

FINAL STATUS SURVEY PLAN

for the

**SNAP ENVIRONMENTAL TEST FACILITY
BUILDING 4024**

OCTOBER 2007

REVISION 0

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PREFACE

The Boeing Company (Boeing) awarded AREVA NP Inc., (AREVA) an Undefined Firm Fixed-Price Letter Contract No. 116285 (contract) January 22, 2007. The Scope of Work for the contract is to plan and perform the demolition and removal of the existing SNAP Environmental Test Facility, (SETF), also known as Building 4024. The facility was used for the testing of small nuclear reactors, and induced radioactivity (i.e., activation products) remains within the building structure. The project is located within Area IV of the Santa Susana Field Laboratory, eastern Ventura County, California.

The project execution requirements involve facility demolition including the complete removal of the subsurface concrete and associated utilities. The desired end state for the project consists of:

1. Verification that the site meets the established site release criteria using MARSSIM-compliant survey methods and techniques for sampling the remaining soil and/or bedrock.
2. The excavation has been backfilled in compliance with the applicable requirements and the site re-graded to natural contours. Note that the term “site” as used here refers to the subsurface excavation, the backfilled locations and the immediate surrounds.

AREVA has developed this Final Status Survey (FSS) Plan to verify the SETF site meets the established release criteria using MARSSIM-compliant survey methods and techniques once the Decommissioning and Decontamination activities are complete.

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LIST OF ACRONYMS AND ABBREVIATIONS

ALARA	As Low as Reasonably Achievable
AMCG	Average Member of the Critical Group
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
DCGL	Derived Concentration Guideline Level
DOE	U.S. Department of Energy
DQO	Data Quality Objective
dpm/100 cm ²	disintegrations per minute per 100 square centimeters
EPA	U. S. Environmental Protection Agency
ICRP	International Council on Radiological Protection
LBGR	Lower Bound of the Gray Region
MDC	minimum detectable concentration
mrem/yr	millirem per year
NRC	U.S. Nuclear Regulatory Commission
μCi	microcuries
OSHA	Occupational Safety and Health Administration
pCi/g	picocuries per gram
PCOC	Potential Contaminant of Concern
PM	project manager
PRGs	preliminary remediation goals
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
SETF	SNAP Environmental Test Facility, Building 4024
SML	Sample/Measurement Location
SNAP	System for Nuclear Auxiliary Power
TEDE	total effective dose equivalent
WRS	Wilcoxon Rank Sum

DEFINITIONS

Class 1 Survey Unit – Areas that have, or had prior to remediation, a potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiological surveys) that exceeds DCGL_w.

Class 2 Survey Unit – An area that has, or had prior remediation, a potential for radioactive contamination or known contamination, but is not expected to exceed the DCGL_w.

Class 3 Survey Unit – Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of radioactivity at a small fraction (~20%) of the DCGL_w based on site operating history and previous radiological surveys.

DCGL_w – Derived Concentration Guideline Level – Contamination limit based on the assumption that concentration of residual activity is evenly distributed over a large area.

DCGL_{EMC} – Derived Concentration Guideline Level – Contamination limit based on the assumption that the concentration of residual activity is distributed as small-elevated areas within a larger area.

Data Quality Objectives (DQOs) – DQOs are qualitative and quantitative statements derived from DQO process that clarify technical and quality objectives, defines the appropriate type of data, and specify levels of decision error that will be used as the basis for establishing the quality and quantity of data necessary to support facility dispositions.

Isolation Controls – Training, posting, and physical access control measures implemented following Post Demolition Survey are designed to ensure that a given area's radiological characterization do not change.

Judgmental Survey (analogous to biased) – Surveys that are performed at locations selected using professional judgment based on unusual appearance, location relative to known contamination areas, and high potential for residual radioactivity.

Measurement Location – A survey location where activity measurements are obtained.

Minimum Detectable Concentration – The smallest amount or concentration of radioactive material in a sample that will yield a net positive count with a 5% probability of falsely interpreting background responses as true activity and a 5% probability of falsely interpreting true activity as background.

Final Status Survey – Radiological measurements, evaluations and support activities undertaken to demonstrate that a facility satisfies the criteria for unrestricted use.

Representative Survey – A survey that is designed to collect an appropriate number of measurements which will give an accurate representation of the radiological conditions in a defined area.

Survey Area – The most general category, comprised of surfaces to be further defined as one or more survey units, bounds of which are defined by existing physical features such as wall, columns, beams, etc.

Survey Design – The process of determining the type, location, number and density of radiological measurements to be taken for a final status survey.

Survey Instructions – Written instructions which specify the type and number of measurements to be taken in a survey area or survey unit. Each survey package shall include survey instructions.

Survey Package – A collection of information in a standardized format for controlling and documenting field measurements taken for a final status survey. A survey package is prepared for each Survey Unit or Survey Area. The survey package includes the survey instructions, survey data sheets, and grid maps.

Survey Point – A smaller subdivision within an area or unit designated as a survey location where measurements are obtained. This area generally refers to the area covered by a detector probe or 100 cm² when a swipe is obtained.

Survey Unit – A contiguous area with similar characteristics and contamination potential. Survey units are established to facilitate the process and aid in the statistical evaluation of the survey data. As a general rule a survey unit is a subset of a survey area.

1. GENERAL INFORMATION

1.1 Introduction

This Final Status Survey Plan presents the approach and process to release the SNAP Environmental Test Facility (SETF) site for unrestricted use. This will require a survey of the site area to verify that no radioactive materials remain above the Derived Concentration Guideline Levels (DCGLs). In order to accomplish this task, the surrounding site area will be surveyed in accordance with this survey plan. This plan is based on the guidance in *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) Reference 6.9*. The criteria and survey protocols specified in this plan have been designed to meet the intent of the current regulations for release of the site for unrestricted use. This Final Status Survey Plan was developed to work in conjunction with the programmatic plans developed to safely and effectively decontaminate and dismantle the facility.

1.2 Objective and Scope of the Final Status Survey Plan

The objective of the Final Status Survey Plan is to verify and document the site meets the established release criteria using MARSSIM-compliant survey methods and techniques after the decommissioning and decontamination are completed.

The scope of this plan is to provide direction for the verification of residual levels of radiological contamination of remaining soil and bedrock prior to the excavation being backfilled and graded to natural contours. This Final Status Survey Plan presents details on how to consistently conduct Final Status Surveys (FSSs) in a compliant, technically defensible, cost-effective manner. Details include data quality objectives Data Quality Objectives (DQOs) and requirements for radiological field instrumentation, laboratory analysis, data analysis and data quality assessment.

Prior to Final Status Surveys, isolation controls shall be established to ensure that areas do not become radiologically contaminated and that FSS data remain valid. If isolation controls are not maintained, areas could become radiological contaminated prior to, during and after FSSs due to adjacent activities and/or by traffic passing through the areas. Such contamination or the potential for contamination would invalidate the FSS data. Controls shall remain in effect until backfill operations commence. In addition, prior to backfill operations, a verification survey by a third party shall be conducted to confirm that controls have been effective.

2. SITE INFORMATION

2.1 Background

The Boeing Company (Boeing) and its predecessor organizations performed nuclear research and energy development activities at its Santa Susana Field Laboratory (SSFL) from about 1954 until the end of 1998. Activities sponsored by the U.S. Department of Energy (DOE) and its predecessor agencies, included engineering, research, development, and manufacturing operations.

The nuclear and energy development facilities, including both the Boeing and the Energy Technology Engineering Center (ETEC) operations, were located in Area IV of the SSFL site, which is situated in the Simi Hills of southeastern Ventura County, California, refer to Figure 1-1, Location Map of SETF, Building 4024 at ETEC. The nuclear work concluded in the late 1980s. The D&D of all remaining SSFL facilities associated with DOE-sponsored activities is currently being performed under the ETEC Closure contract with DOE. The SETF is owned by DOE.

The SETF was designed and erected for testing SNAP (Space Nuclear Auxiliary Power) reactors in a simulated operational environment. The facility was erected in 1960 and was then enlarged in 1962 to provide a second control room and increased operating equipment area. Four unshielded SNAP-type reactors were tested within shielded test cells at the SETF. Following the end of testing, the reactor systems and their associated radioactive test equipment were removed. Additional decontamination and dismantlement operations were performed in 1978 and again in 2005.

2.2 Site Description

The Energy Technology Engineering Center (ETEC) is located within Santa Susana Field Laboratory (SSFL). Figure 1-1 is a location map of Building 4024 at ETEC. Building 4024 was built in the early 1960s to test systems for nuclear auxiliary power (SNAP) reactors in a simulated operational environment. The SNAP reactors were originally developed and tested as a nuclear power source for space vehicles.

