for determining efficiency in NUREG-1507 were specifically developed to address situations when the source, in this case concrete, affects radiation emission rate due to self-attenuation, backscatter, thin coverings, etc. This method accounts for these source effects by separating the efficiency calculation into two components, i.e., instrument efficiency E_i

and source efficiency E_s . The total efficiency E_t, is the product of E_i and E_s as shown below.

$$E_t = (E_i)(E_s)$$

The E_i was determined by calibration to a NIST traceable, large area Tc-99 source. The E_s value was determined empirically through measurements of concrete cores collected from representative site locations. The empirically derived value of 0.35 compares reasonably with the ISO standard default values of 0.25 for betas less than 0.4 MeV and 0.5 for betas greater than 0.4MeV, considering most of the concrete activity is Cs-137 with a beta energy greater than 0.4. Forty three cores were obtained from concrete floors of the buildings known to be contaminated. Cores were collected from the Containment Building loop areas which were considered to represent reactor coolant contamination. Spray Building cores were representative of the ECCS (emergency core cooling system) contamination. Cores collected in the PAB were representative of the waste processing system contamination. The RCA Building cores represented waste systems and decontamination activities. Fuel Building cores represented the spent fuel pool contamination events. Several cores were taken from each building. The core nuclide activities were determined by gamma spectrometry, geometry corrected, then the pCi/g result was multiplied by the mass of the core sample and converted to total gross beta dpm.

The cores were moved to a low background area and counted for gross beta using final survey instrumentation. The cores were initially counted for 1 minute, corrected for background and reported as net cpm. The instrument total efficiency, $E_{t,}$ was calculated as the ratio of the net count rate divided by the net activity in dpm. The initial efficiency data resulted in a mean efficiency of 0.148 with a standard deviation of 0.11. The data showed wide variability with approximately 50% of the individual efficiency values within one standard deviation of the mean. (Tchebycheff's theorem states that 68% of the values of a normally distributed population should be within one standard deviation of the mean.)

The core efficiency data have undergone a re-evaluation since the data were first obtained in order to better understand the wide variation exhibited by the initial data. New cores were collected to replace those previously destroyed during analysis. The cores still remaining were recounted. Five minute count times were used since some of the cores did not have high activity levels. Shielded and unshielded measurements were taken of each core to allow a more accurate background correction for each core. The recounted, reevaluated core data gave a mean total efficiency of 0.130 and a standard deviation of 0.06. The individual, recounted core efficiency values ranged from a high of 0.25 to a low of less than 0.01. Almost 70% of the efficiency measurements were within one sigma of the mean.

The cores were collected from many areas of the plant as described above. Upon physical examination of the cores it was noted that some cores consisted of bare concrete, some had been painted and the paint surface was well worn, some retained a thin coat of paint, and some had been painted with a thick coat of easy-to-decontaminate paint with coatings as thick as 3/32 of an inch. It appears that most of the very low efficiency values came from cores taken in areas where floors were coated with the thick, easy to decontaminate paint. Applying the paint attenuation equation given in NUREG-1507, the thick floor coating would shield the beta particles to the point of almost no detector response. These cores represent areas (RCA floor, Spray Bldg. floor, and Decon Room floor) that will not be amenable to direct measurement by gas-filled detector unless paint is removed. These areas will be surveyed by volumetric sample or in-situ gamma spectroscopy (if justified in technical basis document), or the surface will be remediated before survey. These samples have been removed from the core population in the final E_t calculation.

The cores with the high efficiencies were evaluated to determine if the presence of high levels of naturally occurring beta particles in the concrete mixture may be contributing to the high values. The background correction that was performed on these samples was for area background, not material background. Material background did not contribute significantly to the sample activity.

The use of gross beta counting is a reasonable, cost effective method for measuring concrete contamination. This technique can also be conservatively applied to activity measurements of the Containment wall liner because the liner is a smooth, nearly flat surface. The alternatives to gross counting (e.g., volumetric sampling with gamma spectrum analysis or in-situ gamma spectroscopy), while admittedly more costly and time consuming survey methods, are viable alternatives. Such measures may be applied to areas with thick floor coatings or very irregular surfaces resulting from remediation activities if an acceptable efficiency correction factor cannot be determined.

The table below lists the instrument, source and total efficiencies for the instruments proposed for material scan and direct measurements.

Table 5-5
Survey Instrument Efficiencies
(Material Scan and Direct Measurement Instruments)

Detector	Source Efficiency (E_s)	Total Efficiency (E_t)	Instrument Efficiency (E_i)
Ludlum 43-68	0.389	0.13	0.333
SHP-360	0.225	0.060	0.280

g. Pipe Survey Instrumentation

Remaining pipe will be surveyed to ensure residual remaining activity is less than the DCGL. Pipe crawlers (survey instruments) proposed for use for surveys of pipe with diameters between 1.5 and 12 inches have been shown to have 4B efficiencies ranging from 0.005 to 0.295 respectively. This equates to detection sensitivities of 2800 dpm/100cm^2 to 210 dpm/100cm^2 respectively. This level of sensitivity is adequate to detect residual activity below the BOP embedded pipe DCGL of 100,000 dpm/100cm^2 (800,000 dpm/100cm^2 for spray pipe DCGL) or the buried pipe DCGL of 9,800 dpm/100cm^2.

The Pipe Explorer*TM* has been selected to survey the embedded Spray Building pipe. The Pipe Explorer*TM* system has been used for alpha, beta, gamma and video surveys of over 6,000 feet of piping. The surveys have included pipes with up to 8 elbows and with vertical runs in excess of 9 m. Detectors have been successfully deployed past rocks, oil, and other debris that have obstructed up to 50 percent of the pipe's cross sectional area. The Pipe Explorer*TM* deployment system is capable of conducting surveys in pipes with diameters ranging from 0.05 m to 1.22 m and survey lengths that vary from 30 m up to 300 m. The detectors are protected and propelled by a pneumatically-driven tubular membrane.

The MDA for the 16 inch spray pipe for example is based on Type 1 and 2 errors of 0.05 and is calculated using the Currie (1968) formula as follows:

MDA = $\frac{2.71 + 4.65\sqrt{(BKR)(t)}}{(CF)(t)}$ where MDA is in dpm/100 cm2, BKR is the Background Count Rate (cpm), CF is the Conversion Factor in net cpm/dpm/100 cm^2 and t is the count time in minutes. For a background count rate of 4194 counts per minute and a CF of 6.4E-2 cpm/dpm/100cm^2, an MDA for Cs-137 of 4745 dpm/100cm^2 was calculated.

Table 5-6
Measurement Detection Sensitivities**

Type of Measurement	Detector	Background*	E*** (c/d)	MDC	DCGL
Beta-Gamma Surface Scan	Pancake G-M (SHP-360)	40 cpm	0.06	10484 dpm/100 cm^2	18000 dpm/100 cm^2
Beta-Gamma Surface Scan	Ludlum 43-68 126 cm^2 Gas Proportional	600 cpm	0.13	1832 dpm/100 cm^2	18000 dpm/100 cm^2
Beta-Gamma Juncture Scan	Ludlum 43-68 126 cm^2 Gas Proportional	600 cpm	0.06	3969 dpm/100 cm^2	18000 dpm/100 cm^2
Beta-Gamma Direct	Pancake G-M (SHP-360)	40 cpm	0.06	3554 dpm/100 cm^2	18000 dpm/100 cm^2
Beta-Gamma Direct	Ludlum 43-68 126 cm^2 Gas Proportional	600 cpm	0.13	714 dpm/100 cm^2	18000 dpm/100 cm^2
Beta-Gamma Direct	Ludlum 43-37 582 cm^2 Gas Proportional	2000 cpm	0.141	257 dpm/100 cm^2	18000 dpm/100 cm^2
Beta-Gamma Surface Scan	Ludlum 43-37 582 cm^2 Gas Proportional	2000 cpm	0.141	3585 dpm/100 cm^2	18000 dpm/100 cm^2

Table 5-6
Measurement Detection Sensitivities**

Type of Measurement	**Detector**	**Background***	**E*** (c/d)**	**MDC**	**DCGL**
Beta-Gamma Direct	Ludlum 43-94 39 cm^2 Gas Proportional	75 cpm	0.024 (for 3" pipe) 0.031 (for 2" pipe) 0.036 (for 1" pipe)	4305 dpm/100 cm^2 (for Eff. of 0.024)	100,000 dpm/100 cm^2
Alpha Direct	Ludlum 43-68 126 cm^2 Gas Proportional	1 cpm	0.20	30 dpm/100 cm^2	Beta-Gamma Direct
Gamma Scan (Soil)	NaI(Tl) (SPA-3)	10,000 cpm	0.012	5.9 pCi/g (Cs-137)	2.39 pCi/g (Inside RA) 4.2 pCi/g (Outside RA) (Cs equiv.)
Gamma Scan (Concrete)	NaI(Tl) (SPA-3)	20,000 cpm	TBD	See Ref. 5.12.34	18000 dpm/100 cm^2
Gamma Spectroscopy	HP Ge	N/A	N/A	0.01 pCi/g	2.39 pCi/g (Inside RA) 4.2 pCi/g (Outside RA) (Cs equiv.)
Liquid Beta	Beckman Liquid Scintillation	40 dpm	0.46	3.25E-6 uCi/ml	N/A
Smear Alpha / Beta-Gamma	Tennelec Gas Proportional	0.5 cpm Alpha 30 cpm Beta-gamma	0.25 Alpha 0.35 Beta	25 dpm - alpha 81 dpm - beta-gamma	N/A

*Background values are typical values. These background values are well below the MDCs and are adequate for selecting the instruments for performing surveys. **The table values are based on a one minute direct count or a surface scan rate of 2 inches per second, and a soil scan rate of 20 sec/m^2, unless otherwise noted. *** Efficiencies for concrete surfaces are E_t. E_i, adjusted for geometry effects, is used for pipe survey efficiency.

5.6 Investigation Levels and Elevated Areas Test

During survey unit measurements, levels of radioactivity may be identified by an increase in count rate, an instrument alarm or an elevated sample result that warrant investigation. Elevated measurements may result from either discrete particles, a distributed source, or a change in background activity. In either case the investigations actions would be followed. Depending on the results of the investigation, the survey unit may require no action, may require remediation, and/or may require reclassification and resurvey. Investigation levels and the investigation process are described below.

