



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

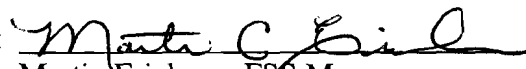
REPORT NO.: YNPS-FSS-OOL-14-00

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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 _{EMC}	DCGL for small areas of elevated activity
DCGL _w	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 _o	Null Hypothesis
HSA	Historical Site Assessment
HTD	Hard-to-Detect
ISOCS	<i>In-situ</i> Object Counting System [®]
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 OOL-14 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 Unit

Survey Area OOL-14 (Wheeler Brook Frontage) consists of an open land area, approximately 2,163 m² in size, which is owned by TransCanada. OOL-14 is south of an upslope from the HT&W railroad track located in Class 1 area OOL-13. There are no sub-surface systems that traverse or connect within OOL-14 and the area was considered to be minimally impacted by site activities given that it was at a distance from the RCA, as delineated in years 2004-2005, and was not accessible by vehicular traffic. The majority of OOL-14 is heavily wooded containing a small section of cleared land that was used as a temporary storage site for thermally desorbed soil. OOL-14 is bordered by Survey Unit OOL-13-01 and OOL-08-04 on the north, OOL-08-04 and OOL-08-03 on the west, OOL-08-03 on the south and OOL-08-01 on the east. A map of the Survey Area and Survey Unit in relation to the site is found in Attachment A.

1.2 Dates of Surveys

Table 1 Date of Surveys and DQOs

Survey Unit	Survey Start Date	Survey End Date	DQA Date
OOL-14-01	7/10/2006	7/13/2006	8/29/2006

1.3 Number and Types of Measurements Collected

Final Status Survey Plans were 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 15 statistical soil samples were taken in the Survey Area, providing data for the non-parametric testing of the Survey Area. In addition to the soil samples, approximately 10% of the Class 3 area was scanned.

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. Soil sample surveys indicated that none of the systematic 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) (that the Survey Unit exceeds the release criteria) is rejected.

1.5 Conclusions

Based upon the evaluation of the data acquired for the FSS, OOL-14 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 per year, 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 per year 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 Unit classified. Survey Unit 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 soil 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, sample locations are identified for the soil samples, using Global Positioning System (GPS) coordinates whenever possible, consistent with the Massachusetts State Plane System, and the scan area 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 OOL-14 (Wheeler Brook Frontage) consists of an open land area, approximately 2,163 m² in size, which is owned by TransCanada. OOL-14 is south of an upslope from the HT&W railroad track located in Class 1 area OOL-13. There are no sub-surface systems that traverse or connect within OOL-14 and the area was considered to be minimally impacted by site activities given that it was at a distance from the RCA, as delineated in years 2004-2005, and was not accessible by vehicular traffic. The majority of OOL-14 is heavily wooded containing a small section of cleared land that was used as a temporary storage site for thermally desorbed soil. OOL-14 is bordered by Survey Units OOL-13-01 and OOL-08-04 on the north, OOL-08-04 and OOL-08-03 on the west, OOL-08-03 on the south and OOL-08-01 on the east. A map of the Survey Area/Unit is found in Attachment A.

3.2 History of Survey Area

A previous FSS of OOL-14 was performed on December 14, 2004. Initial area surveillance was performed on April 21, 2005. The Area Surveillance Plan (ASP) soil sample results were all within 2 standard deviations of the mean of the original FSS data. A section of Survey Area OOL-14 was turned over to the construction/demolition group for staging thermally desorbed PCB contaminated soil. The determination was made that due to the potential for decommissioning activities to impact the survey area, the original FSS would be abandoned.

An additional source of potential activity in the area was the storage of backfill material. Soil, primarily removed from Class 3 areas and some soil from remediated Class 1 areas (treated to remove PCB contamination) was stored within a portion of survey unit OOL-14-01. This soil was radiologically monitored via the (ISOCS) Yankee Rowe Truck Monitor, both prior to and following the desorption treatment. All soils stored in the pile were verified to be less than the DCGLw for the expected nuclide mixture. The soil pile has been removed from survey unit OOL-14-01, and subsequently utilized in backfilling survey units where FSS has been successfully completed.

3.3 Division of Survey Area into Survey Unit

The OOL-14 Survey Area consists of a single Survey Unit, OOL-14-01. A map of the Survey Area/Unit 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

The Table below provides a summary of surveys performed during the Final Status Survey of OOL-14.

Table 2 Dates of Surveys since HSA

Survey Unit	Survey Start Date	Survey End Date	Description
OOL-14-01	7/10/2006	7/13/2006	FSS Survey

4.1.2 Radionuclide Selection and Basis

During the initial DQO process, Cs-137 was identified as the radiological nuclide of concern for OOL-14-01. Characterization survey data from the previous FSS indicated Cs-137 was the only identified LTP specified radionuclide that warranted consideration in the OOL-14 Survey Area. However, soil samples were evaluated for all LTP listed nuclides.

4.1.3 Scoping & Characterization

The Final Status Survey of OOL-14 was previously performed on December 14, 2004. A section of Survey Area OOL-14 was turned over to the construction/demolition group for staging thermally desorbed PCB contaminated soil. The determination was made that due to the potential for decommissioning activities to impact the survey area, the original FSS would be abandoned. The original FSS data collected was used in the characterization and design of this Survey.

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 Unit OOL-14-01 was identified as Class 3 area.