Figure 1-2 shows a site layout of the SNAP Environmental Test Facility (SETF). Figure 1-3 shows an image of Building 4024 from the exterior. Building 4024 is a 13,972 square-foot facility constructed with a steel frame, metal siding, and roofing. The above-grade structure consists of a high bay area, which was cleaned, surveyed, and designated as decommissioned material (DM). Some of the above-grade structures and equipment associated with the general support/operating area and mechanical/electrical support areas were removed in 2005. The two concrete foundations for these buildings remain.

The below-grade structure consists of a concrete vault beneath the high bay area that is separated into three cells. Two cells were used to contain the reactors during testing, with

a transfer cell separating the two. Following the end of testing in the mid-1970s, the reactor systems and their associated radioactive test equipment were removed.

Figure 1-4 shows a cutaway diagram of the underground test vault. The vault is constructed of concrete walls ranging from 2 feet to 9 feet thick, penetrated by various through-tubes, conduits and cooling pipes, and lined with 3/16-inch aluminum plate. The floor was cast on the bedrock and varies from 6.5 to 8 feet thick, depending on the elevation of the bedrock.

A paved yard surrounds the main building. Three radioactive gas holdup tanks and two liquid radioactive waste holdup tanks beneath the paved yard were removed in 1979. Eight empty vaults previously used for the storage of solid radioactive waste remain below the paved yard.