5.6.1 Investigation Levels

NUREG 1727 (Table E.2) and NUREG 1575 (Table 5.8) provide investigation levels for scan surveys. In addition to investigation levels for scan surveys, direct measurement survey investigation levels have also been developed. These additional investigation levels include a very conservative value for Class 3 survey units as shown in Table 5-7.

5.6.2 Investigation Process

Technicians will respond to all instrument alarms while surveying. Upon receiving an alarm, the technician will stop and resurvey the last square meter of area to verify the alarm. Technicians are cautioned, in training, about the importance of the alarm verification survey, instructed on expected instrument response to localized areas of elevated activity and are given specific direction in procedure as to survey extent and scan speed. If the alarm is verified, the technician will mark the area with a flag or other appropriate means. The alarm data may be evaluated by the FSSS with respect to the investigation levels specified in Table 5-7. Each area marked, which exceeds the investigation level specified in Table 5-7, will have an investigation survey instruction prepared. The instruction will require a re-scan of the area, direct measurements, field gamma spectroscopy measurement (as appropriate), and collection of a soil sample (for land surveys). Each investigation will be evaluated and reported in the survey unit Release Record.

The size and average activity level in the elevated area is determined to demonstrate compliance with the area factors. If any location in a Class 2 area exceeds the DCGL, scanning coverage in the vicinity is increased in order to determine the extent and level of the elevated reading(s). If the elevated reading occurs in a Class 3 area, the scanning coverage is increased and the area should be reclassified.

Table 5-7 Investigation Levels		
Classification	**Scan Investigation Levels**[6]	**Direct Investigation Levels**
Class 1	>$DCGL_{EMC}$	>$DCGL_{EMC}$
Class 2	>$DCGL_w$ or >MDC_{scan} if MDC_{scan} is greater than $DCGL_w$.	>$DCGL_w$
Class 3	>$DCGL_w$ or >MDC_{scan} if MDC_{scan} is greater than $DCGL_w$.	>0.5 $DCGL_w$

Investigations should consider: (1) the assumptions made in the survey unit classification; (2) the most likely or known cause of the contamination; and (3) the possibility that other areas within the survey unit may have elevated areas of activity that may have gone undetected. Depending on the results of the investigation, a portion of the survey unit may be reclassified if there is sufficient justification. The results of the investigation process are documented in the survey area Release Record. See also Section 5.6.4 for additional discussion regarding potential reclassification of the survey unit.

5.6.3 Elevated Measurement Comparison (EMC)

The elevated measurement comparison may be used for Class 1 survey units when one or more scan or static measurements exceed the investigation level if remediation is not performed. The EMC provides assurance that unusually large measurements receive the proper attention and that any area having the potential for significant dose contribution is identified. As stated in NUREG-1575, the EMC is intended to flag potential failures in the remediation process and should not be considered the primary means to identify whether or not a survey unit meets the release criterion.

Locations identified by scan with levels of residual radioactivity which exceed the *a priori* $DCGL_{EMC}$ or static measurements with levels of residual radioactivity which exceed the *a priori* $DCGL_{EMC}$ are subject to additional surveys to determine compliance with the elevated measurement criteria. The size of the area containing the elevated residual radioactivity and the average level of residual activity within the area are determined. The average level of activity is compared to the $DCGL_W$ based on the actual area of elevated

[6] Must be calculated *a priori*. The a priori $DCGL_{EMC}$ for soil was calculated to be 5.9 pCi/g in accordance with Section 5.5.6.d.

activity. (If a background reference area is being applied to the survey unit, the mean of the background reference area activity may be subtracted before conducting the EMC).

The *a priori* $DCGL_{EMC}$ is established during the survey design and is calculated as follows:

$$DCGL_{EMC} = \text{Area Factor x DCGL}$$

The area factor is the multiple of the DCGL that is permitted in the area of elevated residual radioactivity without remediation. The area factor is related to the size of the area over which the elevated activity is distributed. That area is generally bordered by levels of residual radioactivity below the DCGL and is determined by the investigation process. Area factors are calculated in Section 6 of the LTP and listed in Tables 6-12 and 6-14.

The actual area of elevated activity is determined by investigation surveys and the area factor is adjusted for the actual area of elevated activity. The product of the adjusted area factor and the DCGLw determines the actual $DCGL_{EMC}$. If the $DCGL_{EMC}$ is exceeded, the area is remediated and resurveyed.

The results of the elevated area investigations in a given survey unit that are below the $DCGL_{EMC}$ limit are evaluated using the equation below. If more than one elevated area is identified in a given survey unit, the unity rule can be used to determine compliance. If the formula value is less than unity, no further elevated area testing is required and the EMC test is satisfied.

$$\frac{d}{DCGL_w} + \frac{(\text{average concentration in elevated area} - d}{(\text{Area Factor})(DCGL_w)} < 1$$

Where: * is the average residual activity in the survey unit. When calculating * for use in this inequality, measurements falling within the elevated area may be excluded provided the overall average in the survey unit is less than the $DCGL_w$.[7] For contaminated concrete (basement fill model), the area factor used in the unity rule may be specified as the survey unit size divided by the elevated area size.

Compliance with the soil $DCGL_{EMC}$ will be determined using the FSS gamma spectroscopy results and a unity rule approach. These general methods will also be applied to other materials where sample gamma spectroscopy is used for FSS. The application of the unity rule to the elevated measurement comparison requires area factors and corresponding

[7] MARSSIM, NUREG-1575, Revision 1, (June 2001), Section 8.5.2, per the EPA website at www.epa.gov/radiation/marssim/docs/revision1.

$DCGL_{EMC}$'s to be calculated for Cs-137, Co-60, and any other gamma emitter identified during FSS, separately.

The methods used to calculate the nuclide specific soil area factors will be the same as described in Section 6.8.2. These area factors are used to determine $DCGL_{EMC}$ for Co-60, Cs-137, and any other identified gamma emitter, for each elevated area being evaluated during FSS. The surrogate radionuclides will be conservatively accounted for through the application of the Cs-137 area factor to the surrogate Cs-137 DCGL since the HTD radionuclides have higher area factors than Cs-137. The $DCGL_{EMC}$'s are used as follows to determine compliance with the elevated measurement comparison. Background could be subtracted from each radionuclide concentration if necessary.

$$\left(\frac{\text{Cs}-137}{\text{Cs}-137_{DCGL_{EMC}}}\right)+\left(\frac{\text{Co}-60}{\text{Co}-60_{DCGL_{EMC}}}\right)+\ldots+\left(\frac{R_N}{DCGL_{EMC_N}}\right)\leq 1.0$$

Where: Cs-137 and Co-60 are the gamma spec results from FSS,

$DCGL_{EMC_N}$ is calculated for the size of the elevated area being evaluated,

R_N is any other gamma emitter identified during FSS, and

$DCGL_{EMC_N}$ is the $DCGL_{EMC}$ for radionuclide N

5.6.4 Remediation and Reclassification

As shown in Table 5-8, for any classification (1, 2 or 3), areas of elevated residual activity above the $DCGL_{EMC}$ are remediated to reduce the residual radioactivity to acceptable levels. Whenever an investigation confirms activity above an action level listed in Table 5-8, an evaluation of the HSA, operational history, design information, and sample results will be performed. The evaluation will consider: (1) the elevated area's location, dimensions, and sample results, (2) an explanation as to the potential cause and extent of the elevated area in the survey unit, (3) the recommended extent of reclassification, if considered appropriate, and (4) any other required actions. Areas that are reclassified as Class 1 are typically bounded by a Class 2 buffer zone to provide further assurance that the reclassified area completely bounds the elevated area. This evaluation process is established to avoid the unwarranted reclassification of an entire survey unit (which can be quite large) while at the same time requiring an assessment as to extent and reasons for the elevated area.

Specifically, for the reclassification (following LTP approval) of a survey unit (or portion of a survey unit) from Class 1 to Class 2, the following criteria will be followed:

1. The survey unit (or portion of a survey unit) to be reclassified as Class 2 must meet the Class 2 designation (LTP Section 5.2.2), i.e., prior to remediation, the reclassified area is not likely to contain residual

radioactivity in excess of the $DCGL_W$.

2. There is sufficient knowledge regarding the distribution of contamination within the reclassified Class 2 area to support a conclusion that subject area is not likely to contain residual radioactivity in excess of the $DCGL_W$.

3. As noted in Table 5-3, for Class 2 Survey Units, the amount of scan coverage will be proportional to the potential for finding areas of elevated activity or areas close to the release criterion in accordance with MARSSIM Section 5.5.3.

Reclassification from either Class 1 or Class 2 to Class 3 would generally observe similar criteria as listed above.

1. The reclassified survey unit (or portions thereof) would be required to meet Class 3 requirements (per Section 5.2.2).

2. There is sufficient knowledge regarding the distribution of contamination within the reclassified Class 3 area to support a conclusion that the area has a low probability of containing residual radioactivity.

3. Scan coverage for the reclassified area will meet Table 5-3 requirements

Per agreements with NRC, Maine Yankee will provide notification to the NRC prior to a reclassification (following LTP approval) of a survey unit (or portion of a survey unit) per the discussion in Section 1.4.

If an individual survey measurement (scan or direct) in a Class 2 survey unit exceeds the DCGL, the survey unit or a portion of it may be reclassified and the survey redesigned and re-performed accordingly. If an individual survey measurement in a Class 3 survey unit exceeds 0.5 DCGL, the survey unit, or portion of a survey unit, will be evaluated, and if necessary, reclassified to a Class 2 and the survey redesigned and re-performed accordingly.

