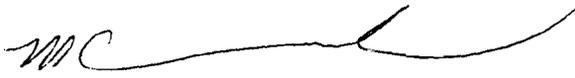


**YANKEE NUCLEAR POWER STATION  
FINAL STATUS SURVEY REPORT**

REPORT NO.: YNPS-FSS-NOL-05-00

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- Appendix B – YA-REPT-00-015-04, *“Instrument Efficiency Determination for Use in Minimum Detectable Concentration Calculations in Support of the Final Status Survey at Yankee Rowe”*
- Appendix C – YA-REPT-00-003-05, *“Generic ALARA Review for Final Status Survey of Soil at YNPS”*
- Appendix D – ALARA Evaluations, NOL-05
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List of Attachments

- Attachment A – Maps and Posting Plots
- Attachment B – Data Quality Assessment Plots and Curves
- Attachment C – Instrument QC Records
- Attachment D – ORTEC Direct Measurement Data
- Attachment E – ISOCS Scan Data

*(In the electronic version, every Table of Contents, Figures, Appendices and Attachments, as well as every mention of a Figure, Appendix or Attachment is a hyperlink to the actual location or document.)*

## List of Abbreviations and Acronyms

AL .....	Action Level
ALARA .....	As Low As Reasonably Achievable
c/d .....	Counts per Disintegration
DCGL .....	Derived Concentration Guideline Level
DCGL <sub>EMC</sub> .....	DCGL for small areas of elevated activity
DCGL <sub>w</sub> .....	DCGL for average concentration over a wide area, used with statistical tests
DQO .....	Data Quality Objectives
EMC .....	Elevated Measurement Comparison
ETD .....	Easy-to-Detect
FSS .....	Final Status Survey
FSSP .....	Final Status Survey Plan
GPS .....	Global Positioning System
H <sub>o</sub> .....	Null Hypothesis
HSA .....	Historical Site Assessment
HTD .....	Hard-to-Detect
ISOCS .....	<i>In-situ</i> Object Counting System <sup>®</sup>
LBGR .....	Lower Bound of the Grey Region
LTP .....	License Termination Plan
MARSSIM .....	Multi-Agency Radiation Survey and Site Investigation Manual
MDA .....	Minimum Detectable Activity
MDC .....	Minimum Detectable Concentration
PAB .....	Primary Auxiliary Building
QAPP .....	Quality Assurance Project Plan
QC .....	Quality Control
RCA .....	Radiological Controlled Area
RP .....	Radiation Protection
RSS .....	Reactor Support Structure
SFP .....	Spent Fuel Pool
VC .....	Vapor Container
VCC .....	Vertical Concrete Cask
VSP .....	Visual Sample Plan
YNPS .....	Yankee Nuclear Power Station

## 1.0 EXECUTIVE SUMMARY

A Final Status Survey (FSS) was performed of Survey Area NOL-05 in accordance with Yankee Nuclear Power Station's (YNPS) License Termination Plan (LTP). This FSS was conducted as an open land area FSS with soil DCGLs.

### 1.1 Identification of Survey Area and Units

Survey Area NOL-05 consists of land area that, since the beginning of plant operations, was posted and controlled as an RCA as delineated in years 2004-2005. The surface of NOL-05 is the exposed land area remaining from the demolition of the WST concrete pad (RCA Warehouse, Waste Disposal Building, and Radioactive Waste Compactor Building) and the remaining remnants from demolition of the PCA-1 bathtub foundation. The remaining footprint includes miscellaneous excavations which expose underlying soil and/or concrete remnants, and the exposed soil grade.

Survey Unit NOL-05-01 is a sub unit of survey area NOL-05 and is bordered by NOL-06-02 to its north, NOL-05-02 to its east, NOL-04-01 to the south and OOL-10-01 to its west. It is approximately 1505 square meters of surface area.

The other sub unit, NOL-05-02, is bordered by Aux-01 and AUX-02 on the north, NOL-02-03 and NOL-03-02 on the east, NOL-04-01 on the south and NOL-05-01 on the west. It consists of an open land survey unit comprised of non-contiguous depressions which expose a large contiguous soil area encompassing a surface area of 1,544 square meters.

A map of the Survey Area and Survey Units in relation to the site is found in Attachment A.

### 1.2 Dates of Surveys

**Table 1 Dates of Surveys**

Survey Unit	Survey Start Date	Survey End Date	DQA Date
NOL-05-01	5/17/2006	6/15/2006	8/18/2006
NOL-05-02	12/5/2005	12/13/2005	8/24/2006

### 1.3 Number and Types of Measurements Collected

Final Status Survey Plan (FSSP) was developed for this Survey Unit in accordance with YNPS LTP and FSS procedures using the MARSSIM protocol. The planning and design of the survey plan employed the Data Quality Objective (DQO) process,

ensuring that the type, quantity and quality of data gathered was appropriate for the decision making process and that the resultant decisions were technically sound and defensible. A total of 50 systematic direct measurement measurements were taken in the Survey Area, providing data for the non-parametric testing. In addition to the direct measurement samples, ISOCS scans were performed to provide 100 percent coverage of the Survey Area.

#### **1.4 Summary of Survey Results**

Following the survey, the data were reviewed against the survey design to confirm completeness and consistency, to verify that the results were valid, to ensure that the survey plan objectives were met and to verify Survey Unit classification. Direct measurement surveys indicated that none of the systematic measurements exceeded the DCGL<sub>w</sub>, depicted in Attachment B. Retrospective power curves were generated and demonstrated that an adequate number of samples were collected to support the Data Quality Objectives. Therefore, the null hypothesis (H<sub>0</sub>) (that the Survey Unit exceeds the release criteria) is rejected.