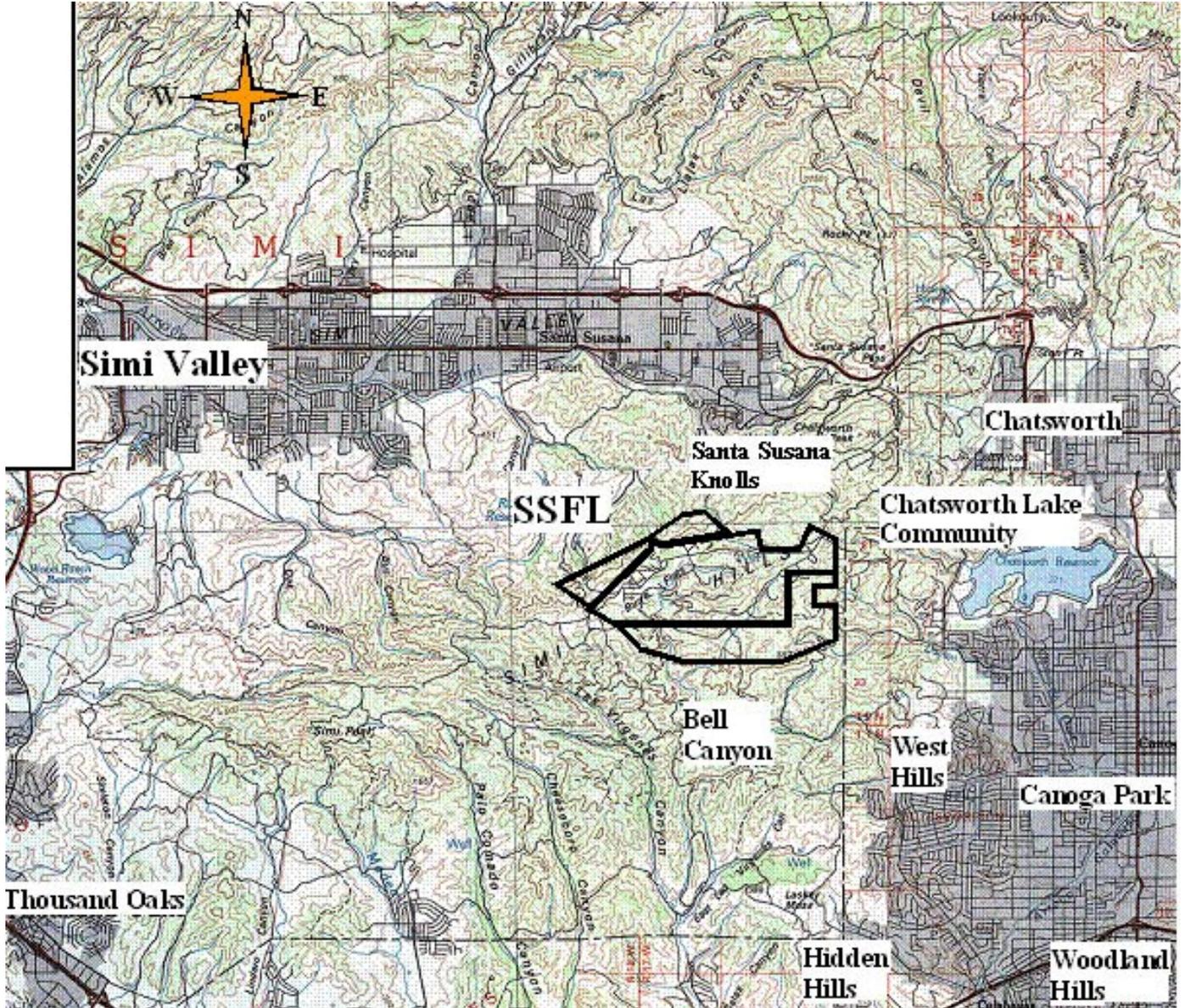


Figure 1-1. Location Map of SETF, Building 4024 at ETEC

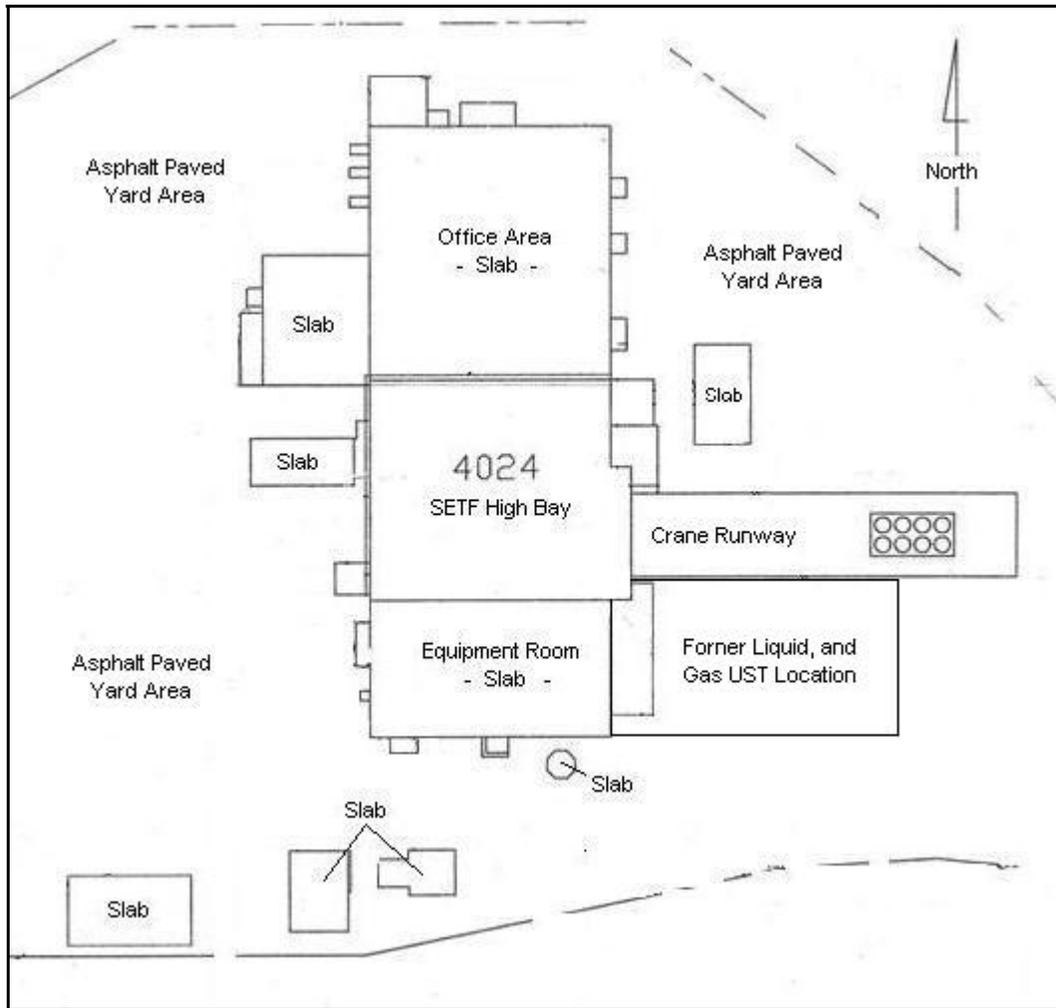


Figure 1-2. SETF Site Layout



Figure 1-3. Exterior of Building 4024

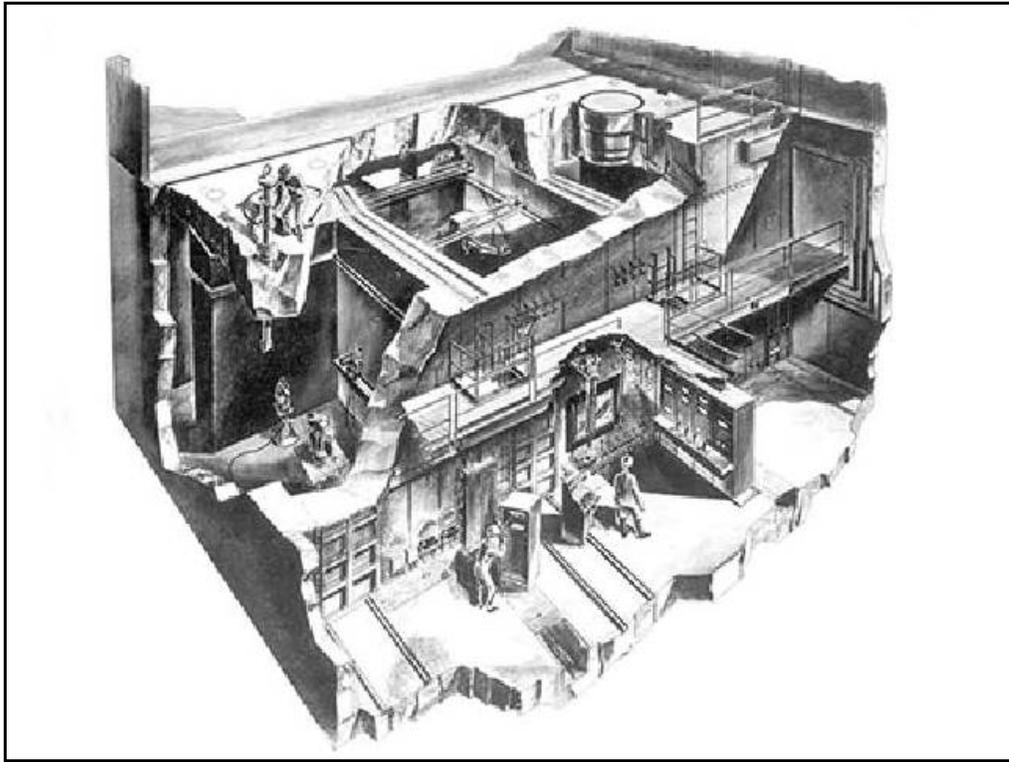


Figure 1-4. Cutaway Diagram of the Underground Test Vault

2.3 Site Conditions at Final Status Survey

The decontamination and dismantlement (D&D) activities planned for the SETF will have been completed. The DM materials including the High Bay, concrete pads, paved yard area, and the SGTCC will have been removed and disposed of at a California Class 1 disposal facility. Prior to removal of the DM portions of the SETF, D&D of the activated test cells will be completed as follows:

- Completely removed the aluminum liner;
- Completely removed the shield wall from each test cell;
- Removed up to eight (8) inch depth of activated concrete from west, north, and east walls;
- Removed up to ten (10) inch depth of activated concrete from south wall;
- Removed up to six (6) inch depth of activated concrete from floor and ceiling surfaces.

The aluminum liner and concrete rubble material generated from decontamination of the test cells will be packaged and shipped as radioactive waste to the Nevada Test Site (NTS) for disposal. In addition to the materials in the test cells for NTS disposal, other items will be removed from the SETF utilizing the same radiological controls as with the test cell decontamination, and that these materials also be packaged and disposed of as radioactive waste at NTS. These items will include:

- Piping for the former contaminated gas and contaminated liquid waste UST systems;
- Floor drain systems and connecting piping in Room B-101, basement operating floor;
- Rubble and debris collected from decontamination of SML 5 and SML 8 surfaces.

After decontamination of the activated test cells has been completed, the remaining structure will be surveyed and shown to be suitable for demolition, and disposal as DM. As the SETF is being demolished the radiologically clean DM will be disposed of at a Class I California disposal facility. Once the SETF DM demolition is complete, the site will also undergo a planned and permitted excavation. A drawing excerpt from the excavation plan is provided as Attachment 1, SETF Site Primary Excavation Plan Primary. This drawing represents the site condition for the final status survey.

2.4 Identity of Potential Contaminants

Radioactivity induced by testing SNAP reactors in the sub grade test cell complex was documented in RS-00025, Building 4024 Concrete Sampling (Reference 6.5). The RS-00025 report provides the results for concrete sampling in the SETF, Building 4024 conducted in 2003. The activity of 1-inch depth cores ranged from no detectable activity to 105 pCi/g of Europium-152 (Eu-152) and 9.4 pCi/g of Cobalt-60 (Co-60), the primary contaminants of concern (COC).

Contamination with constituents Cesium-137 (Cs-137) and Uranium-238 (U-238) (still waiting on analysis results) was detected at two survey measurement locations (SMLs) just at the outside northeast and southwest corners of the SETF as documented in July 2007 radiological characterization and confirmatory survey report (Reference 6.18). During the 2007 survey, the presence of Eu-152 and Co-60 was confirmed as primary COC in the test cells with no other PCOCs present.

The 2007 characterization and confirmatory surveys indicated that generally there were no alpha, beta, and gamma radiation measurements outside of the activated test cells that showed contamination above surface contamination limits presented in the report and SETF measurements were generally within the range of background measurements. Survey measurements and samples from within the gas and liquid waste UST piping and the accessible floor drains in Room B-101 were consistent with background level readings. However, a suspect floor drain was not accessible due to grout covering to drain. As such, data showing the absence or presence of PCOCs will be obtained during removal of the floor drain system.

According to the Historical Site Assessment of Area IV Santa Susana Field Laboratory Ventura County, California (HSA), other potential radionuclide contaminants of concern (PCOC) for Area IV as a whole in addition to Co-60, Eu-152, and Cs-137 include: Am-241, Cs-134, Eu-154, Fe-55, Fe-59, H-3, K-40, Mn-54, Na-22, Ni-63, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, Th-228, Th-230, Th-232, U-234, U-235, and U-238. These PCOCs were tested for during the 2007 characterization and confirmatory survey and will be tested for during the FSS.

2.5 Regulatory Authority and Guidance Documents

The decommissioning and demolition of the SETF Building 4024 will be performed as a non-time critical removal action under the DOE's incumbent CERCLA authority. Use of non-time critical removals for conducting decommissioning activities effectively integrates DOE lead agency responsibility, U.S. Environmental Protection Agency (EPA) oversight responsibility, and stakeholder participation. The DOE Decommissioning Program will utilize DOE expertise in devising and implementing appropriate solutions to decommissioning projects. Effective EPA oversight and stakeholder participation will be provided in compliance with applicable requirements. Decommissioning projects will retain sufficient flexibility to tailor activities to meet specific site needs, and achieve risk reduction and restoration expeditiously.

Regulations and guidance documents utilized for the Final Status Survey Plan development and survey implementation include:

1. DOE Order 5400.5, Radiation Protection of the Public and Environment

2. Policy on Decommissioning of Department of Energy Facilities Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
3. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Revision 1, August 2000
4. NUREG-1501, Background as a Residual Radioactivity Criterion for Decommissioning, NRC Draft Report for Comment, August 1994
5. NUREG-1506, Measurement Methods for Radiological Surveys in Support of New Decommissioning Criteria, NRC, August 1995
6. NUREG-1507, Minimum Detectable Concentrations With Typical Radiation Survey Instruments For Various Contaminants and Field Conditions, NRC, Draft Report for Comment, August 1995

3. SURVEY OVERVIEW

3.1 Data Quality Objectives Process

The DQO process is a series of planning steps that have been defined by MARSSIM to ensure that the type, quantity, and quality of environmental data used in decision-making are appropriate for the intended application. DQOs are qualitative and quantitative statements that clarify the study objective, define the most appropriate data to collect, determine the most appropriate conditions for collecting the data, and specify acceptable levels of decision errors that will be used to establish the quantity and quality of data needed to support the decision. The DQO process is iterative, so specifications may change as new information is obtained during the course of site remediation, until the final status survey is actually performed. The DQO process comprises the seven steps. These seven steps are discussed below (Sections 3.1.1 through 3.1.7).

3.1.1 Step 1: Stating the problem

The objective of decommissioning the SETF is to reduce the residual radioactivity to a level that permits unrestricted release of the site. Data will be needed to support this objective to demonstrate that residual radioactivity remaining at the SETF results in a risk less than the release criterion. This objective will be met by performing a final status survey in individual survey units. A separate decision will be made for each survey unit about whether the release criterion has been met. Information on the location and extent of residual radioactivity and estimated concentration levels will be gained during the characterization survey. Stakeholders in the project include DOE, EPA, Boeing Company, and local residents.