Table 5-8 Investigation Actions			
Action If Investigation Results Exceed:			
Class	$DCGL_{EMC}$	$DCGL_W$	0.5 $DCGL_W$
1	Remediate and resurvey as necessary	Acceptable	Acceptable
2	Remediate, reclassify portions as necessary	Reclassify portions as necessary	Acceptable
3	Remediate, reclassify portions as necessary	Increase scan coverage and reclassify portions as necessary	Increase scan coverage and reclassify portions as necessary

5.6.5 Resurvey

Following an investigation, if a survey unit is reclassified or if remediation activities were performed, a resurvey is performed in accordance with procedures. If a Class 2 area had contamination greater than the $DCGL_W$ it should be reclassified. If the average value of Class 2 direct survey measurements was less than the $DCGL_W$, the $Scan_{MDC}$ was sensitive enough to detect the $DCGL_{EMC}$ and there were no areas greater than the $DCGL_{EMC}$, the survey redesign may be limited to obtaining a 100% scan without having to re-perform the direct measurements. This condition assumes that the sample density meets the requirements for a Class 1 area. If the Class 2 area had contamination greater than the $DCGL_W$, but the $Scan_{MDC}$ was not sensitive enough to detect the $DCGL_{EMC}$, the affected area is reclassified and resurveyed at the sample density determined from the EMC.

5.7 Data Collection and Processing

5.7.1 Sample Handling and Record Keeping

A sample tracking record (chain-of-custody record) accompanies each sample from the point of collection through obtaining the final results to ensure the validity of the sample data. Sample tracking records are controlled and maintained and, upon completion of the data cycle, are transferred to Document Control, in accordance with applicable procedures.

Each survey unit has a document package associated with it which covers the design and field implementation of the survey requirements. Survey unit records are quality records.

5.7.2 Data Management

Survey data are collected from several sources during the data life cycle and are evaluated.

QC replicate measurements are not used as final status survey data. See LTP Section 5.10.4(d) for design and use of QC replicate measurements.

Measurements performed during turnover and investigation surveys can be used as final status survey data if they were performed according to the same requirements as the final survey data. These requirement include: (1) the representativeness of the survey data to reflect the as-left survey unit condition untouched by further remediation; (2) the application of isolation measures to the survey unit to prevent re-contamination and to maintain final configuration; and (3) the data collection and design were in accordance with FSS methods, e.g., scan MDC, investigation levels, survey data point number and location, statistical tests, and EMC tests.

Measurement results stored as final status survey data constitute the final survey of record and are included in the data set for each survey unit used for determining compliance with the site release criteria.

Measurements are recorded in units appropriate for comparison to the DCGL. The recording units for surface contamination are dpm/100 cm^2 and pCi/g for activity concentrations. Numerical values, even negative numbers, are recorded.

Document Control procedures establish requirements for record keeping. Measurement records include, at a minimum, the surveyor's name, the location of the measurement, the instrument used, measurement results, the date and time of the measurement and any surveyor comments.

5.7.3 Data Verification and Validation

The final status survey data are reviewed before data assessment to ensure that they are complete, fully documented and technically acceptable. The review criteria for data acceptability will include at a minimum, the following items:

a. The instrumentation MDC for fixed or volumetric measurements was below the $DCGL_W$ or if no, it was below the $DCGL_{EMC}$ for Class 1, below the $DCGL_W$ for Class 2 and below 0.5 $DCGL_w$ for Class 3 survey units.

b. The instrument calibration was current and traceable to NIST standards,

c. The field instruments were source checked with satisfactory results before and after use each day data were collected or data was evaluated by the FSSE if instruments did not pass a source check in accordance with 5.5.2.c

d. The MDCs and assumptions used to develop them were appropriate for the instruments and techniques used to perform the survey,

e. The survey methods used to collect data were proper for the types of radiation involved and for the media being surveyed,

f. "Special methods" for data collection were properly applied for the survey unit under review. These special methods are either described in this LTP section or will be the subject of an NRC notice of opportunity for review,

g. The chain-of-custody was tracked from the point of sample collection to the point of obtaining results,

h. The data set is comprised of qualified measurement results collected in accordance with the survey design which accurately reflect the radiological status of the facility, and

i. The data have been properly recorded.

If the data review criteria were not met, the discrepancy will be reviewed and the decision to accept or reject the data will be documented in accordance with approved procedures.

5.7.4 Graphical Data Review

Survey data may be graphed to identify patterns, relationships or possible anomalies which might not be so apparent using other methods of review. A posting plot or a frequency plot may be made. Other special graphical representations of the data will be made as the need dictates.

a. Posting Plots

Posting plots may be used to identify spatial patterns in the data. The posting plot consists of the survey unit map with the numerical data shown at the location from which it was obtained. Posting plots can reveal patches of elevated radioactivity or local areas in which the DCGL is exceeded. Posting plots can be generated for background reference areas to point out spatial trends that might adversely affect the use of the data. Incongruities in the background data may be the result of residual, undetected activity, or they may just reflect background variability.

b. Frequency Plots

Frequency plots may be used to examine the general shape of the data distribution. Frequency plots are basically bar charts showing data points within a given range of values. Frequency plots reveal such things as skewness and bimodality (having two peaks). Skewness may be the result of a few areas of elevated activity. Multiple peaks in the data may indicate the presence of isolated areas of residual radioactivity or background variability due to soil types or differing materials of construction. Variability may also indicate the need to more carefully match background reference areas to survey units or to subdivide the survey unit by material or soil type.

5.8 Data Assessment and Compliance

An assessment is performed on the final status survey data to ensure that they are adequate to support the determination to release the survey unit. Simple assessment methods such as comparing the survey data to the DCGL or comparing the mean value to the DCGL are first performed. The statistical tests are then applied to the final data set and conclusions are made as to whether the survey unit meets the site release criterion.

5.8.1 Data Assessment Including Statistical Analysis

The results of the survey measurements are evaluated to determine whether the survey unit meets the release criterion. In some cases, the determination can be made without performing complex, statistical analyses.

a. Interpretation of Sample Measurement Results

An assessment of the measurement results is used to quickly determine whether the survey unit passes or fails the release criterion or whether one of the statistical analyses must be performed. The evaluation matrices are presented in Tables 5-9 and 5-10.

Table 5-9
Interpretation of Sample Measurements When WRS Test Is Used

Measurement Results	Conclusion
Difference between maximum survey unit concentration and minimum reference area concentration is less than DCGLw	Survey unit meets release criterion.
Difference of survey unit average concentration and reference average concentrations greater than DCGLw	Survey unit fails.
Difference between any survey unit concentration and any reference area concentration is greater than DCGLw and the difference of survey unit average concentration and reference area average concentration is less than DCGLw	Conduct WRS test and elevated measurements test.

Table 5-10
Interpretation of Sample Measurements When Sign Test is Used

Measurement Results	Conclusion
All concentrations less than DCGLw	Survey unit meets release criterion
Average concentration greater than DCGLw	Survey unit fails
Any concentration greater than DCGLw and average concentration less than DCGLw	Conduct Sign Test and elevated measurements test.

When required, one of four statistical tests will be performed on the survey data:

1. WRS Test
2. Sign Test
3. WRS Test Unity Rule
4. Sign Test Unity Rule

In addition, survey data are evaluated against the EMC criteria as previously described in Section 5.6.3 and as required by NUREG 1727. The statistical test is based on the null hypothesis (Ho) that the residual radioactivity in the survey unit exceeds the DCGL. There must be sufficient survey data at or below the DCGL to reject the null hypothesis and conclude the survey unit meets the site release criterion for dose. Statistical analyses are performed using a specially designed software package or, if necessary, using hand calculations.

b. Wilcoxon Rank Sum Test

The WRS test, or WRS Unity Rule (NUREG-1505, Chapter 11), may be used when the radionuclide of concern is present in the background or measurements are used that are not radionuclide-specific. In addition, this test is valid only when “less than” measurement results do not exceed 40 percent of the data set.

The WRS test is applied as follows:

1. The background reference area measurements are adjusted by adding the $DCGL_W$ to each background reference area measurement, X_i, $Z_i = X_i + DCGL$.

2. The number of adjusted background reference area measurements, m, and the number of survey unit measurements, n, are summed to obtain N, (N = m + n).

3. The measurements are pooled and ranked in order of increasing size from 1 to N. If several measurements have the same value, they are assigned the average rank of that group of measurements.

4. The ranks of the adjusted background reference area measurements are summed to obtain W_r.

5. The value of W_r is compared with the critical value in Table I.4 of NUREG-1575. If W_r is greater than the critical value, the survey unit meets the site release dose criterion. If W_r is less than or equal to the critical value, the survey unit fails to meet the criterion.

c. Sign Test

The Sign test and Sign test Unity Rule are one-sample statistical tests used for situations in which the radionuclide of concern is not present in background, or is present at acceptable low fractions compared to the $DCGL_W$. If present in background, the gross measurement is assumed to be entirely from plant activities. This option is used when it can be reasonably expected that including the background concentration will not affect the outcome of the Sign test. The advantage of using the Sign test is that a background reference area is not needed. The Sign Test may also be used with background subtraction in accordance with Chapter 12 of NUREG-1505.

The Sign test is conducted as follows:

1. The survey unit measurements, X_i, i = 1, 2, 3, ...N; where N = the number of measurements, are listed.

2. X_i is subtracted from the $DCGL_W$ to obtain the difference $D_i = DCGL_W - X_i$, i = 1, 2, 3,..., N.

3. Differences where the value is exactly zero are discarded and N is reduced by the number of such zero measurements.

4. The number of positive differences are counted. The result is the test statistic S+. Note that a positive difference corresponds to a measurement below the $DCGL_W$ and contributes evidence that the survey unit meets the site release criterion.

5. The value of S+ is compared to the critical value given in Table I.3 of NUREG-1575. The table contains critical values for given values of N and ". The value of " is set at 0.05 during survey design. If S+ is greater than the critical value given in the table, the survey unit meets the site release criterion. If S+ is less than or equal to the critical value, the survey unit fails to meet the release criterion.

d. Unity Rule

The Cs-137 to C0-60 ratio will vary in the final survey soil samples, and this will be accounted for using a “unity rule” approach as described in NUREG-1505 Chapter 11. Unity Rule Equivalents will be calculated for each measurement result using the surrogate adjusted Cs-137 DCGL and the adjusted Co-60 DCGL, as shown in the following equation. (See Section 6.7.2 for the Cs-137_S DCGL calculation.)

$$\text{Unity Rule Equivalent} \le 1 = \frac{\text{Cs-137}}{\text{DCGL}_{(\text{Cs-137}_S)}} + \frac{\text{Co}-60}{\text{DCGL}_{(\text{Co}-60_A)}} + \ldots + \frac{R_N}{\text{DCGL}_{(N_A)}}$$

Where: Cs-137 and Co-60 are the gamma spec results,

$\text{DCGL}_{(\text{Cs}-137_S)}$ is the surrogate Cs-137s DCGL, adjusted to represent the Table 6-11 total surface dose, as applicable (inside RA)

$DCGL_{(Co-60_A)}$ is the Co-60 DCGL, adjusted to represent the Table 6-11 total surface dose, as applicable (inside RA)

R_N is any other identified gamma emitting radionuclides, and
$DCGL_{(N_A)}$ is the adjusted DCGL for radionuclide N.