#### **1.5 Conclusions**

Based upon the evaluation of the data acquired for the FSS, NOL-05 meets the release requirements set forth in the YNPS LTP. The Total Effective Dose Equivalent (TEDE) to the average member of the critical group does not exceed 25 mRem/yr, including that from groundwater. 10CFR20 Subpart E ALARA requirements have been met as well as the site release criteria for the administrative level DCGLs that ensure that the Massachusetts Department of Public Health's 10 mRem/yr limit will also be met.

### **2.0 FSS PROGRAM OVERVIEW**

#### **2.1 Survey Planning**

The YNPS FSS Program employs a strategic planning approach for conducting final status surveys with the ultimate objective to demonstrate compliance with the DCGLs, in accordance with the YNPS LTP. The DQO process is used as a planning technique to ensure that the type, quantity, and quality of data gathered is appropriate for the decision-making process and that the resultant decisions are technically sound and defensible. Other key planning measures are the review of historical data for the Survey Area and the use of peer review for plan development.

#### **2.2 Survey Design**

In designing the FSS, the questions to be answered are: "Does the residual radioactivity, if present in the Survey Area, exceed the LTP release criteria?" and "Is the potential dose from this radioactivity ALARA?" In order to answer these questions, the radionuclides present in the Survey Area must be identified, and the

Survey Units classified. Survey Units are classified with respect to the potential for contamination: the greater the potential for contamination, the more stringent the classification and the more rigorous the survey.

The survey design additionally includes the number, type and locations of direct measurements/samples (as well as any judgmental assessments required), scanning requirements, and instrumentation selection with the required sensitivities or detection levels. DCGLs are developed relative to the surface/material of the Survey Unit and are used to determine the minimum sensitivity required for the survey. Determining the acceptable decision error rates, the lower bound of the gray region (LBGR), statistical test selection and the calculation of the standard deviation and relative shift allows for the development of a prospective power curve plotting the probability of the Survey Unit passing FSS.

### **2.3 Survey Implementation**

Once the planning and development has been completed, the implementation phase of the FSS program begins. Upon completion of remediation and final characterization activities, a final walk down of the Survey Unit is performed. If the unit is determined to be acceptable (i.e. physical condition of the unit is suitable for FSS), it is turned over to the FSS team, and FSS isolation and control measures are established. After the Survey Unit isolation and controls are in place, grid points are identified for the direct measurements/samples, using Global Positioning System (GPS) coordinates whenever possible, consistent with the Massachusetts State Plane System, and the area scan grid is identified. Data is collected and any required investigations are performed.

### **2.4 Survey Data Assessment**

The final stage of the FSS program involves assessment of the data collected to ensure the validity of the results, to demonstrate achievement of the survey plan objectives, and to validate Survey Unit classification. During this phase, the DQOs and survey design are reviewed for consistency between DQO output, sampling design and other data collection documents. A preliminary data review is conducted to include: checking for problems or anomalies, calculation of statistical quantities and preparation of graphical representations for data comparison. Statistical tests are performed, if required, and the assumptions for the tests are verified. Conclusions are then drawn from the data, and any deficiencies or recommendations for improvement are documented.

### **2.5 Quality Assurance and Quality Control Measures**

YNPS FSS activities are implemented and performed under approved procedures, and the YNPS Quality Assurance Project Plan (QAPP) assures plans, procedures and instructions have been followed during the course of FSS, as well as providing guidance for implementing quality control measures specified in the YNPS LTP.

### **3.0 SURVEY AREA INFORMATION**

#### **3.1 Survey Area Description**

Survey Area NOL-05 consists of land area that, since the beginning of plant operations, was posted and controlled as an RCA as delineated in years 2004-2005. The surface of NOL-05 is the exposed land area remaining from the demolition of the WST concrete pad (RCA Warehouse, Waste Disposal Building, and Radioactive Waste Compactor Building) and the remaining remnants from demolition of the PCA-1 “bathtub” foundation. The remaining footprint includes miscellaneous excavations which expose underlying soil and/or concrete remnants, and the exposed soil grade.

A map of the Survey Area and Survey Units in relation to the site is found in Attachment A.

#### **3.2 History of Survey Area**

In addition to the normal migration of minor levels of contamination in the RCA NOL 05 was contaminated by radioactive liquid leakage from the original plant Safety Injection Tank, a radioactive spill (Abnormal Occurrence Report 61-15, “Radioactive Spill Chemistry Sample Container Breakage,” dated September 21, 1961), and a contamination event (Plant Information Report 75-07, “Yard Area Contamination,” dated August 12, 1975).

#### **3.3 Division of Survey Area into Survey Units**

The NOL-05 Survey Area is divided into two Survey Units; NOL-05-01 which is a Class 1 Survey Unit and NOL-05-02 which is also Class 1 Survey Unit. Survey Unit NOL-05-01 is a sub unit of survey area NOL-05 and is bordered by NOL-06-02 to its north, NOL-05-02 to its east, NOL-04-01 to the south and OOL-10-01 to its west. It is approximately 1505 square meters of surface area. The other sub unit, NOL-05-02, is bordered by Aux-01 and AUX-02 on the north, NOL-02-03 and NOL-03-02 on the east, NOL-04-01 on the south and NOL-05-01 on the west. It consists of an open land survey unit comprised of non-contiguous depressions which expose a large contiguous soil area encompassing a surface area of 1,544 square meters.