3.1.2 Step 2: Identifying the Decision

The primary decommissioning criterion is that the risk to future occupants at the SETF site from residual radioactivity that is distinguishable from background must be less than 1×10^{-6} EPA cancer incidence risk for a residential scenario. The decision statement is:

Has the decommissioning risk criterion been met in individual survey units?

EPA preliminary remediation goals (PRGs) will be used to define residual contamination goals. These goals are referred to as derived concentration guideline levels (DCGLs). DCGLs were derived for individual nuclides for residual contamination of soils. The numerical release criterion proposed for demonstrating that the risk criterion has been met will be that the sum-of-fractions of quotients of concentrations and DCGLs of contributing radionuclides shall be less than unity. If a survey unit fails to meet this numerical release criterion, the need for additional sampling or remediation will be evaluated.

The DCGLs assume that the level of residual radioactivity is uniformly distributed across the survey unit; they are designated $DCGL_W$ ¹ in this plan. A nonparametric statistical test, the Sign Test, may be applied to the sampling data taken at distinct locations in the survey unit to determine whether this level meets the release criterion. The test will be based on the probabilities of rejecting a true null hypothesis (Type I error) and accepting a false null hypothesis (Type II error) established in the sixth step of the DQO process.

In addition, a separate $DCGL_{EMC}$ (the DCGL used for the elevated measurement comparison) will be calculated if it is assumed that residual radioactivity is concentrated in a much smaller area (i.e., in only a small percentage of the entire survey unit). The $DCGL_{EMC}$ will be calculated for survey planning purposes and will trigger further investigation of a portion of the survey unit. Any measurement from the survey unit will be considered elevated if it exceeds the $DCGL_{EMC}$. However, the elevated measurement alone does not indicate that the survey unit fails to meet the release criterion, only that further investigation will be necessary to determine the actual extent and concentration level of the elevated area. This information may be used with further modeling to demonstrate that the release criterion has been met.

3.1.3 Step 3: Identifying Inputs to the Decision

The purpose of Step 3 is to identify the information needed to resolve the decision statement identified in Step 2 and sources of this information. The primary inputs to the decision statement are the DCGLs and the distribution of radionuclide concentrations at each survey unit. This information will be developed using site and survey unit characteristics data, decision error magnitudes, and radionuclide concentration data. Sources of data are discussed below.

3.1.3.1 Derived Concentration Guidelines

DCGLs for individual radionuclides were developed using data on radiological and physical characteristics of the SETF site for receptor scenarios that quantify modes and rates of exposure. Soil DCGLs for the SETF site have been developed using EPA cancer incidence risk levels based on residential soil exposure scenario. Primarily, measurements of residual contamination of surface soils will be performed by isotopic analysis of samples and results compared with the DCGLs. Scans of survey unit surface and exposure rate measurements at one meter above the surface will be performed in addition to the samples to show uniformity.

3.1.3.2 Measurement of Radionuclide Concentrations

Radionuclide concentrations are a primary input to the decision rule. Measuring radionuclide concentrations involves delineating discrete survey units, identifying the

¹ The “W” in $DCGL_W$ stands for Wilcoxon Rank Sum test, which is the statistical test recommended in MARSSIM for demonstrating compliance when the contaminant is present in background. The Sign test recommended for demonstrating compliance when the contaminant is not present in background also uses the $DCGL_W$.

nature and number of measurements, and selecting measurement techniques. Delineating survey areas is discussed in Step 4 of the DQO process (Section 3.1.4).

3.1.3.3 Nature and Number of Measurements

The decision rule and the site physical and radiological characteristics will direct the nature of measurements taken. The decision rule described in Step 5 of the DQO process (Section 3.1.5) requires knowledge of individual radionuclide concentrations in volumes of soil. In addition, the decision rule requires assessing the potential for elevated concentrations. Thus, types of samples will include volumes of soil and scans of the survey area.

For a given survey unit, MARSSIM provides direction on how to determine the minimum number of measurement or sample locations to be collected based on the nonparametric statistical test to be used to evaluate the data. This number is based on the desired power of the statistical test (confidence levels), the expected variation in the sample or measurement results, and the width of the gray region which impacts the probability of incorrectly failing to release a survey unit that meets the criteria for release for unrestricted use. The survey results will be used to assess the presence or absence of radiological contamination in each survey unit.

To determine the number of measurements needed in an impacted survey unit for the surveys, settings recommended in Reference 7.15, Appendix A, Section A.7, Volume II of the NUREG-1757 and the MARSSIM Section 5.5 will be used.

3.1.3.4 Identification of Measurement Techniques

Radionuclide-specific measurement techniques will be needed for both gamma- and beta-emitting radionuclides in surface soil. The gamma-emitting radionuclides are projected to dominate the dose and/or risk for the residential use scenario for surface soils. A list of candidate measurements is presented in Table 3-1, and techniques used in the radionuclide-specific and scanning measurements are discussed below.

Table 3-1. Survey Instrumentation

Measurement	Instrument Type
Scanning: <ul style="list-style-type: none"> • Alpha • Beta • Gamma 	<ul style="list-style-type: none"> • Gas proportional, Zn S(Ag) scintillation • Gas proportional, Geiger-Mueller • NaI (TI) scintillation
Radionuclide-specific: <ul style="list-style-type: none"> • Beta • Gamma 	<ul style="list-style-type: none"> • Liquid scintillation • ISOCS Ge solid state or equivalent

* ISOCS- In Situ Object Characterization System – ISOCS is a specific example of a portable, solid-state detector based spectroscopy system that provides in-situ, quantitative and qualitative information on the types and amounts of radiation present.

3.1.3.5 Scanning Measurements

Scanning will be performed to locate radiation anomalies that might indicate elevated areas of residual activity and that will require further investigation or action. Scanning will be performed using a gamma detector for surface soils. If the scanning results exceed an investigation level determined for the detector and survey parameters, further investigation will be performed using direct measurement or sampling. Scanning will be performed to provide 100% coverage for Class 1 areas and 10% to 100% coverage for Class 2 areas. Scanning will be performed as judged necessary for Class 3 areas.

3.1.3.6 Direct Field Measurements

Direct field measurements on surface soils will be made at fixed locations using an exposure rate instrument. This will provide a qualitative measure of radioactivity present in surface soils. A portable *in situ* gamma spectrometer may be used in direct measurements of surface soils to quantitatively verify sample results. Gamma spectrometry will allow direct measurement of all gamma-emitting radionuclides, including Cs-137, Co-60, Eu-152, and Eu-154. Other potential radionuclides (PCOC) at the SETF include Am-241, Cs-134, Fe-55, Fe-59, H-3, Mn-54, Na-22, Ni-63, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, Th-228, Th-230, Th-232, Th-234, U-234, U-235, and U-238. Although these PCOC radionuclides do not have significant gamma radiations, their concentrations were inferred from the concentrations of the measured radionuclides based on established ratios in each survey unit. The established ratios will be confirmed through further sampling and laboratory analysis.

The probability sampling performed by field measurements will be systematic sampling on a systematic grid, with a random start for Class 1 and Class 2 areas and simple random sampling for Class 3 areas. It is anticipated that only these measurements will be used in conducting the nonparametric statistical test. However,

results from scanning, direct field measurements, and laboratory analysis of samples may be used for elevated measurement comparison against an upper limit value.

3.1.3.7 Sampling and Laboratory Analysis

Sampling and laboratory analysis will be required during the final status survey to confirm the established ratios for the non-gamma-emitting radionuclides, to further define the extent of potential contamination, and to determine maximum radiation levels within an area. For surface soils it is expected that ratios of non-gamma-emitting radionuclides to gamma-emitting radionuclides can be developed using field measurements. Probability sampling using locations chosen on a random or random start systematic grid basis will be limited to direct field measurements for these surfaces. If it is determined through further characterization or confirmation sampling that any of the ratios are not constant, probability sampling will be employed for laboratory analysis of the non-gamma-emitting radionuclides.

3.1.3.8 Background Determination

The radionuclide contaminants of concern Co-60 and Eu-152 that have the highest potential to be present at the SETF site survey units do not occur in natural background concentrations and results from isotopic analysis of FSS samples will be used to determine if survey units meet release criteria. For radionuclides that are present in background (U, Th, K-40, Cs-137, Sr-90 etc.) sampling and analysis will be performed and the Wilcoxon-Rank-Sum (WRS) statistical test will be used to evaluate the results. The sum-of-fractions will be used for instances where multiple radionuclides are present and the WRS test will be used to evaluate results. In addition, direct field measurements will be compared to background study values. Comparison to background levels will be required for the scan and exposure rate measurements, topographical considerations will be weighed for this background comparison.

