Final

Radiological Final Status Survey of Building 4006

Santa Susana Field Laboratory

Ventura County, California

Contract Number 114579

Prepared for:

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Bq/cm^2	Becquerel per square centimeter
Boeing	The Boeing Company
CABRERA	Cabrera Services, Inc.
cm	centimeter
cm/sec	centimeters per second
cm^2	square centimeters
cpm	counts per minute
Cs	Cesium (e.g., ^{137}Cs)
DoD	U.S. Department of Defense
DOE	U. S. Department of Energy
DPH	California Department of Public Health
dpm	disintegration per minute
DQO	Data Quality Objective
EDA	Exploratory Data Analysis
EPA	U. S. Environmental Protection Agency
ETEC	Energy Technology Engineering Center
f^2	square foot
FSP	Field Sampling Plan
FSS	Final Status Survey
H	Hydrogen (e.g., ^{3}H or tritium)
HSA	Historical Site Assessment
K	Potassium (e.g., ^{40}K)
keV	kilo electron Volts
Kr	Krypton (e.g., ^{85}Kr)
LSC	Liquid Scintillation Counting
m	meter
m^2	square meters
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
mCi	millicurie
MDC	Minimum Detectable Concentration
Mn	Manganese (e.g., ^{54}Mn)
ml	milliliter
mrem/yr	millirem per year
Na	Sodium (e.g., ^{22}Na)
NASA	National Aeronautics and Space Administration
NELAP	National Environmental Laboratory Accreditation Program
NIST	National Institute of Standards and Technology
NRC	U. S. Nuclear Regulatory Commission
Pb	Lead (e.g., ^{206}Pb)
pCi/g	picocurie per gram
Pu	Plutonium (e.g., ^{238}Pu)
QC	Quality Control
Ra	Radium (e.g., ^{226}Ra)
RMDF	Radioactive Materials Disposal Facility
RMHF	Radioactive Materials Handling Facility

Sr	Strontium (e.g., ^{90}Sr)
SSFL	Santa Susana Field Laboratory
Th	Thorium (e.g., ^{232}Th)
TPU	Total Propagated Uncertainty
U	Uranium (e.g., ^{238}U)
U.S.C.	United States Code
µR/hr	micro Roentgen per hour
µrem/yr	microrem per year
µSv/yr	micro sievert per year

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EXECUTIVE SUMMARY

This report presents the results of the radiological survey performed of Building 4006 at the Santa Susana Field Laboratory (SSFL) in Ventura County, California. The survey was performed in May, 2008 by Cabrera Services, Inc. (CABRERA). Radiological data were collected in accordance with the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (EPA, 2000) and the *Field Sampling Plan for the Radiological Final Status Survey of Building 4006* (FSP, Cabrera, 2008). The purpose of the survey was to verify the building meets the *Approved Sitewide Release Criteria for Remediation of Radiological Facilities at the SSFL* (Rocketdyne, 1999). These criteria for release to unrestricted use have been approved by the U.S. Department of Energy (DOE) and California Department of Public Health (CDPH).

The building was cleaned by Boeing personnel prior to performing the radiological survey. The interior of the building was divided into three Class 3 survey units; the high bay, laboratory, and office areas. The exterior of the building was divided into two additional Class 3 survey units; the roof and exterior walls. The building was divided into grids and survey data were collected from a minimum of 15 randomly selected grids in each survey unit. Survey data were also collected from targeted areas selected based on professional judgment. Targeted areas included floor drains, ventilation exits, and entry doors.

Each randomly selected or targeted grid was scanned for alpha- and beta-emitting surface residual radioactivity over 100% of accessible surfaces. A 1-minute static measurement of total alpha and total beta radioactivity was performed near the center of the grid, and then a dry smear was collected from a 100 cm^2 area at the same location as the static measurement. A wet smear was collected to evaluate the potential presence of tritium from a 100 cm^2 area adjacent to the static measurement location. A dose rate reading was taken on contact at the same location as the static measurement. If the scanning within the grid identified any location with detectable radioactivity above background (i.e., greater than 2,500 dpm/100 cm^2) a static measurement, dry smear, and dose rate measurement were performed at that location.

Measurements confirmed surface residual radioactivity to be below the levels given in the *Approved Sitewide Release Criteria for Remediation of Radiological Facilities at the SSFL* (Rocketdyne, 1999). Based on the measured surface residual radioactivity levels, Building 4006 can be released for unrestricted use.

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1.0 INTRODUCTION AND SITE BACKGROUND

This report presents the results of the radiological survey performed of Building 4006 at the Santa Susana Field Laboratory (SSFL) in Ventura County, California. The survey was performed in May, 2008 by Cabrera Services, Inc. (CABRERA). Radiological data were collected in accordance with the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (EPA, 2000) and the *Field Sampling Plan for the Radiological Final Status Survey of Building 4006* (FSP, Cabrera, 2008). The purpose of the survey was to verify the building meets the *Approved Sitewide Release Criteria for Remediation of Radiological Facilities at the SSFL* (Rocketdyne, 1999). These criteria for release to unrestricted use have been approved by the U.S. Department of Energy (DOE) and California Department of Public Health (DPH).

The Boeing Company (Boeing) contracted with CABRERA to perform the survey. Boeing operates Area IV of the SSFL for the DOE. Under the authority of the Atomic Energy Act [42 United States Code (U.S.C.) 201 et seq.], DOE is responsible for establishing a comprehensive health, safety, and environmental program for managing facilities. As an Agreement State under the Atomic Energy Act, the State of California has jurisdiction over non-DOE radiological activities at the SSFL. Data of sufficient type, quantity, and quality were needed to satisfactorily demonstrate to the California DPH, formerly the Department of Health Services, that residual radioactivity in Building 4006 demonstrates compliance with the approved release criteria for unrestricted use.

1.1 Historical Background and Radiological Overview

In the late 1940s, North American Aviation acquired land in the Simi Hills between the Simi and San Fernando Valleys. That land, now known as SSFL, was used primarily for the testing of rocket engines. Atomics International, a division of North American Aviation, was formed in 1955 and part of Area IV at SSFL was set aside and used for nuclear reactor development and testing. In 1984 Atomics International merged with Rocketdyne. Boeing purchased Rocketdyne in 1996. Area IV of the SSFL is used for DOE-sponsored activities. Boeing, the National Aeronautics and Space Administration (NASA), and the U.S. Department of Defense (DoD)have used the balance of the SSFL for rocket and laser testing.

Activities in Area IV started in the mid 1950s. Until 1964, these activities were primarily related to sodium-cooled nuclear power plant development and development of space power systems with sodium and potassium as coolants. The Energy Technology Engineering Center (ETEC, originally known as the Liquid Metal Engineering Center) was formed in the mid 1960s as an Atomic Energy Commission (now DOE) laboratory for the development of liquid metal heat transfer systems in support of the Liquid Metal Fast Breeder Reactor Program. Nuclear operations at Area IV included 10 nuclear research reactors, seven critical facilities, the Hot Laboratory, the Nuclear Materials Development Facility, and various test and nuclear material storage areas. All nuclear operations ended in 1988. Since that time DOE-funded activities have focused on decontamination and decommissioning of the ETEC facilities.

The *Historical Site Assessment of Area IV, Santa Susana Field Laboratory, Ventura County, California* (HSA, Sapere, 2005) describes the history and use of Building 4006. Building 4006 is centrally located in Area IV and was operated as a non-nuclear sodium laboratory. Its principal function was research and development for sodium systems and components. While the building was predominantly a non-radiological facility, there are records of minor uses of radioactive materials, including encapsulated cylinders of uranium oxide powder, components

activated with Manganese-54 (^{54}Mn), tritiated titanium foils in gas chromatographs, and sodium loop level gauges possibly employing Cesium-137 (^{137}Cs) sources. Several minor radiation surveys have been performed in the past related to these activities. No radioactivity was detected. In addition, soil sampling following removal of the building septic tank and leach-field did not detect any contamination. The building is not a designated or posted radiological facility. Only limited amounts of radioactivity were used in Building 4006 and results of historical radiological monitoring activities detected no contamination in Building 4006. The potential for detectable levels of residual radioactivity to be present in Building 4006 is very low. Therefore, Building 4006 is classified as a Class 3 area based on MARSSIM guidance.

Building 4006 is shown in Figure 1-1. It was constructed with a steel frame and walls and measures 1,234 square meters (m^2). The building is oriented length-wise on a northwest to southeast axis. It was closed for operations in 1999.

Figure 1-1 Building 4006

(southeast end of building; view from south corner)

(northeast side of building; view from south corner)

1.2 Release Criteria

The criteria for releasing Building 4006 for unrestricted use is found in the *Approved Sitewide Release Criteria for Remediation of Radiological Facilities at the SSFL* (Rocketdyne, 1999), specifically the surface contamination and ambient gamma exposure rate guidelines presented in Sections 4 and 5, respectively. These criteria have been approved by the DOE and California DPH.

Based on the Historical Site Assessment (HAS), the radionuclides of concern that may be present as residual radioactivity in Building 4006 are Uranium-234 (^{234}U), ^{235}U, ^{238}U, ^{137}Cs, ^{54}Mn, and Tritium. The surface residual radioactivity guidelines for these radionuclides are given in Table 1-1. The ambient gamma exposure rate guideline is 5 microRoentgen per hour (µR/hr) above natural background, measured at one meter above the surface.

Since a combination of alpha-emitting (i.e. uranium isotopes), beta/gamma-emitting (^{54}Mn and ^{137}Cs), and tritium surface residual radioactivity may be present, the sum of fractions rule was applied to demonstrate compliance with the approved release criteria. Using the sum of fractions rule, the release criterion for surface residual radioactivity is met where the sum of fractions is less than or equal to unity.

Table 1-1 Surface Residual Radioactivity Guidelines for SSFL Facilities

Radionuclide	***Type of Radiation***	***Average over 1 m^2 ($dpm/100\ cm^2$)***	***Maximum over 100 cm^2 ($dpm/100\ cm^2$)***	***Removable ($dpm/100\ cm^2$)***
uranium (^{234}U, ^{235}U, ^{238}U)	alpha	5,000	15,000	1,000
mixed fission products (^{137}Cs)	beta, gamma	5,000	15,000	1,000
activation products (^{54}Mn)	beta, gamma	5,000	15,000	1,000
tritium	beta	---	---	10,000

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2.0 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) were developed to define the purpose of the radiological survey, clarify what data should be collected to satisfy the purpose, and specify the performance requirements for the quality of information to be obtained from the data.

2.1 Step 1 – State the Problem

2.1.1 Problem Description

Building 4006 is identified in the *Historical Site Assessment* (Sapere, 2005) as radiologically impacted. Radiological data are needed to verify that the building meets the guidelines in the *Approved Release Criteria* (Rocketdyne, 1999) for release of the building for unrestricted use.

2.1.2 Planning Team Members

CABRERA is responsible for developing this work plan and providing the necessary materials, consumables, and qualified personnel, including qualified radiation survey technicians, to conduct the radiological survey. Boeing provides information on current and past activities in the form of historical radiological data.

2.1.3 Primary Decision Maker

The primary decision maker is the Boeing Project Manager.

2.1.4 Available Resources and Relevant Deadlines

Sufficient resources have been allocated for CABRERA to develop and implement this work plan. The radiological Final Status Survey (FSS) will be performed once the Field Sampling Plan (FSP) is approved. Upon completion of the radiological FSS, a report will be prepared summarizing the survey data and documenting the conclusion regarding the suitability of Building 4006 for release for unrestricted use.

2.2 Step 2 – Identify the Decision

2.2.1 Principal Study Question

The principal study question is: "Do the levels of residual radioactivity in Building 4006 meet the guidelines in the *Approved Release Criteria* (Rocketdyne, 1999)?"

2.2.2 Alternative Actions

The following alternative actions will result from resolution of the principle study question:

- If the levels of residual radioactivity meet the guidelines (see Section 1.2), then the building will be considered suitable for release for unrestricted use.
- If the levels of residual radioactivity do not meet the guidelines, then the primary decision maker or designee will be consulted to determine further action. Such action may include recommendations for remediation, additional survey data collection, and/or the calculation of incremental risk or dose.

2.2.3 Decision Statement

Based on the principal study question and the alternative actions listed above, the decision statement is: Determine whether or not the levels of residual radioactivity in Building 4006 meet the guidelines for release for unrestricted use.

2.3 Step 3 – Identify Inputs to the Decision

2.3.1 Radionuclides of Concern

The radionuclides of concern that may be present as residual surface radioactivity in Building 4006 are ^{234}U, ^{235}U, ^{238}U, ^{137}Cs, ^{54}Mn, and tritium.

2.3.2 Potentially Affected Media

The potentially affected media are the interior and exterior building surfaces, which primarily consist of the following materials: corrugated metal, structural steel, sheet metal, concrete, sheetrock, linoleum, carpet, and acoustical ceiling tile.

2.3.3 Action Levels

Action levels, shown in Table 2-1, have been established that will cause further evaluation of identified areas of elevated surface residual radioactivity.

The action level for scan measurements specified in the FSP was three standard deviations above the mean. Since the scan data were not recorded, it was not possible to calculate a mean and standard deviation. Therefore, the action level for scanning was changed to be any detectable alpha or beta radiation. The minimum detectable concentration (MDC) for scanning, or scan MDC, is determined by the background count rate. The background count rate varies for different media, so the scan MDC varies for different media.

Background measurements were performed for the different media found in Building 4006 by performing 1-minute static measurements on non-impacted materials. Table 2-1 lists the results of the background measurements on different media.

Table 2-1 Background Count Rates

Medium	***Background Count Rate (counts per minute)***
Concrete Floor	225
Tile Floor, Drywall, Ceiling Tile	140
Carpet	185
Sheet Metal, Lights, Vents	180
Porcelain Sinks	289
Tar and Gravel Roof	210

MARSSIM provides guidance on calculating scan MDCs for alpha-emitting radionuclides (MARSSIM Appendix J). The alpha scan MDC is based on the probability of detecting a single count when a known activity concentration is present. The equation for calculating the probability of detecting a single count (MARSSIM Equation J-5) is:

$$P(n \geq 1) = 1 - e^{-\frac{GEd}{60v}}$$

Where:

P(n≥1) = probability of observing one or more counts

G = source activity (1,000 dpm)

E	=	4-π detector efficiency (0.216)
d	=	width of the detector in the direction of scanning (10 cm)
v	=	scan speed (5 cm/sec)
60	=	conversion factor (sec/min)

The probability of observing at least 1 count when scanning an area larger than 100 cm^2 with an activity of 1,000 dpm/100 cm^2 is greater than 0.99, or 99%. Therefore, the scan speed of 5 cm/sec is adequate for detecting activity concentrations equal to the release criterion. The actual scan MDC for alpha-emitting radionuclides can be calculated by setting the probability of observing one or more counts to 95% and solving the equation for the source activity, G. The equation becomes:

$$0.05 = e^{-\frac{GEd}{60v}}$$

Inserting the values for E, d, and v listed above, the equation simplifies to:

$$\ln 0.05 = -0.0072 \times G$$

Solving this equation for G results in a value of 420 dpm/100 cm^2. There is a 95% probability that the surveyor will stop and investigate alpha activity greater than or equal to 420 dpm/100 cm^2 while scanning. Therefore, the scan MDC for alpha-emitting radionuclides is 420 dpm/100 cm^2.

MARSSIM also provides guidance on calculating scan MDCs for beta/gamma-emitting radionuclides (MARSSIM Section 6.7.2.1). The beta/gamma scan MDC for surfaces is based on a 2-stage scanning process described by signal detection theory. The two stages of scanning are continuous monitoring for areas where the instrument response is consistent, followed by stationary counting when the technician observes an increase in the count rate. The equation for calculating the beta-emitting radionuclide scan MDC (MARSSIM Equations 6-8, 6-9, and 6-10) is:

$$Scan\ MDC = \frac{d' \times \sqrt{b_i} \times 60/i}{\sqrt{p} \times \varepsilon_i \times \varepsilon_s \times \frac{probe\ area}{100\ cm^2}}$$

Where:

d’	=	index of sensitivity (2.32, assumes 25% false positives)
b_i	=	background during counting interval (max 289 cpm = 9.63 counts/2 sec)
i	=	observation interval (10 cm wide by 5 cm/sec = 2 sec)
p	=	surveyor efficiency (0.5 from MARSSIM)
ε_i	=	instrument efficiency (0.224)
ε_s	=	surface efficiency (0.500 from ISO 7503)
probe area	=	Ludlum Model 43-68 (126 cm^2)

Since the scan MDC is directly proportional to the square root of the background count rate, the maximum background count rate will result in the maximum scan MDC. The maximum background count rate is 289 counts per minute (cpm). The scan MDC corresponding to a background of 289 cpm is approximately 1,300 dpm/100 cm^2 (1287.7 dpm/100 cm^2) above background. Therefore, the scan MDC for beta/gamma-emitting radionuclides is adequate for detecting activity concentrations equal to the release criterion.

The action levels for static and removable measurements of alpha- and beta-emitting surface residual radioactivity are given in units of disintegrations per minute per 100 square centimeters (dpm/100 cm^2) and are based on one-half the surface residual radioactivity guidelines for average and removable residual radioactivity given in Table 1-1.

Table 2-2 Action Levels

Action Levels[a]		
Scan Measurements	***Static Measurements***	***Removable Measurements***[b]
any detectable activity	2,500 dpm/100 cm^2	500 dpm/100 cm^2

Note:
(a) Values given are distinguishable from background for both alpha and beta radiation.
(b) Does not apply to tritium measurements.

The action level for gamma exposure rate measurements is 5 μR/hr above background based on the *Approved Release Criteria* (Rocketdyne, 1999). There is no action level for tritium surface residual radioactivity since this type of radioactivity cannot be reliably measured in the field.

2.3.4 Measurement Inputs

Static measurements of alpha- and beta-emitting surface residual radioactivity, smear samples analyzed for gross alpha and beta radioactivity and tritium, and gamma exposure rate measurements will be used as quantitative inputs to the principal study question. Scan measurements of alpha- and beta-emitting surface residual radioactivity will be used as qualitative inputs to the principal study question.

2.4 Step 4 – Define the Study Boundaries

2.4.1 Define the Target Population

The target population is the surface residual radioactivity concentrations of the radionuclides of concern and ambient gamma exposure rates.

2.4.2 Spatial Boundaries of the Decision Statement

Survey data will be collected from exposed, accessible floor, wall, and ceiling surfaces in each survey unit. Biased survey data will also be collected equipment, systems, and components inside and outside the building such as roof vents, conduit, piping, ductwork, and entry doors, which are considered to have been susceptible to radioactive contamination from building activities.

2.4.3 Scale of Decision Making

Decisions will be made on two fundamental levels:

- Localized areas – a decision to collect additional data will be made for discrete areas where measurement results exceed one or more action levels.

- Survey unit – a decision will be made for each survey unit as to the suitability of the survey unit for release for unrestricted use or, alternatively, the need for remediation, additional data collection, and/or calculation of incremental risk or dose.

2.5 Step 5 – Develop a Decision Rule

The decision statement resulted in the decision rules, listed in Table 2-3, for data collection and analysis using the statistical test and retrospective power analysis. If no alternative to the action (i.e., "then" statement) given in Table 2-3 was listed, no action was required.

Table 2-3 Decision Rules

Parameter	***IF***	***THEN***
Scan Measurements	Areas where activity above background was detected during the scan survey,	Select one or more biased measurement locations in each identified area; collect: ▪ alpha and beta static measurements, and ▪ alpha/beta smear samples.
Static Measurements	Residual radioactivity exceeds 2,500 dpm/100 cm^2 alpha or beta,	Perform 100% scan coverage (if not already done) of 4 m^2 area around measurement; select four biased measurement locations; collect: ▪ alpha and beta static measurements, and ▪ alpha/beta smear samples. Step out as needed to define area; compare results to Table 1-1 values.
Smear Samples	Residual radioactivity exceeds 500 dpm/100 cm^2 alpha or beta,	
Surface Residual Radioactivity	Average, maximum, or removable levels exceed allowable values in Table 1-1,	Consult Boeing Project Manager to determine further action, if any.

2.6 Step 6 – Specify Limits on Decision Errors

False positive (Type I) and false negative (Type II) decision error rates associated with the calculation of instrument MDCs and the number of static measurements were set at 0.05 (5%). Deterministic release criteria will be applied to the data themselves (see Section 1.2).

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3.0 DATA COLLECTION

The data collected according to project DQOs and survey data collection requirements specified in the FSP are both quantitative and qualitative in nature. Both probability-based (random) and judgmental (targeted) methods were used to collect data, as described in the survey design in Section 3.0 of the FSP (CABRERA, 2008). The data were reviewed, verified, and validated during and after collection. Data were quantitatively analyzed for direct comparison to action levels and qualitatively reviewed to determine further investigation during the project.

3.1 Survey Units

Building 4006 was divided into 5 Class 3 survey units. Each of the survey units and the data collection activities in that survey unit are described in the following sections.