A map of the Survey Area and Unit divisions is found in Attachment A.

## 4.0 SURVEY UNIT INFORMATION

### 4.1 Summary of Radiological Data Since Historical Site Assessment (HSA)

#### 4.1.1 Chronology and Description of Surveys Since HSA

Survey Unit	Date	Activity
NOL-05-01	5/17/2006	Performed Sample Quantity Calculations, established DQOs
	5/18/2006	Performed walk-down of Survey Unit
	5/18/2006	Established Isolation and Controls
	5/18/2006	Performed Job Hazard Analysis
	5/18/2006	Performed Unit Classification
	5/17/2006 & 6/8/2006	Generated FFS Sample Plans
	5/19/2006 to 6/15/2006	Initiated Scans, and Direct measurements.
	8/18/2006	Performed DQA, FSS Complete
NOL-05-02	12/2/2005	Generated FFS Sample Plans
	12/5/2005	Performed Job Hazard Analysis
	11/27/05	Performed Sample Quantity Calculations, established DQOs
	12/2/2005	Performed walk-down of Survey Unit
	12/5/2005	Established Isolation and Controls
	12/1/2005	Performed Unit Classification
	12/5/2005 to 12/13/2005	Initiated Scans, and Direct measurements.
	8/24/2006	Performed DQA, FSS Complete

#### 4.1.2 Radionuclide Selection and Basis

During the initial DQO process, Co-60, Cs-137 and Ag-108m were identified as the radiological nuclides of concern for NOL-05-01, while Co-60 and Cs-137 were identified for NOL-05-02. Characterization survey data from the HSA data indicated no other LTP-specified radionuclides warranted consideration in the NOL-05 Survey Area, however, the soil samples were evaluated for all LTP listed nuclides.

#### 4.1.3 Scoping & Characterization

Forty (40) samples from the HSA data were used to provide the characterization data for Survey Area NOL-05. The data was sufficient to support FSS planning of Survey Area NOL. Based on a review of the characterization data, Co-60, Cs-137 and Ag-108m are the only plant-related radionuclides that were identified consistently in the characterization samples analyzed.

## **4.2 Basis for Classification**

Based upon the radiological condition of this Survey Area identified in the operating history and as a result of the decommissioning activities performed to date, Survey Area NOL-05 is identified as a Class 1 Area.

## **4.3 Remedial Actions and Further Investigations**

### **4.3.1 NOL-05-01 Remedial Actions and Further Investigations**

Three ISOCS scans were identified for investigation. One of these areas required remediation. No elevated areas remained in NOL-05-01 in excess of DCGL<sub>emc</sub>.

### **4.3.2 NOL-05-02 Remedial Actions and Further Investigations**

Three ISOCS scans were investigated with no remediation warranted. Two investigations were prompted, by ISOCS, during the FSS of WST-01-02. One small area (< 1 m<sup>2</sup>) was identified and remediated. A particle was found ~ 1 foot beneath the surface adjacent to a wall in the other area and was removed. No elevated areas remained in NOL-05-02 in excess of DCGL<sub>emc</sub>.

## **4.4 Unique Features of Survey Area**

Survey Area NOL-05 is an open land area containing soils and small rocks. As a result of excavation and remediation, small to rather large depressions are present in the Survey Area.

## **4.5 ALARA Practices and Evaluations**

The generic ALARA evaluation for soils is documented in Appendix C, Technical Report YA-REPT-00-003-05, "Generic ALARA Review for Final Status Survey of Soil at YNPS". The report is augmented by individual evaluations which are found in Appendix D, which concludes that no further remediation of soil below the DCGL is warranted.

## **5.0 SURVEY UNIT FINAL STATUS SURVEY**

### **5.1 Survey Planning**

#### **5.1.1 Final Status Survey Plan and Associated DQOs**

The FSS for NOL-05 Survey Area was planned and developed in accordance with the LTP using the DQO process. Form DPF-8856.1,

found in YNPS Procedure 8856, “*Preparation of Survey Plans,*” was used to provide guidance and consistency during development of the FSS Plan(s). The FSS Plan(s) can be found in [Appendix A](#). The DQO process allows for systematic planning and is specifically designed to address problems that require a decision to be made in a complex survey design and, in turn, provides alternative actions.

The DQO process was used to develop an integrated survey plan providing the Survey Unit identification, sample size, selected analytical techniques, survey instrumentation, and scan coverage. The Sign Test was specified for non-parametric statistical testing for this Survey Unit, if required. The design parameters developed are presented below.