4.3 Remedial Actions and Further Investigations

Neither investigations nor remedial actions were required in this Survey Area.

4.4 Unique Features of Survey Area

The majority of OOL-14 is heavily wooded containing a small section of cleared land that was used as a temporary storage site for thermally desorbed soil.

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 OOL-14 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 Plans. The FSS Plans 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 design parameters developed are presented below.

Table 3 Survey Area OOL-14 Design Parameters

Survey Unit	Design Parameter	Value	Basis
OOL-14-01	Survey Unit Area	2163 m ²	Class 3, Soil, no restrictions
	Number of Direct Measurements	15 (calculated) + 0 (added) Total: 15	α (Type I) = 0.05 β (Type II) = 0.05 σ : 0.0484 Relative Shift: 2 DCGLw: 3 Cs-137 LBGR: 2.9032
	Critical Value	N/A	No area > DCGLw Allowable
	Gridded Sample Area Size Factor	Class 3: N/A	No grid in Class 3 area

Survey Unit	Design Parameter	Value	Basis
	Sample Grid Spacing:	No Grid	No grid in Class 3 area, random locations
	Direct Measurement Investigation Level	> 50% DCGLw	Class 3 Area: > 50% DCGLw
	Scanning Coverage Requirements	Judgmental	Class 3 Soil Area: Judgmental
	Scan Investigation Level	> Background	Class 3 Area: Detectable over background

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 OOL-14 Survey Area and throughout this report, the administrative acceptance criterion of 8.73 mRem per year has been set for Soil LTP-listed radionuclides.

Table 4 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 statistical measurements. The quantity of statistical measurements collected for each unit is listed above in the table titled "Survey Area OOL-14 Design Parameters". Split samples and recounts are addressed under the quality control section 6.2. The OOL-14-01 soil sampling grid was developed as a random pattern with a random starting point. Sample measurement locations are provided in Attachment A.

OOL-14-01 was scanned approximately 10% with a SPA-3. No activity greater than background or DCGLw, attributable to plant radionuclides, was present in OOL-14-04.

5.2 Survey Implementation Activities

The Table below provides a summary of daily activities performed during the Final Status Survey of OOL-14.

Table 5 FSS Activity Summary for OOL-14

Survey Unit	Date	Activity
OOL-14-01	7/7/2006	Performed walk-down of Survey Unit
	7/7/2006	Established Isolation and Controls
	7/6/2006	Performed Job Hazard Analysis
	7/6/2006	Performed Unit Classification
	7/6/2006	Performed Sample Quantity Calculations, established DQOs
	7/6/2006	Generated FFS Sample Plans
	7/10/2006 to 7/13/2006	Initiated Scans, and Direct measurements.
	8/29/2006	Performed DQA, FSS Complete

5.3 Surveillance Surveys

5.3.1 Periodic Surveillance Surveys

Upon completion of the FSS of Survey Area OOL-14, 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 OOL-14.

5.3.3 Investigations

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

5.4 Survey Results

Soil sample surveys indicated that OOL-14 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 6 Soil Sample Summary

Sample Description	SOF
OOL-14-01-001-F	0.05
OOL-14-01-003-F	0.07
OOL-14-01-004-F	0.09
OOL-14-01-005-F	0.44
OOL-14-01-006-F	0.05
OOL-14-01-007-F	0.06
OOL-14-01-008-F	0.16
OOL-14-01-010-F	0.10
OOL-14-01-011-F	0.11
OOL-14-01-012-F	0.08
OOL-14-01-013-F	0.11
OOL-14-01-014-F	0.07
OOL-14-01-020-F	0.05
OOL-14-01-021-F	0.19
OOL-14-01-022-F	0.10
Max	0.44
Average	0.05
Standard Deviation	0.10

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.

All fixed-point sample concentrations were below DCGLw and no sum-of-fractions were equal to or greater than one. No elevated areas were identified during SPA-3 scans, therefore no investigations were required. All off-site sample results were < DCGLw for all plant related nuclides including hard-to-detect radionuclides. The data were within one standard deviation with the exception of one data point for each Co-60 and Cs-137 which were high but well below the DCGLw. A review of the posting plot does not clearly reveal any spatial trends. The frequency plots and scatter plots indicate a normal distribution about the arithmetic mean with a slight skew to the right. The quantile plot has a slight asymmetry in the lower quartile. The assumptions of the statistical test are verified.

6.0 QUALITY ASSURANCE AND QUALITY CONTROL

6.1 Instrument QC Checks

Operation of the E-600 w/SPA-3 was in accordance with DP-8535, "*Setup and Operation of the Eberline E-600 Digital Survey Instrument*," with QC checks performed in accordance with DP-8540, "*Operation and Source Checks of Portable Friskers*." Instrument response checks were performed prior to and after use for the E-600 w/SPA-3. All instrumentation involved with the FSS of OOL-14 satisfied the above criteria for the survey. QC records are found in Attachment C.

6.2 Split Samples and Recounts

One split and one recount '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 OOL-14.

7.0 CONCLUSION

The FSS of OOL-14 has been performed in accordance with YNPS LTP and applicable FSS procedures. Evaluation of the soil sample data has shown none of the systematic soil samples 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.

OOL-14 meets the objectives of the Final Status Survey.

Based upon the evaluation of the data acquired for the FSS, OOL-14 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 per year, 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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