The unity rule equivalent results will be used to demonstrate compliance assuming the DCGL is equal to 1.0 using the criteria listed in the LTP, Tables 5-9 and 5-10. If the application of the WRS or Sign test is necessary, these tests will be applied using the unity rule equivalent results and assuming that the DCGL is equal to 1.0. An example of a WRS test using the unity rule is provided in NUREG-1505, Page 11-3, Section 11.4. If the WRS test is used, or background subtraction is used in conjunction with the Sign test, background concentrations will also be converted to Unity Rule Equivalents prior to performing test.

The Sign test will be used without background subtraction if background Cs-137 is not considered a significant fraction of the DCGL. Note that the surrogate Cs-137 DCGL will be used for both the statistical tests and comparisons with the criteria in LTP Tables 5-9 and 5-10.

The same general surrogate and unity rule methods described above for soil will be applied to other materials, such as activated concrete, where sample gamma spectroscopy is used for final survey as opposed to gross beta measurements.

5.8.2 Data Conclusions

The results of the statistical tests, including application of the EMC, allow one of two conclusions to be made. The first conclusion is that the survey unit meets the site release dose criterion. The data provide statistically significant evidence that the level of residual radioactivity in the survey unit does not exceed the release criterion. The decision to release the survey unit is made with sufficient confidence and without further analysis.

The second conclusion that can be made is that the survey unit fails to meet the release criterion. The data are not conclusive in showing that the residual radioactivity is less than the release criterion. The data are analyzed further to determine the reason for the failure.

Possible reasons are that:

1. the average residual radioactivity exceeds the DCGL, or

2. the test did not have sufficient power to reject the null hypothesis (i.e., the result is due to random statistical fluctuation).

The power of the statistical test is a function of the number of measurements made and the standard deviation in measurement data. The power is determined from 1-$ where $ is the value for Type II errors. A retrospective power analysis may be performed using the methods described in Appendices I.9 and I.10 of NUREG-1575. If the power of the test is insufficient due to the number of measurements, additional samples may be collected as directed by procedure. A greater number of measurements increases the probability of passing if the survey unit actually meets the release criterion. If failure was due to the presence of residual radioactivity in excess of the release criterion, the survey unit must be remediated and resurveyed.

5.8.3 Compliance

The final status survey is designed to demonstrate that licensed radioactive materials have been removed from MY station facilities and property to the extent that residual levels of radioactive contamination are below the radiological criteria for unrestricted use as approved by the NRC. The site-specific radiological criteria presented in this plan demonstrate compliance with the criteria of 10CFR20.1402 and State of Maine Law LD 2688-SP1084.

If the measurement results pass the requirements of Tables 5-9 and 5-10 of Section 5.8.1, and the elevated areas evaluated per Section 5.6.3 pass the elevated measurement comparison, then the survey unit is suitable for unrestricted release.

5.9 Reporting Format

Survey results are documented in history files, survey unit release records, and in the final status survey report. Other reports may be generated as requested by the NRC.

5.9.1 History File

A history file of relevant operational and decommissioning data has been compiled. The history file consists of the HSA, GTS Characterization Report, Classification Basis, and 50.75(g) file information. The purpose of the history file is to provide a substantive basis for the survey unit classification, and hence, the level of intensity of the final status survey. The history file contains:

1. Operating history which could affect radiological status

2. Summarized scoping and site characterization data

3. Other relevant information

5.9.2 Survey Unit Release Record

A separate release record is prepared for each survey unit. The survey unit release record is a document containing sufficient information necessary to demonstrate compliance with the site release criteria. This record includes at least:

a. Description of the survey unit

b. Survey unit design information

c. Survey results

d. Survey unit investigations performed and their results

e. Survey unit data assessment results

When a survey unit release record is given final approval it becomes a quality record.

5.9.3 Final Status Survey Report

Survey results will be described in a written report to the NRC. The actual structures, land, or piping system included in each written report may vary depending on the status of ongoing decommissioning activities.

The final status survey report provides a summary of the survey results and the overall conclusions which demonstrate that the MY facility and site meet the radiological criteria for unrestricted use. Information such as the number and type of measurements, basic statistical quantities, and statistical analysis results are included in the report. The level of detail is sufficient to clearly describe the final status survey program and to certify the results. The format of the final report will contain the following topics:

1.0 Overview of the Results

2.0 Discussion of Changes to FSS

3.0 Final Status Survey Methodology
- Survey unit sample size
- Justification for sample size

4.0 Final Status Survey Results

- Number of measurements taken
- Survey maps
- Sample concentrations
- Statistical evaluations, including power curves
- Judgmental and miscellaneous data sets
- Investigations and results (anomalous data)

5.0 Conclusion for each survey unit

- Any Changes from initial assumptions on extent of residual activity.
- Simplified General Retrospective Dose Estimate: For illustrative purposes, relevant FSS data will be reviewed to determine a gross average of residual contamination level which will be used to calculate a retrospective dose estimate. This retrospective dose estimate, which will be provided in the final report, may be helpful in illustrating to various stakeholders Maine Yankee's compliance with the dose based release criteria.

5.9.4 Other Reports

Other reports will be prepared and submitted as requested.

5.10 FSS Quality Assurance Plan (QAP)

The Final Status Survey QAP, as described in this section, is developed and implemented by trained and qualified personnel. The FSS QAP will ensure that the site will be surveyed, evaluated and determined to be acceptable for unrestricted use if the residual activity results in an annual TEDE to the average member of the critical group of 10 mrem/year or less for all pathways and 4 mrem or less for groundwater drinking sources (enhanced state clean-up levels). Ensuring that the site meets the requirements for license termination is a complex process. Quality must be built in to each phase of the plan and measures must be taken during the execution of the plan to determine whether the expected level of quality is being achieved.

The Quality Assurance activities for decommissioning are based on the requirements of 10CFR50.82. The objective of the FSS QAP is to ensure that the survey data collected are of the type and quality needed to demonstrate with sufficient confidence that the site is suitable for unrestricted release. The objective is met through use of the DQO process for FSS design, analysis and evaluation. The plan ensures that: 1) the elements of the final status survey plan are implemented in accordance with the approved procedures; 2) surveys are conducted by trained personnel using calibrated instrumentation; 3) the quality of the data collected is adequate; 4) all phases of package design and survey are properly reviewed, and oversight is provided; and 5) corrective actions, when identified, are implemented in a timely manner and are determined to be effective. The FSS QA Plan will be applied to the following aspects of final status survey activities.

5.10.1 Project Management and Organization

The FSS project organization has been established within the Maine Yankee radiation protection organization for planning and implementation of the final status survey. This organization, depicted in Figure 5-6 (at end of Section 5), is directed by the Manager of Projects - FSS who reports to the Radiation Protection Manager (RPM). The RPM maintains overall responsibility for the performance of the final status survey and overall integration of the FSS project with other decommissioning activities[8].

The Final Status Survey project organization consists of the following functional levels:

a. Manager of Projects (MOP) - FSS: The Manager of Projects for Final Status Survey (MOP FSS) is responsible for the administration of, and ensuring the implementation of, the FSS Plan. The MOP FSS is responsible for ensuring activities conducted as part of the FSS are performed in accordance with the FSS Quality Assurance Plan. The MOP FSS is responsible for management of personnel assigned to the FSS section. The MOP FSS is responsible for approving FSS Release Records and ensuring contractual and licensing obligations are satisfied. The MOP FSS reports to the RPM.

b. Superintendent of Radiation Remediation (SRR): The SRR has the overall responsibility for the planning, monitoring and coordination of radiological remediation in preparation for FSS activities. The SRR has responsibility for establishing, maintaining and implementing the programs, procedures and evaluations to support radiological remediation. The SRR has responsibility for the pre-demolition surveys of structures being demolished as well as the control of radioactive material resulting from demolition. The SRR, when directed, has responsibility for Turnover Surveys prior to area acceptance for FSS. The SRR reports to the MOP-FSS.

c. Superintendent of Final Status Survey (SFSS): The Superintendent of Final Status Survey (SFSS) is responsible for the preparation and implementation of the FSS program. The SFSS has overall responsibility for program

[8] See Section 5.10.1 for discussion of the relationship between the FSS project organization and the Maine Yankee Quality Assurance Program

direction, technical content, and ensuring the program complies with applicable NRC regulations and guidance. The SFSS is responsible for resolution of issues or concerns raised by NRC, the State of Maine, or other stakeholders, as well as any programmatic issues raised by Maine Yankee Management. The SFSS provides overall management and direction to FSS personnel. Interface with regulatory agencies and other outside organizations regarding the FSS Program will be conducted primarily by the SFSS. The SFSS reviews and approves the qualification and selection of FSS personnel and approves the content of training to FSS personnel and other personnel on FSS topics. The SFSS approves reports of FSS results. The SFSS reports to the MOP-FSS.

d. Radiochemist: The Radiochemist is responsible for the conduct of the day to day activities performed by Chemistry personnel and for the supervision of the counting room personnel and activities. The Radiochemist is responsible for data quality of onsite FSS sample analyses. (If samples are processed offsite, the MY Quality Assurance Program determines the quality requirements for offsite procurement.) The Radiochemist reports to the Superintendent Radiation Engineering and Technical Support.

e. FSS Engineer (FSSE): The FSS Engineer (FSSE) is responsible for the technical support, development, and implementation of FSS procedures. The FSSE is responsible for the review of survey packages and the review of all data collected in support of the FSSE. The FSSE reviews FSS procedures and reviews reports of FSS results. The FSSE reports to the SFSS.