3.1.1 High Bay

The high bay occupies the southwest half of Building 4006. The high bay consists of a single large room. The interior of the high bay in Building 4006 was identified as a single Class 3 survey unit. The floor area of the high bay is approximately 710 m^2. The high bay was divided into 100 square foot (ft^2) grids. Grids were either 10-feet by 10-feet or 5-feet by 20-feet along the northeast wall. Figure 3-1 shows the grids defined for the high bay.

Fifteen grids were randomly selected on the floor (A-10, 15, 23, 24, 28, 32, 40, 41, 47, 50, 52, 54, 60, 66, and 70), 4 grids were randomly selected on the walls (B-10, D-4, E-29, and E-43), and 1 grid was randomly selected on the ceiling (F-42). The random grids are identified on Figure 3-1. One hundred percent of the accessible surfaces in each randomly selected grid were surveyed for alpha and beta radiation. Static measurements, dry smears, wet smears, and dose rate measurements were performed in the center of each randomly selected grid. Targeted measurements were collected in 3 of the randomly selected grids based on professional judgment. Grid A-15 included a sink where a static measurement and dry smear were collected, grid E-29 included an air duct where a static measurement and dry smear were collected, and grid F-42 (ceiling) included a light where a static measurement and dry smear were collected.

Five grids on the floor included penetrations that were identified for targeted measurements (A-19, 20, 39, 55, and 68). Six grids on the walls included air ducts and vents that were identified for targeted measurements (C-20, 26, E-18, 23, 27, and 31). The targeted grids are identified on Figure 3-1. A static measurement, dry smear, and dose rate reading on contact were collected from each targeted location.

A total of 39 static measurements, 39 dry smears, 39 dose rate measurements, and 20 wet smears were collected inside the high bay.

3.1.2 Laboratory Area

The laboratory area occupies the northeast corner of Building 4006. The laboratory area consists of 2 large rooms and a central hallway. The floor area of the laboratory is approximately 310 m^2. The laboratory area was identified as a single Class 3 survey unit. The laboratory area was divided into 100 ft^2 grids. Grids were either 10-feet by 10-feet or 5-feet by 20-feet along the northeast wall. Figure 3-2 shows the grids defined for the laboratory area.

Ten grids were randomly selected on the floor (N-4, 7, 10, 13, 15, 16, 18, 19, 20, and 21). Four grids were randomly selected on the walls (P-2, P-3, R-2, and R-4). One grid was randomly selected on the ceiling (S-4). The random grids are identified on Figure 3-2. One hundred

percent of the accessible surfaces in each randomly selected grid were surveyed for alpha and beta radiation. Static measurements, dry smears, wet smears, and dose rate measurements were performed in the center of each randomly selected grid. Targeted measurements were collected in 1 of the randomly selected grids based on scanning survey results. Grid N-18 identified a location with beta radiation potentially exceeding background where a static measurement and dry smear were collected.

One grid on the floor included a floor drain identified as a targeted location (N-6). Three grids on the ceiling included lights that were investigated as targeted locations (S-3, S-7, and S-15). Three grids on the ceiling included air ducts or vents that were investigated as targeted locations (S-5, S-9, and S-10). The targeted grids are identified on Figure 3-2. A static measurement, dry smear, and dose rate reading on contact were collected from each targeted location.

A total of 23 static measurements, 23 dry smears, 23 dose rate measurements, and 15 wet smears were collected inside the laboratory area.

3.1.3 Office Area

The office area occupies the southeast quarter of Building 4006. The office area includes a large room divided into cubicles, 2 smaller offices, 2 bathrooms, and a utility closet. The office area has a floor area of approximately 210 m^2. The office area was identified as a single Class 3 survey unit. The office area was divided into 100 ft^2 grids. Grids were either 10-feet by 10-feet or 5-feet by 20-feet along the northeast wall. Figure 3-3 shows the grids defined for the office area.

Ten grids were randomly selected on the floor (H-1, 2, 10, 12, 16, 25, 32, 33, 34, and 35). Four grids were randomly selected on the walls (J-6, J-7, K-1, and L-1). One grid was randomly selected on the ceiling (M-28). The random grids are identified on Figure 3-3. One hundred percent of the accessible surfaces in each randomly selected grid were surveyed for alpha and beta radiation. Static measurements, dry smears, wet smears, and dose rate measurements were performed in the center of each randomly selected grid.

Two grids on the floor included floor drains identified as targeted locations (H-19 and H-20). Two grids on the wall included sinks identified as targeted locations (J-9 and J-10) Two grids on the ceiling included lights that were investigated as targeted locations (M-12 and M-15). Two grids on the ceiling included air ducts or vents that were investigated as targeted locations (M-4 and M-7). The targeted grids are identified on Figure 3-3. A static measurement, dry smear, and dose rate reading on contact were collected from each targeted location.

A total of 30 static measurements, 30 dry smears, 30 dose rate measurements, and 15 wet smears were collected inside the office area.

3.1.4 Roof

The roof included the two-story high bay roof (area G), the single story roof for the laboratory and office areas (area T), and a small overhang on the south side of Building 4006 (area U). The roof was identified as a single Class 3 survey area. The roof area was approximately 1,300 m^2. The roof was divided into 100 ft^2 grids. Grids were either 10-feet by 10-feet or 5-feet by 20-feet along the northeast wall and correspond to the same grid numbers on the corresponding floor areas. Figures 3-1, 3-2, and 3-3 show the grids defined for the roof.

Thirteen grids were randomly selected to investigate the roof (G-18, 24, 31, 49, 57, 63, T-35, 37, 41, U-1, 2, 3 and 4). The random grids are identified on Figures 3-1, 3-2, and 3-3. One hundred percent of the accessible surfaces in each randomly selected grid were surveyed for alpha and beta radiation. Static measurements, dry smears, and dose rate measurements were performed in the center of each randomly selected grid. Wet smears were not performed because weathering outdoors would remove any traces of tritium from building surfaces.

Sixteen grids on the roof were identified as targeted locations because of the presence of air vents, air conditioning ducts, or fume hoods (G-36, 38, 40, 42, 44, 46, T-5, 8, 15, 16, 18, 20, 23, 27, 30, and 48). Measurements were performed both inside and outside the items located in each of these grids. The targeted grids are identified on Figures 3-1, 3-2, and 3-3. Static measurements, dry smears, and dose rate measurements were performed in the center of each targeted grid.

A total of 48 static measurements, 48 dry smears, and 48 dose rate measurements were collected on the roof.

3.1.5 Exterior Walls

The exterior walls of Building 4006 were identified as a single Class 3 survey unit. The area of the exterior walls is approximately 800 m^2. The exterior walls were divided into 100 ft^2 grids. Grids were either 10-feet by 10-feet or 5-feet by 30-feet at the ends of the high bay. Figure 3-4 shows the grids defined for the exterior walls.

Eight grids were randomly selected to investigate the exterior walls (V-9, V-11, W-37, W-44, X-10, X-12, Y-20, and Y-28). The random grids are identified in Figure 3-4. One hundred percent of the accessible surfaces in each randomly selected grid were surveyed for alpha and beta radiation. Static measurements, dry smears, and dose rate measurements were performed in the center of each randomly selected grid. Wet smears were not performed because weathering outdoors would remove any traces of tritium from building surfaces. Targeted measurements were collected in 2 of the randomly selected grids based on professional judgment. Grid W-44 included an air intake vent where static measurements and dry smears were collected inside and outside the unit. Grid X-12 included a heater room and a compressor room where static measurements and dry smears were collected on metal equipment and the concrete floors of the rooms.

One grid was identified as a targeted location because it included an air intake vent. The area surrounding the vent was scanned and static measurements and dry smears were collected both inside and outside the unit. Four grids were identified as targeted locations because they included doors into the building (V-10, V-12, W-42, and Y-14). The doors were scanned and direct measurements and dry smears were collected on the door handles. The targeted grids are identified in Figure 3-4.

A total of 20 static measurements, 20 dry smears, and 20 dose rate measurements were collected on the exterior walls.

3.2 Survey and Sampling

Survey and sampling were performed in accordance with the FSP. Quality control measures implemented as part of the data collection process are discussed in Section 5.0.

3.2.1 Exposure Rate Measurements

Exposure rate measurements were performed using a Bicron MicroRem® tissue-equivalent scintillation detector. The measurements were taken using the "slow" response time constant setting. The detector was positioned in contact with the surface being measured and allowed to stabilize prior to recording the measurement (approximately 30 seconds). Dose rate readings ranged from 10 to 14 μR/hr with an average of 11 μR/hr. None of the results exceeded the release criterion of 5 μR/hr above the background dose rate of 11 μR/hr. The individual dose rate readings are listed in Appendix A. The raw data sheets are provided in Appendix B.

3.2.2 Scan Measurements

Scan measurements were performed to locate radiation anomalies that might indicate areas with elevated residual radioactivity where further data collection was warranted. Scan measurements were performed using a Ludlum Model 43-68 126 cm^2 gas proportional detector with a Ludlum Model 2360 alpha/beta data logger. The scan coverage was 100% of accessible building surfaces in grids where measurements were performed. Only one of the scan surveys identified a potential for beta radiation greater than background in grid N-18 on the floor of the laboratory area. The static measurement and dry smear collected at this location did not identify any alpha or beta activity concentrations significantly above background. The raw data sheets documenting the scan survey results for individual grids are provided in Appendix B.

3.2.3 Static Measurements

Static measurements were performed using a Ludlum Model 43-68 126 cm^2 gas proportional detector with a Ludlum Model 2360 alpha/beta data logger. Static measurements were performed by placing the detector on the surface to be measured, taking one-minute alpha and beta scaler counts, and recording the readings. Static measurement data are summarized in Table 3-1.

Table 3-1 Summary of Static Measurement Results

Survey Unit	*Average (dpm/100 cm^2)*	*Standard Deviation (dpm/100 cm^2)*	*Median (dpm/100 cm^2)*	*Minimum (dpm/100 cm^2)*	*Maximum (dpm/100 cm^2)*	*Number of Measurements*
High Bay Alpha	17	25	15	-15	88	39
High Bay Beta	203	42	202	138	314	39
Laboratory Alpha	5.1	34	0.0	-15	147	23
Laboratory Beta	82	306	28	-305	1176	23
Office Alpha	23	42	15	-15	162	30
Office Beta	163	284	99	-432	843	30
Roof Alpha	169	154	96	0.0	529	48
Roof Beta	295	331	305	-376	1148	48
Exterior Alpha	59	61	29	0.0	206	20
Exterior Beta	316	312	255	-128	1190	20

Static measurements were collected at 20 or more measurement locations in each survey unit. A random pattern was used to select initial measurement locations. Additional targeted locations were selected based on results of the scanning survey (grid N-18 only) or based on professional judgment. All floor drains, sinks, and air vents were identified as targeted locations. Hand drawn maps were used to document measurement locations. Gross counts were converted to net dpm/100 cm^2 by subtracting the daily instrument background response check value and dividing the difference by the total efficiency (see Section 5.2). None of the static measurement results exceeded the project action level of 2,500 dpm/100 cm^2. None of the static measurement results exceeded the release criterion of 5,000 dpm/100 cm^2 average or 15,000 dpm/100 cm^2 maximum. The individual static measurement readings are listed in Appendix A. The raw data sheets are provided in Appendix B.

3.2.4 Smear Samples – Alpha/Beta

Alpha/beta smear samples were collected from building surfaces using dry smears over an area of approximately 100 cm^2 each. A dry smear sample was collected at each static measurement location and analyzed onsite for removable alpha and beta radioactivity using a Ludlum Model 43-10-1 dual phosphor Zincsulfide (silver activated) alpha/beta scintillation detector with a Ludlum Model 2929 alpha/beta scaler using a one-minute count time. The alpha/beta smear sample results are summarized in Table 3-2. Gross counts were converted to net dpm/100 cm^2 by subtracting the daily instrument background response check value and dividing the difference by the total efficiency (see Section 5.2).

Table 3-2 Summary of Alpha/Beta Smear Sample Data

Survey Unit	*Average (dpm/100 cm²)*	*Standard Deviation (dpm/100 cm²)*	*Median (dpm/100 cm²)*	*Minimum (dpm/100 cm²)*	*Maximum (dpm/100 cm²)*	*Number of Measurements*
High Bay Alpha	0.14	1.5	-0.57	-0.85	5.1	39
High Bay Beta	-25	43	-19	-150	41	39
Laboratory Alpha	0.56	1.9	-0.57	-0.85	5.1	23
Laboratory Beta	-38	42	-42	-133	32	23
Office Alpha	0.23	1.8	-0.85	-0.85	5.4	30
Office Beta	-14	38	-6.8	-91	74	30
Roof Alpha	1.4	2.4	0.85	-0.85	8.0	48
Roof Beta	-14	43	-11	-110	75	48
Exterior Alpha	0.48	1.7	-0.57	-0.85	4.8	20
Exterior Beta	-4.4	46	-2.3	-73	109	20

None of the alpha/beta smear results exceeded the project action level of 500 dpm/100 cm^2. None of the alpha/beta smear results exceeded the release criterion of 1,000 dpm/100 cm^2. The individual dry smear results are listed in Appendix A. The raw data sheets are provided in Appendix B.

3.2.5 Smear Samples – Tritium

Tritium smear samples were collected over approximately 100 cm^2 using a moistened paper smear. The smears were placed in 20 milliliters (ml) liquid scintillation counter vials provided by the offsite laboratory containing 5 ml of de-ionized water. The wet smears were sent to an analytical laboratory and analyzed for gross beta activity by liquid scintillation counting (LSC). The region of interest for beta particle energies was set for low-energy beta particles between 0 and 19 kiloelectron volts (keV) and calibrated using tritium as a beta particle source. The tritium smear sample results are summarized in Table 3-3. Gross counts were converted to dpm by dividing by the tritium efficiency. The laboratory results are reported in units of dpm. Since each wet smear was collected over an area of 100 cm^2, the tritium smear results are reported in units of dpm/100 cm^2. No tritium smears were collected on exterior building surfaces.

Table 3-3 Summary of Tritium Smear Sample Data

Survey Unit	*Average (dpm/100 cm²)*	*Standard Deviation (dpm/100 cm²)*	*Median (dpm/100 cm²)*	*Minimum (dpm/100 cm²)*	*Maximum (dpm/100 cm²)*	*Number of Measurements*
High Bay	0.61	2.4	0.0	-1.2	11	20
Laboratory	2.1	0.80	1.9	0.81	3.6	15
Office	14	13	9.1	1.2	47	15

None of the tritium smear results exceeded the release criterion of 10,000 dpm/100 cm^2. The individual tritium smear results are listed in Appendix A. The field survey sheets are provided in Appendix B. The laboratory results and chains of custody are provided in Appendix C.

3.3 Background Reference Areas

No background reference areas were established, but representative material background measurements were performed using radiologically non-impacted materials. For example, the background for sheet metal was determined by performing measurements on a metal storage container located on the west side of Building 4006. Other non-impacted materials were located in various locations in the vicinity of Building 4006. Sample location 2 in grid X-12 reported the highest count rate for beta radiation associated with Building 4006. The concentration is 2,246 dpm/100 cm^2 without correcting for background (or 1,190 dpm/100 cm^2 after correcting for background). Therefore, the selection of background reference materials is not considered critical for supporting compliance decisions for this site. However media-specific backgrounds listed in Table 2-1 were subtracted for scan, static and smear measurements.