**Table 2 Survey Area NOL-05 Design Parameters**

Survey Unit	Design Parameter	Value	Basis
NOL-05-01	Area	1505 m <sup>2</sup>	Class 1, ≤2,000 m <sup>2</sup>
	Number of Direct Measurements	15 (calculated)	$\alpha$ (Type I) = 0.05
		+ 5 (added)	$\beta$ (Type II) = 0.05
		Total: 20	$\sigma$ : 0.122 Relative Shift: 2 Adjusted LBGR: .756
	Sample Area	75.25m <sup>2</sup>	Area / Sample #
	Sample Grid Spacing: Triangular	9.3m	Square Root (Area/(0.866*Sample #))
	Scan area	1505 m <sup>2</sup>	Class 1 Area – 100%
Scan Investigation Level	Co-60: 0.18pCi/gm Cs-137 : 0.7pCi/gm	1m 180° ISOCS	
NOL-05-02	Area	1544 m <sup>2</sup>	Class 1, ≤2,000 m <sup>2</sup>
	Number of Direct Measurements	15 (calculated)	$\alpha$ (Type I) = 0.05
		+ 15 (added)	$\beta$ (Type II) = 0.05
		Total: 30	$\sigma$ : 0.33 Relative Shift: 2.1 LBGR: .7 (Co-60)
	Sample Area	51.5m <sup>2</sup>	Area / Sample #
	Sample Grid Spacing: Triangular	7.7m	Square Root (Area/(0.866*Sample #))
	Scan area	1544 m <sup>2</sup>	Class 1 Area – 100%
Scan Investigation Level	Co-60: 0.18pCi/gm Cs-137 : 0.7pCi/gm	1m 180° ISOCS	

### 5.1.2 Deviations from the FSS Plan as Written in the LTP

The FSSP design was performed to the criteria of the LTP; therefore, no LTP deviations with potential impact to this Survey Area need to be evaluated.

### 5.1.3 DCGL Selection and Use

For the final evaluation of the NOL-05 Survey Area and throughout this report, the administrative acceptance criterion of 8.73 mRem/yr has been set for Soil LTP-listed radionuclides.

**Table 3 Soil DCGL Values**

Nuclide	Soil 8.73 mR/yr (pCi/g)	Nuclide	Soil 8.73 mR/yr (pCi/g)
Co-60	1.4E+00	H-3	1.3E+02
Nb-94	2.5E+00	C-14	1.9E+00
Ag-108m	2.5E+00	Fe-55	1.0E+04
Sb-125	1.1E+01	Ni-63	2.8E+02
Cs-134	1.7E+00	Sr-90	6.0E-01
Cs-137	3.0E+00	Tc-99	5.0E+00
Eu-152	3.6E+00	Pu-238	1.2E+01
Eu-154	3.3E+00	Pu-239	1.1E+01
Eu-155	1.4E+02	Pu-241	3.4E+02
Am-241	1.0E+01	Cm-243	1.1E+01

### 5.1.4 Measurements

Error tolerances and characterization sample population statistics drove the selection of the number of fixed point measurements. 15 measurements were needed per Unit in the event the Sign test may have been used. In addition to the 15 statistical measurements needed per Unit, 5 additional statistical samples were added in NOL-05-01 and 15 statistical samples were added in NOL-05-02 to enhance the power of the survey. No biased, 3 recount, and 4 split sample were also collected in the NOL-05 Survey Area.

The direct measurement sampling grid was developed as a systematic grid with spacing consisting of a triangular pitch pattern with a random starting point. Sample measurement locations are provided in Attachment A.

## 5.2 Survey Implementation Activities

The Table below provides a summary of daily activities performed during the Final Status Survey of NOL-05.

**Table 4 FSS Activity Summary for NOL-05**

Survey Unit	Date	Activity
NOL-05-01	5/17/2006	Performed Sample Quantity Calculations, established DQOs
	5/18/2006	Performed walk-down of Survey Unit
	5/18/2006	Established Isolation and Controls
	5/18/2006	Performed Job Hazard Analysis
	5/18/2006	Performed Unit Classification
	5/17/2006 & 6/8/2006	Generated FFS Sample Plans
	5/19/2006 to 6/15/2006	Initiated Scans, and Direct measurements.
	8/18/2006	Performed DQA, FSS Complete
NOL-05-02	12/2/2005	Generated FFS Sample Plans
	12/5/2005	Performed Job Hazard Analysis
	11/27/05	Performed Sample Quantity Calculations, established DQOs
	12/2/2005	Performed walk-down of Survey Unit
	12/5/2005	Established Isolation and Controls
	12/1/2005	Performed Unit Classification
	12/5/2005 to 12/13/2005	Initiated Scans, and Direct measurements.
	8/24/2006	Performed DQA, FSS Complete

## 5.3 Surveillance Surveys

### 5.3.1 Periodic Surveillance Surveys

Upon completion of the FSS of Survey Area NOL-05, the Survey Area was placed into the program for periodic surveillance surveys on a quarterly basis in accordance with YNPS procedure DP-8860, “*Area Surveillance Following Final Status Survey.*” These surveys provide assurance that areas with successful FSS remain unchanged until license termination.

### 5.3.2 Resurveys

No resurveys were performed in NOL-05-01, however a resurvey was performed in NOL-05-02 on 02/23/2006 due to 500 cubic yards of un-surveyed soil which was inadvertently transferred and distributed onto portions of NOL-05-02. The resurvey sample results (Mean Co-60 = 0.02 Cs-137 = 0.03) were evaluated against the original FSS sample data (Mean+3Std.Dev. Co-60 = 0.53 Cs-137 = 0.23) and no statistical differences were found. The resurvey demonstrated that there was no change in the Survey Area’s status

### 5.3.3 Investigations

No additional investigations were required for this Survey Unit due to surveillance surveys.

## 5.4 Survey Results

Direct measurement surveys indicated that NOL-05-01 and NOL-05-02 had no systematic measurements that exceeded the  $DCGL_W$ , depicted in [Attachment B](#). Retrospective power curves were generated and demonstrated that an adequate number of samples were collected to support the Data Quality Objectives. Therefore, the null hypothesis ( $H_0$ ) (that the Survey Unit exceeds the release criteria) is rejected.