f. FSS Specialist (FSSS): The FSSS is responsible for preparation of survey packages for individual survey areas, including history files, survey designs and instructions. In addition, the FSSS is responsible for preparation of survey maps, grid maps, layout diagrams, composite view drawings and other graphics as necessary to support FSS reporting. The FSSS reports to the Superintendent FSS.

g. FSS Supervisor: The FSS Supervisor is responsible for control and implementation of survey packages as received from the FSS Specialist. The FSS Supervisor is responsible for coordination of turnover surveys, final status surveys, and survey area preparation such as gridding and accessibility needs. The FSS Supervisor is responsible for coordination and scheduling of FSS Technicians to support the FSS schedule and ensuring all necessary instrumentation and other equipment is available to support survey activities. The FSS Supervisor is also responsible for maintaining access controls over completed FSS survey areas. The FSS Supervisor reports to the SFSS.

h. Instrumentation Technician (IT): The IT is responsible for maintaining the pedigree of instrumentation used for FSS by implementing the procedural requirements for calibration, maintenance and daily checks. The IT ensures that sufficient and properly calibrated instrumentation is available to support FSS. The IT is responsible for the calibration and maintenance of FSS instrumentation. The IT reports to the Instrumentation, Sources and Respiratory Protection Engineer (ISRPE). (The ISRPE's responsibilities include the site RP instrumentation program.)

i. FSS Technician: The FSS Technician is responsible for performance of FSS measurements and collection of FSS samples in accordance with FSS procedures and survey package instructions. The FSS Technician reports to the FSS Supervisor.

j. Site Quality and its Relationship to the Maine Yankee Quality Assurance Program.

(1) The Maine Yankee Quality Assurance Program has been established as required by, and to assure conformance with, 10CFR50 Appendix B and other regulations relevant to the decommissioning of Maine Yankee.[9]

(2) The MY President has overall responsibility for all aspects of the QA Program.

(3) The Quality Programs Manager (QPM) has the overall authority and responsibility for establishing and measuring the effectiveness of the Quality Assurance Program. By provisions in the Program, the QPM has direct access to senior management positions.

(4) The QPM reports through the Director, Nuclear Safety and Regulatory Affairs, through the Vice President and Chief Financial Officer, who in turn reports to the President).[10]

(5) The MY Quality Assurance Program supports the FSS QAP by activities and services related to quality, such as, the establishment of requirements and assessing adequacy of implementation for procurement control, procedures and instructions, corrective actions, record retention, and audits/surveillances.

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[9] Sections I.B.1 and II.C, MY Quality Assurance Program, May 1, 2002.

[10] The overall MY site organization is illustrated (with QA reporting lines) in Figure 6.1-1 of the MY Defueled Safety Analysis Report (DSAR). As noted in this figure, the QPM has a "functional report" to the President on matters of quality (DSAR Section 6.1.2).

5.10.2 Project Description and Schedule

Each area of the site will be divided into survey units and classified as directed by procedure. The survey measurements for each survey unit will be determined during the survey design phase. Portions of the final status survey will be performed during deconstruction activities as areas become available for survey. The non-impacted areas may be evaluated for release prior to significant decommissioning activities taking place.

5.10.3 Quality Objectives and Measurement Criteria

Type I errors will be established at 0.05 unless authorized by the NRC. Type II errors will be set at 0.05 or greater.

a. Training and Qualification

Personnel performing final status survey measurements will be trained and qualified . Training will include the following topics:

- Procedures governing the conduct of the final status survey,
- Operation of field and laboratory instrumentation used in the final status survey, and
- Collection of final status survey measurements and samples.

The extent of training and qualification will be commensurate with the education, experience and proficiency of the individual and the scope, complexity and nature of the activity. Records of training will be maintained in accordance with the approved course description for Initial and Continuing Training for Decommissioning.

b. Survey Documentation

Each final status survey measurement will be identified by date, instrument, location, type of measurement, and mode of operation. Generation, handling and storage of the original final status survey design and data packages will be controlled. The FSS records have been designated as quality documents and, as such, they will be maintained as such in accordance with procedures.

5.10.4 Measurement/Data Acquisition

a. Survey Design and Sampling Methods

The site will be divided into survey areas. Each survey area package may contain one or more survey units. Each survey area package will specify the type and number of measurements required based on the classification of each survey unit.

b. Written Procedures

Sampling and survey tasks must be performed properly and consistently in order to assure the quality of the final status survey results. The measurements will be performed in accordance with approved, written procedures. Approved procedures describe the methods and techniques used for the final status survey measurements.

c. Chain of Custody

Responsibility for custody of samples from the point of collection through the determination of the final survey results is established by procedure. When custody is transferred, a chain of custody form will accompany the sample for tracking purposes. Secure storage will be provided for archived samples.

d. Quality Control Surveys

Procedures establish built-in Quality Control checks in the survey process for both field and laboratory measurements, as described in LTP Section 5.4.5(f). For structures and systems, QC replicate scan measurements will consist of resurveys of a minimum of 5% of randomly selected class 1, 2, or 3 survey units typically performed by a different technician with results compared to the original measurement. The acceptance criterion shall be that the same conclusion as the original survey was reached based on the repeat scan. If the acceptance criterion is not met, an investigation will be conducted to determine the cause and corrective action.

Quality Control for direct surface contamination and/or exposure rate measurements will consist of repeat measurements of a minimum of 5% of the survey units using the same instrument type, taken by a different technician (except in cases where there is only one instrument or specialized training is required to operate the equipment) and the results compared to the original measurements using the same instrument type. The acceptance criterion for direct measurements is specified in approved procedures.

For soil, water and sediment samples, Quality Control will consist of participation in the laboratory Inter-comparison Program. However, as an additional quality measure, approximately 5% of such samples may be subjected to blind duplicate samples or third party analyses. The acceptance criterion for blank samples is that no plant-derived radionuclides are detected. The criterion for blind duplicates is that the two measurements are within the value specified by approved procedure. For third party analyses, the acceptance criterion is the same as those for blind duplicates. Some sample media, such as asphalt, will not be subjected to split or blind duplicate analyses due to the lack of homogeneity. These samples will simply be recounted to determine if the two counts are within 20% of each other, when necessary.

If QC replicate measurements or sample analyses fall outside of their acceptance criteria, a documented investigation will be performed in accordance with approved procedures; and if necessary, the Corrective Action Process described in Section 5.10.5(c) will be implemented. The investigation will typically involve verification that the proper data sets were compared, the relevant instruments were operating properly and the survey/sample points were properly identified and located. Relevant personnel are interviewed, as appropriate, to determine if proper instructions and procedures were followed and proper measurement and handling techniques were used including chain of custody, where applicable. When deemed appropriate, additional measurements are taken. Following the investigation, a documented determination is made regarding the usability of the survey data and if the impact of the discrepancy adversely affects the decision on the radiological status of the survey unit.

e. Instrumentation Selection, Calibration and Operation

Proper selection and use of instrumentation will ensure that sensitivities are sufficient to detect radionuclides at the minimum detection capabilities as specified in Section 5.5.2 as well as assure the validity of the survey data. Instrument calibration will be performed with NIST traceable sources using approved procedures. Issuance, control and operation of the survey instruments will be conducted in accordance with the Instrumentation Program procedure.

f. Control of Consumables

In order to ensure the quality of data obtained from FSS surveys and samples, new sample containers will be used for each sample taken. Tools used to collect samples will be cleaned to remove contamination prior to taking additional samples. Tools will be decontaminated after each sample collection and surveyed for contamination.

g. Control of Vendor-Supplied Services

Vendor-supplied services, such as instrument calibration and laboratory sample analysis, will be procured from appropriate vendors in accordance with approved quality and procurement procedures.

h. Database Control

Software used for data reduction, storage or evaluation will be fully documented and certified by the vendor. The software will be tested prior to use by an appropriate test data set.

i. Data Management

Survey data control from the time of collection through evaluation is specified by procedure. Manual data entries will be second verified.

5.10.5 Assessment and Oversight

a. Assessments

FSS self-assessments will be conducted in accordance with approved procedures. The findings will be tracked and trended in accordance with these procedures.

b. Independent Review of Survey Results

Randomly selected survey packages (approximately 5%) from survey units will be independently reviewed by the Quality Programs Department to ensure that the survey measurements have been taken and documented in accordance with approved procedures.

c. Corrective Action Process

The corrective action process, already established as part of the site's 10 CFR Part 50 Appendix B Quality Assurance Program, will be applied to FSS for the documentation, evaluation, and implementation of corrective actions. The process will be conducted in accordance with approved procedures which describe the methods used to initiate Condition Reports (CRs) and resolve self assessment and corrective action issues related to FSS. The CR evaluation effort is commensurate with the classification of the

CR and could include root cause determination, barrier screening and extent of condition reviews.

d. Reports to Management

Reports of audits and trend data will be reported to management in accordance with approved procedure.

5.10.6 Data Validation

Survey data will be reviewed prior to evaluation or analysis for completeness and for the presence of outliers. Comparisons to investigation levels will be made and measurements exceeding the investigation levels will be evaluated. Procedurally verified data will be subjected to the Sign test, the Wilcoxon Rank Sum (WRS) test, or WRS Unity test as appropriate. Technical evaluations or calculations used to support the development of DCGLs will be independently verified to ensure correctness of the method and the quality of data.

5.10.7 NRC and State Confirmatory Measurements

Maine Yankee anticipates that both the NRC and the State of Maine Department of Human Services (DHS) - Division of Health Engineering (DHE) may choose to conduct confirmatory measurements in accordance with applicable laws and regulations. The NRC may take confirmatory measurements to make a determination in accordance with 10 CFR 50.82(a)(11) that the final radiation survey and associated documentation demonstrate that the facility and site are suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20, subpart E. Maine state law requires Maine Yankee to permit monitoring by the Maine State Nuclear Safety Inspectors (22 MRSA 664, sub-§2, as amended by PL 1999, c. 739, §1 and 38 MRSA 1451, sub-§11, as amended by PL 1999, c. 741, §1) This monitoring includes, among other things, taking radiological measurements for the purpose of verifying compliance with applicable state laws (including the enhanced state radiological criteria) and confirming and verifying compliance with NRC standards for unrestricted license termination. Maine Yankee will demonstrate compliance with the 25 mrem/yr criteria of 10 CFR Part 20, Subpart E by demonstrating compliance with the enhance state radiological criteria. Therefore, the confirmatory measurements taken by the NRC and the State of Maine will be based upon the same criteria, DCGL. Timely and frequent communications with these agencies will ensure that they are afforded sufficient opportunity for these confirmatory measurements prior to Maine Yankee implementing any irreversible decommissioning actions (e.g. backfilling basements with soil fill material.)