Figure 3-1 Building 4006 High Bay Sampling Grids

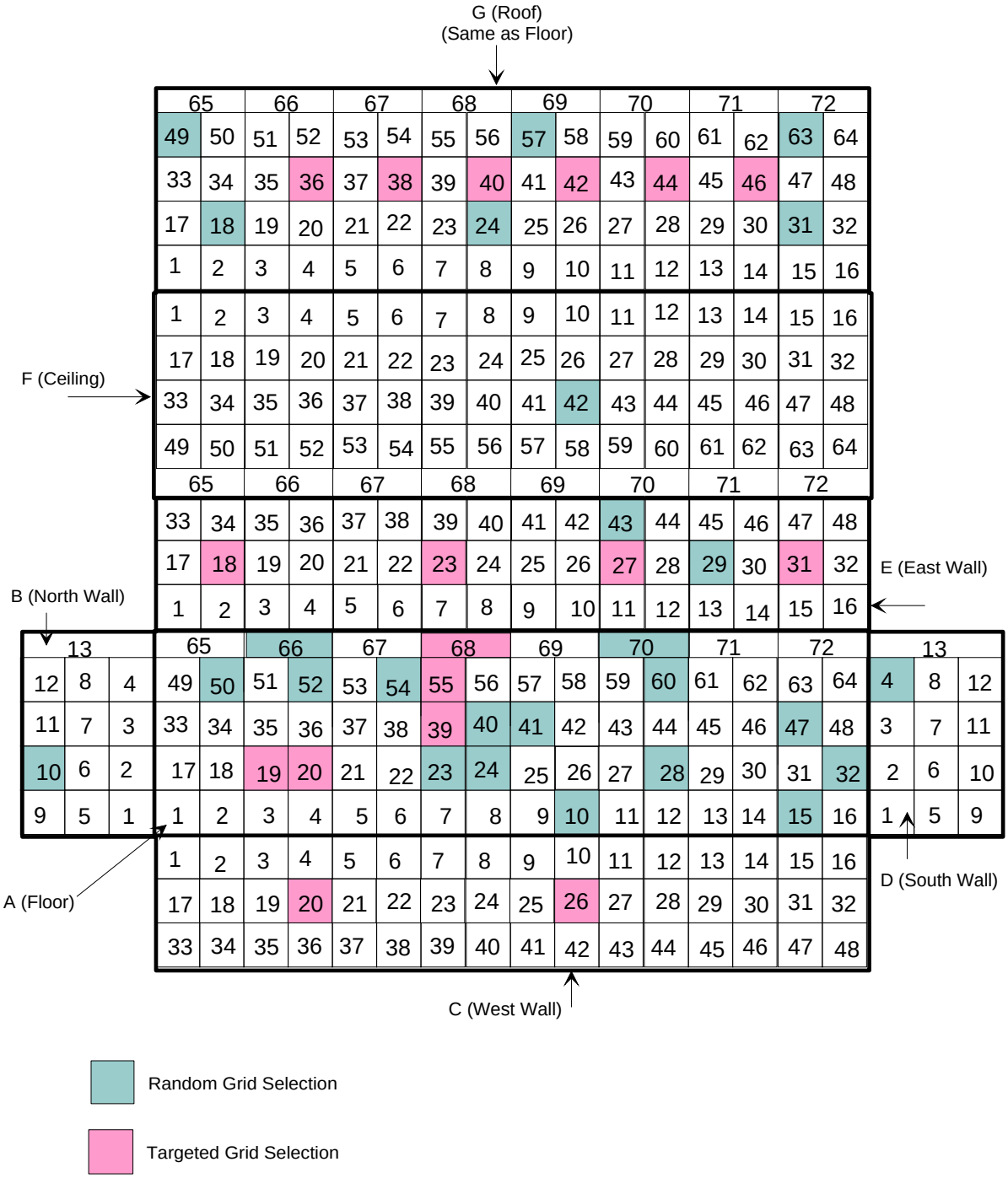


Figure 3-2 Building 4006 Laboratory Sampling Grids

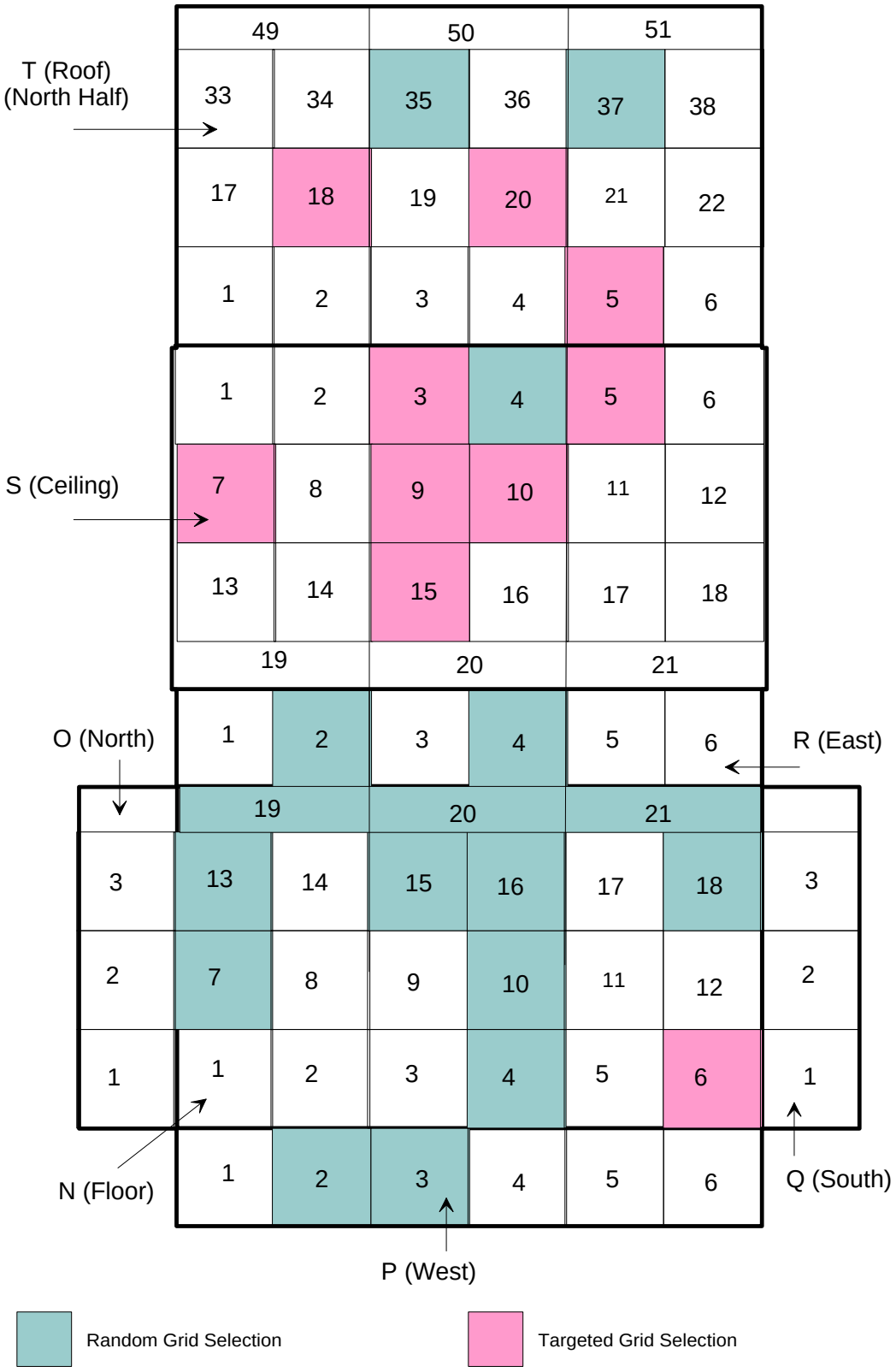


Figure 3-3 Building 4006 Office Sampling Grids

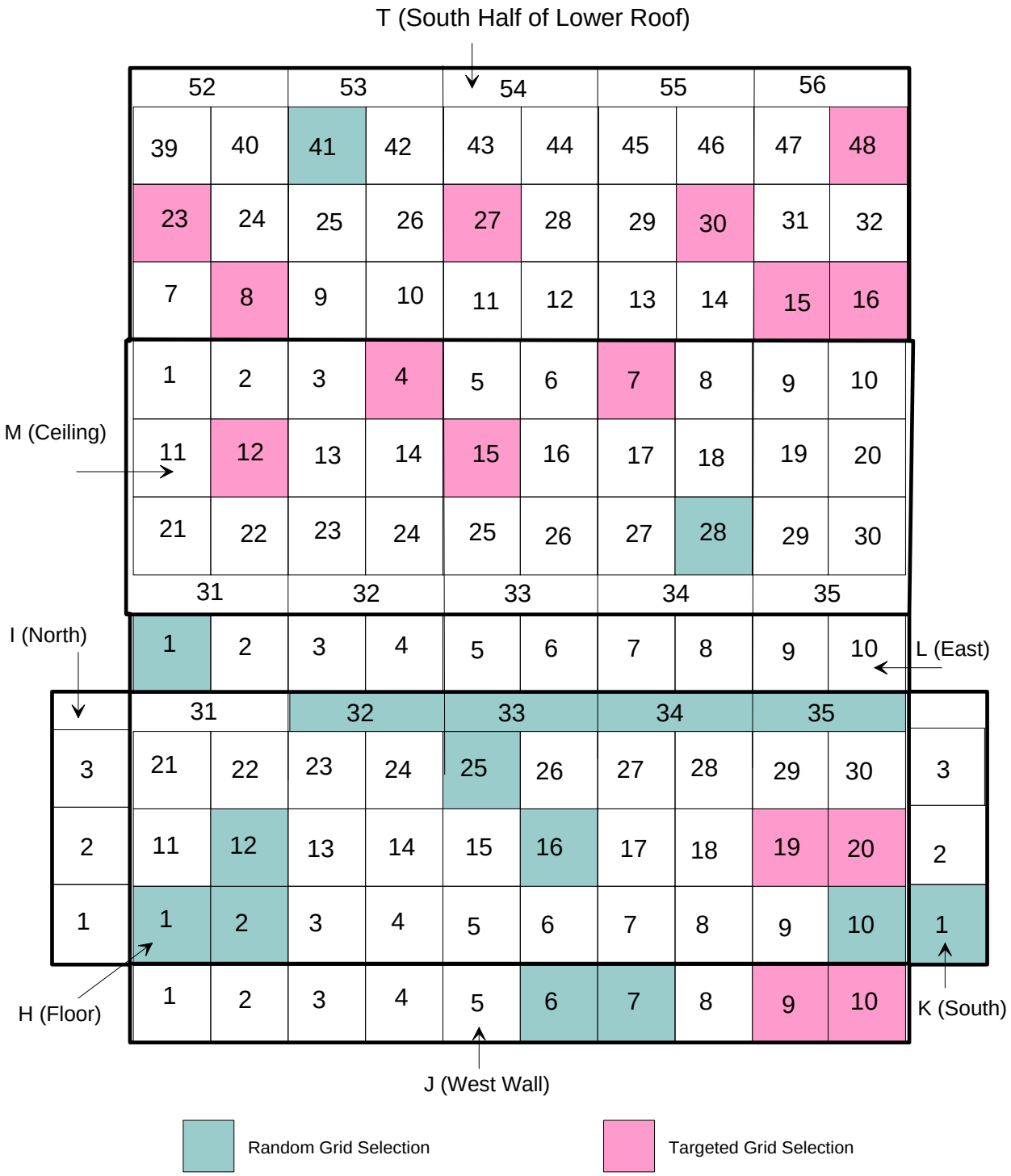
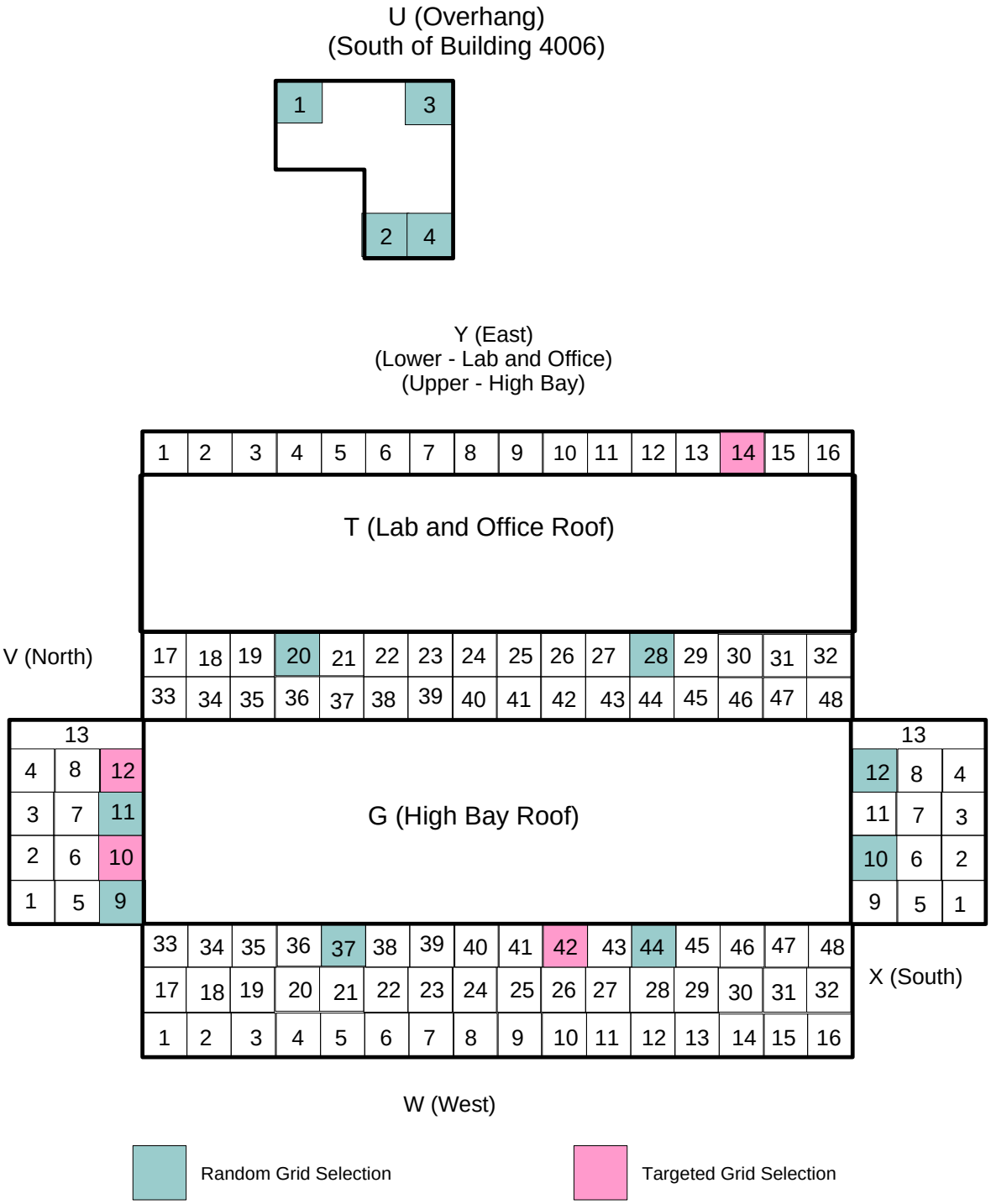


Figure 3-4 Building 4006 Exterior Walls Sampling Grids



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4.0 DATA EVALUATION

Data were evaluated to determine whether or not the residual radioactivity exceeds the approved release criterion listed in Table 1-1. As applied here, the building material is not considered suitable for unrestricted release unless all of the survey data are less than or equal to the corresponding release criterion.

4.1 Data Validation and Verification

Survey data were reviewed to verify they are authentic, appropriately documented, and technically defensible. The review criteria for data acceptability were:

- The instruments used to collect the data were capable of detecting the radiation types and energies of interest at or below the action levels.
- The calibration of the instruments used to collect the data was current and radioactive sources used for calibration were NIST traceable.
- Instrument response was checked before and, where required, after instrument use each day data were collected.
- The MDCs and the assumptions used to develop them were appropriate for the instruments and the survey methods used to collect the data.
- The survey methods used to collect the data were appropriate for the media and types of radiation being measured.
- The custody of samples collected for laboratory analysis was tracked from the point of collection until final results were obtained.

All of the survey data met all of the applicable criteria. All of the survey data were verified and validated for use in demonstrating compliance with the release criterion.

4.2 Exploratory Data Analysis

The data were evaluated using exploratory data analysis (EDA), which uses statistical tools to investigate data sets in order to understand their important characteristics. Summary statistics provided numerical values for measures of central tendency (e.g., mean, median), variation (e.g., standard deviation), and spread (e.g., minimum, maximum). Data evaluation and statistical analysis were performed and a separate decision was made for each of the 5 survey units as to its suitability for release. Static measurement and smear data are summarized in Tables 3-1, 3-2, and 3-3.

Exploratory data analysis was used to understand the characteristics of the data populations as well as to validate assumptions underlying the statistical test, which are that the data are symmetric, statistically independent, and have no trends. For a normally distributed population in smaller data sets like these, a range larger than approximately five times the standard deviation would be considered unusual. None of the populations have an unusually large range since the ranges are generally between 4 and 5 standard deviations. Large differences between the average and the median are an indication of the skewness (i.e., non-symmetry) in the data. Skewness is a function of the difference between the mean and the median relative to the standard deviation. None of the populations appear to be skewed based on the similar values for the mean and median and the relatively large standard deviations.

4.3 Surface Residual Radioactivity Release Criterion

Static measurements of alpha- and beta/gamma-emitting surface residual radioactivity were compared to the limits for surface contamination of existing structures by alpha- and beta/gamma-emitting radionuclides given in Table 1-1. The limits for alpha- and beta/gamma-emitting radionuclides were compared to the appropriate release criterion independently. The sum of fractions was calculated for each grid location and compared to a release criterion of 1.0. The sum of fractions for each grid location was calculated using the following equations:

$$SOF_t = \frac{Static\ \alpha + Static\ \beta}{5{,}000\ dpm/100\ cm^2} + \frac{Tritium}{10{,}000\ dpm/100\ cm^2}$$

$$SOF_r = \frac{Smear\ \alpha + Smear\ \beta}{1{,}000\ dpm/100\ cm^2} + \frac{Tritium}{10{,}000\ dpm/100\ cm^2}$$

Where:

SOF_t	=	sum of fractions for total radioactivity
SOF_r	=	sum of fractions for removable radioactivity
Static α	=	static measurement dpm/100 cm^2 α
Static β	=	static measurement dpm/100 cm^2 β
Smear α	=	dry smear dpm/100 cm^2 α
Smear β	=	dry smear dpm/100 cm^2 β
Tritium	=	wet smear dpm/100 cm^2

The static measurement of total activity at a specific location includes the removable activity since the static measurement was performed prior to collecting the smear sample. Therefore, it is not necessary to include both static and smear measurements in the same sum of fractions calculation because the result would account for the same radioactivity twice. However, to ensure all the release criteria are accounted for it is necessary to calculate a sum of fractions based on the total activity and a second sum of fractions based on the removable activity. If either of the sum of fractions calculations provides a result greater than 1.0, that grid location does not demonstrate compliance with the release criteria.

When a count rate was less than background providing a negative result, zero was substituted for the negative result when calculating the sum of fractions. Table 4-1 summarizes the results of the sum of fractions calculations for each of the survey units in Building 4006. The maximum sum of fractions for any of the grid locations is 0.31 for location 2 (i.e., outside the vent) in grid G-44 on the roof of the high bay.

Table 4-1 Summary of Sum of Fractions Calculations

Survey Unit	*Average*	*Standard Deviation*	*Median*	*Minimum*	*Maximum*	*Number of Measurements*
Static Measurements and Tritium						
High Bay	0.023	0.029	0.013	0.0	0.13	39
Laboratory	0.031	0.052	0.0059	0.0	0.24	23
Office	0.046	0.051	0.024	0.0	0.18	30
Roof	0.099	0.080	0.085	0.0	0.31	48
Exterior	0.076	0.063	0.069	0.0059	0.25	20
Smear Measurements and Tritium						
High Bay	0.0068	0.012	0.000091	0.0	0.043	39
Laboratory	0.0054	0.010	0.00033	0.0	0.034	23
Office	0.010	0.017	0.0022	0.0	0.076	30
Roof	0.013	0.019	0.0028	0.0	0.075	48
Exterior	0.016	0.027	0.0020	0.0	0.11	20

None of the sums of fractions exceeds the release criterion of 1.0. Results of individual sum of fraction calculations are listed in Appendix A.

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5.0 QUALITY CONTROL

Survey data collection activities were performed in a controlled, deliberate manner by trained individuals with calibrated instruments following written procedures and/or protocols. Data were recorded and reviewed, and documentation is auditable. Instrumentation capable of detecting the radiation types and energies of interest were selected, calibrated, and maintained for survey data collection (see Appendix D).

5.1 Precision, Accuracy, Representativeness, Comparability, and Completeness

Quality control (QC) measures were implemented to ensure data met known and suitable data quality criteria, i.e., precision, accuracy, representativeness, comparability, and completeness. Variables related to data precision and accuracy was monitored by instrument response checks designed to monitor the performance of the instrumentation used to collect the data. Duplicate analyses were performed by the analytical laboratory and the results compared. The representativeness of the data was ensured by the use of standardized data collection methods and techniques established in written procedures, listed in Table 5-1. Routine monitoring of surveyor performance and environmental factors was performed to ensure data comparability. The type and quantity of collected data were reviewed against project DQOs (see Section 2.0) to ensure data completeness.

Table 5-1 CABRERA Operating Procedures Used for Survey Data Collection

Number	*Title*
OP-001	Radiological Surveys
OP-005	Volumetric and Material Sampling
OP-008	Chain of Custody
OP-009	Use and Control of Radioactive Check Sources
OP-020	Operation of Contamination Survey Meters
OP-023	Operation of Micro-R Meters

5.2 Field Survey Instrumentation

Commercially available radiation detection and measurement instrumentation were selected based on reliable operation, detection sensitivity, operating characteristics, and expected performance in the field. Table 5-2 lists the types of field instrumentation used.

Table 5-2 Field Instrumentation

Measurement Type	*Detector Type*	*Physical Detector Area and Window Density*	*Instrument Model*	*Detector Model*
Exposure Rate Static	Tissue-equiv. scintillation	N/A	Bicron MicroRem®	N/A
Alpha/Beta Scan/Static	Gas Proportional	126 cm^2 1.2 mg/cm^2 aluminized mylar	Ludlum 2360	Ludlum 43-68
Alpha/Beta Smears	ZnS(Ag) scintillation	2” (5.1cm) diameter 0.4 mg/cm^2	Ludlum 2929	Ludlum 43-10-1

5.2.1 Calibration and Maintenance

Survey instruments were calibrated prior to use. Radiation detection instruments were calibrated for the radiation types and energies of interest. Radioactive sources used for calibration purposes

are traceable to the National Institute of Standards and Technology (NIST). Instrumentation was inspected prior to use to ensure its proper working condition, and properly protected against inclement weather conditions in the operation. Copies of the instrument calibration sheets are provided in Appendix D.

5.2.2 Instrument Response

Instrument response checks were conducted to assure constancy in instrument response, to verify the detector was operating properly, and to demonstrate that measurement results were not the result of detector contamination. Instrument response was checked before and after instrument use each day data were collected. A check source was used that emits the same type of radiation (i.e., alpha, beta, and/or gamma) as the radiation being measured and that gives a similar instrument response. The response check was performed at a set location using a specified source-detector alignment that could easily be repeated.

Prior to initial instrument use, at least 10 measurements were made using a source representative of the radiation types and energies of interest. At least 10 one-minute measurements were also made with the source removed to determine the instrument's expected response to ambient background. Background was monitored qualitatively to assess daily variations that may have impacted instrument MDCs. From the initial source measurements, the mean of the observed count rate was calculated. The acceptance criterion was ± 20% of the mean of the initial source counts. Source checks were monitored using a control chart, with control limits set at ± 20% of the average count rate. For the alpha/beta smear counter, the acceptance criterion for each channel was set at ± 2σ or 3σ from the mean. If an alpha/beta counting system channel fell outside 2σ of the mean but within 3σ of the mean, the source check was repeated. The results of the daily source checks are provided in Appendix D.

5.2.3 Detection Sensitivity

The detection sensitivities of field instrumentation are shown in Table 5-3. The results shown are based on representative count times, background counts and instrument and surface efficiencies. Instrument-specific values based on actual field conditions and backgrounds were used to establish a priori MDC values for scan and static measurements prior to instrument use. The MDC values were calculated as described in MARSSIM Section 6.7.1.

Table 5-3 Field Instrumentation Detection Sensitivities

Detector Model	*Type of Emission*	*Count Time (min)*	*Back-ground (cpm)*	*Instrument Efficiency (cpm/dpm)*	*Scan MDC*[(a)] *(dpm/100 cm^2)*	*Static MDC*[(b)] *(dpm/100 cm^2)*
Ludlum 43-68	Alpha	1	1	0.054	416[(c)]	112[(c)]
Ludlum 43-68	Beta	1	289	0.112	1,300[(c,d)]	580[(c)]
Ludlum 43-10-1	Alpha	1	<1	0.38[(e)]	N/A	10
Ludlum 43-10-1	Beta	1	60	0.18[(e)]	N/A	150

Notes:
(a) Scan MDC is calculated per MARSSIM Equation 6-10 and assumes a surveyor efficiency of 0.5, and a value of 1.38 for acceptable false indications.
(b) Static MDC is calculated per MARSSIM Equation 6-7.
(c) Based on surface efficiencies for alpha and beta of 0.25 and 0.50, respectively.
(d) Scan MDC is for activity concentration above background as described in Section 2.3.3.
(e) 4π detection efficiency assumed; i.e., surface efficiency equals unity.

The instrument efficiency, i.e., the ratio between the net count rate of the instrument and the 2π surface emission rate of a radiation source, was determined by counting the source with the detector in a fixed position from the source (reproducible geometry). A jig was used to create the reproducible geometry and a source to detector distance of 1 cm was used for scan measurements. For static measurements, the detector was placed on contact with the source. A surface efficiency of 0.5 was used for beta-emitting radiations. A value of 0.25 was used for alpha-emitting radiations. These values were established based on surface geometry considerations. The surface efficiency is the ratio between the number of radiation particles emerging from the measurement surface of the area being surveyed (the source) and the total number of radiation particles being released within that source per unit time.

5.3 Analytical Laboratory Performance

Eberline is certified by a state that is authorized to provide National Environmental Laboratory Accreditation Program (NELAP) certification. Three types of QC samples were analyzed to evaluate laboratory performance:

- Laboratory control samples to evaluate potential bias in the measurement results.
- Replicate samples to precision and the effectiveness of sample preparation techniques.
- Reagent blank samples to evaluate the potential for laboratory contamination.