**Table 5 NOL-05-01 Direct Measurement Summary**

Sample Description	Sum of Fractions	Sample Description	Sum of Fractions
NOL-05-01-001-F	0.11	NOL-05-01-011-F	0.12
NOL-05-01-002-F	0.05	NOL-05-01-012-F	0.14
NOL-05-01-003-F	0.03	NOL-05-01-013-F	0.09
NOL-05-01-004-F	0.06	NOL-05-01-014-F	0.05
NOL-05-01-005-F	0.06	NOL-05-01-015-F	0.22
NOL-05-01-006-F	0.08	NOL-05-01-016-F	0.07
NOL-05-01-007-F	0.04	NOL-05-01-017-F	0.06
NOL-05-01-008-F	0.04	NOL-05-01-018-F	0.12
NOL-05-01-009-F	0.05	NOL-05-01-019-F	0.04
NOL-05-01-010-F	0.06	NOL-05-01-020-F	0.06

Maximum Sum of Fractions	0.22
Standard Deviation	0.05

**Table 6 NOL-05-02 Direct Measurement Summary**

Sample Description	Sum of Fractions	Sample Description	Sum of Fractions
NOL-05-02-001-F	0.28	NOL-05-02-016-F	0.10
NOL-05-02-002-F	0.10	NOL-05-02-017-F	0.17
NOL-05-02-003-F	0.08	NOL-05-02-018-F	0.11
NOL-05-02-004-F	0.11	NOL-05-02-019-F	0.17
NOL-05-02-005-F	0.07	NOL-05-02-020-F	0.14
NOL-05-02-006-F	0.14	NOL-05-02-021-F	0.10
NOL-05-02-007-F	0.07	NOL-05-02-022-F	0.58
NOL-05-02-008-F	0.13	NOL-05-02-023-F	0.13
NOL-05-02-009-F	0.07	NOL-05-02-024-F	0.07
NOL-05-02-010-F	0.08	NOL-05-02-025-F	0.26
NOL-05-02-011-F	0.05	NOL-05-02-026-F	0.38
NOL-05-02-012-F	0.05	NOL-05-02-027-F	0.31
NOL-05-02-013-F	0.09	NOL-05-02-028-F	0.22

Sample Description	Sum of Fractions	Sample Description	Sum of Fractions
NOL-05-02-014-F	0.20	NOL-05-02-029-F	0.12
NOL-05-02-015-F	0.21	NOL-05-02-030-F	0.05

Maximum Sum of Fractions	0.58
Standard Deviation	0.12

Table 7 NOL-05-01 ISOCS Scan Summary

Sample Description	Sum of Fractions	Sample Description	Sum of Fractions
NOL-05-01-101-F-G	0.00	NOL-05-01-188-F-G	0.00
NOL-05-01-102-F-G	0.00	NOL-05-01-189-F-G	0.00
NOL-05-01-103-F-G	0.00	NOL-05-01-190-F-G	0.00
NOL-05-01-104-F-G	0.00	NOL-05-01-191-F-G	0.00
NOL-05-01-105-F-G	0.00	NOL-05-01-192-F-G	0.00
NOL-05-01-106-F-G	0.00	NOL-05-01-193-F-G	0.00
NOL-05-01-107-F-G	0.00	NOL-05-01-194-F-G	0.00
NOL-05-01-108-F-G	0.00	NOL-05-01-195-F-G	0.00
NOL-05-01-109-F-G	0.00	NOL-05-01-196-F-G	0.00
NOL-05-01-110-F-G	0.00	NOL-05-01-197-F-G	0.52
NOL-05-01-111-F-G	0.00	NOL-05-01-198-F-G	0.00
NOL-05-01-112-F-G	0.00	NOL-05-01-199-F-G	0.00
NOL-05-01-113-F-G	0.00	NOL-05-01-200-F-G	0.00
NOL-05-01-114-F-G	0.00	NOL-05-01-201-F-G	0.00
NOL-05-01-115-F-G	0.00	NOL-05-01-202-F-G	0.00
NOL-05-01-116-F-G	0.00	NOL-05-01-203-F-G	0.00
NOL-05-01-117-F-G	0.00	NOL-05-01-204-F-G	0.00
NOL-05-01-118-F-G	0.00	NOL-05-01-205-F-G	0.00
NOL-05-01-119-F-G	0.00	NOL-05-01-206-F-G	0.00
NOL-05-01-120-F-G	0.00	NOL-05-01-207-F-G	0.00
NOL-05-01-121-F-G	0.00	NOL-05-01-208-F-G	0.12
NOL-05-01-122-F-G	0.00	NOL-05-01-209-F-G	0.00
NOL-05-01-123-F-G	0.00	NOL-05-01-210-F-G	0.00
NOL-05-01-124-F-G	0.00	NOL-05-01-211-F-G	0.10
NOL-05-01-125-F-G	0.00	NOL-05-01-212-F-G	0.00
NOL-05-01-126-F-G	0.00	NOL-05-01-213-F-G	0.00
NOL-05-01-127-F-G	0.00	NOL-05-01-214-F-G	0.00
NOL-05-01-128-F-G	0.00	NOL-05-01-215-F-G	0.00
NOL-05-01-129-F-G	0.00	NOL-05-01-216-F-G	0.00
NOL-05-01-130-F-G	0.00	NOL-05-01-217-F-G	0.00
NOL-05-01-131-F-G	1.74	NOL-05-01-218-F-G	0.00
NOL-05-01-132-F-G	0.00	NOL-05-01-219-F-G	0.00
NOL-05-01-133-F-G	0.00	NOL-05-01-220-F-G	0.00
NOL-05-01-134-F-G	0.00	NOL-05-01-221-F-G	0.00
NOL-05-01-135-F-G	0.00	NOL-05-01-222-F-G	0.00
NOL-05-01-136-F-G	0.00	NOL-05-01-223-F-G	0.00
NOL-05-01-137-F-G	0.00	NOL-05-01-224-F-G	0.00