5.11 Access Control Measures

5.11.1 Turnover

Due to the large scope of the final status survey and the need for some activities to be performed in parallel with dismantlement activities, a systematic approach to turnover of areas is established. Prior to acceptance of a survey unit for final status survey, the following conditions must be satisfied, unless authorized by the FSS Superintendent in accordance with established procedures. These include:

a. Decommissioning activities having the potential to contaminate the survey unit must be complete.

b. Tools and equipment not required for the survey must be removed, and housekeeping and cleanup must be complete, except as noted in section 5.1.2.a.

c. Decontamination activities in the area must be complete.

d. Final remediation surveys, where applicable, must be complete. These surveys will consist of: |

    1. Scan surveys or fixed measurements to ensure that surface contamination is within the FSS total surface contamination limits.

    2. Smear surveys to ensure that the removable surface contamination is within the FSS removable surface contamination limits (i.e., 10% of the surface contamination limit).

    3. Volumetric samples or scans to ensure soil remediation is within acceptable FSS concentration limits.

e. Access control or other measures to prevent recontamination must be implemented.

f. Turnover surveys may be performed and documented to the same standards as FSS surveys so that data can be used for FSS.

5.11.2 Walkdown

The principal objective of the walkdown is to assess the physical scope of the survey unit. For systems, it will include a review of system drawings and a physical walkdown of the system. Structures and open land areas will also be walked down. The walkdown is best completed when the final configuration of the area is known, usually near or after completion of decommissioning activities for the area.

The walkdown ensures that the area has been left in the necessary configuration for FSS or that any further work has been identified. The walkdown provides detailed physical information for survey design. Details such as floor coatings, structural interferences or sources needing special survey techniques can be determined.

Specific requirements will be identified for accessing the survey area and obtaining support functions necessary to conduct the final status surveys, such as scaffolding, interference removal, and electrical tag out. Safety concerns, such as access to confined spaces, tidal areas, and high walls and/or ceilings, will be identified.

5.11.3 Transfer of Control

Once a walkdown has been performed and the turnover requirements have been met, control of access to the area is transferred from the Construction and Radiation Protection operations groups to the FSS group. Turnover is accomplished using administrative controls. Access control and isolation methods are described below.

5.11.4 Isolation and Control Measures

Since decommissioning activities will not be completed prior to the start of the final status survey, measures will be implemented to protect survey areas from contamination during and subsequent to the final status survey. Decommissioning activities creating a potential for the spread of contamination will be completed within each survey unit prior to the final status survey. Additionally, decommissioning activities which create a potential for the spread of contamination to adjacent areas will be evaluated and controlled.

Upon commencement of the final status survey for survey areas within the RA where there is a potential for re-contamination, implementation of one or more of the following control measures will be required:

a. Personnel training

b. Installation of barriers to control access to surveyed areas

c. Installation of barriers to prevent the migration of contamination from adjacent overhead areas

d. Installation of postings requiring contamination monitoring prior to surveyed area access

e. Locking entrances to surveyed areas of the facility

f. Installation of tamper-evident labels

Routine contamination surveys will be performed in areas following FSS completion to monitor for indications of re-contamination and to verify postings and access control measures. Survey frequency will be based on the potential for re-contamination as determined by the FSS Superintendent. At a minimum, routine surveys will be performed quarterly for structures located within the RA. Routine contamination control surveys will not be required for open land areas and structures outside of the RA that are not normally occupied and are unlikely to be impacted by decommissioning activities.

Routine surveys of areas where FSS has been completed will normally include survey locations at floor level and on lower walls. Locations will be selected on a judgmental basis, based on technician experience and conditions present in the survey area at the time of the survey, but are primarily designed to detect the migration of contamination from decommissioning activities taking place in adjacent and other areas in close proximity which could cause a potential change in conditions.

5.12 References

5.12.1 10CFR20.1402, Radiological Criteria for Unrestricted Use.

5.12.2 10CFR50.82, Termination of License.

5.12.3 40CFR141.25 through 27, National Primary Drinking Water Regulations.

5.12.4 State of Maine Law - LD 2688-SP1084, “An Act to Establish Clean-up Standards for Decommissioning Nuclear Facilities,” April 26, 2000

5.12.5 MY Post Shutdown Decommissioning Activities Report (PSDAR), MN-97-99, dated August 27, 1997 as supplemented by MN-98-65 dated November 3, 1998 .

5.12.6 MY Historical Site Assessment, as transmitted by MN-01-038 dated October 1, 2001.

5.12.7 GTS Duratek, “Characterization Survey Report for the Maine Yankee Atomic Power Plant,” Volumes 1-9, 1998.

5.12.8 MY Quality Assurance Program.

5.12.9 MY Corrective Action Program.

5.12.10 NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM), Revision 1 (June 2001)

5.12.11 NUREG-1507, "Minimum Detectable Concentrations With Typical Radiation Survey Instruments for Various Field Conditions," December 1997

5.12.12 NUREG-1505, "A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys," Rev.1, June 1998 draft.

5.12.13 NUREG-1549, "Using Decision Methods for Dose Assessment to Comply with Radiological Criteria for License Termination," July 1998 draft.

5.12.14 Appendix E, NUREG 1727, "Demonstrating Compliance with the Radiological Criteria for License Termination," September 15, 2000.

5.12.15 NUREG-1727, "NMSS Decommissioning Standard Review Plan," September 15, 2000.

5.12.16 Initial and Continuing Training For Decommissioning course descriptions.

5.12.17 Radiation Protection Performance Assessment Program (PMP 6.0.8).

5.12.18 Radiation Protection Instrumentation Program (PMP 6.4).

5.12.19 Operation and Calibration of the Gamma Spectroscopy System (DI 6-306).

5.12.20 Operation of the Packard Model 4430 Liquid Scintillation (DI 6-316)

5.12.21 Final Status Survey Program (PMP 6.7).

5.12.22 FSS Survey Procedure for Structures, Systems and Soils (PMP 6.7.1).

5.12.23 FSS Survey Unit Classification (PMP 6.7.2).

5.12.24 FSS Quality Control (PMP 6.7.3).

5.12.25 FSS Survey Package Preparation and Control (PMP 6.7.4).

5.12.26 FSS Survey Area Turnover and Control (PMP 6.7.5).

5.12.27 FSS Data Processing and Reporting (PMP 6.7.8).

5.12.28 Selection, Training and Qualification of RP/Waste Personnel (PMP 6.9).

5.12.29 Instrument Quality Assurance (PMP 6.4.1).

5.12.30 Document Control Program (0-17-1).

5.12.31 Operation of the Tennelec LB-5100 Gas Flow Proportional Instrument procedure (DI 6-210).

5.12.32 Instrument Selection and MDC Calculation (EC 009-01).

5.12.33 NRC letter to Maine Yankee, dated August 23, 2002 regarding classification downgrade and other LTP issues.

5.12.34 Use of the SPA-3 Detector for Concrete Scan Surveys (EC 002-03) |

5.12.35 White Paper 2002-001, "The Approach for Dealing with Background Radioactivity for Maine Yankee Final Status Surveys" |

5.12.36 Revised Report on Eberline Model E-600 Field Testing (MN- 03-009) |

5.12.37 Maine Yankee Letter to NRC, MN-03-051, dated September 3, 2003, Technical Basis Document for NRC Review - Forebay FSS Survey Measurement Methods (In-Situ Gamma Spectroscopy) - 30 Day Notice per LTP Requirement |

5.12.38 Maine Yankee Letter to NRC, MN-03-067, dated October 21, 2003, Maine Yankee Response to NRC and State of Maine Comments on the Technical Basis Document for NRC Review - Forebay FSS Survey Measurement Methods (In-Situ Gamma Spectroscopy) |

ATTACHMENT 5A

Embedded and Buried Pipe
Initial Final Survey Classification Description

Embedded and Buried Piping Remaining on Site:

The following sections of embedded and buried piping will remain on site following demolition of above grade structures. This list includes a description of the piping, the potential for the piping to contain residual contamination and a description and the initial MARSSIM classification of the survey units.

Containment Spray (C0300)

System Description: The function of the Containment Spray (CS) system was to reduce the peak pressure in the containment building following a loss of coolant accident by spraying water into the containment atmosphere, to remove radioactive iodine, which would be released to the containment atmosphere during a loss of coolant accident, and to supply water to the suction of the High Pressure Safety Injection pumps following receipt of a Recirculation Actuation Signal (RAS) to provide the required suction head. The CS system initially took suction from the Refueling Water Storage Tank. The system could take an alternate suction from the containment safeguards sump upon receiving the RAS signal.

Residual Contamination Potential: The Containment Spray piping has a high potential for residual contamination. The portion of the piping that will remain following demolition of above grade structures is embedded in the concrete foundation of the Containment Building. The water source available for the system, Refueling Water Storage Tank, was contaminated.

Survey Units: The Containment Spray piping will be surveyed as a single survey unit. The survey unit will have an initial MARSSIM classification of Class 1. The classification is based on the known presence of contamination in the suction source for the system.

Containment Foundation Drains (C2000)

System Description: The Containment Foundation Drain piping is used to transfer groundwater from around the foundation of the Containment Building to lower the hydrostatic pressure exerted on the foundation. The remaining piping consists of four, two inch ID, horizontal, plastic, transfer pipes at approximately the -46' 6" elevation which run radially from underneath the ICI pit to the Containment Foundation Drain Sump Pumpwell and one, six inch, horizontal, open joint clay pipe at approximately the -18' 6" elevation which runs about 90 degrees around the southwest circumference of the containment foundation from the Spray Building to the Containment Foundation Drain Sump Pumpwell. The horizontal transfer pipes drain to the common, vertical, six foot ID, Containment Foundation Drain Sump Pumpwell which runs from the -52' 3" elevation to grade level.