The analytical laboratory reviewed the data for consistency and reasonableness and determined program requirements had been satisfied. The QC sample results are found with the laboratory analytical data in Appendix C.

5.4 Data Quality Assessment

Survey data were verified to be reliable, appropriately documented, and technically defensible. Specifically, the following conclusions were made:

- The instruments used to collect the data were capable of detecting the radiation types and energies of interest at or below the action levels.
- The calibration of the instruments used to collect the data was current and radioactive sources used for calibration were NIST traceable.
- Instrument response was checked before and after instrument use each day data were collected.
- The MDCs and the assumptions used to develop them were appropriate for the instruments and the survey methods used to collect the data.
- The survey methods used to collect the data were appropriate for the media and types of radiation being measured.
- The custody of samples collected for laboratory analysis was tracked from the point of collection until final results were obtained.
- The survey data consist of qualified measurement results that are representative of the area of interest and collected as prescribed by the survey design.

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6.0 SUMMARY AND CONCLUSION

The purpose of the survey was to collect data to demonstrate compliance with the approved release criteria listed in Table 1-1.

Measurements of alpha- and beta/gamma-emitting surface residual radioactivity were compared individually to the appropriate release criteria, and sums of fractions for each grid location were compared to the release criterion of 1.0. None of the individual measurement results for static measurements or dry smears exceeded any of the individual release criteria. None of the sums of fractions exceeded the release criterion of 1.0. Therefore, the survey data demonstrate compliance with the approved release criteria. Building 4006 is recommended for unrestricted release.

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7.0 REFERENCES

The following works were consulted in preparing this report.

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Appendix A:
Field Measurement Results

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High Bay Field Results												
	Direct Reading						Dry Smear					
	Alpha			Beta			Alpha			Beta		
Survey Grid	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2
A10	1	1	0	225	254	205.5	0.2	0	-0.6	61.4	58	-19.3
A15 (1)	1	2	15	225	159	-467.7	0.2	1	2.3	61.4	64	14.8
A15 (2)	1	5	59	225	163	-439.3	0.2	0	-0.6	61.4	56	-30.7
A19	1	2	15	147	168	148.8	0.3	0	-0.9	62	62	0.0
A20 (1)	1	0	-15	147	156	63.8	0.3	0	-0.9	62	65	17.0
A20 (2)	1	4	44	147	173	184.2	0.3	0	-0.9	62	60	-11.4
A23	1	2	15	225	202	-163.0	0.2	0	-0.6	61.4	35	-150.0
A24	1	3	29	225	236	77.9	0.2	0	-0.6	61.4	55	-36.4
A28	1	0	-15	225	245	141.7	0.2	0	-0.6	61.4	62	3.4
A32	1	3	29	225	266	290.5	0.2	1	2.3	61.4	48	-76.1
A39	1	7	88	225	227	14.2	0.3	0	-0.9	62	62	0.0
A40	1	1	0	225	237	85.0	0.2	1	2.3	61.4	61	-2.3
A41	1	3	29	225	230	35.4	0.2	0	-0.6	61.4	64	14.8
A47	1	4	44	225	278	375.6	0.2	0	-0.6	61.4	58	-19.3
A50	1	2	15	225	218	-49.6	0.2	0	-0.6	61.4	51	-59.1
A52	1	3	29	225	225	0.0	0.2	2	5.1	61.4	60	-8.0
A54	1	4	44	225	179	-326.0	0.2	0	-0.6	61.4	66	26.1
A55	1	4	44	225	233	56.7	0.3	0	-0.9	62	61	-5.7
A60	1	4	44	225	314	630.7	0.2	0	-0.6	61.4	52	-53.4
A66	1	2	15	225	202	-163.0	0.2	0	-0.6	61.4	45	-93.2
A68	1	5	59	225	214	-77.9	0.3	0	-0.9	62	53	-51.1
A70	1	1	0	225	282	403.9	0.2	0	-0.6	61.4	44	-98.9
B10	1	1	0	225	205	-141.7	0.3	0	-0.9	59.8	53	-38.6
C20	1	3	29	205	199	-42.5	0.3	0	-0.9	59.8	57	-15.9
C26	1	2	15	180	144	-255.1	0.3	1	2.0	59.8	67	40.9
D4	1	1	0	140	151	77.9	0.3	0	-0.9	62	57	-28.4
E18	1	1	0	180	211	219.7	0.3	1	2.0	59.8	67	40.9
E23 (1)	1	1	0	180	205	177.2	0.3	0	-0.9	59.8	64	23.9
E23 (2)	1	0	-15	180	148	-226.8	0.3	0	-0.9	59.8	66	35.2
E27	1	4	44	180	164	-113.4	0.3	1	2.0	59.8	46	-78.4
E29 (1)	1	1	0	180	171	-63.8	0.3	1	2.0	59.8	48	-67.0
E29 (2)	1	1	0	180	180	0.0	0.3	0	-0.9	59.8	55	-27.3
E31 (1)	1	2	15	180	194	99.2	0.3	1	2.0	59.8	53	-38.6

High Bay Field Results												
	Direct Reading						Dry Smear					
	Alpha			Beta			Alpha			Beta		
Survey Grid	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2
E31 (2)	1	0	-15	180	167	-92.1	0.3	1	2.0	59.8	61	6.8
E31 (3)	1	0	-15	180	165	-106.3	0.3	1	2.0	59.8	51	-50.0
E43	1	0	-15	180	138	-297.6	0.3	0	-0.9	59.8	44	-89.8
F20	1	0	-15	180	233	375.6	0.3	0	-0.9	59.8	52	-44.3
F42 (1)	1	1	0	180	194	99.2	0.3	0	-0.9	59.8	62	12.5
F42 (2)	1	3	29	180	175	-35.4	0.3	0	-0.9	59.8	60	1.1

Average		17		203				0.14			-25
St. Dev.		25		42				1.5			43
Median		15		202				-0.57			-19
Minimum		-15		138				-0.85			-150
Maximum		88		314				5.1			41
# of Measurements		39		39				39			39

High Bay Sum of Fraction Results								
	Direct Reading		Dry Smear		Wet Smear	Dose Rate	SOF_t	SOF_r
	Alpha	Beta	Alpha	Beta	Tritium (dpm/100 cm^2)			
Survey Grid	dpm/100 cm2	dpm/100 cm2	dpm/100 cm2	dpm/100 cm2	Concentration	uR/h		
A10	0	205.5	-0.6	-19.3	0.063	11	0.0411	0.0000
A15 (1)	15	-467.7	2.3	14.8	-0.472	11	0.0029	0.0170
A15 (2)	59	-439.3	-0.6	-30.7		11	0.0118	0.0000
A19	15	148.8	-0.9	0.0		12	0.0327	0.0000
A20 (1)	-15	63.8	-0.9	17.0		12	0.0128	0.0170
A20 (2)	44	184.2	-0.9	-11.4		12	0.0457	0.0000
A23	15	-163.0	-0.6	-150.0	-0.347	11	0.0029	0.0000
A24	29	77.9	-0.6	-36.4	0.495	11	0.0215	0.0000
A28	-15	141.7	-0.6	3.4	1.73	10	0.0285	0.0036
A32	29	290.5	2.3	-76.1	-0.227	11	0.0640	0.0023
A39	88	14.2	-0.9	0.0		11	0.0205	0.0000
A40	0	85.0	2.3	-2.3	0.13	11	0.0170	0.0023
A41	29	35.4	-0.6	14.8	1.14	11	0.0131	0.0149
A47	44	375.6	-0.6	-19.3	-0.061	12	0.0839	0.0000
A50	15	-49.6	-0.6	-59.1	-0.251	14	0.0029	0.0000
A52	29	0.0	5.1	-8.0	0.249	12	0.0059	0.0051
A54	44	-326.0	-0.6	26.1	-0.471	12	0.0088	0.0261
A55	44	56.7	-0.9	-5.7		11	0.0202	0.0000
A60	44	630.7	-0.6	-53.4	0.021	11	0.1350	0.0000
A66	15	-163.0	-0.6	-93.2	0.906	12	0.0030	0.0001
A68	59	-77.9	-0.9	-51.1		11	0.0118	0.0000
A70	0	403.9	-0.6	-98.9	0.579	13	0.0808	0.0001
B10	0	-141.7	-0.9	-38.6	0.145	11	0.0000	0.0000
C20	29	-42.5	-0.9	-15.9		11	0.0059	0.0000
C26	15	-255.1	2.0	40.9		11	0.0029	0.0429
D4	0	77.9	-0.9	-28.4	-0.533	11	0.0156	0.0000
E18	0	219.7	2.0	40.9		11	0.0439	0.0429
E23 (1)	0	177.2	-0.9	23.9		11	0.0354	0.0239
E23 (2)	-15	-226.8	-0.9	35.2		11	0.0000	0.0352
E27	44	-113.4	2.0	-78.4		11	0.0088	0.0020
E29 (1)	0	-63.8	2.0	-67.0	10.5	11	0.0011	0.0030
E29 (2)	0	0.0	-0.9	-27.3		11	0.0000	0.0000
E31 (1)	15	99.2	2.0	-38.6		11	0.0228	0.0020

High Bay Sum of Fraction Results								
	Direct Reading		Dry Smear		Wet Smear	Dose Rate	SOF_t	SOF_r
	Alpha	Beta	Alpha	Beta	Tritium (dpm/100 cm^2)			
Survey Grid	dpm/100 cm2	dpm/100 cm2	dpm/100 cm2	dpm/100 cm2	Concentration	uR/h		
E31 (2)	-15	-92.1	2.0	6.8		11	0.0000	0.0088
E31 (3)	-15	-106.3	2.0	-50.0		11	0.0000	0.0020
E43	-15	-297.6	-0.9	-89.8	-1.17	11	0.0000	0.0000
F20	-15	375.6	-0.9	-44.3		11	0.0751	0.0000
F42 (1)	0	99.2	-0.9	12.5	-0.213	11	0.0198	0.0125
F42 (2)	29	-35.4	-0.9	1.1		11	0.0059	0.0011

Average	17	18	0.14	-25	0.61	11	0.023	0.0068
St. Dev.	25	230	1.5	43	2.4	0.7	0.029	0.012
Median	15	14	-0.57	-19	0.0	11	0.013	0.000091
Minimum	-15	-468	-0.85	-150	-1.2	10	0.0	0.0
Maximum	88	631	5.1	41	11	14	0.13	0.043
# of Measurements	39	39	39	39	20	39	39	39

Laboratory Field Results												
	Direct Reading						Dry Smear					
	Alpha			Beta			Alpha			Beta		
Survey Grid	bkgd cpm	cpm	dpm/100 cm^2	bkgd cpm	cpm	dpm/100 cm^2	bkgd cpm	cpm	dpm/100 cm^2	bkgd cpm	cpm	dpm/100 cm^2
N4	1	11	147	140	168	198.4	0.2	1	2.3	61.4	67	31.8
N6	1	1	0	140	132	-56.7	0.3	0	-0.9	62	58	-22.7
N7	1	0	-15	140	171	219.7	0.2	0	-0.6	61.4	49	-70.5
N10	1	1	0	140	171	219.7	0.2	0	-0.6	61.4	61	-2.3
N13	1	0	-15	140	135	-35.4	0.2	0	-0.6	61.4	50	-64.8
N15	1	1	0	140	141	7.1	0.2	0	-0.6	61.4	55	-36.4
N16	1	0	-15	140	128	-85.0	0.2	2	5.1	61.4	57	-25.0
N18 (1)	1	1	0	140	133	-49.6	0.2	1	2.3	61.4	65	20.5
N18 (2)	1	0	-15	140	155	106.3	0.2	0	-0.6	61.4	60	-8.0
N19	1	0	-15	140	179	276.4	0.2	2	5.1	61.4	51	-59.1
N20	1	1	0	140	197	403.9	0.2	0	-0.6	61.4	38	-133.0
N21	1	1	0	140	152	85.0	0.2	0	-0.6	61.4	46	-87.5
P2	1	0	-15	140	143	21.3	0.3	0	-0.9	62	52	-56.8
P3	1	1	0	140	144	28.3	0.2	1	2.3	61.4	52	-53.4
R2	1	2	15	140	124	-113.4	0.3	0	-0.9	62	64	11.4
R4	1	4	44	140	149	63.8	0.3	0	-0.9	62	63	5.7
S3	1	2	15	180	230	354.3	0.2	0	-0.6	61.4	54	-42.0
S4	1	1	0	140	306	1176.3	0.3	0	-0.9	62	52	-56.8
S5	1	1	0	180	145	-248.0	0.3	1	2.0	62	55	-39.8
S7	1	0	-15	180	137	-304.7	0.3	0	-0.9	62	50	-68.2
S9	1	3	29	180	151	-205.5	0.3	0	-0.9	62	52	-56.8
S10	1	0	-15	180	143	-262.2	0.3	1	2.0	59.8	65	29.5
S15	1	0	-15	180	192	85.0	0.2	1	2.3	61.4	46	-87.5

Average		5.1			82			0.56			-38
St. Dev.		34			306			1.9			41.6
Median		0.0			28			-0.57			-42
Minimum		-15			-305			-0.85			-133
Maximum		147			1176			5.1			32
# of Measurements		23			23			23			23

Laboratory Area Sum of Fraction Results								
	Direct Reading		Dry Smear		Wet Smear	Dose Rate	SOF_t	SOF_r
	Alpha	Beta	Alpha	Beta	Tritium (dpm/100 cm^2)			
Survey Grid	dpm/100 cm^2	dpm/100 cm^2	dpm/100 cm^2	dpm/100 cm^2	Concentration	uR/h		
N4	147	198.4	2.3	31.8	1.93	10	0.0693	0.0343
N6	0	-56.7	-0.9	-22.7		12	0.0000	0.0000
N7	-15	219.7	-0.6	-70.5	2.73	13	0.0442	0.0003
N10	0	219.7	-0.6	-2.3	3.62	12	0.0443	0.0004
N13	-15	-35.4	-0.6	-64.8	2.94	12	0.0003	0.0003
N15	0	7.1	-0.6	-36.4	3.33	12	0.0018	0.0003
N16	-15	-85.0	5.1	-25.0	1.57	12	0.0002	0.0053
N18 (1)	0	-49.6	2.3	20.5	0.808	12	0.0001	0.0228
N18 (2)	-15	106.3	-0.6	-8.0		10	0.0213	0.0000
N19	-15	276.4	5.1	-59.1	2.39	12	0.0555	0.0054
N20	0	403.9	-0.6	-133.0	2.05	12	0.0810	0.0002
N21	0	85.0	-0.6	-87.5	1.5	12	0.0172	0.0002
P2	-15	21.3	-0.9	-56.8	1.62	11	0.0044	0.0002
P3	0	28.3	2.3	-53.4	1.25	12	0.0058	0.0024
R2	15	-113.4	-0.9	11.4	1.26	10	0.0031	0.0115
R4	44	63.8	-0.9	5.7	2.27	10	0.0218	0.0059
S3	15	354.3	-0.6	-42.0		12	0.0738	0.0000
S4	0	1176.3	-0.9	-56.8	1.92	10	0.2355	0.0002
S5	0	-248.0	2.0	-39.8		12	0.0000	0.0020
S7	-15	-304.7	-0.9	-68.2		12	0.0000	0.0000
S9	29	-205.5	-0.9	-56.8		12	0.0059	0.0000
S10	-15	-262.2	2.0	29.5		12	0.0000	0.0315
S15	-15	85.0	2.3	-87.5		12	0.0170	0.0023

Average	5.1	82	0.56	-38	2.1	12	0.031	0.0054
St. Dev.	34	306	1.9	41.6	0.80	0.9	0.052	0.010
Median	0.0	28	-0.57	-42	1.9	12	0.0059	0.00033
Minimum	-15	-305	-0.85	-133	0.81	10	0.0	0.0
Maximum	147	1176	5.1	32	3.6	13	0.24	0.034
# of Measurements	23	23	23	23	15	23	23	23

Office Area Field Results												
	Direct Reading						Dry Smear					
	Alpha			Beta			Alpha			Beta		
Survey Grid	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2
H1	1	2	15	185	238	375.6	0.2	0	-0.6	61.4	60	-8.0
H2	1	3	29	185	220	248.0	0.2	1	2.3	61.4	64	14.8
H10	1	1	0	140	180	283.4	0.3	0	-0.9	62	61	-5.7
H12	1	0	-15	185	186	7.1	0.2	0	-0.6	61.4	58	-19.3
H16	1	2	15	185	179	-42.5	0.2	0	-0.6	61.4	52	-53.4
H19 (1)	1	2	15	140	160	141.7	0.3	0	-0.9	62	65	17.0
H19 (2)	1	0	-15	140	154	99.2	0.3	0	-0.9	62	48	-79.5
H19 (3)	1	3	29	140	148	56.7	0.3	0	-0.9	62	58	-22.7
H20 (1)	1	1	0	289	340	361.4	0.3	0	-0.9	62	64	11.4
H20 (2)	1	2	15	140	169	205.5	0.3	0	-0.9	62	63	5.7
H20 (3)	1	6	73	140	170	212.6	0.3	0	-0.9	62	55	-39.8
H25	1	4	44	185	192	49.6	0.2	1	2.3	61.4	64	14.8
H32	1	0	-15	185	179	-42.5	0.2	0	-0.6	61.4	68	37.5
H33	1	1	0	185	188	21.3	0.2	2	5.1	61.4	58	-19.3
H34	1	0	-15	185	180	-35.4	0.2	0	-0.6	61.4	58	-19.3
H35	1	0	-15	185	182	-21.3	0.2	1	2.3	61.4	62	3.4
J6	1	0	-15	140	127	-92.1	0.3	0	-0.9	62	51	-62.5
J7	1	0	-15	140	154	99.2	0.3	0	-0.9	62	51	-62.5
J9 (1)	1	6	73	289	408	843.3	0.3	0	-0.9	62	62	0.0
J9 (2)	1	9	118	289	358	488.9	0.3	1	2.0	62	75	73.9
J9 (3)	1	0	-15	289	403	807.8	0.3	0	-0.9	62	53	-51.1
J10 (1)	1	12	162	289	368	559.8	0.1	2	5.4	58.6	60	8.0
J10 (2)	1	3	29	289	348	418.1	0.1	1	2.6	58.6	50	-48.9
K1	1	2	15	140	164	170.1	0.3	0	-0.9	62	61	-5.7
L1	1	6	73	140	149	63.8	0.2	0	-0.6	61.4	66	26.1
M4	1	5	59	180	136	-311.8	0.3	0	-0.9	62	59	-17.0
M7	1	1	0	180	119	-432.3	0.3	1	2.0	62	64	11.4
M12	1	2	15	180	237	403.9	0.3	0	-0.9	62	46	-90.9
M15	1	2	15	180	186	42.5	0.3	0	-0.9	62	50	-68.2
M28	1	1	0	140	127	-92.1	0.3	0	-0.9	62	68	34.1

Office Area Field Results												
	Direct Reading						Dry Smear					
	Alpha			Beta			Alpha			Beta		
Survey Grid	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2
Average			23			163			0.23			-14
St. Dev.			42.4			284.4			1.8			38.3
Median			15			99			-0.85			-6.8
Minimum			-15			-432			-0.85			-91
Maximum			162			843			5.4			74
# of Measurements			30			30			30			30

Office Area Sum of Fraction Results								
	Direct Reading		Dry Smear		Wet Smear	Dose Rate	SOF_t	SOF_r
	Alpha	Beta	Alpha	Beta	Tritium (dpm/100 cm^2)			
Survey Grid	dpm/100 cm2	dpm/100 cm2	dpm/100 cm2	dpm/100 cm2	Concentration	uR/h		
H1	15	375.6	-0.6	-8.0	17.5	12	0.0798	0.0018
H2	29	248.0	2.3	14.8	34.9	12	0.0590	0.0205
H10	0	283.4	-0.9	-5.7	9.07	13	0.0576	0.0009
H12	-15	7.1	-0.6	-19.3	11.7	12	0.0026	0.0012
H16	15	-42.5	-0.6	-53.4	18.4	13	0.0048	0.0018
H19 (1)	15	141.7	-0.9	17.0		13	0.0313	0.0170
H19 (2)	-15	99.2	-0.9	-79.5		12	0.0198	0.0000
H19 (3)	29	56.7	-0.9	-22.7		12	0.0172	0.0000
H20 (1)	0	361.4	-0.9	11.4		13	0.0723	0.0114
H20 (2)	15	205.5	-0.9	5.7		13	0.0440	0.0057
H20 (3)	73	212.6	-0.9	-39.8		13	0.0572	0.0000
H25	44	49.6	2.3	14.8	3.8	12	0.0191	0.0174
H32	-15	-42.5	-0.6	37.5	46.9	12	0.0047	0.0422
H33	0	21.3	5.1	-19.3	15.5	12	0.0058	0.0067
H34	-15	-35.4	-0.6	-19.3	26.3	12	0.0026	0.0026
H35	-15	-21.3	2.3	3.4	1.98	12	0.0002	0.0059
J6	-15	-92.1	-0.9	-62.5	1.24	12	0.0001	0.0001
J7	-15	99.2	-0.9	-62.5	7.99	12	0.0206	0.0008
J9 (1)	73	843.3	-0.9	0.0		12	0.1833	0.0000
J9 (2)	118	488.9	2.0	73.9		12	0.1213	0.0759
J9 (3)	-15	807.8	-0.9	-51.1		12	0.1616	0.0000
J10 (1)	162	559.8	5.4	8.0		12	0.1443	0.0134
J10 (2)	29	418.1	2.6	-48.9		12	0.0895	0.0026
K1	15	170.1	-0.9	-5.7	4.03	12	0.0374	0.0004
L1	73	63.8	-0.6	26.1	5.33	12	0.0280	0.0267
M4	59	-311.8	-0.9	-17.0		11	0.0118	0.0000
M7	0	-432.3	2.0	11.4		11	0.0000	0.0134
M12	15	403.9	-0.9	-90.9		12	0.0837	0.0000
M15	15	42.5	-0.9	-68.2		11	0.0114	0.0000
M28	0	-92.1	-0.9	34.1	7.67	12	0.0008	0.0349