<b>Sample Description</b>	<b>Sum of Fractions</b>	<b>Sample Description</b>	<b>Sum of Fractions</b>
NOL-05-01-138-F-G	0.00	NOL-05-01-225-F-G	0.00
NOL-05-01-139-F-G	0.00	NOL-05-01-226-F-G	0.00
NOL-05-01-140-F-G	0.00	NOL-05-01-227-F-G	0.00
NOL-05-01-141-F-G	0.00	NOL-05-01-228-F-G	0.00
NOL-05-01-142-F-G	0.00	NOL-05-01-229-F-G	0.00
NOL-05-01-143-F-G	0.00	NOL-05-01-230-F-G	0.00
NOL-05-01-144-F-G	0.00	NOL-05-01-231-F-G	0.00
NOL-05-01-145-F-G	0.00	NOL-05-01-232-F-G	0.00
NOL-05-01-146-F-G	0.00	NOL-05-01-233-F-G	0.00
NOL-05-01-147-F-G	0.00	NOL-05-01-234-F-G	0.00
NOL-05-01-148-F-G	0.00	NOL-05-01-235-F-G	0.00
NOL-05-01-149-F-G	0.00	NOL-05-01-236-F-G	0.00
NOL-05-01-150-F-G	0.00	NOL-05-01-237-F-G	0.00
NOL-05-01-151-F-G	0.00	NOL-05-01-238-F-G-I	0.00
NOL-05-01-152-F-G	0.00	NOL-05-01-239-F-G-I	0.00
NOL-05-01-153-F-G	0.00	NOL-05-01-240-F-G-I	0.00
NOL-05-01-154-F-G	0.00	NOL-05-01-241-F-G-I	0.00
NOL-05-01-155-F-G	0.00	NOL-05-01-242-F-G-I	0.00
NOL-05-01-156-F-G	0.00	NOL-05-01-243-F-G-I	0.00
NOL-05-01-157-F-G	0.00	NOL-05-01-244-F-G-I	0.00
NOL-05-01-158-F-G	0.00	NOL-05-01-245-F-G-I	0.00
NOL-05-01-159-F-G	0.00	NOL-05-01-246-F-G-I	0.00
NOL-05-01-160-F-G	0.00	NOL-05-01-247-F-G-I	0.00
NOL-05-01-161-F-G	0.00	NOL-05-01-248-F-G-I	0.00
NOL-05-01-162-F-G	0.00	NOL-05-01-249-F-G-I	0.00
NOL-05-01-163-F-G	0.00	NOL-05-01-250-F-G-I	0.04
NOL-05-01-164-F-G	0.00	NOL-05-01-251-F-G-I	0.21
NOL-05-01-165-F-G	0.00	NOL-05-01-252-F-G-I	0.00
NOL-05-01-166-F-G	0.00	NOL-05-01-253-F-G-I	0.00
NOL-05-01-167-F-G	0.00	NOL-05-01-254-F-G-I	1.63
NOL-05-01-168-F-G	0.00	NOL-05-01-255-F-G-I	0.00
NOL-05-01-169-F-G	0.00	NOL-05-01-256-F-G-I	0.63
NOL-05-01-170-F-G	0.00	NOL-05-01-257-F-G-I	1.54
NOL-05-01-171-F-G	0.00	NOL-05-01-258-F-G-I-R	0.14
NOL-05-01-172-F-G	0.00	NOL-05-01-259-F-G-I	2.29
NOL-05-01-173-F-G	0.00	NOL-05-01-260-F-G-I	0.69
NOL-05-01-174-F-G	0.00	NOL-05-01-261-F-G-I	0.80
NOL-05-01-175-F-G	0.00	NOL-05-01-262-F-G-I	0.83
NOL-05-01-176-F-G	0.45	NOL-05-01-263-F-G-I	0.69
NOL-05-01-177-F-G	0.00	NOL-05-01-264-F-G-I	0.55
NOL-05-01-178-F-G	0.00	NOL-05-01-265-F-G-I	0.63
NOL-05-01-179-F-G	0.20	NOL-05-01-266-F-G-I	0.26
NOL-05-01-180-F-G	0.00	NOL-05-01-267-F-G-I	0.36
NOL-05-01-181-F-G	0.00	NOL-05-01-268-F-G-I	0.41
NOL-05-01-182-F-G	0.00	NOL-05-01-269-F-G-I	0.25
NOL-05-01-183-F-G	0.00	NOL-05-01-270-F-G-I	0.18
NOL-05-01-184-F-G	0.00	NOL-05-01-271-F-G-I	0.16

Sample Description	Sum of Fractions	Sample Description	Sum of Fractions
NOL-05-01-185-F-G	0.00	NOL-05-01-272-F-G-I	0.10
NOL-05-01-186-F-G	0.00	NOL-05-01-273-F-G-I	0.00
NOL-05-01-187-F-G	0.00		