Residual Contamination Potential: The Containment Foundation Drain piping has a potential for residual contamination, but is not likely to contain residual radioactivity in excess of the $DCGL_w$. The piping is wholly contained in the Restricted Area and there are known instances of contaminated liquid spills in the area around the Containment Building.

Survey Units: The Containment Foundation Drain piping will be surveyed as a single survey unit. The initial MARSSIM classification of the survey unit was Class 1. The basis for classification was operational knowledge of the system and data collected in support of the Radiological Environmental

Monitoring Program. Upon reevaluation of continued characterization data with respect to the balance of plant embedded piping DCGLw, this survey unit has been reclassifed to Class 2.

Sanitary Waste (D0400)

System Description: The Sanitary Waste (SW) piping was used to transfer waste from the various buildings on site to the Sewage Treatment Plant where the waste was treated prior to disposal. The system transferred waste from all areas of the site including sanitary facilities formerly located in the Restricted Area. The portions of the piping that will remain after the demolition of above grade structures will be contained within the Manhole system described in the Storm Drains system. The Radiological Environmental Monitoring Program requires that this outfall be monitored periodically. The original outfall for the system was to the Back River following treatment. In the mid-1980s, the outfall for the system was connected to the city of Wiscasset sewage treatment system.

Residual Contamination Potential: The Sanitary Waste piping has a low potential for residual contamination. The leg of the piping that formerly serviced the sanitary facilities in the Restricted Area was removed from service in the early 1980s. Other portions of the system may have been contaminated with medical isotopes; however, these isotopes are short lived and should be decayed away by the time the system is surveyed.

Survey Units: The abandoned leg of the Sanitary Sewer piping that connected the sanitary facilities in the Restricted Area to the Sewage Treatment Plant will be surveyed as a single survey unit. The initial MARSSIM classification of the piping will be Class 3. The classification is based on operational knowledge of the system and survey data collected during initial site characterization[1].

Circulating Water (D0500)

System Description: The Circulating Water (CW) system supplied cooling water to the main condenser tube bundles. The system took suction from the Back River at the Circulating Water Pump House. Four CW pumps took suction from an individual bay and discharged to an individual tube bundle. The CW in the tube bundle removed heat from the turbine exhaust steam that condensed the steam to condensate water for return to the steam generators. The CW exiting the tube bundles combined and was directed to the seal pit and the forebay. Water from the seal pit and forebay was returned to the Back River. The Circulating Water system is considered a “secondary side” system in that there was a physical barrier (Main Steam and Condensate systems) between the water in the Circulating System and the contaminated systems of the primary plant (Reactor Coolant, etc.).

Residual Contamination Potential: The Circulating Water piping has a very low potential for residual

[1] “Initial site characterization” (or ICS) refers to the initial characterization work performed by GTS Duratek as documented in the “Characterization Survey Report for the Maine Yankee Atomic Power Plant,” 1998. (See the Reference Section 5.12.) “Continuing characterization” refers to additional characterization which followed the ICS and is an ongoing activity which collects additional data, as required, to support remediation, dose assessment, and FSS activities. See also Section 2.1.

contamination. The piping was separated from the primary system by several interface systems. The Steam Generator U-tubes acted as the separator for the primary and secondary systems, and the main condenser tube bundles acted as the separator for the secondary system (Main Steam, Condensate, etc.) and the CW piping. The operational history of the facility indicates that no significant primary to secondary leakage occurred, implying that there is a very remote chance the system may have become contaminated. Additionally, CW system pressure was maintained above the pressure of the turbine exhaust steam. In the event of a tube bundle leak, the CW system water would have leaked into the Condensate system instead of Condensate leaking into the CW system. During site characterization activities, low levels of detectable activity were identified on the main condenser outlet side of the Circulating Water piping. Continuing Characterization Survey samples collected in the CW piping identify very low levels of plant related radionuclides. The suspected cause of the contamination was recirculation of allowable effluent discharges into the suction side of the Circulating Water Pump House.

Survey Units: The Circulating Water system will be divided into two survey units. The first survey unit will consist of the inlet side piping ending at the floor of the Turbine Hall where the pipes have been cut off at floor level. The second survey unit will consist of the outlet side piping at the floor of the Turbine Hall where the pipes were cut off at floor level and ending at the Seal Pit and Fore Bay area. Both survey units for this survey area will initially be classified as MARSSIM Class 3. The basis for classification of the survey units is operational knowledge of the system, data obtained in support of the Radiological Environmental Monitoring Program, and limited sampling of the piping conducted during site characterization surveys.

<u>Service Water (D0600)</u>

The Service Water System consists of two buried inlet pipes that carried sea water through the component cooling heat exchangers. The discharge of the system consists of a single buried line that goes into the seal pit.

The discharge side of the pipe receives the liquid effluent discharge pipe. The waste header is contained within its own local Restricted Area within the Turbine Building. During Site Characterization, low levels of detectable activity were identified on the discharge side of the piping. No direct beta measurements were above the MDA. Nine samples of removable beta activity were detected above the MDA (3134 dpm/100cm^2 was the maximum value). The positive indications of residual activity in this system are associated with the liquid effluent header location and the liquid radwaste radiation monitor installed at that location. Gamma isotopic samples collected at the liquid effluent line entrance point and at the radiation monitor were positive for Co-60 (700 pCi/g).

The radwaste piping will be removed and disposed of as radioactive waste. The buried inlet portions of the Service Water system will be removed outside of the Turbine Building and the portions beneath the Turbine Building will be abandoned in place. The remaining portions of the service water discharge piping meet the criteria of a Class 3 area and will be surveyed as a single survey unit.

<u>Fire Protection (D0700)</u>

System Description: The water portion of the Fire Protection (FP) system is the only section that will remain following demolition of above grade structures. Water for firefighting was stored in a man-made storage pond located northwest of the plant. Makeup water for the pond was supplied from the Montsweag Reservoir. Water was transferred to the storage pond by two reservoir pumps, which were operated as required to keep the storage pond full. The former storage pond is addressed as part of survey area R0900. Two fire pumps took suction from the storage pond and discharged to the yard loop where they supplied various fire headers and hydrants. The FP system did not supply firefighting water to the Containment Building. The hose stations in the Containment Building were supplied from the Primary Water System. The Fire Protection system is considered a “support system” in that it did not interface with the primary or secondary side of the nuclear steam supply system.

Residual Contamination Potential: The Fire Protection piping has a very low potential for residual contamination. The piping did not interface with either the primary or the secondary side systems of the nuclear steam supply system. Although sections of the piping reside in the Restricted Area, the system operating pressure, even at static head conditions, was sufficient to ensure that any leakage would occur from the system, not into the system. The Fire Water Protection system has been inadvertently cross connected with potentially contaminated systems in the past. Samples collected during the Continuing Characterization Survey have only identified naturally occurring radioactive material. No licensed activity has been identified in the system.

Survey Units: The Fire Protection piping will be surveyed as a single survey unit. The survey unit will consist of all buried and embedded piping remaining after the demolition of the site above grade structures. The initial MARSSIM classification for the Fire Protection piping will be Class 3. The classification is based on knowledge of system operation and samples collected in the storage pond during site characterization surveys and samples of the system collected as part of the Continuing Characterization Survey.

Storm Drains (D3500)

System Description: The Storm Drain (SD) system is used to drain water from the facility to the Back River. The system functions as a gravity drain system to remove the water via a system of drain grates, manholes and piping. The system drains the entire site both inside and outside the Protected Area. Manholes 1 through 3 (Section 1 of the piping) drain the Protected Area outside the Restricted Area and south of the Turbine Building and Service Building. The outfall for this portion of the piping is a 24” line that drains to the Back River south of the Circulating Water Pump House (CWPH). Manholes 4 and 5 (Section 2 of the piping) drain an area inside the Protected Area outside the Restricted Area east of the Turbine Building. This line drains the area around the Main Transformers. The outfall for this leg of the piping is a 15” line that drains to the Back River north of the CWPH. Manholes 6 through 11 and un-numbered manholes north of the Turbine Building (Section 3 of the piping) drain an area both inside and outside the Protected Area. The area drained is all outside the Restricted Area. These legs all collect at Manhole 7 and the combined outfall is routed to the Back River immediately adjacent to the north side of the CWPH. Manholes 13 and 14 (Section 4 of the piping) drain the upper access road and the upper contractor parking lot. The outfall for this section of the piping is the Back River north of the Information Center building. Manholes 30A, and 31 through 37 (Section 5 of the piping) drain an area inside the Protected Area in the Restricted Area. This leg of the piping drains the main RCA Yard area around the Containment Building and the alley between the Containment Building and the Service Building. These legs all collect at Manhole 35 and the combined outfall is routed to the Seal Pit Forebay. Manholes 21 through 24 (Section 6 of the piping) drain the north side of the Restricted Area and the roof of the WART Building. The area drained is inside the Protected Area and both inside and outside the Restricted Area. The combined outfall for this leg joins another leg at Manhole 27. Manholes 25A, 25B, 26 through 29 and 38 (Section 7 of the piping) drains areas adjoining the Fire Pond and Warehouse and outside the west end of the Restricted Area. The outfall from Manhole 24 joins this leg at Manhole 27. The combined outfall for this leg of the piping is routed to Bailey Cove.

Residual Contamination Potential: The Storm Drain piping has a low potential in some legs and a high potential in some legs for residual contamination. Sections 1 through 4 and section 7 upstream of manhole 27 have a low potential for residual contamination. Sections 5 through 7 (downstream of and including manhole 27) have a high potential for residual contamination. Sections 1 through 4 and section 7 upstream of manhole 27 drain areas that have historically been outside the Restricted Area and have a low potential for residual contamination. Sections 5 through 7 (downstream of and including manhole 27) drain areas in and adjacent to the Restricted Area and may have become contaminated due to loose surface contamination in and on yard structures and equipment being washed into the drain legs by rain water runoff and snow melting.