Office Area Sum of Fraction Results								
	Direct Reading		Dry Smear		Wet Smear	Dose Rate	SOF_t	SOF_r
	Alpha	Beta	Alpha	Beta	Tritium (dpm/100 cm^2)			
Survey Grid	dpm/100 cm2	dpm/100 cm2	dpm/100 cm2	dpm/100 cm2	Concentration	uR/h		
Average	23	163	0.23	-14	14	12	0.046	0.010
St. Dev.	42.4	284.4	1.8	38.3	13.1	0.5	0.051	0.017
Median	15	99	-0.85	-6.8	9.1	12	0.024	0.0022
Minimum	-15	-432	-0.85	-91	1.2	11	0.0	0.0
Maximum	162	843	5.4	74	47	13	0.18	0.076
# of Measurements	30	30	30	30	15	30	30	30

Building 4006 Roof Field Results												
	Direct Reading						Dry Smear					
	Alpha			Beta			Alpha			Beta		
Survey Grid	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2
G18	1	5	59	210	230	141.7	0.2	0	-0.6	61.4	67	31.8
G24	1	5	59	210	332	864.5	0.2	0	-0.6	61.4	65	20.5
G31	1	5	59	210	265	389.7	0.2	1	2.3	61.4	67	31.8
G36 (1)	1	2	15	180	162	-127.6	0.2	0	-0.6	61.4	73	65.9
G36 (2)	1	37	529	180	252	510.2	0.2	1	2.3	61.4	59	-13.6
G38 (1)	1	4	44	180	145	-248.0	0.2	1	2.3	61.4	53	-47.7
G38 (2)	1	25	353	180	232	368.5	0.2	1	2.3	61.4	50	-64.8
G40 (1)	1	3	29	180	191	77.9	0.2	0	-0.6	61.4	65	20.5
G40 (2)	1	31	441	180	291	786.6	0.2	3	8.0	61.4	66	26.1
G42 (1)	1	2	15	180	200	141.7	0.2	1	2.3	61.4	60	-8.0
G42 (2)	1	25	353	180	293	800.7	0.2	0	-0.6	61.4	62	3.4
G44 (1)	1	6	73	180	157	-163.0	0.2	0	-0.6	61.4	63	9.1
G44 (2)	1	27	382	180	342	1148.0	0.2	2	5.1	61.4	64	14.8
G46 (1)	1	8	103	180	197	120.5	0.2	0	-0.6	61.4	69	43.2
G46 (2)	1	34	485	180	282	722.8	0.2	2	5.1	61.4	64	14.8
G49	1	4	44	210	208	-14.2	0.2	1	2.3	61.4	62	3.4
G57	1	5	59	210	259	347.2	0.2	0	-0.6	61.4	50	-64.8
G63	1	3	29	210	192	-127.6	0.2	1	2.3	61.4	44	-98.9
T5 (1)	1	2	15	180	166	-99.2	0.2	0	-0.6	61.4	43	-104.5
T5 (2)	1	14	191	180	203	163.0	0.2	0	-0.6	61.4	55	-36.4
T8 (1)	1	4	44	210	201	-63.8	0.2	0	-0.6	61.4	60	-8.0
T8 (2)	1	26	367	210	201	-63.8	0.2	2	5.1	61.4	42	-110.2
T15 (1)	1	5	59	180	212	226.8	0.2	1	2.3	61.4	59	-13.6
T15 (2)	1	12	162	180	220	283.4	0.2	3	8.0	61.4	66	26.1
T16 (1)	1	5	59	180	215	248.0	0.2	0	-0.6	61.4	53	-47.7
T16 (2)	1	24	338	180	252	510.2	0.2	2	5.1	61.4	48	-76.1
T16 (3)	1	25	353	180	246	467.7	0.2	2	5.1	61.4	56	-30.7
T18 (1)	1	1	0	180	127	-375.6	0.2	1	2.3	61.4	60	-8.0
T18 (2)	1	14	191	180	226	326.0	0.2	1	2.3	61.4	51	-59.1
T20 (1)	1	2	15	180	145	-248.0	0.2	1	2.3	61.4	52	-53.4
T20 (2)	1	7	88	180	189	63.8	0.2	0	-0.6	61.4	62	3.4
T23 (1)	1	4	44	180	197	120.5	0.2	0	-0.6	61.4	54	-42.0
T23 (2)	1	31	441	180	242	439.3	0.2	1	2.3	61.4	60	-8.0

Building 4006 Roof Field Results												
	Direct Reading						Dry Smear					
	Alpha			Beta			Alpha			Beta		
Survey Grid	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2
T27 (1)	1	4	44	180	191	77.9	0.2	1	2.3	61.4	52	-53.4
T27 (2)	1	18	250	180	233	375.6	0.2	0	-0.6	61.4	62	3.4
T30 (1)	1	4	44	180	205	177.2	0.2	0	-0.6	61.4	74	71.6
T30 (2)	1	28	397	180	231	361.4	0.2	0	-0.6	61.4	63	9.1
T35	1	4	44	210	307	687.4	0.2	2	5.1	61.4	54	-42.0
T37	1	6	73	210	234	170.1	0.1	0	-0.3	59.8	73	75.0
T41	1	4	44	210	291	574.0	0.2	0	-0.6	61.4	66	26.1
T48 (1)	3	26	338	180	284	737.0	0.2	1	2.3	61.4	57	-25.0
T48 (2)	3	12	132	180	206	184.2	0.2	0	-0.6	61.4	52	-53.4
T48 (3)	3	17	206	180	226	326.0	0.2	0	-0.6	61.4	55	-36.4
T48 (4)	3	28	367	180	276	680.3	0.2	0	-0.6	61.4	58	-19.3
U1	1	10	132	180	261	574.0	0.3	0	-0.9	59.8	57	-15.9
U2	1	12	162	180	264	595.2	0.3	1	2.0	59.8	54	-33.0
U3	1	13	176	180	233	375.6	0.3	0	-0.9	59.8	55	-27.3
U4	1	15	206	180	256	538.5	0.3	1	2.0	59.8	65	29.5

Average		169			295			1.4			-14
St. Dev.		154.0			331.1			2.4			43.4
Median		96			305			0.85			-10.8
Minimum		0.0			-376			-0.85			-110
Maximum		529			1148			8.0			75
# of Measurements		48			48			48			48

Building 4006 Roof Sum of Fraction Results							
	Direct Reading		Dry Smear		Dose Rate	SOF_t	SOF_r
	Alpha	Beta	Alpha	Beta			
Survey Grid	dpm/100 cm2	dpm/100 cm2	dpm/100 cm2	dpm/100 cm2	uR/h		
G18	59	141.7	-0.6	31.8	11	0.0401	0.0318
G24	59	864.5	-0.6	20.5	11	0.1847	0.0205
G31	59	389.7	2.3	31.8	11	0.0897	0.0341
G36 (1)	15	-127.6	-0.6	65.9	11	0.0029	0.0659
G36 (2)	529	510.2	2.3	-13.6	11	0.2079	0.0023
G38 (1)	44	-248.0	2.3	-47.7	11	0.0088	0.0023
G38 (2)	353	368.5	2.3	-64.8	11	0.1442	0.0023
G40 (1)	29	77.9	-0.6	20.5	11	0.0215	0.0205
G40 (2)	441	786.6	8.0	26.1	11	0.2455	0.0341
G42 (1)	15	141.7	2.3	-8.0	11	0.0313	0.0023
G42 (2)	353	800.7	-0.6	3.4	11	0.2307	0.0034
G44 (1)	73	-163.0	-0.6	9.1	11	0.0147	0.0091
G44 (2)	382	1148.0	5.1	14.8	11	0.3060	0.0199
G46 (1)	103	120.5	-0.6	43.2	11	0.0447	0.0432
G46 (2)	485	722.8	5.1	14.8	11	0.2416	0.0199
G49	44	-14.2	2.3	3.4	11	0.0088	0.0057
G57	59	347.2	-0.6	-64.8	11	0.0812	0.0000
G63	29	-127.6	2.3	-98.9	11	0.0059	0.0023
T5 (1)	15	-99.2	-0.6	-104.5	11	0.0029	0.0000
T5 (2)	191	163.0	-0.6	-36.4	11	0.0708	0.0000
T8 (1)	44	-63.8	-0.6	-8.0	11	0.0088	0.0000
T8 (2)	367	-63.8	5.1	-110.2	11	0.0735	0.0051
T15 (1)	59	226.8	2.3	-13.6	11	0.0571	0.0023
T15 (2)	162	283.4	8.0	26.1	11	0.0890	0.0341
T16 (1)	59	248.0	-0.6	-47.7	11	0.0614	0.0000
T16 (2)	338	510.2	5.1	-76.1	11	0.1696	0.0051
T16 (3)	353	467.7	5.1	-30.7	11	0.1641	0.0051
T18 (1)	0	-375.6	2.3	-8.0	11	0.0000	0.0023
T18 (2)	191	326.0	2.3	-59.1	11	0.1034	0.0023
T20 (1)	15	-248.0	2.3	-53.4	11	0.0029	0.0023
T20 (2)	88	63.8	-0.6	3.4	11	0.0304	0.0034
T23 (1)	44	120.5	-0.6	-42.0	11	0.0329	0.0000
T23 (2)	441	439.3	2.3	-8.0	11	0.1761	0.0023

Building 4006 Roof Sum of Fraction Results							
	Direct Reading		Dry Smear		Dose Rate	SOF_t	SOF_r
	Alpha	Beta	Alpha	Beta			
Survey Grid	dpm/100 cm2	dpm/100 cm2	dpm/100 cm2	dpm/100 cm2	uR/h		
T27 (1)	44	77.9	2.3	-53.4	11	0.0244	0.0023
T27 (2)	250	375.6	-0.6	3.4	11	0.1251	0.0034
T30 (1)	44	177.2	-0.6	71.6	11	0.0442	0.0716
T30 (2)	397	361.4	-0.6	9.1	11	0.1516	0.0091
T35	44	687.4	5.1	-42.0	11	0.1463	0.0051
T37	73	170.1	-0.3	75.0	11	0.0487	0.0750
T41	44	574.0	-0.6	26.1	11	0.1236	0.0261
T48 (1)	338	737.0	2.3	-25.0	11	0.2150	0.0023
T48 (2)	132	184.2	-0.6	-53.4	11	0.0633	0.0000
T48 (3)	206	326.0	-0.6	-36.4	11	0.1063	0.0000
T48 (4)	367	680.3	-0.6	-19.3	11	0.2095	0.0000
U1	132	574.0	-0.9	-15.9	11	0.1413	0.0000
U2	162	595.2	2.0	-33.0	11	0.1514	0.0020
U3	176	375.6	-0.9	-27.3	11	0.1104	0.0000
U4	206	538.5	2.0	29.5	11	0.1489	0.0315

Average	169	295	1.4	-14	11	0.099	0.013
St. Dev.	154.0	331.1	2.4	43.4	0.0	0.080	0.019
Median	96	305	0.85	-10.8	11	0.085	0.0028
Minimum	0.0	-376	-0.85	-110	11.0	0.0	0.0
Maximum	529	1148	8.0	75	11	0.31	0.075
# of Measurements	48	48	48	48	48	48	48

Exterior Walls Field Results												
	Direct Reading						Dry Smear					
	Alpha			Beta			Alpha			Beta		
Survey Grid	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2	bkgd cpm	cpm	dpm/100 cm2
V9	1	5	59	180	187	49.6	0.3	1	2.0	62	61	-5.7
V10	1	1	0	180	202	155.9	0.3	0	-0.9	59.8	58	-10.2
V11	1	2	15	180	190	70.9	0.3	0	-0.9	62	51	-62.5
V12	1	3	29	180	185	35.4	0.3	0	-0.9	59.8	60	1.1
W37	1	7	88	180	217	262.2	0.3	0	-0.9	62	59	-17.0
W38 (1)	1	4	44	180	227	333.0	0.3	1	2.0	59.8	79	109.1
W38 (2)	1	15	206	180	252	510.2	0.3	1	2.0	59.8	47	-72.7
W42	1	3	29	180	177	-21.3	0.3	1	2.0	59.8	61	6.8
W44	1	2	15	180	249	488.9	0.3	1	2.0	62	60	-11.4
W44 (1)	1	3	29	180	212	226.8	0.3	0	-0.9	59.8	68	46.6
W44 (2)	1	15	206	180	250	496.0	0.3	2	4.8	59.8	65	29.5
X10	1	12	162	180	205	177.2	0.3	0	-0.9	62	53	-51.1
X12 (1)	1	5	59	180	234	382.7	0.3	1	2.0	62	65	17.0
X12 (2)	1	4	44	180	348	1190.5	0.3	0	-0.9	59.8	66	35.2
X12 (3)	1	3	29	180	303	871.6	0.3	0	-0.9	59.8	65	29.5
X12 (4)	1	5	59	180	190	70.9	0.1	0	-0.3	59.8	62	12.5
X12 (5)	1	3	29	180	162	-127.6	0.1	0	-0.3	59.8	63	18.2
Y14	1	2	15	180	215	248.0	0.3	1	2.0	59.8	49	-61.4
Y20	2	4	29	180	246	467.7	0.3	0	-0.9	62	56	-34.1
Y28	2	4	29	180	240	425.2	0.3	0	-0.9	62	50	-68.2

Average		59			316			0.48			-4.4
St. Dev.		60.9			312.4			1.7			45.6
Median		29			255			-0.57			-2.3
Minimum		0			-128			-0.85			-73
Maximum		206			1190			4.8			109
# of Measurements		20			20			20			20

Exterior Walls Sum of Fraction Results							
	Direct Reading		Dry Smear		Dose Rate	SOF_t	SOF_r
	Alpha	Beta	Alpha	Beta			
Survey Grid	dpm/100 cm2	dpm/100 cm2	dpm/100 cm2	dpm/100 cm2	uR/h		
V9	59	49.6	2.0	-5.7	11	0.0217	0.0020
V10	0	155.9	-0.9	-10.2	11	0.0312	0.0000
V11	15	70.9	-0.9	-62.5	11	0.0171	0.0000
V12	29	35.4	-0.9	1.1	11	0.0130	0.0011
W37	88	262.2	-0.9	-17.0	11	0.0701	0.0000
W38 (1)	44	333.0	2.0	109.1	11	0.0754	0.1111
W38 (2)	206	510.2	2.0	-72.7	11	0.1432	0.0020
W42	29	-21.3	2.0	6.8	11	0.0059	0.0088
W44	15	488.9	2.0	-11.4	11	0.1007	0.0020
W44 (1)	29	226.8	-0.9	46.6	11	0.0512	0.0466
W44 (2)	206	496.0	4.8	29.5	11	0.1404	0.0344
X10	162	177.2	-0.9	-51.1	11	0.0678	0.0000
X12 (1)	59	382.7	2.0	17.0	11	0.0883	0.0190
X12 (2)	44	1190.5	-0.9	35.2	11	0.2469	0.0352
X12 (3)	29	871.6	-0.9	29.5	11	0.1802	0.0295
X12 (4)	59	70.9	-0.3	12.5	11	0.0259	0.0125
X12 (5)	29	-127.6	-0.3	18.2	11	0.0059	0.0182
Y14	15	248.0	2.0	-61.4	11	0.0525	0.0020
Y20	29	467.7	-0.9	-34.1	11	0.0994	0.0000
Y28	29	425.2	-0.9	-68.2	11	0.0909	0.0000
Average	59	316	0.48	-4.4	11	0.076	0.016
St. Dev.	60.9	312.4	1.7	45.6	0.0	0.063	0.027
Median	29	255	-0.57	-2.3	11	0.069	0.0020
Minimum	0	-128	-0.85	-73	11	0.0059	0.0
Maximum	206	1190	4.8	109	11	0.25	0.11
# of Measurements	20	20	20	20	20	20	20

Appendix B:
Field Survey Data Sheets
Electronic Files

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Appendix C
Laboratory Analytical Results

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EBERLINE SERVICES

EBERLINE ANALYTICAL CORPORATION
2030 Wright Avenue
Richmond, California 94804-3849
Phone (510) 235-2633 Fax (510) 235-0438
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www.eberlineservices.com

June 12, 2008

Mr. Tony Mason
Cabrera Services
3620 N. Rancho Dr, Ste. 114
Las Vegas, NV 89130

Ref: Cabrera P.O. 114579 CA 010
Eberline Services Report R805157-8215

Dear Mr. Mason:

Enclosed are tritium results for fifty filter samples received at Eberline Services on May 20, 2008. The samples were analyzed by direct liquid scintillation counting i.e. the received samples were placed in counting vials with scintillation cocktail and counted. No problems were encountered during the analyses, all QC sample results were within the control limits described in Eberline Services Quality Control Procedures Manual.

Please call if you have any questions concerning the enclosed report.

Regards,

Melissa Mannion
Senior Program Manager

MCM/njv

Enclosure: Report/CoC

Eberline Services

ANALYSIS RESULTS

SDG 8215 Client CABRERA SERV
Work Order R805157-01 Contract 114579 CA 010
Received Date 05/20/08 Matrix FILTER

Client Sample ID	Lab Sample ID	Collected	Analyzed	Nuclide	Results ± 2σ	Units	MDA
A-10	8215-001	05/16/08	05/30/08	H-3	0.063 ± 1.4	DPM/Smpl	2.33
A-15	8215-002	05/16/08	05/30/08	H-3	-0.472 ± 1.3	DPM/Smpl	2.27
A-23	8215-003	05/16/08	05/30/08	H-3	-0.347 ± 1.3	DPM/Smpl	2.26
A-24	8215-004	05/16/08	05/30/08	H-3	0.495 ± 1.4	DPM/Smpl	2.28
A-28	8215-005	05/16/08	05/30/08	H-3	1.73 ± 1.5	DPM/Smpl	2.43
A-32	8215-006	05/16/08	05/30/08	H-3	-0.227 ± 1.3	DPM/Smpl	2.28
A-40	8215-007	05/16/08	05/30/08	H-3	0.130 ± 1.4	DPM/Smpl	2.40
A-47	8215-008	05/16/08	05/30/08	H-3	-0.061 ± 1.3	DPM/Smpl	2.24
A-50	8215-009	05/16/08	05/30/08	H-3	-0.251 ± 1.4	DPM/Smpl	2.32
A-52	8215-010	05/16/08	05/30/08	H-3	0.249 ± 1.4	DPM/Smpl	2.29
A-54	8215-011	05/16/08	05/30/08	H-3	-0.471 ± 1.3	DPM/Smpl	2.26
A-60	8215-012	05/16/08	05/30/08	H-3	0.021 ± 1.4	DPM/Smpl	2.32
A-66	8215-013	05/16/08	05/29/08	H-3	0.906 ± 1.5	DPM/Smpl	2.45
A-70	8215-014	05/16/08	05/29/08	H-3	0.579 ± 1.5	DPM/Smpl	2.45
B-10	8215-015	05/16/08	05/29/08	H-3	0.145 ± 1.5	DPM/Smpl	2.45
D-4	8215-016	05/16/08	05/29/08	H-3	-0.533 ± 1.4	DPM/Smpl	2.40
E-29	8215-017	05/16/08	05/29/08	H-3	10.5 ± 1.7	DPM/Smpl	2.46
E-43	8215-018	05/16/08	05/29/08	H-3	-1.17 ± 1.4	DPM/Smpl	2.40
F-42	8215-019	05/16/08	05/29/08	H-3	-0.213 ± 1.4	DPM/Smpl	2.40
H-1	8215-020	05/16/08	05/29/08	H-3	17.5 ± 1.9	DPM/Smpl	2.49

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Report Date 06/11/08
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Eberline Services

ANALYSIS RESULTS

SDG 8215 | Client CABRERA SERV
Work Order R805157-01 | Contract 114579 CA 010
Received Date 05/20/08 | Matrix FILTER