Table 8 NOL-05-02 ISOCs Scan Summary

Sample Description	Sum of Fractions	Sample Description	Sum of Fractions
NOL-05-02-101-F-G	0.00	NOL-05-02-155-F-G	0.68
NOL-05-02-102-F-G	0.00	NOL-05-02-156-F-G	0.00
NOL-05-02-103-F-G	0.00	NOL-05-02-157-F-G	0.00
NOL-05-02-104-F-G	0.00	NOL-05-02-158-F-G	0.41
NOL-05-02-105-F-G	0.64	NOL-05-02-159-F-G	0.46
NOL-05-02-106-F-G	0.68	NOL-05-02-160-F-G	0.57
NOL-05-02-107-F-G	1.39	NOL-05-02-161-F-G	0.33
NOL-05-02-107-F-I-G-001	1.05	NOL-05-02-162-F-G	0.76
NOL-05-02-107-F-I-G-002	0.58	NOL-05-02-163-F-G	0.42
NOL-05-02-107-F-I-G-003	0.28	NOL-05-02-164-F-G	0.00
NOL-05-02-107-F-I-G-004	0.00	NOL-05-02-165-F-G	0.30
NOL-05-02-107-F-I-G-005	0.55	NOL-05-02-166-F-G	0.07
NOL-05-02-108-F-G	0.09	NOL-05-02-167-F-G	0.70
NOL-05-02-109-F-G	0.10	NOL-05-02-168-F-G	0.91
NOL-05-02-110-F-G	0.22	NOL-05-02-169-F-G	0.00
NOL-05-02-111-F-G	0.28	NOL-05-02-170-F-G	0.46
NOL-05-02-112-F-G	0.04	NOL-05-02-171-F-G	0.54
NOL-05-02-113-F-G	0.00	NOL-05-02-172-F-G	0.22
NOL-05-02-114-F-G	0.06	NOL-05-02-173-F-G	0.00
NOL-05-02-115-F-G	0.00	NOL-05-02-174-F-G	0.00
NOL-05-02-116-F-G	0.00	NOL-05-02-175-F-G	0.58
NOL-05-02-117-F-G	0.67	NOL-05-02-176-F-G	0.39
NOL-05-02-118-F-G	0.00	NOL-05-02-177-F-G	0.86
NOL-05-02-119-F-G	0.00	NOL-05-02-178-F-G	0.50
NOL-05-02-120-F-G	0.00	NOL-05-02-179-F-G	0.00
NOL-05-02-121-F-G	0.30	NOL-05-02-180-F-G	0.04
NOL-05-02-122-F-G	0.17	NOL-05-02-181-F-G	0.42
NOL-05-02-123-F-G	0.34	NOL-05-02-182-F-G	0.00
NOL-05-02-124-F-G	0.00	NOL-05-02-183-F-G	0.00
NOL-05-02-125-F-G	0.00	NOL-05-02-184-F-G	0.11
NOL-05-02-126-F-G	0.00	NOL-05-02-185-F-G	0.11
NOL-05-02-127-F-G	0.00	NOL-05-02-186-F-G	0.08
NOL-05-02-128-F-G	0.00	NOL-05-02-187-F-G	0.37
NOL-05-02-129-F-G	0.00	NOL-05-02-188-F-G	0.26
NOL-05-02-130-F-G	0.00	NOL-05-02-189-F-G	0.51
NOL-05-02-131-F-G	0.00	NOL-05-02-190-F-G	0.65
NOL-05-02-132-F-G	0.00	NOL-05-02-191-F-G	0.00
NOL-05-02-133-F-G	0.00	NOL-05-02-192-F-G	0.00
NOL-05-02-134-F-G	0.07	NOL-05-02-193-F-G	0.00
NOL-05-02-135-F-G	0.00	NOL-05-02-194-F-G	0.29

Sample Description	Sum of Fractions	Sample Description	Sum of Fractions
NOL-05-02-136-F-G	0.58	NOL-05-02-195-F-G	0.34
NOL-05-02-137-F-G	0.44	NOL-05-02-196-F-G	1.31
NOL-05-02-138-F-G	0.00	NOL-05-02-196-F-I-G-001	1.51
NOL-05-02-139-F-G	0.00	NOL-05-02-196-F-I-G-002	0.24
NOL-05-02-140-F-G	0.00	NOL-05-02-196-F-I-G-003	0.17
NOL-05-02-141-F-G	0.00	NOL-05-02-196-F-I-G-004	0.00
NOL-05-02-142-F-G	0.04	NOL-05-02-197-F-G	0.00
NOL-05-02-143-F-G	0.51	NOL-05-02-198-F-G	0.00
NOL-05-02-144-F-G	0.64	NOL-05-02-199-F-G	0.00
NOL-05-02-145-F-G	0.00	NOL-05-02-200-F-G	1.99
NOL-05-02-146-F-G	0.54	NOL-05-02-200-F-I-G-001	1.63
NOL-05-02-147-F-G	0.00	NOL-05-02-200-F-I-G-002	0.62
NOL-05-02-148-F-G	0.00	NOL-05-02-200-F-I-G-003	0.16
NOL-05-02-149-F-G	0.00	NOL-05-02-200-F-I-G-004	0.21
NOL-05-02-150-F-G	0.34	NOL-05-02-201-F-G	0.00
NOL-05-02-151-F-G	0.04	NOL-05-02-202-F-G	0.00
NOL-05-02-152-F-G	0.42	NOL-05-02-203-F-G	0.00
NOL-05-02-153-F-G	0.35	NOL-05-02-203-F-G	0.00
NOL-05-02-154-F-G	0.84	NOL-05-02-204-F-G	0.00

## 5.5 Data Quality Assessment

The Data Quality Assessment phase is the part of the FSS where survey design and data are reviewed for completeness and consistency, ensuring the validity of the results, verifying that the survey plan objectives were met, and validating the classification of the Survey Unit.