3.1.4 Step 4: Defining Study Boundaries

Defining spatial and temporal boundaries helps ensure the samples taken during the final status survey are representative of the survey unit. The spatial area under consideration for release is the SETF site that remains after the structure has been removed, refer to Attachment 1, SETF Site Primary Excavation Plan Primary. This drawing represents the site condition for the final status survey. Because statistical methods will be used to define the number of samples taken and extent of surveys performed, it will be important to classify survey areas and to define their constituent survey units to minimize variability of concentrations. Furthermore, concentration levels of residual radioactivity before remediation will be used to define the type of statistical sampling and the extent of scanning coverage for each survey unit.

The survey areas are classified as either non-impacted areas or impacted areas. Non-impacted areas have no potential for residual contamination. Impacted areas are further divided into one of three classifications:

- **Class 1 Areas**— Areas that has, or had prior to remediation, a potential for radioactive contamination (based on operating history) or known contamination (based on previous surveys) above the DCGL_w.
- **Class 2 Areas**—Areas that has, or had prior remediation, a potential for radioactivity, or known contamination, but is not expected to exceed the DCGL_w.
- **Class 3 Areas**— Areas that are not expected to contain any residual radioactivity, or are expected to contain levels of radioactivity at a small fraction (~20%) of the DCGL_w based on site operating history and previous radiological surveys.

3.1.4.1 Spatial Boundaries

The Characterization and Confirmatory Survey Report describes the SETF and its current radiological status. Because contaminated equipment and piping will be removed and disposed of, contamination levels on them will not be used to classify the facility. The building and below grade portions of the structure will be demolished after decontamination, the concrete rubble will be shipped offsite for disposal. As a conservative measure, all outside areas will be surveyed as Class 1 survey units.

3.1.4.2 Temporal Boundaries

Some remedial action support and survey measurements of environmental media (e.g., soil, and water) will be sampled in the remedial action survey to aid in design of the final status survey and further decontamination if necessary.

3.1.4.3 Reference Coordinates

Reference coordinate systems will be established at the SETF site to select and relocate measurement and sampling locations. A diagram showing each survey unit will be prepared.

3.1.5 Step 5: Developing a Decision Rule

A decision rule relates the concentration of residual radioactivity in the survey unit to the release criterion so that decisions can be made based on the results of the final status survey. The decision rule proposed in this final status survey plan consists of a statistical test and an elevated measurement comparison. Because radionuclide-specific measurements will be made and the primary contaminants of concern (Co-60 and Eu-152) are not present in background at significant levels, if all of the measurements are below the DCGL_w, the survey unit will meet the release criterion. However, if the average of the measurements is above the DCGL_w, the survey unit will not meet the release criterion.

When the average is below the $DCGL_W$ and some of the measurements are above the $DCGL_W$, a Sign test and the elevated measurement comparison will be used to determine if the release criterion has been met. Sections 3.1.5.1 and 3.1.5.2 define the parameters that will be used with the methods presented in MARSSIM for determining the number of samples (direct field measurements) that will be necessary for the statistical test to be valid.

3.1.5.1 The Statistical Test

The sign test for statistical analysis does not use background radioactivity data. Therefore, the sign test will be performed on soil sample concentrations for radionuclides that are not present at significant background levels, and the WRS test will be performed on soil sample concentrations for radionuclides that are present in the background. Also, because it is expected that the variability in the data will be small relative to the $DCGL_W$, the following hypotheses have been chosen for the statistical test:

The null hypothesis, H_0 = the survey unit does not meet the release criterion.

The alternative hypothesis, H_a = the survey unit meets the release criterion.

3.1.5.2 Elevated Measurement Comparison

The decision rule for the elevated measurement comparison will be a two-stage process. In the first stage, areas will be flagged as potentially elevated at the specified investigation levels. Investigation levels will be established in consultation with EPA staff and other regulatory agencies. In the second stage, the actual average concentration over the actual extent of elevated area will be compared to the release criterion. The level at which measurements should be flagged will depend on the unit classification. For Class 1 survey units, areas will be flagged if the direct measurement or scanning measurement indicates concentrations above the $DCGL_{EMC}$. For Class 2 survey units, areas will be flagged if the direct field measurement or scanning measurement indicates concentrations above the $DCGL_W$. For Class 3 survey units, areas will be flagged if the direct measurement indicates concentrations above one-half of the $DCGL_W$ or the scanning measurement indicates concentrations above the minimum detectable concentrations.

3.1.6 Step 6: Specifying Limits on Decision Errors

3.1.6.1 Scanning and Direct Field Measurement Technique Detection Capabilities

Scanning and direct field measurements are for “information only” and not required measurements to demonstrate clean up goals have been achieved. Sampling and analysis of materials with analysis results in pCi/g are the primary measurements. These primary measurements will be used to demonstrate that clean up goals have been achieved and that a survey area or unit is suitable for release for unrestricted use in accordance with current regulations and regulatory guidance. Therefore, the

primary measurements are the only measurements that will be compared to DCGLs relating to release criteria.

Contact gamma and gamma exposure rate measurements at 1 meter above the surface will be performed for informational purposes. Measurement results (cpm) will be compared to background cpm values for evaluation purposes. To evaluate the exposure rate measurements, the mean of results of background study for surface soil are to be used as background reference. Measurement results will be compared to background ± 3 sigma of the data set to evaluate if the result is statistically different from natural background. It is not possible for instrument scan MDCs to be less than the $DCGL_{EMC}$ when extremely low 10^{-6} risk-based DCGLs are used. Therefore the parametric background comparison method described above is not intended to be based on MARSSIM protocols.

The gamma surface scan is to help identify any areas of residual contamination in the soil. Any area where a noticeable increase in the count rate is detected will be flagged for further investigation and or sampling.

3.1.6.2 Type I and Type II Errors

A Type I error is made when the null hypothesis, H_0 , is rejected when it is true (i.e. a false negative error). A Type II error is made when the null hypothesis is not rejected when it is false (i.e. a false positive error). The error rates are expressed as the probability that a survey unit passes when it should fail (α for this scenario) or fails when it should pass (β for this scenario). Because the measurement variability is expected to be small at the DCGL, the α for this project has initially been chosen to be 0.05, or 5 percent, probability. The β for this project initially has been chosen to be 0.05, or 5 percent, probability.

3.1.6.3 The Gray Region

A Lower Boundary of the Gray Region (LBGR) also will need to be selected to apply the statistical test. The LBGR is the concentration level below which further remediation is not reasonably achievable. The statistical test uses the LBGR to define the level that above which false positive rates greater than that specified by the limits on decision errors are accepted. The LBGR is limited by the variability exhibited by the measurements and the decision errors chosen. It is estimated that an LBGR equal to one-half of the $DCGL_W$ can be achieved for the SETF decommissioning project. The concentration range between the LBGR and the DCGL defines the gray region of residual radioactivity concentrations in which the consequences of decision errors are relatively minor.

3.1.7 Step 7: Optimizing the Design

The DQO process is neither static nor sequential. New information will be gathered during remediation that will be incorporated into the planning process. The final status

survey will be optimized by examining all of the factors that affect the decision errors and sample sizes. This may include further evaluating the $DCGL_W$, the $DCGL_{EMC}$, and the measurement standard deviation. The estimate of the measurement standard deviation will include both the uncertainty in the measurement process and any anticipated spatial and temporal concentration variations.

3.2 Documentation of the Final Status Survey

The final status survey plan will be documented in a report that summarizes SETF operations, site characterization data, remediation activities, all elements of the DQO process and the results of the FSS survey. The description of SETF operations, site characteristics, and remediation will provide perspective and allow the report to function as a stand-alone document. The report will include a description of QA and QC procedures for all elements of the process. The primary focus of the report will be describing the decision process followed to evaluate each survey unit. Detail will be sufficient to recreate the decision in the future.

3.3 Derived Concentration Guideline Levels (DCGLs)

The values listed in Table 3-2 are aggregate soil DCGLs to be used during the final survey status survey (FSS) of the SETF soil areas once the structure has been removed. The decontamination goal after demolition is to achieve an average site risk level of 1×10^{-6} or ALARA using the multi-isotope, sum-of-fractions rule. The 1×10^{-6} cancer incidence risk levels will serve as soil DCGLs for the FSS.