Client Sample ID	Lab Sample ID	Collected	Analyzed	Nuclide	Results ± 2σ	Units	MDA
H-2	8215-021	05/16/08	05/29/08	H-3	34.9 ± 2.3	DPM/Smpl	2.64
H-10	8215-022	05/16/08	05/29/08	H-3	9.07 ± 2.1	DPM/Smpl	3.20
H-12	8215-023	05/16/08	05/29/08	H-3	11.7 ± 1.8	DPM/Smpl	2.52
H-16	8215-024	05/16/08	05/30/08	H-3	18.4 ± 2.0	DPM/Smpl	2.60
H-25	8215-025	05/16/08	05/30/08	H-3	3.80 ± 1.6	DPM/Smpl	2.51
H-32	8215-026	05/16/08	05/30/08	H-3	46.9 ± 2.6	DPM/Smpl	2.61
H-33	8215-027	05/16/08	06/05/08	H-3	15.5 ± 2.3	DPM/Smpl	3.23
H-34	8215-028	05/16/08	05/30/08	H-3	26.3 ± 2.7	DPM/Smpl	3.43
H-35	8215-029	05/16/08	05/30/08	H-3	1.98 ± 1.6	DPM/Smpl	2.54
J-6	8215-030	05/16/08	05/30/08	H-3	1.24 ± 1.5	DPM/Smpl	2.51
J-7	8215-031	05/16/08	05/30/08	H-3	7.99 ± 1.7	DPM/Smpl	2.53
K-1	8215-032	05/16/08	05/30/08	H-3	4.03 ± 1.6	DPM/Smpl	2.53
L-1	8215-033	05/16/08	05/30/08	H-3	5.33 ± 1.7	DPM/Smpl	2.62
M-28	8215-034	05/16/08	05/30/08	H-3	7.67 ± 1.7	DPM/Smpl	2.51
N-4	8215-035	05/16/08	05/30/08	H-3	1.93 ± 1.5	DPM/Smpl	2.48
N-7	8215-036	05/16/08	05/30/08	H-3	2.73 ± 1.6	DPM/Smpl	2.62
N-10	8215-037	05/16/08	05/30/08	H-3	3.62 ± 1.6	DPM/Smpl	2.53
N-13	8215-038	05/16/08	05/30/08	H-3	2.94 ± 1.6	DPM/Smpl	2.54
N-15	8215-039	05/16/08	05/29/08	H-3	3.33 ± 1.6	DPM/Smpl	2.51
N-16	8215-040	05/16/08	05/29/08	H-3	1.57 ± 1.5	DPM/Smpl	2.46

Certified by
Report Date 06/11/08

Eberline Services

ANALYSIS RESULTS

SDG 8215 Client CABRERA SERV
Work Order R805157-01 Contract 114579 CA 010
Received Date 05/20/08 Matrix FILTER

Client Sample ID	Lab Sample ID	Collected	Analyzed	Nuclide	Results ± 2σ	Units	MDA
N-18	8215-041	05/16/08	05/29/08	H-3	0.808 ± 1.4	DPM/Smpl	2.29
N-19	8215-042	05/16/08	05/29/08	H-3	2.39 ± 1.5	DPM/Smpl	2.45
N-20	8215-043	05/16/08	05/29/08	H-3	2.05 ± 1.6	DPM/Smpl	2.64
N-21	8215-044	05/16/08	05/29/08	H-3	1.50 ± 1.4	DPM/Smpl	2.36
P-2	8215-045	05/16/08	05/29/08	H-3	1.62 ± 1.4	DPM/Smpl	2.30
P-3	8215-046	05/16/08	05/29/08	H-3	1.25 ± 1.4	DPM/Smpl	2.30
R-2	8215-047	05/16/08	05/29/08	H-3	1.26 ± 1.4	DPM/Smpl	2.32
R-4	8215-048	05/16/08	05/29/08	H-3	2.27 ± 1.4	DPM/Smpl	2.27
S-4	8215-049	05/16/08	05/29/08	H-3	1.92 ± 1.4	DPM/Smpl	2.27
A-41	8215-050	05/16/08	05/29/08	H-3	1.14 ± 1.5	DPM/Smpl	2.44

Certified by
Report Date 06/11/08
Page 3

Eberline Services

QC RESULTS

SDG 8215 | Client CABRERA SERV
Work Order R805157-01 | Contract 114579 CA 010
Received Date 05/20/08 | Matrix FILTER

Lab Sample ID	Nuclide	Results	Units	Amount Added	MDA	Evaluation
LCS						
8215-051	H-3	594 ± 19	DPM/Smpl	523	6.92	114% recovery
BLANK						
8215-052	H-3	-0.796 ± 1.3	DPM/Smpl	NA	2.32	<MDA
LCS						
8215-054	H-3	580 ± 8.3	DPM/Smpl	523	3.10	111% recovery
BLANK						
8215-055	H-3	-0.134 ± 1.4	DPM/Smpl	NA	2.43	<MDA
LCS						
8215-057	H-3	553 ± 7.3	DPM/Smpl	523	2.65	106% recovery
BLANK						
8215-058	H-3	0.606 ± 1.4	DPM/Smpl	NA	2.34	<MDA

DUPLICATES				ORIGINALS					
								3σ	
Sample ID	Nuclide	Results ± 2σ	MDA	Sample ID	Results ± 2σ	MDA	RPD	(Tot)	Eval
8215-053	H-3	-0.580 ± 1.3	2.30	8215-006	-0.227 ± 1.3	2.28	-	0	satis.
8215-056	H-3	19.4 ± 2.4	3.12	8215-027	15.5 ± 2.3	3.23	22	36	satis.
8215-059	H-3	0.825 ± 1.4	2.32	8215-049	1.92 ± 1.4	2.27	-	0	satis.

Certified by
Report Date 06/11/08
Page 4

Eberline Services – Richmond

Chain of Custody

CLIENT: Cabrera Services
ADDRESS: 3620 N. Rancho Dr
Suite 114 LV, NV 89130
PROJECT: SSFL

PURCHASE ORDER NO. _____

DATE 5-16-08 PAGE 1 OF 5

TAT (IN DAYS) 30

SAMPLERS SIGNATURE: D A Davis

SAMPLE NO.	DATE	TIME	LOCATION	H^3	SAMPLE TYPE OR MATRIX	# CONTAINERS	OBSERVATIONS, COMMENTS, VOLUMES, SPECIAL OR ADDITIONAL TEST
A-10	5-16-08	0800	SSFL	✓	Filter		
A-15		0802		✓			
A-23		0804		✓			
A-24		0806		✓			
A-28		0808		✓			
A-32		0810		✓			
A-40		0812		✓			
A-47		0814		✓			
A-50		0816		✓			
A-52		0818		✓			
A-54		0820		✓			
A-60	5-16-08	0822		✓			

PARAMETERS

1) RELINQUISHED BY / DATE: DADavis 5-16-08
COMPANY: Cabrera

2) RECEIVED BY / DATE: 05/20/08
COMPANY: EBERLINE

3) RELINQUISHED BY / DATE:
COMPANY:

4) RECEIVED BY / DATE:
COMPANY:

5) RELINQUISHED BY / DATE:
COMPANY:

6) RECEIVED BY / DATE:
COMPANY:

7) RELINQUISHED BY / DATE:
COMPANY:

8) RECEIVED BY / DATE:
COMPANY:

TOTAL NO. OF CONTAINERS: 1

METHOD OF SHIPMENT: FedEx

SPECIAL SHIPMENT-HANDLING, STORAGE REQUIREMENTS, OR POSSIBLE HAZARDS

2030 Wright Avenue P.O. Box 4040 Richmond, CA 94804-0040 (510) 235-2633 FAX No. (510) 235-0438

Eberline Services – Richmond

Chain of Custody

CLIENT: Cabrera Services

ADDRESS: 3620 N. Rancho Dr
Suite 114 LV, NV 89130

PROJECT: SSFL

SAMPLERS SIGNATURE: David A Dan

PURCHASE ORDER NO. _____

DATE 5-16-08 PAGE 2 OF 5

TAT (IN DAYS) 30

SAMPLE NO.	DATE	TIME	LOCATION	MI	SAMPLE TYPE OR MATRIX	# CONTAINERS	OBSERVATIONS, COMMENTS, VOLUMES, SPECIAL OR ADDITIONAL TEST
A-66	5-16-08	0824	SSFL	✓	Filter		
A-70		0826		✓			
B-10		0828		✓			
D-4		0830		✓			
E-29		0832		✓			
E-43		0834		✓			
F-42		0836		✓			
H-1		0838		✓			
H-2		0840		✓			
H-10		0842		✓			
H-12		0844		✓			
H-16	5-16-08	0846		✓	Filter		

PARAMETERS

1) RELINQUISHED BY / DATE:	2) RECEIVED BY / DATE:	3) RELINQUISHED BY / DATE:	4) RECEIVED BY / DATE:	TOTAL NO. OF CONTAINERS: 1
David A Dan 5-16-08	05/20/08			METHOD OF SHIPMENT: FEDEX
COMPANY: Cabrera	COMPANY: EBERLINE	COMPANY:	COMPANY:	SPECIAL SHIPMENT-HANDLING, STORAGE REQUIREMENTS, OR POSSIBLE HAZARDS
5) RELINQUISHED BY / DATE:	6) RECEIVED BY / DATE:	7) RELINQUISHED BY / DATE:	8) RECEIVED BY / DATE:	
COMPANY:	COMPANY:	COMPANY:	COMPANY:	

2030 Wright Avenue P.O. Box 4040 Richmond, CA 94804-0040 (510) 235-2633 FAX No. (510) 235-0438

Eberline Services – Richmond

Chain of Custody

CLIENT: Cabrera Services

ADDRESS: 3620 N. Rancho Dr
Suite 114 LV, NV 89130

PROJECT: SSFL

PURCHASE ORDER NO. _____

DATE 5/16/08 PAGE 3 OF 5

TAT (IN DAYS) 30

SAMPLERS SIGNATURE: DhOm

SAMPLE NO.	DATE	TIME	LOCATION	H-3	SAMPLE TYPE OR MATRIX	# CONTAINERS	OBSERVATIONS, COMMENTS, VOLUMES, SPECIAL OR ADDITIONAL TEST
H-25	5-16-08	0848	SSFL	✓	Filter		
H-32		0850		✓			
H-33		0852		✓			
H-34		0854		✓			
H-35		0856		✓			
J-6		0858		✓			
J-7		0900		✓			
K-1		0902		✓			
L-1		0904		✓			
M-28		0906		✓			
N-4		0908		✓			
N-7	5-16-08	0910		✓			

1) RELINQUISHED BY / DATE: DhOm 5-16-08
COMPANY: Cabrera

2) RECEIVED BY / DATE: MTW 05/20/08
COMPANY: EBERLINE

3) RELINQUISHED BY / DATE:
COMPANY:

4) RECEIVED BY / DATE:
COMPANY:

TOTAL NO. OF CONTAINERS: 1

METHOD OF SHIPMENT: FEDEX

5) RELINQUISHED BY / DATE:
COMPANY:

6) RECEIVED BY / DATE:
COMPANY:

7) RELINQUISHED BY / DATE:
COMPANY:

8) RECEIVED BY / DATE:
COMPANY:

SPECIAL SHIPMENT-HANDLING, STORAGE REQUIREMENTS, OR POSSIBLE HAZARDS

2030 Wright Avenue P.O. Box 4040 Richmond, CA 94804-0040 (510) 235-2633 FAX No. (510) 235-0438

Eberline Services – Richmond

Chain of Custody

CLIENT: Cabrera Services

ADDRESS: 3620 N. Rancho Dr
Suite 114 LV, NV 89130

PROJECT: SSFL

SAMPLERS SIGNATURE: DA Dam

PURCHASE ORDER NO. _____

PARAMETERS

BB
DATE 4 PAGE 4 OF 5
5/16/08
TAT (IN DAYS) 30

SAMPLE NO.	DATE	TIME	LOCATION	H-3												SAMPLE TYPE OR MATRIX	# CONTAINERS	OBSERVATIONS, COMMENTS, VOLUMES, SPECIAL OR ADDITIONAL TEST
N-10	5-16-08	0912		✓												Filter		
N-13		0914		✓														
N-15		0916		✓														
N-16		0918		✓														
N-18		0920		✓														
N-19		0922		✓														
N-20		0924		✓														
N-21		0926		✓														
P-2		0928		✓														
P-3		0930		✓														
R-2		0932		✓														
R-4	5-16-08	0934		✓												↓		

1) RELINQUISHED BY / DATE:	2) RECEIVED BY / DATE:	3) RELINQUISHED BY / DATE:	4) RECEIVED BY / DATE:	TOTAL NO. OF CONTAINERS: 1
DA Dam 5-16-08	FW 05/20/08			METHOD OF SHIPMENT: FEDEX
COMPANY: Cabrera	COMPANY: EBERLINE	COMPANY:	COMPANY:	SPECIAL SHIPMENT-HANDLING, STORAGE REQUIREMENTS, OR POSSIBLE HAZARDS
5) RELINQUISHED BY / DATE:	6) RECEIVED BY / DATE:	7) RELINQUISHED BY / DATE:	8) RECEIVED BY / DATE:	
COMPANY:	COMPANY:	COMPANY:	COMPANY:	

2030 Wright Avenue P.O. Box 4040 Richmond, CA 94804-0040 (510) 235-2633 FAX No. (510) 235-0438

Eberline Services – Richmond

Chain of Custody

CLIENT: Cabrera Services

ADDRESS: 3620 N. Rancho Dr
Suite 114 LV, NV 89130

PROJECT: SSFL

SAMPLERS SIGNATURE: DA Da

PURCHASE ORDER NO. _____

DATE 5-16-08 PAGE 15 OF 5

TAT (IN DAYS) 30

SAMPLE NO.	DATE	TIME	LOCATION	H3	SAMPLE TYPE OR MATRIX	# CONTAINERS	OBSERVATIONS, COMMENTS, VOLUMES, SPECIAL OR ADDITIONAL TEST
S-4	5-16-08	0936		✓	Filter ~~Filter~~ BB		
A-41	5-16-08	0938		✓	Filter		
		A					
	N						

1) RELINQUISHED BY / DATE: DA Da 5-16-08
COMPANY: Cabrera

2) RECEIVED BY / DATE: [illegible] 05/20/08
COMPANY: EBERLINE

3) RELINQUISHED BY / DATE:
COMPANY:

4) RECEIVED BY / DATE:
COMPANY:

5) RELINQUISHED BY / DATE:
COMPANY:

6) RECEIVED BY / DATE:
COMPANY:

7) RELINQUISHED BY / DATE:
COMPANY:

8) RECEIVED BY / DATE:
COMPANY:

TOTAL NO. OF CONTAINERS: 1

METHOD OF SHIPMENT: FEDEX

SPECIAL SHIPMENT-HANDLING, STORAGE REQUIREMENTS, OR POSSIBLE HAZARDS

2030 Wright Avenue P.O. Box 4040 Richmond, CA 94804-0040 (510) 235-2633 FAx No. (510) 235-0438

EBERLINE SERVICES

RICHMOND, CA LABORATORY

SAMPLE RECEIPT CHECKLIST

JK 5/20/08

Client: CABRERA SERVICES City LAS VEGAS State NV

Date/Time received 05/20/08 09:30 CoC No. SSFL

Container I.D. No. ICE CHEST Requested TAT (Days) 30 P.O. Received Yes [ ] No [ ]

INSPECTION

1. Custody seals on shipping container intact? Yes [ ] No [ ] N/A [X]
2. Custody seals on shipping container dated & signed? Yes [ ] No [ ] N/A [X]
3. Custody seals on sample containers intact? Yes [ ] No [ ] N/A [X]
4. Custody seals on sample containers dated & signed? Yes [ ] No [ ] N/A [X]
5. Packing material is: Wet [ ] Dry [X]
6. Number of samples in shipping container: 50 Sample Matrix M
7. Number of containers per sample: 1 (Or see CoC _____)
8. Samples are in correct container Yes [Y] No [ ]
9. Paperwork agrees with samples? Yes [X] No [ ]
10. Samples have: Tape [ ] Hazard labels [ ] Rad labels [ ] Appropriate sample labels [X]
11. Samples are: In good condition [X] Leaking [ ] Broken Container [ ] Missing [ ]
12. Samples are: Preserved [ ] Not preserved [ ] pH _____ Preservative _____
13. Describe any anomalies:

14. Was P.M. notified of any anomalies? Yes [ ] No [ ] Date _____
15. Inspected by JKW Date: 05/20/08 Time: 11:50

Customer Sample No.	Beta/Gamma cpm	Ion Chamber mR/hr	Wipe	Customer Sample No.	Beta/Gamma cpm	Ion Chamber mR/hr	wipe
ALL SAMPLES	<LLD						

Ion Chamber Ser. No. _____ Calibration date _____

Alpha Meter Ser. No. _____ Calibration date _____

Beta/Gamma Meter Ser. No. 113722 Calibration date 13 SEP 08

Appendix D:
Field Survey Instrumentation QC Data

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Equipment Chi-Square Distribution Worksheet

Count No.	X_i	X_m-X_i	$(X_m-X_i)^2$
1	5731	-96.4	9292.96
2	5627	7.6	57.76
3	5726	-91.4	8353.96
4	5500	134.6	18117.16
5	5602	32.6	1062.76
6	5634	0.6	0.36
7	5657	-22.4	501.76
8	5689	-54.4	2959.36
9	5597	37.6	1413.76
10	5635	-0.4	0.16
11	5649	-14.4	207.36
12	5684	-49.4	2440.36
13	5618	16.6	275.56
14	5583	51.6	2662.56
15	5568	66.6	4435.56
16	5662	-27.4	750.76
17	5575	59.6	3552.16
18	5756	-121.4	14737.96
19	5517	117.6	13829.76
20	5682	-47.4	2246.76
Sum total	112692		86898.8
X_m	5634.6		

Instrument/Detector	2360 w/43-68
Serial # / Serial#	184951/ PR126794
Date Performed	13-May-08
Count time interval (minutes)	1
Source Used	TH-230

X^2 = 15.42

Note: Accept χ^2 if between 8.91 and 32.8

Instrument Efficiency Calculator (Rev 2)

PROJECT NAME

Boeing SSFL RMHF Building Survey

ISOTOPE	SOURCE ID #:	SOURCE CREATION DATE:
Th-230	4006-02	6/26/2002

Initial Source DPM	half life, yrs	Decay-to-Date	lamda, yr-1	decay, yrs	DPM on Date Efficiency Performed
26,100	7.54E+04	4/28/2008	9.193E-06	5.84	**26099**

Source µCi	half life, yrs	Decay-to-Date	lamda, yr-1	decay, yrs	µCi on Date Efficiency Performed

Average background counts, cpm	Average Source plus background counts, cpm	DPM Based Calculated Efficiency, cpm/dpm	µCi Based Calculated Efficiency, cpm/dpm
1.4	4244.0	**0.163**	

For:

Instrument/Probe	Ludlum 2360	w/43-68
Serial numbers	184933/ PR 190490	

By:

Name	Date Performed
B. Badaoui	4/8/2008

	Background Counts, cpm	Source plus Background Counts, cpm
	2	4175
	0	4256
	3	4141
	0	4285
	0	4151
	1	4379
	1	4212
	2	4364
	3	4212
	2	4265
Average	1.4	4244.0

Equipment Chi-Square Distribution Worksheet

Count No.	X_i	X_m-X_i	$(X_m-X_i)^2$
1	4827	193.45	37422.90
2	4977	43.45	1887.90
3	5014	6.45	41.60
4	5082	-61.55	3788.40
5	5116	-95.55	9129.80
6	5093	-72.55	5263.50
7	4974	46.45	2157.60
8	4999	21.45	460.10
9	5019	1.45	2.10
10	5114	-93.55	8751.60
11	5043	-22.55	508.50
12	5023	-2.55	6.50
13	4941	79.45	6312.30
14	5119	-98.55	9712.10
15	4964	56.45	3186.60
16	5011	9.45	89.30
17	4991	29.45	867.30
18	4982	38.45	1478.40
19	5038	-17.55	308.00
20	5082	-61.55	3788.40
Sum total	100409		95163.0
X_m	5020.5		

Instrument/Detector	2360 w/43-68
Serial # / Serial#	184933/ PR190490
Date Performed	12-May-08
Count time interval (minutes)	1
Source Used	Tc-99

X^2 = 18.96

Note: Accept χ^2 if between 8.91 and 32.8

Instrument Efficiency Calculator (Rev 2)

PROJECT NAME

Boeing SSFL RMHF Building Survey

ISOTOPE	SOURCE ID #:	SOURCE CREATION DATE:
Tc-99	4003-02	6/26/2002

Initial Source DPM	half life, yrs	Decay-to-Date	lamda, yr-1	decay, yrs	DPM on Date Efficiency Performed
21,800	2.11E+05	4/28/2008	3.285E-06	5.84	**21800**

Source µCi	half life, yrs	Decay-to-Date	lamda, yr-1	decay, yrs	µCi on Date Efficiency Performed

Average background counts, cpm	Average Source plus background counts, cpm	DPM Based Calculated Efficiency, cpm/dpm	µCi Based Calculated Efficiency, cpm/dpm
131.5	5021.5	**0.224**	