The sample design and the data acquired were reviewed and found to be in accordance with applicable YNPS procedures DP-8861, “*Data Quality Assessment*”; DP-8856, “*Preparation of Survey Plans*”; DP-8853, “*Determination of the Number and Locations of FSS Samples and Measurements*”; DP-8857, “*Statistical Tests*”; DP-8865, “*Computer Determination of the Number of FSS Samples and Measurements*” and DP-8852, “*Final Status Survey Quality Assurance Project Plan*”.

The Data Quality Assessment power curves, scatter, quantile and frequency plots are found in [Attachment B](#). Posting Plots are found in [Attachment A](#).

### 5.5.1 NOL-05-01 Data Quality Assessment

Fixed-point sample concentrations were below the DCGLw and no sum-of-fractions were equal to or greater than one. Results from the off-site lab confirmed that no LTP HTD radionuclides exist in this survey unit. The data set was within approximately three standard deviations with normal dispersion about the mean. The data posting plot does not clearly reveal any systematic spatial trends. The quantile plot indicated slight asymmetry below due to a number of low readings. The frequency plot was slightly skewed high. The survey maintained sufficient power to pass the unit and the data set verified the assumptions of the statistical test.

### 5.5.2 NOL-05-02 Data Quality Assessment

Fixed-point sample concentrations were below the DCGLw and no sum-of-fractions were equal to or greater than one. Results from the off-site lab confirmed that no LTP HTD radionuclides exist in this survey unit greater than DCGLw. The data set was within approximately three standard deviations with normal dispersion about the mean with exception of one of the measurement, which was less than the DCGLw. The data posting plot does not clearly reveal any systematic spatial trends. The quantile plot indicated slight asymmetry below due to a number of low readings. The frequency plot was slightly skewed high. The survey maintained sufficient power to pass the unit and the data set verified the assumptions of the statistical test.

## 6.0 QUALITY ASSURANCE AND QUALITY CONTROL

### 6.1 Instrument QC Checks

Operation of the portable ISOCS was in accordance with DP-8871, "Operation of the Canberra Portable ISOCS System," with QC checks performed in accordance with DP-8869, "In-situ (ISOCS) Gamma Spectrum Assay System Calibration Procedure" and DP-8871, "Operation of the Canberra Portable ISOCS System." Instrument response checks were performed once per shift for the Portable ISOCS. Any flags (i.e. anomalies in the QC results) encountered during the ISOCS QC Source Count were corrected/ resolved prior to surveying. All instrumentation involved with the FSS of NOL-05 satisfied the above criteria for the survey. QC records are found in Attachment C.

## 6.2 Split Samples and Recounts

### 6.2.1 NOL-05-01 Split Samples and Recounts

One recount and two split ‘QC’ samples were gathered and within tolerable limits in accordance with DP-8864, “*Split Sample Assessment for Final Status Survey*”.

### 6.2.2 NOL-05-02 Split Samples and Recounts

Two recount and two split “QC” samples were gathered and within tolerable limits in accordance with DP-8864, “*Split Sample Assessment for Final Status Survey*”.

## 6.3 Self-Assessments

No self-assessments were performed during the FSS of NOL-05.

## 7.0 CONCLUSION

The FSS of NOL-05 has been performed in accordance with YNPS LTP and applicable FSS procedures. Evaluation of the direct measurement data has shown none of the systematic direct measurements exceeded the  $DCGL_w$ , depicted in Attachment B. Retrospective power curves were generated and demonstrated that an adequate number of samples were collected to support the Data Quality Objectives. Therefore, the null hypothesis ( $H_0$ ) is rejected.

NOL-05 meets the objectives of the Final Status Survey.

Based upon the evaluation of the data acquired for the FSS, NOL-05 meets the release requirements set forth in the YNPS LTP. The Total Effective Dose Equivalent (TEDE) to the average member of the critical group does not exceed 25 mRem/yr, including that from groundwater. 10CFR20 Subpart E ALARA requirements have been met as well as the site release criteria for the administrative level DCGLs that ensure that the Massachusetts Department of Public Health’s 10 mRem/yr limit will also be met.

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List of Appendices

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Appendix A – YNPS-FSSP-NOL-05, *“Final Status Survey Planning Worksheets*

Appendix B – YA-REPT-00-015-04, *“Instrument Efficiency Determination for Use in Minimum Detectable Concentration Calculations in Support of the Final Status Survey at Yankee Rowe”*

Appendix C – YA-REPT-00-003-05, *“Generic ALARA Review for Final Status Survey of Soil at YNPS”*

Appendix D – ALARA Evaluations, NOL-05

Appendix E – YA-REPT-00-018-05, *“Use of In-situ Gamma Spectrum Analysis to Perform Elevated Measurement Comparison in Support of Final Status Surveys”*

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List of Attachments

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Attachment A – Maps and Posting Plots

Attachment B – Data Quality Assessment Plots and Curves

Attachment C – Instrument QC Records

Attachment D – ORTEC Direct Measurement Data

Attachment E – ISOCS Scan Data

*(In the electronic version, every Table of Contents, Figures, Appendices and Attachments, as well as every mention of a Figure, Appendix or Attachment is a hyperlink to the actual location or document.)*