Table 3-2. Soil DCGL Goals for Final Status Survey¹

Radionuclide	10 ⁻⁶ Risk Factor	
	Goal ¹ (pCi/g)	MDC* (pCi/g)
Am-241	1.87	0.94
Co-60	0.04	0.03
Cs-134	0.16	0.08
Cs-137	0.06	0.04
Eu-152*	0.04	0.04
Eu-154*	0.05	0.05
Mn-54	0.69	0.35
K-40*	0.11	0.10
Na-22	0.09	0.04
H-3*	2.28	2.28
Fe-55	2690	1345
Ni-63	94.8	47
Pu-238	2.97	1.49
Pu-239/240	2.59	1.30
Pu-241	406	203
Sr-90	0.23	0.12
Th-228	20.2	10.1
Th-232	3.1	1.6
U-234	4.0	2.0
U-235	0.20	0.10
U-238	0.74	0.37

Note 1, DCGLs are from EPA cancer incidence risk levels based on residential soil exposure scenario, in pCi/gram.

*Estimated achievable MDC.

4. SURVEY DESIGN AND IMPLEMENTATION

4.1 Introduction

The purpose of this survey is to provide sufficient, accurate data to confirm radiological conditions of the SETF environmental soil areas met the criteria for unrestricted release of the SETF.

The project team will perform surveys according to AREVA procedures, survey package instructions (field sampling plans), and this Final Status Survey Plan. The procedures identify survey instrument requirements, measurement and sample collection, and data reduction and evaluation methods, while the survey package identifies specific instructions to implement the survey protocols contained in this FSS. Implementation of this FSS will include the following:

- A walk-down of the site to assist in the survey design. Survey units and classifications have been established, and measurement frequency and type determined for each survey unit.
- A sufficient number of measurements shall be taken to conclusively demonstrate that the DQOs have been met.
- Survey packages (or field sampling plans) tracking mechanisms will be developed for each of the survey units. These survey packages will provide the survey team with specific sampling and measurement instructions.
- The project team will perform survey measurements and collect samples for laboratory analysis as defined in the survey package. Measurements will be performed using appropriate calibrated instruments and daily instrument quality control (QC) checks will be performed before and after each day's work.
- The project team will mark or map the survey locations as applicable.
- Survey data collected during the project will be downloaded from the survey instrument to a secure data management system for storage, analysis, and reporting.
- Supervisory personnel will review the completed survey packages to ensure that all required surveys have been performed and that the completed survey packages contain all necessary information.

The facility shall be broken down into survey areas and survey units during design of the FSS. A survey area is a general term referring to any portion or all the facility. For example a survey area could be the entire facility or two or more specified areas within the facility. Survey units are generally a subset of a survey area and include areas with similar characteristics and contamination potential. Survey units are typically limited in size to ensure each area is assigned an adequate number of data points. The suggested maximum surface areas for survey units are:

- For Impacted Class 1 Areas - 2000 m² for land areas

- For Impacted Class 2 Areas - 2000 – 10,000 m² for land areas
- For Impacted Class 3 Areas – MARRISM does not suggest a limit for land areas

These size restrictions are guidelines. However, significant deviations from these guidelines must receive prior approval from the FSS Manager. If additional measurements are collected, larger areas may be used. For example, if an area is classified as Impacted Class 1 and has 4000 m² of surface area, then the number of measurements calculated would be multiplied by 2 to account for the increased surface area. In addition, no survey unit will be less than 100 m² in order to achieve an acceptable sample population. The Final Status Survey Engineer shall be responsible for dividing the facility into appropriate survey areas and survey units in accordance with this FSS plan.

4.2 Survey Requirements

As previously discussed, a survey unit is a discrete area consisting of surfaces with the same potential for contamination, similar physical boundaries and/or dimensions for which a separate decision will be made as to whether or not the area meets the criteria for release for unrestricted use. The survey units to be surveyed as part of this final status survey will be classified as a Class 3, Class 2, or a Class 1 survey unit based on the following:

- Class 1 Areas: Areas that have, or had prior to remediation, a potential for radioactive contamination (based on operating history) or known contamination (based on previous surveys) above the DCGL.
- Class 2 Areas: Areas that have, or had prior to remediation, a potential for radioactive contamination, but are not expected to exceed the DCGL.
- Class 3 Areas: Any impacted area that is not expected to contain any residual radioactivity, or is expected to contain levels of residual radioactivity at a small fraction of the DCGL.

According to the MARSSIM, Section 5, for FSS of open land areas there is no size or area limit associated with Class 3 survey units, Class 2 survey units are limited to 10,000 m² and Class 1 survey units are limited to 2,000 m². For the final status surveys, the survey area size will be determined based upon the specific area and the most efficient and practical size needed to bound the lateral and vertical extent of contamination identified in the area.

For a given survey unit the MARSSIM provides direction on how to determine the minimum number of measurement or sample locations to be collected based on the nonparametric statistical test to be used to evaluate the data. Statistical tests are not needed in survey units where survey measurement results show contamination above DCGLs is present. These areas will be marked for decontamination and post-remediation survey. However, surveys conducted in areas that are shown to be suitable for release for unrestricted use will be evaluated in accordance with requirements contained in the Data Evaluation and Review section of this plan. This number is based on the desired power of

the statistical test (confidence levels), the expected variation in the sample or measurement results, the width of the gray region which impacts the probability of incorrectly failing to release a survey unit that meets the criteria for release for unrestricted use, and in some cases the sensitivity of the scans to be performed.

To determine the number of measurements needed for a survey area or unit, for final status surveys, parameters recommended in Appendix A, Section A7, Volume II of NUREG-1757 and the MARSSIM Section 5.5 will be used. The parameters to determine the number of measurements in a survey unit will be as follows:

- The null hypothesis (H_0) will be that residual radioactivity in the survey unit exceeds the release criterion.
- For the purpose of the final status survey, Type I error (α) will be set at 0.05 or 5 percent and Type II error (β) will be set at 0.05 or 5 percent.
- The lower bound of the gray region (LBGR) will be conservatively set at 50% of the DCGL, but could be adjusted later to provide a value for the relative shift between the range of 1 to 3 (Reference 6.9, Vol.2 Appendix A).
- The relative shift will be initially conservatively set to 1.3, but may be adjusted, based on actual survey unit data.

Because the survey measurements include radionuclide specific sample analysis results that will be corrected for values from the background study, the sign test will be used and the number of measurements will be taken from the MARSSIM Table 5.5. This will result in a value of “N” (prescribed number of measurements) equal to 21 for each survey area and/or unit. For added conservatism, the minimum number of measurements for each survey area/unit will be increased by 20% to account for potentially unusable data.

Alternately, the Visual Sample Plan (VSP) program may be employed to assist with survey planning and determining number of measurement locations necessary for a survey. VSP was developed by Pacific Northwest National Laboratory (PNL) and DOE to assist with survey design and two-dimensional modeling of environmental (land areas) and for structural surfaces. VSP provides planning assistance for sampling design and uses MARSSIM based mathematical and statistical algorithms to determine how many samples are needed for either environmental or structural survey units and assists with survey maps and drawings to show where samples should be taken.

For Class 3 survey units, the measurement and sample locations will be random and judgmental (biased), for Class 2 survey areas/units, the measurement and sample locations will be a combination of systematic and judgmental (biased) and for Class 1 survey areas/units, the measurement and sample locations will be systematic. In addition to the systematic measurements to be collected or performed in Class 1 survey areas/units, biased measurements may be collected at locations with potential for contamination.

For the final status surveys of open land survey areas/units within the impacted portion of the site, scanning will be as follows:

- Class 3 survey areas/units will receive judgmental scans,
- Class 2 survey areas/units will receive 10 to 100% judgmental and/or systematic scans, and
- Class 1 survey areas/units will receive 100% systematic scans.

The scans for Class 3 and Class 2 survey units will be performed in the immediate vicinity of each sample or measurement location.

4.3 Sampling/Grid Spacing

The grid spacing for the measurement and samples is estimated in two ways depending upon the shape of the grid (either triangular or rectangular grid). If a triangular grid is used, the grid spacing is estimated as follows:

$$L = \sqrt{\frac{A}{0.866N}}$$

Where A = Survey unit Area
 N = Number of measurements

If a square grid is used, the spacing is estimated as follows:

$$L = \sqrt{\frac{A}{N}}$$

4.4 Starting Location

Once the number of measurements and the grid spacing are determined, a starting point for the survey must be established for each survey unit. This will be performed by selecting a reference point for the survey unit, such as the corner of the room, and using a random number generator to provide a random number between 0 and 1, for an initial offset from the reference point in both the x and y coordinates. The random number pair will be multiplied by the calculated grid spacing, providing the offset from the reference point for the first grid location.

Upon establishing the first grid location, the calculated grid spacing will be used to establish a grid system throughout the survey unit. If the survey unit includes the floor, walls and ceiling, the grid will be extended to all surfaces from the initial point.