Survey Units: The Storm Drain piping may be divided into two survey units. The first survey unit will include sections 1 through 4 and section 7 upstream of manhole 27 of the piping. The initial MARSSIM classification for this section of the piping will be Class 3. The basis for classification is operational knowledge, survey data obtained for initial site characterization activities and as part of the Continuing Characterization Survey, and results of the Radiological Environmental Monitoring Program. The second survey unit will consist of sections 5 through 7 (downstream of and including manhole 27) of the piping. The initial MARSSIM classification for this section of the piping will be Class 1. The basis for classification is operational knowledge and survey data obtained during initial site characterization and the Continuing Characterization Survey.

Roof Drains (D3600)

System Description: The Roof Drain (RD) system removed water from the roofs of various site buildings and transferred the water to the Storm Drain system. The Roof Drains from buildings outside the RCA were routed to the Storm Drain piping sections that will be classified as Class 3. The Roof Drains from buildings inside the RCA were routed to the Storm Drain piping sections that will be classified as Class 1.

Residual Contamination Potential: Sections of the Roof Drain system outside the RCA have a low potential for residual contamination. Sections of the Roof Drain system inside the RCA have a high potential for residual contamination.

Survey Units: The portions of the system that will remain following demolition of above grade structures are buried and embedded sections of the system that are associated with the Storm Drain system. For this reason, the Roof Drains will be surveyed as part of the Storm Drain system.

Containment, Primary Auxiliary Building and Containment Spray Building Penetrations (D3700)

System Description: Several Containment Building penetrations will remain following demolition of the above grade structure. The penetrations contain embedded piping from numerous primary and secondary systems. The remaining penetrations are as follows:

- Approximately 20 linear feet of up to 1” piping
- Approximately 35 linear feet of 1.5” piping
- Approximately 50 linear feet of 2” piping
- Approximately 35 linear feet of 3” piping
- Approximately 55 linear feet of 4” piping
- Approximately 100 linear feet of 6” piping
- Approximately 45 linear feet of 8” piping
- Approximately 5 linear feet of 10” piping
- Approximately 25 linear feet of 16” piping
- Approximately 10 linear feet of 24” piping
- Approximately 20 linear feet of 30” piping
- Approximately 11 linear feet of 40” Fuel Transfer Tube piping

Each of these penetration, except for the Fuel Transfer Tube, consists of a five foot length of pipe penetration through the containment foundation wall. The calculated surface area of this embedded piping is approximately 78 m^2.

The Primary Auxiliary Building and Spray Building Penetrations (60ft). Several non-containment piping penetrations through the Primary Auxiliary Building and Spray Building will remain in the respective building foundations following demolition of the above grade structure. Each of these penetrations consists of a 2 to 3 foot length of pipe penetration through the building foundation wall. The calculated surface area of this embedded piping is approximately 19.5 m^2.

The spent fuel pool liner leak detection system (24ft). Four 1 inch lines embedded in the spent fuel pool structure will remain following demolition of the above grade structure. The calculated surface area of this embedded piping is approximately 0.6 m^2

Residual Contamination Potential: The penetrations that will remain in the Containment Building, Primary Auxiliary Building and Spray Building have a high potential for residual contamination. One of the systems identified as having a remaining section of embedded piping is Containment Spray, which is known to contain residual contamination.

Survey Units: The remaining sections of embedded piping in the Containment Building may be surveyed as a single survey unit. The initial MARSSIM classification assigned to the penetrations is Class 1. The basis for classification is the known presence of contamination in the Containment Spray system, the potential for residual contamination in the remaining piping due to system operation and lack of control of the penetrations to prevent contamination during dismantlement activities in the Containment Building.

Class 1 Survey Units:

Containment Spray System (C0300)

Physical Characteristics: The remaining embedded section of the Containment Spray piping consists of metal piping.

Decontamination: Prior to performing the FSS, the remaining piping will be decontaminated. The decontamination will consist of hydrolasing the embedded piping from the Containment Safeguards Sump to the suction of the Containment Spray Pumps. Following the hydrolasing, the leg of embedded piping will be surveyed for gross removable contamination.

Scan surveys for the Containment Spray piping will be conducted at the accessible ends of the embedded piping. The surface area scanned will be a small percentage of the total area of the system. The location of the measurements will be determined by dividing the total length of the pipe by the number of measurements to be collected. The systematic spacing of the survey measurements is in keeping with the guidance of NUREG-1575 and NUREG-1727. Total Surface Contamination measurements will be collected using a pipe crawler.

Containment Foundation Drains (C2000) - Moved to Class 2 Survey Units

Storm Drains (D3500)

Survey Unit: The Class 1 survey unit for the Storm Drain piping consists of the section of the piping bound by Manholes 30A and 31 through 37 and the section of the piping bound by Manholes 21 through 24. The survey unit includes an unnumbered manhole adjacent to the location of tank TK-16 in the Restricted Area yard.

Physical Characteristics: The remaining sections of buried Storm Drains piping consist of both metal and concrete piping. Some of the metal sections are smooth wall and some are corrugated.

Decontamination: The piping will require decontamination prior to performance of the Final Status Survey. The decontamination will consist of removing the sand and sediment from the piping low points and accesses (the manholes). The sand in the piping contains naturally occurring radioactive material.

Scan Surveys: Although this is Class 1 piping, physical access limits available measurement locations and scan survey locations. Therefore, scan surveys for the Storm Drain piping will be limited to accessible portions of the piping Scan surveys will be performed in areas with the highest potential for contamination based on professional judgment. For this reason, the scan survey will be biased to piping low points and interfaces and the scan survey will be performed in the vicinity of the Total Surface Contamination measurements identified for the piping. Scan surveys will be performed on as much of the interior surfaces of the piping as possible.

Survey Location Designation: Survey measurements for the Storm Drain piping will be collected at existing access points. The locations will be selected based on engineering judgment and biased to areas expected to contain the highest residual activity levels. As the Final Status Survey of the remaining embedded and buried piping for the Storm Drain system will be biased and not random, the minimum number of measurements collected on the system interior surfaces will be the number calculated using the methods described above or 30 measurements, whichever is greater.

Building Penetrations (D3800)

Physical Characteristics: The remaining embedded piping in the Building Penetrations survey unit consists of smooth metal piping surfaces.

Decontamination: The embedded piping remaining in the system will be decontaminated prior to performance of the Final Status Survey.

Scan Survey Coverage: 100% of the accessible system surfaces will receive a scan survey. Sections of embedded piping that are inaccessible will receive 100% gross removable contamination surveys. This will include sections that are too small to allow probe entry into the pipe.

Survey Location Designation: Each penetration will be assigned a number. The number of fixed point measurements will be calculated using the method described in the “sample size determination” section of this plan. The measurements will be randomly assigned to the penetrations. The random measurements will be used due to the difficulty of performing a systematic survey of the penetrations. The penetrations reside at multiple elevations of the building in a non-contiguous manner. These factors make it virtually impossible to perform a systematic survey of the penetrations.

Class 2 Survey Units:

Containment Foundation Drains (C2000)

Physical Characteristics: The remaining buried sections of the Containment Foundation Drains piping consists of plastic and clay piping. The vertical pumpwell wall has perforated sections to allow groundwater to enter the pumpwell. The horizontal piping consists of intact plastic and open joint clay piping.

Decontamination: The Containment Foundation Drain piping is not expected to require decontamination. Samples of the outlet of the piping collected for the Radiological Environmental Monitoring Program have identified Tritium as the only plant related radionuclide in the outlet.

Scan Surveys: Scan surveys for the Containment Foundation Drain piping will be limited to accessible portions of the piping from the Containment Foundation Drain Sump Pumpwell. Scan surveys will be performed on 10 to 100% of the interior surfaces of the piping and pumpwell. The number of measurements will be determined using the sign test and will be applied to the total accessible surface area of the pipe and pumpwell. The systematic spacing of the survey measurements is in keeping with the guidance of NUREG-1575 and NUREG-1727. Total Surface Contamination measurements will be collected using a manually deployed detector. When direct sample locations fall upon surfaces which are not amenable to suface detection (e.g., moisture saturated surfaces or pipe access restraicted by calcium build-up), the volumetric samples of concrete or internal pipe scrapings will be taken and analyzed in accordance with Section 5.5.1.a.

A volumetric sample will also be taken of sediment accumulated at the bottom of the sump pumpwell, if available.

Class 3 Survey Units:

Scan Survey Coverage:

Scan surveys for Class 3 system survey units will be determined based on the Historical Site Assessment (HSA) for the survey unit. In cases where the initial site characterization and the continuing site characterization did not identify the presence of removable contamination or fixed point total surface contamination in excess of the $DCGL_w$, the areal extent of the scanning will be determined by engineering judgment and should be in the range of 1 to 10% of the accessible surfaces of the system. Section 5.5.3 of NUREG-1575 recommends that scan surveys be performed in areas with the highest potential for contamination based on professional judgment. For this reason, the scan survey will be biased to system low points and system interfaces and the scan survey will be performed in the vicinity of the Total Surface Contamination measurements identified for the system.

Sample Size Determination:

The number of samples required for a survey unit is based on the following:

Statistical Test to be used: For Class 3 system survey units, the sign test will be used to test the null hypothesis.

Estimate of Standard Deviation: The estimated standard deviation values for the systems will be derived from characterization data or measurements additional background measurements, if necessary. In the event that there is insufficient data to estimate the standard deviation, the standard deviations developed for Class 3 structural survey units with similar contamination potential as the system (i.e. Turbine Building 21' elevation may be used for the Circulating Water system). The basis for the estimated standard deviation used for the design of the Final Status Survey of the survey area or survey unit will be given in the survey package design instructions.

The previously listed factors directly impact the number of measurements that will be collected in each survey unit. This method of calculating the number of survey measurements is valid regardless of the size of the survey unit or the type of material (i.e. structure or open land area) being surveyed. Experience has shown that this method typically requires that approximately 14 measurements are required for each survey unit at the Maine Yankee site. This method may also be used to determine the number of measurements required to demonstrate compliance in a system survey unit. The basis for the method described is that random designation of survey measurement location allows for a lower sample population to be used for the statistical analysis of the survey unit. As the Final Status Survey of the remaining embedded and buried piping systems will be biased and not random, the minimum number of measurements collected on the system interior surfaces will be the number calculated using the methods described in the "Sample Size Determination" section or 30 measurements, whichever is greater.