For:

Instrument/Probe	Ludlum 2360	w/43-68
Serial numbers	184933/ PR 190490	

By:

Name	Date Performed
B. Badaoui	4/8/2008

	Background Counts, cpm	Source plus Background Counts, cpm
	129	4827
	137	4977
	120	5014
	141	5082
	130	5116
	114	5093
	143	4974
	126	4999
	130	5019
	145	5114
Average	131.5	5021.5

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 2)

Counting Instrument:	Ludlum 2360	Detector:	43-68	Cal. Date:	4/22/2008
Serial #:	184933	Serial #:	PR190490	Cal. Due Date OK?	OK
Detector Active Area or Area Covered by Smear (cm^2):	100				

	Efficiency (fraction)	Source Nuclide	Source Number	Original Source Activity (DPM)	Source Creation Date	$T_{1/2}$ (yr)	Source Decayed Activity	Required MDA (DPM/100cm^2)	Control Chart & Daily Bkg Count Time	Control Chart & Daily Source-Sample Count Time	Control Chart bkg Average α/β cpm	Control Chart bkg 1 sigma, cpm	Control Chart Source-bkg Average α/β cpm	Control Chart source 1 sigma, cpm
Alpha	0.1630	Th-230	4006-02	26,100	6/26/2002	7.70E+04	26,099	2500	1	1	1.40	1.17	4318.3	103.31
Beta	0.2240	Tc-99	4003-02	21,800	6/26/2002	2.13E+05	21,800	2500	1	1	131.50	10.08	4890.0	87.64

Date	Daily Bkg Counts		Daily Check Source Counts		Daily Bkg Rate (cpm)		Net Daily Source Rate (cpm)		Bkg QC Pass/Fail		Source QC Pass/Fail				α MDA OK?	β MDA OK?
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	MDA α (dpm)	MDA β (dpm)		
5/12/2008	1	113	4377	5048	1.0	113.0	4376.0	4935.0	PASS	PASS	PASS	PASS	46.95	234	Yes	Yes
5/13/2008	1	128	4502	5104	1.0	128.0	4501.0	4976.0	PASS	PASS	PASS	PASS	46.95	248	Yes	Yes
5/14/2008	0	115	4296	5061	0.0	115.0	4296.0	4946.0	PASS	PASS	PASS	PASS	18.40	236	Yes	Yes
5/15/2008	1	126	4416	5141	1.0	126.0	4415.0	5015.0	PASS	PASS	PASS	PASS	46.95	247	Yes	Yes
5/16/2008	1	144	4520	5132	1.0	144.0	4519.0	4988.0	PASS	PASS	PASS	PASS	46.95	263	Yes	Yes
5/19/2008	0	134	4378	5098	0.0	134.0	4378.0	4964.0	PASS	PASS	PASS	PASS	18.40	254	Yes	Yes

Ludlum Model 2360, Serial #184933

Initial Background and Source Counts for Control Chart								
	Initial bkg counts				Initial source plus bkg counts			
#	Alpha	cpm	Beta	cpm	Alpha	cpm	Beta	cpm
1	2.00	2	129.00	129	4175	4175	4827	4827
2	0.00	0	137.00	137	4276	4276	4977	4977
3	3.00	3	120.00	120	4482	4482	5014	5014
4	0.00	0	141.00	141	4482	4482	5082	5082
5	0.00	0	130.00	130	4256	4256	5116	5116
6	1.00	1	114.00	114	4242	4242	5093	5093
7	1.00	1	143.00	143	4363	4363	4974	4974
8	2.00	2	126.00	126	4379	4379	4999	4999
9	3.00	3	130.00	130	4285	4285	5019	5019
10	2.00	2	145.00	145	4257	4257	5114	5114
Mean		1.40		131.5		4319.7		5021.5
$S_{(n-1)}$		1.17		10.08		103.36		87.49
-3 sigma		-2.12		101.26		4009.62		4759.02
+3 sigma		4.92		161.74		4629.78		5283.98
-2 sigma		-0.95		111.34		4112.98		4846.51
+2 sigma		3.75		151.66		4526.42		5196.49
					Mean-bkg	4318.3		4890.0
					$S_{(n-1)}$	103.31		87.64
				Mean-bkg	-3 sigma	4008.36		4627.07
				Mean-bkg	+3 sigma	4628.24		5152.93
				Mean-bkg	-2 sigma	4111.68		4714.72
				Mean-bkg	+2 sigma	4524.92		5065.28

Equipment Chi-Square Distribution Worksheet

Count No.	X_i	X_m-X_i	$(X_m-X_i)^2$
1	4175	57.4	3294.76
2	4276	-43.6	1900.96
3	4193	39.4	1552.36
4	4190	42.4	1797.76
5	4256	-23.6	556.96
6	4242	-9.6	92.16
7	4141	91.4	8353.96
8	4245	-12.6	158.76
9	4285	-52.6	2766.76
10	4257	-24.6	605.16
11	4265	-32.6	1062.76
12	4282	-49.6	2460.16
13	4103	129.4	16744.36
14	4151	81.4	6625.96
15	4379	-146.6	21491.56
16	4141	91.4	8353.96
17	4128	104.4	10899.36
18	4364	-131.6	17318.56
19	4363	-130.6	17056.36
20	4212	20.4	416.16
Sum total	84648		123508.8
X_m	4232.4		

Instrument/Detector	2360 w/43-68
Serial # / Serial#	184933/ PR190490
Date Performed	12-May-08
Count time interval (minutes)	1
Source Used	TH-230

X^2 = 29.18

Note: Accept χ^2 if between 8.91 and 32.8

Instrument Efficiency Calculator (Rev 2)

PROJECT NAME

Boeing SSFL RMHF Building Survey

ISOTOPE	SOURCE ID #:	SOURCE CREATION DATE:
Th-230	4006-02	6/26/2002

Initial Source DPM	half life, yrs	Decay-to-Date	lamda, yr-1	decay, yrs	DPM on Date Efficiency Performed
26,100	7.54E+04	4/28/2008	9.193E-06	5.84	**26099**

Source µCi	half life, yrs	Decay-to-Date	lamda, yr-1	decay, yrs	µCi on Date Efficiency Performed

Average background counts, cpm	Average Source plus background counts, cpm	DPM Based Calculated Efficiency, cpm/dpm	µCi Based Calculated Efficiency, cpm/dpm
0.9	5631.1	**0.216**	

For:

Instrument/Probe	Ludlum 2360	w/43-68
Serial numbers	184951 w/ PR126794	

By:

Name	Date Performed
B. Badaoui	4/8/2008

	Background Counts, cpm	Source plus Background Counts, cpm
	0	5726
	0	5500
	0	5602
	1	5634
	0	5657
	0	5662
	2	5575
	2	5756
	3	5517
	1	5682
Average	0.9	5631.1

Equipment Chi-Square Distribution Worksheet

Count No.	X_i	X_m-X_i	$(X_m-X_i)^2$
1	5108	-31.65	1001.72
2	4940	136.35	18591.32
3	4999	77.35	5983.02
4	5031	45.35	2056.62
5	5165	-88.65	7858.82
6	5136	-59.65	3558.12
7	5066	10.35	107.12
8	5243	-166.65	27772.22
9	4975	101.35	10271.82
10	5036	40.35	1628.12
11	5100	-23.65	559.32
12	5044	32.35	1046.52
13	4990	86.35	7456.32
14	5134	-57.65	3323.52
15	5265	-188.65	35588.82
16	5049	27.35	748.02
17	5033	43.35	1879.22
18	5009	67.35	4536.02
19	5050	26.35	694.32
20	5154	-77.65	6029.52
Sum total	101527		140690.6
X_m	5076.4		

Instrument/Detector	2360 w/43-68
Serial # / Serial#	184951/ PR126794
Date Performed	8-May-08
Count time interval (minutes)	1
Source Used	Tc-99

X^2 = 27.71

Note: Accept χ^2 if between 8.91 and 32.8

Instrument Efficiency Calculator (Rev 2)

PROJECT NAME

Boeing SSFL RMHF Building Survey

ISOTOPE	SOURCE ID #:	SOURCE CREATION DATE:
Tc-99	4003-02	6/26/2002

Initial Source DPM	half life, yrs	Decay-to-Date	lamda, yr-1	decay, yrs	DPM on Date Efficiency Performed
21,800	2.11E+05	4/28/2008	3.285E-06	5.84	**21800**

Source µCi	half life, yrs	Decay-to-Date	lamda, yr-1	decay, yrs	µCi on Date Efficiency Performed

Average background counts, cpm	Average Source plus background counts, cpm	DPM Based Calculated Efficiency, cpm/dpm	µCi Based Calculated Efficiency, cpm/dpm
185.9	5069.9	**0.224**	

For:

Instrument/Probe	Ludlum 2360	w/43-68
Serial numbers	184951 w/ PR126794	

By:

Name	Date Performed
B. Badaoui	4/8/2008

	Background Counts, cpm	Source plus Background Counts, cpm
	206	5108
	200	4940
	187	4999
	189	5031
	183	5165
	158	5136
	189	5066
	170	5243
	199	4975
	178	5036
Average	185.9	5069.9

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 2)

Counting Instrument:	Ludlum 2360	Detector:	43-68	Cal. Date:	1/30/2008
Serial #:	184951	Serial #:	PR126794	Cal. Due Date OK?	OK
Detector Active Area or Area Covered by Smear (cm^2):	100				

	Efficiency (fraction)	Source Nuclide	Source Number	Original Source Activity (DPM)	Source Creation Date	$T_{1/2}$ (yr)	Source Decayed Activity	Required MDA (DPM/100cm^2)	Control Chart & Daily Bkg Count Time	Control Chart & Daily Source-Sample Count Time	Control Chart bkg Average α/β cpm	Control Chart bkg 1 sigma, cpm	Control Chart Source-bkg Average α/β cpm	Control Chart source 1 sigma, cpm
Alpha	0.2160	Th-230	4006-02	26,100	6/26/2002	7.70E+04	26,099	2500	1	1	0.90	1.10	5630.2	83.89
Beta	0.2240	Tc-99	4003-02	21,800	6/26/2002	2.13E+05	21,800	2500	1	1	185.90	14.52	4884.0	102.50

Date	Daily Bkg Counts		Daily Check Source Counts		Daily Bkg Rate (cpm)		Net Daily Source Rate (cpm)		Bkg QC Pass/Fail		Source QC Pass/Fail				α MDA OK?	β MDA OK?
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	MDA α (dpm)	MDA β (dpm)		
5/13/2008	0	187	5587	5179	0.0	187.0	5587.0	4992.0	PASS	PASS	PASS	PASS	13.89	297	Yes	Yes
5/14/2008	0	199	5610	5220	0.0	199.0	5610.0	5021.0	PASS	PASS	PASS	PASS	13.89	306	Yes	Yes
5/15/2008	1	190	5520	5087	1.0	190.0	5519.0	4897.0	PASS	PASS	PASS	PASS	35.43	300	Yes	Yes
5/16/2008	1	199	5563	5250	1.0	199.0	5562.0	5051.0	PASS	PASS	PASS	PASS	35.43	306	Yes	Yes
5/19/2008	1	189	5643	5189	1.0	189.0	5642.0	5000.0	PASS	PASS	PASS	PASS	35.43	299	Yes	Yes
5/21/2008	1	198	5730	5108	1.0	198.0	5729.0	4910.0	PASS	PASS	PASS	PASS	35.43	306	Yes	Yes

Ludlum Model 2360, Serial #184951

Initial Background and Source Counts for Control Chart								
	Initial bkg counts				Initial source plus bkg counts			
#	Alpha	cpm	Beta	cpm	Alpha	cpm	Beta	cpm
1	0.00	0	206.00	206	5726	5726	5108	5108
2	0.00	0	200.00	200	5500	5500	4940	4940
3	0.00	0	187.00	187	5602	5602	4999	4999
4	1.00	1	189.00	189	5634	5634	5031	5031
5	0.00	0	183.00	183	5657	5657	5165	5165
6	0.00	0	158.00	158	5662	5662	5136	5136
7	2.00	2	189.00	189	5575	5575	5066	5066
8	2.00	2	170.00	170	5756	5756	5243	5243
9	3.00	3	199.00	199	5517	5517	4975	4975
10	1.00	1	178.00	178	5682	5682	5036	5036
Mean		0.90		185.9		5631.1		5069.9
$S_{(n-1)}$		1.10		14.52		83.69		93.34
-3 sigma		-2.40		142.35		5380.04		4789.88
+3 sigma		4.20		229.45		5882.16		5349.92
-2 sigma		-1.30		156.86		5463.73		4883.22
+2 sigma		3.10		214.94		5798.47		5256.58
					Mean-bkg	5630.2		4884.0
					$S_{(n-1)}$	83.89		102.50
				Mean-bkg	-3 sigma	5378.52		4576.50
				Mean-bkg	+3 sigma	5881.88		5191.50
				Mean-bkg	-2 sigma	5462.41		4679.00
				Mean-bkg	+2 sigma	5797.99		5089.00

Equipment Chi-Square Distribution Worksheet

Count No.	X_i	X_m-X_i	$(X_m-X_i)^2$
1	9213	-33.3	1108.89
2	9486	-306.3	93819.69
3	9140	39.7	1576.09
4	9007	172.7	29825.29
5	9352	-172.3	29687.29
6	9069	110.7	12254.49
7	9120	59.7	3564.09
8	9237	-57.3	3283.29
9	8995	184.7	34114.09
10	9232	-52.3	2735.29
11	9085	94.7	8968.09
12	9089	90.7	8226.49
13	9163	16.7	278.89
14	9127	52.7	2777.29
15	9096	83.7	7005.69
16	9311	-131.3	17239.69
17	9153	26.7	712.89
18	9140	39.7	1576.09
19	9236	-56.3	3169.69
20	9343	-163.3	26666.89
Sum total	183594		288590.2
X_m	9179.7		

Instrument/Detector	2929
Serial # / Serial#	137607
Date Performed	28-Apr-08
Count time interval (minutes)	1
Source Used	TH-230

X^2 = 31.44

Note: Accept χ^2 if between 8.91 and 32.8

Instrument Efficiency Calculator (Rev 2)

PROJECT NAME

Boeing SSFL RMHF Building Survey

ISOTOPE	SOURCE ID #:	SOURCE CREATION DATE:
Th-230	4006-02	6/26/2002

Initial Source DPM	half life, yrs	Decay-to-Date	lamda, yr-1	decay, yrs	DPM on Date Efficiency Performed
26,100	7.54E+04	4/28/2008	9.193E-06	5.84	**26099**

Source µCi	half life, yrs	Decay-to-Date	lamda, yr-1	decay, yrs	µCi on Date Efficiency Performed

Average background counts, cpm	Average Source plus background counts, cpm	DPM Based Calculated Efficiency, cpm/dpm	µCi Based Calculated Efficiency, cpm/dpm
0.5	9185.1	**0.352**	

For:

Instrument/Probe	Ludlum 2929 w 43-10-1
Serial numbers	137607/PR142936

By:

Name	Date Performed
B. Badaoui	4/29/2008

	Background Counts, cpm	Source plus Background Counts, cpm
	0.5	9213
	0.6	9486
	0.3	9140
	0.4	9007
	1	9352
	0.7	9069
	0.3	9120
	0.6	9237
	0.1	8995
	0.8	9232
Average	0.5	9185.1

Equipment Chi-Square Distribution Worksheet

Count No.	X_i	X_m-X_i	$(X_m-X_i)^2$
1	3932	-22.25	495.06
2	3866	43.75	1914.06
3	3905	4.75	22.56
4	3864	45.75	2093.06
5	3910	-0.25	0.06
6	3980	-70.25	4935.06
7	3843	66.75	4455.56
8	3997	-87.25	7612.56
9	3808	101.75	10353.06
10	3965	-55.25	3052.56
11	3918	-8.25	68.06
12	3913	-3.25	10.56
13	3875	34.75	1207.56
14	3856	53.75	2889.06
15	3809	100.75	10150.56
16	4061	-151.25	22876.56
17	3900	9.75	95.06
18	3912	-2.25	5.06
19	4005	-95.25	9072.56
20	3876	33.75	1139.06
Sum total	78195		82447.8
X_m	3909.8		

Instrument/Detector	2929
Serial # / Serial#	137607
Date Performed	28-Apr-08
Count time interval (minutes)	1
Source Used	Tc-99

X^2 = 21.09

Note: Accept χ^2 if between 8.91 and 32.8

Instrument Efficiency Calculator (Rev 2)

PROJECT NAME

Boeing SSFL RMHF Building Survey

ISOTOPE	SOURCE ID #:	SOURCE CREATION DATE:
Tc-99	4003-02	6/26/2002

Initial Source DPM	half life, yrs	Decay-to-Date	lamda, yr-1	decay, yrs	DPM on Date Efficiency Performed
21,800	2.11E+05	4/28/2008	3.285E-06	5.84	**21800**

Source µCi	half life, yrs	Decay-to-Date	lamda, yr-1	decay, yrs	µCi on Date Efficiency Performed

Average background counts, cpm	Average Source plus background counts, cpm	DPM Based Calculated Efficiency, cpm/dpm	µCi Based Calculated Efficiency, cpm/dpm
59.8	3907.0	**0.176**	

For:

Instrument/Probe	Ludlum 2929 w 43-10-1
Serial numbers	137607/PR142936

By:

Name	Date Performed
B. Badaoui	4/29/2008

	Background Counts, cpm	Source plus Background Counts, cpm
	61.1	3932
	57.4	3866
	56.7	3905
	59.5	3864
	59.5	3910
	60.3	3980
	60.7	3843
	60.2	3997
	61.8	3808
	60.5	3965
Average	59.8	3907.0

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 2)

Counting Instrument:	Ludlum 2929	Detector:	43-10-1	Cal. Date:	4/22/2008
Serial #:	137607	Serial #:	PR142936	Cal. Due Date OK?	OK
Detector Active Area or Area Covered by Smear (cm^2):	100				

	Efficiency (fraction)	Source Nuclide	Source Number	Original Source Activity (DPM)	Source Creation Date	$T_{1/2}$ (yr)	Source Decayed Activity	Required MDA (DPM/100cm^2)	Control Chart & Daily Bkg Count Time	Control Chart & Daily Source-Sample Count Time	Control Chart bkg Average α/β cpm	Control Chart bkg 1 sigma, cpm	Control Chart Source-bkg Average α/β cpm	Control Chart source 1 sigma, cpm
Alpha	0.3520	Th-230	4006-02	26,100	6/26/2002	7.70E+04	26,099	500	10	1	0.53	0.27	9184.6	153.20
Beta	0.1760	Tc-99	4003-02	21,800	6/26/2002	2.13E+05	21,800	500	10	1	59.77	1.60	3847.2	62.24

Date	Daily Bkg Counts		Daily Check Source Counts		Daily Bkg Rate (cpm)		Net Daily Source Rate (cpm)		Bkg QC Pass/Fail		Source QC Pass/Fail		MDA α (dpm)	MDA β (dpm)	α MDA OK?	β MDA OK?
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta				
4/29/2008	6	604	9147	3907	0.6	60.4	9146.4	3846.6	PASS	PASS	PASS	PASS	16.12	169	Yes	Yes
4/30/2008	3	589	9122	3895	0.3	58.9	9121.7	3836.1	PASS	PASS	PASS	PASS	13.89	168	Yes	Yes
5/1/2008	2	605	9014	3891	0.2	60.5	9013.8	3830.5	PASS	PASS	PASS	PASS	12.91	170	Yes	Yes
5/2/2008	1	574	9035	3874	0.1	57.4	9034.9	3816.6	PASS	PASS	PASS	PASS	11.62	166	Yes	Yes
5/5/2008	4	625	9099	3900	0.4	62.5	9098.6	3837.5	PASS	PASS	PASS	PASS	14.72	172	Yes	Yes
5/6/2008	9	581	9244	3802	0.9	58.1	9243.1	3743.9	PASS	PASS	PASS	PASS	17.82	166	Yes	Yes
5/7/2008	2	615	9012	3860	0.2	61.5	9011.8	3798.5	PASS	PASS	PASS	PASS	12.91	171	Yes	Yes
5/8/2008	4	603	9097	3908	0.4	60.3	9096.6	3847.7	PASS	PASS	PASS	PASS	14.72	169	Yes	Yes
5/9/2008	3	597	9066	3915	0.3	59.7	9065.7	3855.3	PASS	PASS	PASS	PASS	13.89	169	Yes	Yes
5/12/2008	1	581	9053	3959	0.1	58.1	9052.9	3900.9	PASS	PASS	PASS	PASS	11.62	166	Yes	Yes
5/13/2008	1	628	9118	3950	0.1	62.8	9117.9	3887.2	PASS	PASS	PASS	PASS	11.62	172	Yes	Yes
5/14/2008	2	614	9005	3885	0.2	61.4	9004.8	3823.6	PASS	PASS	PASS	PASS	12.91	171	Yes	Yes
5/15/2008	3	620	9068	3995	0.3	62.0	9067.7	3933.0	PASS	PASS	PASS	PASS	13.89	171	Yes	Yes
5/16/2008	3	598	9195	3998	0.3	59.8	9194.7	3938.2	PASS	PASS	PASS	PASS	13.89	169	Yes	Yes
5/19/2008	1	586	9065	3939	0.1	58.6	9064.9	3880.4	PASS	PASS	PASS	PASS	11.62	167	Yes	Yes
5/20/2008	2	600	9242	3844	0.2	60.0	9241.8	3784.0	PASS	PASS	PASS	PASS	12.91	169	Yes	Yes
5/21/2008	3	598	9256	3987	0.3	59.8	9255.7	3927.2	PASS	PASS	PASS	PASS	13.89	169	Yes	Yes