Once an area has been gridded, a check to ensure that the number of grid locations satisfies the calculated number of measurements that is to be performed. If not, smaller grid spacing will be used to ensure the minimum number of measurements/samples is obtained.

4.5 Survey Implementation

The implementation of this survey plan will include the following:

- Survey instrumentation will be set up and source checked to ensure proper operation.
- The Survey Supervisor will perform preliminary inspections of the areas to identify additional specific survey requirements.
- The Survey Supervisor will review for applicability the survey packages developed for the survey areas.
- The project team will establish the survey area grid by following survey protocols and map the survey locations as applicable.
- The project team will take survey measurements and analyze samples using appropriate calibrated instruments and perform daily source and background checks before and after each day's work.
- Survey measurements and sample analysis data collected during the final status survey will be downloaded from the survey and analysis instrumentation into a database for storage and processing.
- The Survey Supervisor will review the completed survey packages to ensure that all required surveys have been performed.
- The Survey Supervisor will review the survey results to identify any areas exceeding the specified final status criteria.

4.6 Instrumentation and Selection

Selection and use of survey instrumentation will ensure sensitivities are sufficient to detect the radionuclides of concern at or below minimum detection requirements.

The final status survey team will use Data Logger instrumentation such as a Ludlum Model 2350 or equivalent instrument with a 2-inch x 2-inch detector for exposure and gamma scans. The Data Logger is a portable microprocessor computer based counting instrument capable of operation with NaI(Tl) gamma scintillation, gas-flow proportional, GM and ZnS scintillation detectors.

Isotopic quantification and identification will be performed on soil samples by AREVA Environmental Laboratory (AREVA E-Lab). The AREVA E-Lab will analyze these samples using High Purity Germanium (HPGe) based gamma spectroscopy system to quantify gamma-emitting radionuclides.

Table 4-6. Survey Instrumentation

Instrument/ Detector	Detector Type	Radiation Detected	Calibration Source	Use
Ludlum Model 2350 with. 44-10 detector or equal	NaI (Tl) Scintillator	Gamma	¹³⁷ Cs (γ)	Gamma exposure rate and gamma scans.
HPGe Gamma Spectrometer System	HPGe	Gamma energy and intensity	Mixed gamma	Nuclide identification and quantification of media samples.

4.7 Instrument Calibration

The data loggers, associated detectors and all other portable instrumentation will be calibrated on an annual basis using National Institute of Standards and Technology (NIST) traceable sources and calibration equipment. Calibration typically includes:

- High Voltage calibration,
- Discriminator/threshold calibration,
- Window calibration,
- Alarm operation verification, and
- Scaler calibration verification

The detector calibration includes:

- Operating voltage determination,
- Calibration constant determination, and
- Dead time correction determination

Calibration labels showing the instrument identification number, calibration date and calibration due date will be attached to all portable field instruments.

The gamma spectroscopy system will be calibrated in accordance with AREVA E-Lab Quality Assurance Program using NIST traceable sources. Quality control documentation for the gamma spectroscopy system and all portable or semi-portable instrumentation is maintained at the SETF project location.

4.8 Sources

All sources used for calibration or efficiency determinations for the survey will be representative of the instrument's response to the identified radionuclides and are traceable to NIST. The sources that will be used during the surveys will include ^{99}Tc , ^{230}Th , ^{137}Cs and mixed gamma sources.

Radiation Protection Technicians will control the radioactive sources used for instrument response checks and efficiency determination in accordance with approved procedures for possessing and using check sources at the SETF site. Sources will be stored securely and signed out when needed in the field. A source sign-out log will track the location of all sources when they are removed from the source storage area

4.9 Survey Protocols/Requirements

The survey of the facility grounds will consist of gamma scans and soil sampling for gamma spectroscopy analysis. Surveys will be performed as follows:

Gamma Surface Scans

Gamma scans will be performed as instructed in each survey package in all outdoor soil areas of the SETF, above the surfaces of soils. The scan areas will be, as specified in the survey package for Class 1 survey units, 10% to 100% for Class 2 survey units, and as needed or judgmental for Class 3 survey units. A 2-inch x 2-inch NaI (Tl) gamma scintillation detector will be used with a data logger such as the Ludlum Model 2350 to help identify any areas of residual contamination in the soil. When scanning, the detector will be moved in a serpentine manner in close proximity with the surface while listening to the audible output of the instrument. The digital display readout will also be observed for any elevated counts detected. Any areas where a noticeable increase in the count rate is determined will be flagged for further investigation and/or sampling.

Exposure Rate Measurements (Static)

A 2-inch x 2-inch NaI (Tl) gamma scintillation detector will be used with the data logger such as the Ludlum Model 2350 to help identify any areas of residual contamination in the soil. The exposure rate measurements will be performed at survey measurement location on the grounds with the detector 1 meter above the surface and no closer to 1 meter proximity with any other surface. The exposure rate measurement count time will be integrated for 15 to 60 seconds as required by survey package instructions.

It is important to note that these exposure rate measurements are not required measurements to demonstrate clean up goals have been achieved. Sampling and analysis of materials with analysis results in pCi/g are the primary measurements. These primary measurements will be used to demonstrate that clean up goals have been achieved and that a survey area or unit is suitable for release for unrestricted use in accordance with current

regulations and regulatory guidance. Therefore, the primary measurements are the only measurements that will be compared to DCGLs relating to release criteria. Exposure rate measurements will be collected for “information only”

Material Sampling

Material (soil) samples will be collected as instructed in each survey package. An adequate amount of material will be collected at each location to allow for split sample analysis on 5% of the samples collected. Approximately one to two liters of material will be collected, dried, homogenized and sieved to minus 1/4-inch mesh to remove debris from the sample. The samples will be analyzed offsite by AREVA E-Lab. All samples will be analyzed for isotopes identified in Table 3.2. All samples shipped offsite for analysis will be accompanied with a Chain of Custody Form. Depth profiles may be performed and samples collected at depth intervals (i.e., vertical depths) specified in the instructions for each survey package. This operation (if required) will use a 3- to 4-inch diameter stainless steel auger or with motorized sampling equipment such as a Geoprobe or equivalent with a split spoon sampler.

4.10 Minimum Detectable Concentration

Minimum Detectable Concentration (MDC) is defined as the smallest amount or concentration of radioactive material that will yield a net positive count with a 5% probability of falsely interpreting background as contamination, and a 5% chance of falsely interpreting contamination as background.

The scan MDC for soil will be calculated according to the guidance provided in the MARSSIM Section 6.7.2.1, as follows:

$$ScanMDC = \frac{MDCR}{\sqrt{pE_iE_s} \left(\frac{A}{100} \right)}$$

Where:

$MDCR$ = Minimum detectable count rate

E_i = instrument efficiency

E_s = surface efficiency

p = surveyor efficiency

A = Detector Area (cm²)

The MDC for the gamma spectral analysis of soil will be based on sample count times sufficient to detect less than the DCGLs for the radionuclides of concern and other potential radionuclides or for best sensitivity achievable. The gamma spectroscopy system will be operated such that for Co-60, Eu-152 and Cs-137, a MDC of less than 0.03, 0.04 and 0.04 pCi/g respectively will be maintained. The calculation of the MDC for the

gamma spectroscopy system is a function of the analysis software. The daily verification that required MDC radionuclides of concern will be maintained and will be provided in conjunction with daily system background checks.

The MDC for radionuclides that can not be quantified via gamma spectrometry analysis will be based on count times sufficient to detect approximately 50% of the DCGL or best sensitivity achievable.

4.11 Survey Records

The project team will maintain records of surveys in the survey packages for each area according to project procedures. The survey package will include the following records depending upon the survey design and protocols:

- 1) Survey Package Worksheet giving the package identification, survey location information, general survey instructions and any specific survey instructions
- 2) Survey Unit Diagram or drawing of the area to be surveyed as available
- 3) Photographs of the survey area, as necessary, to show special or unique conditions
- 4) Completed Chain of Custody Form for all samples shipped offsite
- 5) Printout of laboratory isotopic analysis results, and in appropriate units, i.e., pCi/gram
- 6) Data logger (Ludlum Model 2350) data files with measurement results converted to appropriate units (i.e., dpm/100 cm²) for all direct surface contamination measurements

The SETF final status survey team will use instrument vendor provided computer programs to download the contents and survey data from the data logger memory and from analytical instrument computers to SDMS measurement specific databases. Survey reports that present all raw data, converted data, and information by survey location will then be generated. The survey technician and supervisor will review these reports for completeness, accuracy, and suspect entries.

Any changes to the database tables such as detector efficiency and background, that could affect survey results, will require approval by the final status survey supervisor. In addition, changes to data in the primary table will require a written explanation on a change request. The change request will be attached to the survey report and maintained as a permanent record.

Data and document control will include the maintenance of the raw data files, translated data files and documentation of all corrections made to the data. The databases will be backed up on a daily basis.

4.12 Final Status Survey Package Instructions

Final status survey package instructions will be developed according to the guidance provided in the MARSSIM regarding field sampling plans for radiological surveys. The survey package instructions will describe the number, type, and location of direct measurements and samples with the analyses to be performed. Specific survey package instructions will be developed for each area to be surveyed in accordance with this final status survey plan for environmental areas

4.12.1 Environmental Areas

Specific survey package instructions will be developed to provide guidance to final status survey personnel with regard to performance of measurements and collection of samples for environmental survey areas and/or units. Once the survey area or unit has been prepared for surveying, grid reference system installed and/or SMLs marked, survey personnel will begin the final status survey by performing gamma scans of soil areas as directed by survey package instructions. The scans are necessary to reacquire elevated areas identified in the previous characterization report and will aid in delineating radiologically contaminated areas from clean areas. The surface soil radiation measurements that follow will be performed at locations indicated in survey package instructions:

- Gamma scans at 15 cm above the surface for soil areas and as directed for surfaces,
- Exposure rate measurements at 1 meter above sample locations of soil surfaces, and
- Surface soil samples (0-15 cm depth) for radionuclide analysis.

The gamma scans will be followed by exposure rate measurements at 1 meter above the surface and surface soil samples (0-15 cm depth) for gamma spectrometry analysis. Once, the surface soil radioactivity measurements have been completed, if contamination is detected at levels greater than the soil DCGL, the depth of contamination will be investigated.

4.13 Data Evaluation and Review

The soil sample analysis results will be corrected with values from the background study and then compared against the soil DCGL values. If multiple radionuclides attributable to operational activities are identified in the soil, the sum of the fraction rule will apply. Individual survey results exceeding 50% of the DCGL criteria will be identified and evaluated. Survey results that approach or exceed the DCGL will be considered cause for additional investigation or decontamination and/or remediation actions.

At the completion of the surveys conducted in each survey area or survey unit of the site, measurement results will be obtained and evaluated according to the final status survey DQOs. The guidance provided in the MARSSIM of survey, measure, analyze data and data evaluation according to the survey DQOs will be repeated during the final status

survey. Once all DQOs have been achieved, the final status survey of the area/unit will be considered complete.

5. QUALITY ASSURANCE AND QUALITY CONTROL

AREVA's Quality Assurance/Quality Control (QA/QC) Programs ensure that all quality and regulatory requirements are satisfied. All activities affecting quality are controlled by procedures and the *Quality Assurance Project Plan for SETF Surveys*, Rev 0, March 2007, AREVA (QAPP). These documents include the following Quality Control measures as an integral part of the survey process.

5.1 General Provisions

5.1.1 Selection of Personnel

Project management and supervisory personnel are required to have extensive experience with AREVA procedures and the QA/QC plan and be familiar with the requirements of this Survey and Sampling Plan. Management must have prior experience with the radionuclide(s) of concern and a working knowledge of the instruments used to detect the radionuclides onsite.

AREVA will select supervisory personnel to direct the survey based upon their experience and familiarity with the survey procedures and processes. Likewise, Health Physics technicians who will perform the surveys will be selected based upon their qualifications and experience.

5.1.2 Written Procedures

All survey tasks that are essential to survey data quality will be controlled by standard operating procedures (SOPs) and this plan. A list of plans and procedures is provided in the QAPP.

5.1.3 Instrumentation Selection, Calibration, and Operation

AREVA has selected instruments proven to reliably detect the radionuclides present at the SETF facility. Instruments will be calibrated by AREVA qualified vendors under approved procedures using calibration sources traceable to the NIST. All detectors are subject to daily response checks when in use.

Procedures for calibration, maintenance, accountability, operation, and quality control of radiation detection instruments implement the guidelines established in American National Standard Institute (ANSI) standard ANSI N323-1978 and ANSI N42.17A-1989.

5.1.4 Survey Documentation

The survey packages will be the primary method of controlling and tracking the hard copy records of survey results. Records of surveys will be documented and maintained in the survey package for each area (or survey unit) according to AREVA procedures. Each survey measurement will be identified by the date, technician, instrument type and serial number, detector type and serial number, location code, type of measurement, mode of instrument operation, and Quality Control (QC) sample number, as applicable.

5.1.5 Chain of Custody

Procedures establish responsibility for the custody of samples from the time of collection until results are obtained. All samples shipped offsite for analysis will be accompanied by a chain-of-custody record to track each sample.

5.1.6 Independent Review of Survey Results

The survey package and survey data from each area will receive an independent review to verify all documentation is complete and accurate.

5.2 Training

All project personnel will receive site-specific training to identify the specific hazards present in the work and survey areas. Training will also include a briefing and review of this Plan, AREVA procedures, the QAPP and the Site Health and Safety Plan (HASP). Copies of all training records will be maintained onsite through the duration of onsite activities.

During site orientation and training, survey personnel will become familiar with site emergency procedures. In the event of an emergency, personnel will act in accordance with all applicable site emergency procedures and the HASP.

In order to meet the MARSSIM objective for variance and precision, the survey team will perform quality assurance checks on 5% of all sample analyses. The QC samples will include split samples and/or duplicate or replicate samples of each type of sampled material (e.g., soil, concrete) obtained and analyzed. Split samples will be analyzed if an ample amount of material is collected in a sample. The sample will be homogenized and split into two separate samples for analysis. Duplicate or replicate samples are obtained by using the same sampling procedure at a point directly adjacent to the original sample location. The location of the samples to be duplicated shall be chosen such that an adequate number of samples will be collected to achieve requirements. Each duplicate sample shall undergo the same analyses as the initial sample.

Bias in the sample analysis process will be determined quantitatively by the analysis of blank samples, matrix spike sample and/or laboratory control sample (LCS) spiked by the analytical laboratory. In order to meet the MARSSIM objective for variance in bias, the

AREVA Environmental Laboratory will perform quality assurance checks on 5% of all sample analyses performed for each type of sample and analytical analysis performed. The AREVA E-Lab QA/QC program will be in effect for the analysis of samples.

6. REFERENCES

- 6.1 DOE Order 5400.5, Radiation Protection of the Public and the Environment
- 6.2 Policy on Decommissioning of Department of Energy Facilities Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), May 22, 1995
- 6.3 Executive Order No. D-62-02, Cleanup and Abatement Order (CAO) No. R9-2002-330: Moratorium on Disposal of Low-Level Radioactive Wastes, Governor, State of California, issued September 29, 2002
- 6.4 N001SRR140131, Approved Sitewide Release Criteria for Remediation of Radiological Facilities at the SSFL, Boeing, 1999
- 6.5 Team Product Document No: RS-00025, Building 4024 Concrete Sampling, Boeing 12/15/04
- 6.6 Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California
- 6.7 Quality Assurance Project Plan for the SETF Survey, Rev 0, March 2007, AREVA
- 6.8 Health and Safety Plan for the SETF Decommissioning, March 2007, ARE
- 6.9 Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Revision 1, August 2000, EPA402-R-97-016 Rev1 (NUREG-1575 Rev 1)
- 6.10 Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP), Part I, July 2004, EPA402-B-04-001A (NUREG-1576)
- 6.11 NUREG-1501, Background as a Residual Radioactivity Criterion for Decommissioning, NRC, Draft Report for Comment August 1994
- 6.12 NUREG-1506, Measurement Methods for Radiological Surveys in Support of New Decommissioning Criteria, NRC, August 1995
- 6.13 NUREG-1507, Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions, NRC, Draft Report for Comment August 1995
- 6.14 NUREG-1757, Consolidated NMSS Decommissioning Guidance, Vol. 1, Decommissioning Process for Materials Licensees, Decommissioning Process for Materials Licensees, Revision 2, September 2006

- 6.15 NUREG-1757, Consolidated NMSS Decommissioning Guidance, Vol. 2, Decommissioning Process for Materials Licensees, Characterization, Survey, and Determination of Radiological Criteria, Revision 1, September 2006
- 6.16 American National Standard Institute (ANSI) Standard ANSI N323-1978, Radiation Protection Instrumentation Test and Calibration."
- 6.17 ANSI N42.17A-1989, American National Standard Performance Specifications for Health Physics Instrumentation - Portable Instrumentation for Use in Normal Environmental Conditions – Description
- 6.18 Report of Radiological Characterization and Confirmatory Survey Results for the SNAP Environmental Test Facility – Building 4024

7. ATTACHMENTS

7.1 Attachment 1, SETF Site Primary Excavation Plan

Attachment 1, SETF Site Primary Excavation Plan