Ludlum Model 2929 Smear Counter

Initial Background and Source Counts for Control Chart								
	Initial bkg counts				Initial source plus bkg counts			
#	Alpha	cpm	Beta	cpm	Alpha	cpm	Beta	cpm
1	5.00	0.5	611.00	61.1	9213	9213	3932	3932
2	6.00	0.6	574.00	57.4	9486	9486	3866	3866
3	3.00	0.3	567.00	56.7	9140	9140	3905	3905
4	4.00	0.4	595.00	59.5	9007	9007	3864	3864
5	10.00	1	595.00	59.5	9352	9352	3910	3910
6	7.00	0.7	603.00	60.3	9069	9069	3980	3980
7	3.00	0.3	607.00	60.7	9120	9120	3843	3843
8	6.00	0.6	602.00	60.2	9237	9237	3997	3997
9	1.00	0.1	618.00	61.8	8995	8995	3808	3808
10	8.00	0.8	605.00	60.5	9232	9232	3965	3965
Mean		0.53		59.8		9185.1		3907.0
$S_{(n-1)}$		0.27		1.60		153.36		62.23
-3 sigma		-0.27		54.98		8725.02		3720.30
+3 sigma		1.33		64.56		9645.18		4093.70
-2 sigma		0.00		56.58		8878.38		3782.53
+2 sigma		1.06		62.96		9491.82		4031.47
					Mean-bkg	9184.6		3847.2
					$S_{(n-1)}$	153.20		62.24
				Mean-bkg	-3 sigma	8724.98		3660.50
				Mean-bkg	+3 sigma	9644.16		4033.96
				Mean-bkg	-2 sigma	8878.17		3722.74
				Mean-bkg	+2 sigma	9490.97		3971.72

Inst.# 104556		
QC Daily Source		
Date	Result (cpm)	P/F
4/28/2008	10	Pass
4/29/2008	10	Pass
4/30/2008	12	Pass
5/1/2008	10	Pass
5/2/2008	12	Pass
5/5/2008	12	Pass
5/6/2008	10	Pass
5/7/2008	10	Pass
5/8/2008	14	Pass
5/9/2008	14	Pass
5/12/2008	10	Pass
5/13/2008	10	Pass
5/14/2008	10	Pass
5/15/2008	10	Pass
5/16/2008	10	Pass
5/19/2008	10	Pass
5/20/2008	10	Pass

Inst.# 104556		Source Ser. #	53
Initial Source Readings		Nuclide	Co-57
Date	Result (cpm)		
4/28/2008	10		
4/28/2008	12		
4/28/2008	10		
4/28/2008	10		
4/28/2008	15		
4/28/2008	12		
4/28/2008	10		
4/28/2008	10		
4/28/2008	15		
4/28/2008	15		
	Average		
	12		

Inst.# 104556		
QC Daily Source		
Date	Result (cpm)	P/F
4/28/2008	1,000	Pass
4/29/2008	900	Pass
4/30/2008	1000	Pass
5/1/2008	900	Pass
5/2/2008	900	Pass
5/5/2008	900	Pass
5/6/2008	1000	Pass
5/7/2008	900	Pass
5/8/2008	900	Pass
5/9/2008	900	Pass
5/12/2008	900	Pass
5/13/2008	900	Pass
5/14/2008	1000	Pass
5/15/2008	900	Pass
5/16/2008	1000	Pass
5/19/2008	900	Pass
5/20/2008	1000	Pass

Inst.# 104556		Source Ser. #	1698-03
Initial Source Readings		Nuclide	Cs-137
Date	Result (cpm)		
4/28/2008	900		
4/28/2008	1,000		
4/28/2008	900		
4/28/2008	1,000		
4/28/2008	900		
4/28/2008	900		
4/28/2008	1,000		
4/28/2008	900		
4/28/2008	900		
4/28/2008	1,000		
	Average		
	940		

EBERLINE SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Beta Standard

S.O.# 3905
P.O.# 0423

Description of Standard:

Model No. DNS-12 Serial No. 4003-02 Isotope Tc-99

Electroplated on polished SS disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi beta emission rate was measured using an internal gas flow proportional chamber. Absolute counting of beta particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated beta source S/N 2148/90.

Measurement Result:

The observed beta count rate from the surface of the disc per minute (cpm) on the calibration date was:

13,600 ± 409

The total disintegration rate (dpm) assuming 25 % backscatter of beta particles from the surface of the disc, was:

21,800 ± 654 (0.00983 μCi)

The uncertainty of the measurement is 3 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST Reviewed by:

Calibration Technician: Art Reust Q.A. Representative:

Calibration Date: 6-26-2002 Reviewed Date: 6-27-02

Analytical Services
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4238
(505) 345-3461 Fax (505) 761-5416
Toll Free (866) RAD-LABS (723-5227)
www.eberlineservices.com

EBERLINE SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# 3905
P.O.# 0423

Description of Standard:

Model No. DNS-11 Serial No. 4006-02 Isotope Th-230

Electroplated on polished SS disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was:

13,200 ± 397

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc, was:

26,100 ± 783 (0.0118 μCi)

The uncertainty of the measurement is 3 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST Reviewed by:

Calibration Technician: Art Reust Q.A. Representative:

Calibration Date: 6-26-2002 Reviewed Date: 6-27-02

Analytical Services
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4238
(505) 345-3461 Fax (505) 761-5416
Toll Free (866) RAD LABS (723-5227)
www.eberlineservices.com

Certificate of Calibration

2 Channel Scaler Certificate of Calibration

Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Manufacturer: Ludlum Model: 2929 Serial No.: 137607

All Ranges Calibrated Electronically; Ludlum Pulser Generator Serial No.: 97743 ☐ 201932 ☑

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997, N323D - 2002
NMRCB Registration No. 481-3 • Calibration of Radiation Detection Instruments & Devices

☑ Mechanical ck. ☐ Meter Zeroed ☐ Geotropism ck. ☐ F/S Response ck. ☑ Audio ck.

☐ THR/WIN ck. High Voltage ck. ☑ 500v ☑ 1000v ☑ 1500v ☐ Battery ck. (min 4.4 vdc)

Alpha Threshold.: 170 mV Beta Threshold.: 4 mV Beta Window.: 50 mV

Voltage setting: 650 volts = 2.70 on HV Dial (Pot.)

Instrument found within tolerance (+/- 10%) ☐ Yes ☐ No

Reference Setting	Alpha Channel Digital Readout		Beta Channel Digital Readout	
	Instrument "As Found Reading"	Integrated Counts (1-minute count)	Instrument "As Found Reading"	Integrated Counts (1-minute count)
400 Kcpm	400 Kcpm	399843	400 Kcpm	399854
40 Kcpm	40 Kcpm	39995	40 Kcpm	39988
4 Kcpm	4 Kcpm	3999	4 Kcpm	4000
400 cpm	400 cpm	399	400 cpm	398

Calibrated By: _____ Calibration Date: 4-22-08

Calibration Due: 4-22-09

Reviewed By: _____ Date: 4/23/08

ERG Form 1.02D

Certificate of Calibration

Voltage Plateau Form

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Detector Mfg.: Ludlum Model: 43-10-1 Serial No.: PR142936

Counter Mfg.: Ludlum Model: 2929 Serial No.: 137607

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 481-3 • Calibration of Radiation Detection Instruments & Devices

Alpha Threshold: 170 mV Beta Threshold: 4 mV Beta Window: 50 mV

Geometry / Distance to source: In planchett Cable Length: ☑ 39 inch ☐ Other: _____

Alpha Source: ☑ Th230 @ 13,000 dpm (2/14/08) sn: 4098-03 ☐ Other: _____

Beta Source: ☑ Tc99 @ 16,800 dpm (2/14/08) sn: 4099-03 ☐ Other: _____

Count Time: 1 minute(s)

High Voltage	Alpha Source Counts		Beta Source Counts		Background Counts		Pot. Setting
	Alpha	Beta	Alpha	Beta	Alpha	Beta	
600	4559	240	3	2493	0	39	2.50
→ 650	4742	303	2	3177	1	63	2.70
700	4876	482	4	3915	1	73	3.90
750	4840	743	5	4135	0	97	3.10

Comments: Recommended Operating High Voltage: 650 volts

Calibrated By: _____ Calibration Date: 4-22-08

Calibration Due: 4-22-09

Reviewed By: _____ Date: 4/23/08

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER ERG (ENVIRO SES GRP) ORDER NO. 282438 / 316559

Mfg. Ludlum Measurements, Inc. Model 19 Serial No. 104556

Mfg. _____ Model _____ Serial No. _____

Cal. Date 24-Aug-07 Cal Due Date 24-Aug-08 Cal. Interval 1 Year Meterface 202-016

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 59 % Alt 697.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☐ Window Operation ☐ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 2.2 VDC

☐ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 750 V Input Sens. 34 mV Det. Oper. _____ V at _____ mV Threshold Dial Ratio _____ = _____ mV

☐ HV Readout (2 points) Ref./Inst. _____ / _____ V Ref./Inst. _____ / _____ V

COMMENTS:

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
5000	4000 uR/hr	4000	4000
5000	1000 uR/hr	1000	1000
500	400 uR/hr = 71,600 cpm	390	400
500	100 uR/hr	100	100
250	200 uR/hr = 37,400 cpm	200	200
250	100 uR/hr	100	100
50	7160 cpm	40	40
50	1790 cpm	10	10
25	3740 cpm	20	20
25	935 cpm	5	5

*Uncertainty within ± 10% C.F. within ± 20% 50, 25 **Range(s) Calibrated Electronically**

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout			

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Log Scale			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978 State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ S-394/1122 ☐ 1131 ☑ 781

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N _____ ☐ Beta S/N _____ ☐ Other _____

☑ m 500 S/N 189506 ☐ Oscilloscope S/N _____ ☑ Multimeter S/N 57390613

Calibrated By: William Tensley Date 24-August-07

Reviewed By: Rhonda Hamm Date 24 Aug 07

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.
FORM C22A 01/24/2007

AC Inst. Only ☐ Passed Dielectric (Hi Pot) or Continuity Test ☐ Failed: _____

Certificate of Calibration

Ratemeter Certificate of Calibration

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Manufacturer: Ludlum Model: 2360 Serial No.: 184951

All Ranges Calibrated Electronically; Ludlum Pulser Generator Serial No.: ☑ 97743 ☐ 201932

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 481-3 • Calibration of Radiation Detection Instruments & Devices

☑ Mechanical ck. ☑ Meter Zeroed ☑ Geotropism ck. ☐ F/S Response ck. ☑ Audio ck.

☑ THR/WIN ck. High Voltage ck. ☑ 500v ☑ 1000v ☑ 1500v ☑ Battery ck. (min 4.4 vdc)

Alpha Threshold.: 120 mV Beta Threshold.: 4 mV Beta Window.: 50 mV

Internal Calibration Date Reset ☑ Instrument found within tolerance (+/- 10%) Yes ☑ No ☐

Reference Setting	Instrument "As Found Reading"	Instrument Meter Reading
400 Kcpm	+/- 10%	400 Kcpm
100 Kcpm	+/- 10%	100 Kcpm
40 Kcpm	+/- 10%	40 Kcpm
10 Kcpm	+/- 10%	10 Kcpm
4 Kcpm	+/- 10%	4 Kcpm
1 Kcpm	+/- 10%	1 Kcpm
400 cpm	+/- 10%	400 cpm
100 cpm	+/- 10%	100 cpm

Reference Setting	Instrument "As Found Reading"	Integrated Counts (1-minute count)
400 Kcpm	+/- 10%	398305
40 Kcpm	+/- 10%	39896
4 Kcpm	+/- 10%	4003
400 cpm	+/- 10%	400

Calibrated By: _____ Calibration Date: 1-30-08

Calibration Due: 1-30-09

Reviewed By: _____ Date: 1-30-08

Certificate of Calibration

Voltage Plateau Form

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Detector Mfg.: Ludlum Model: 43-68 Serial No.: PR126794

Counter Mfg.: Ludlum Model: 2360 Serial No.: 184951

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 481-3 • Calibration of Radiation Detection Instruments & Devices

Alpha Threshold: 120 mV Beta Threshold: 4 mV Beta Window: 50 mV

Detector geometry to source: ☑ Face, ☐ Side, ☐ Below, ☐ Other:

Distance to source: ☑ Contact, ☐ 6-Inches, ☐ Other:

Alpha Source : ☑ Th230 @ 13,300 dpm (1/19/07) sn: 4098-03 ☐ Other:

Beta Source: ☑ Tc99 @ 17,800 dpm (1/15/07) sn: 4099-03 ☐ Other:

Count Time: 1 Minute

High Voltage	Alpha Source Counts		Beta Source Counts		Background Counts	
	Alpha	Beta	Alpha	Beta	Alpha	Beta
1550	1959	1064	5	4012	3	229
1575	1952	1094	9	4198	3	219
→ 1600	2162	1186	25	4440	4	317
1625	2411	1099	104	3983	4	326
1650	2599	954	364	3143	21	300

Comments: Recommended Operating High Voltage: 1600 est ~~1650~~ volts

Calibrated By: [signature] Calibration Date: 1-30-08

Calibration Due: 1-30-09

Reviewed By: [signature] Date: 1-30-08

Certificate of Calibration

Ratemeter Certificate of Calibration

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Manufacturer: Ludlum Model: 2360 Serial No.: 184933

All Ranges Calibrated Electronically; Ludlum Pulser Generator Serial No.: ☐ 97743 ☑ 201932

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 481-3 • Calibration of Radiation Detection Instruments & Devices

☑ Mechanical ck. ☑ Meter Zeroed ☑ Geotropism ck. ☐ F/S Response ck. ☑ Audio ck.

☐ THR/WIN ck. High Voltage ck. ☑ 500v ☑ 1000v ☑ 1500v ☑ Battery ck. (min 4.4 vdc)

Alpha Threshold.: 120 mV Beta Threshold.: 4 mV Beta Window.: ~~30~~ 50 CP mV

Internal Calibration Date Reset ☑ Instrument found within tolerance (+/- 10%) Yes ☑ No ☐

Reference Setting	Instrument "As Found Reading"	Instrument Meter Reading
400 Kcpm	400 Kcpm	400 Kcpm
100 Kcpm	100 Kcpm	100 Kcpm
40 Kcpm	40 Kcpm	40 Kcpm
10 Kcpm	10 Kcpm	10 Kcpm
4 Kcpm	4 Kcpm	4 Kcpm
1 Kcpm	1 Kcpm	1 Kcpm
400 cpm	400 cpm	400 cpm
100 cpm	100 cpm	100 cpm

Reference Setting	Instrument "As Found Reading"	Integrated Counts (1-minute count)
400 Kcpm	+/- 10%	398814
40 Kcpm	+/- 10%	39889
4 Kcpm	+/- 10%	3989
400 cpm	+/- 10%	399

Calibrated By: [signature] Calibration Date: 4-22-08

Calibration Due: 4-22-09

Reviewed By: [signature] Date: 4/23/08

Certificate of Calibration

Voltage Plateau Form

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Detector Mfg.: Ludlum Model: 43-68 Serial No.: PR190490

Counter Mfg.: Ludlum Model: 2360 Serial No.: 184933

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 481-3 • Calibration of Radiation Detection Instruments & Devices

Alpha Threshold: 120 mV Beta Threshold: 4 mV Beta Window: 50 mV

Detector geometry to source: ☑ Face, ☐ Side, ☐ Below, ☐ Other:

Distance to source: ☑ Contact, ☐ 6-Inches, ☐ Other:

Alpha Source : ☑ Th230 @ 13,000 dpm (2/14/08) sn: 4098-03 ☐ Other:

Beta Source: ☑ Tc99 @ 16,800 dpm (2/14/08) sn: 4099-03 ☐ Other:

Count Time: 1 Minute

High Voltage	Alpha Source Counts		Beta Source Counts		Background Counts	
	Alpha	Beta	Alpha	Beta	Alpha	Beta
1500	907	1046	16	2967	1	127
1550	1509	1103	21	4248	5	228
1575	1816	1091	37	4324	1	235
→ 1600	1813	1157	28	4351	3	311
1625	1816	1091	99	3832	8	295
1650	2035	886	411	3028	29	257
1700	3637	391	4297	289	266	53

Comments: Recommended Operating High Voltage: 1600 volts

Calibrated By: [signature] Calibration Date: 4-22-08

Calibration Due: 4-22-09

Reviewed By: [signature] Date: 4/23/08

Certificate of Calibration

Voltage Plateau Form

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Detector Mfg.: Ludlum Model: 43-37 Serial No.: PR113577

Counter Mfg.: Ludlum Model: 2224 Serial No.: 143031

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 481-3 • Calibration of Radiation Detection Instruments & Devices

Alpha Threshold: 100 mV Beta Threshold: 4 mV Beta Window: 40 mV

Detector geometry to source: ☑ Face, ☐ Side, ☐ Below, ☐ Other:

Distance to source: ☑ Contact, ☐ 6-Inches, ☐ Other:

Alpha Source : ☑ Th230 @ 13,000 dpm (2/14/08) sn: 4098-03 ☐ Other:

Beta Source: ☑ Tc99 @ 16,800 dpm (2/14/08) sn: 4099-03 ☐ Other:

Count Time: 1 Minute

High Voltage	Alpha Source Counts		Beta Source Counts		Background Counts	
	Alpha	Beta	Alpha	Beta	Alpha	Beta
1650	1142	1700	18	4142	21	891
1675	1254	1913	23	4225	13	1116
1700	1580	2273	30	4531	21	1454
1725	1740	2342	126	4359	38	1653

Comments: Recommended Operating High Voltage: 1675 volts

Calibrated By: [signature] Calibration Date: 4-22-08

Calibration Due: 4-22-09

Reviewed By: [signature] Date: 4/23/08

Certificate of Calibration

Ratemeter Certificate of Calibration

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Manufacturer: Ludlum Model: 2224 Serial No.: 143031

All Ranges Calibrated Electronically; Ludlum Pulser Generator Serial No.: ☐ 97743 ☑ 201932

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 481-3 • Calibration of Radiation Detection Instruments & Devices

☑ Mechanical ck. ☑ Meter Zeroed ☑ Geotropism ck. ☐ F/S Response ck. ☑ Audio ck.

☐ THR/WIN ck. High Voltage ck. ☑ 500v ☑ 1000v ☑ 1500v ☑ Battery ck. (min 4.4 vdc)

Alpha Threshold.: 100 mV Beta Threshold.: 4 mV Beta Window.: 40 mV

Internal Calibration Date Reset ☑ Instrument found within tolerance (+/- 10%) Yes ☑ No ☐

Reference Setting	Instrument "As Found Reading"	Instrument Meter Reading
400 Kcpm	400 Kcpm	400 Kcpm
100 Kcpm	100 Kcpm	100 Kcpm
40 Kcpm	40 Kcpm	40 Kcpm
10 Kcpm	10 Kcpm	10 Kcpm
4 Kcpm	4 Kcpm	4 Kcpm
1 Kcpm	1 Kcpm	1 Kcpm
400 cpm	400 cpm	400 cpm
100 cpm	100 cpm	100 cpm

Reference Setting	Instrument "As Found Reading"	Integrated Counts (1-minute count)
400 Kcpm	+/- 10%	399801
40 Kcpm	+/- 10%	39982
4 Kcpm	+/- 10%	3994
400 cpm	+/- 10%	400

Calibrated By: [signature] Calibration Date: 4-22-08

Calibration Due: 4-22-09

Reviewed By: [signature] Date: 4/23/08

ERG Form 1.02C

Certificate of Calibration

Ratemeter Certificate of Calibration

ERG
Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Manufacturer: Ludlum Model: 2224 Serial No.: 146714

All Ranges Calibrated Electronically; Ludlum Pulser Generator Serial No.: ☐ 97743 ☑ 201932

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 481-3 • Calibration of Radiation Detection Instruments & Devices

☑ Mechanical ck. ☑ Meter Zeroed ☑ Geotropism ck. ☐ F/S Response ck. ☑ Audio ck.

☐ THR/WIN ck. High Voltage ck. ☑ 500v ☑ 1000v ☑ 1500v ☑ Battery ck. (min 4.4 vdc)

Alpha Threshold.: 100 mV Beta Threshold.: 4 mV Beta Window.: 40 mV

Internal Calibration Date Reset ☒ Instrument found within tolerance (+/- 10%) Yes ☑ No ☐

Reference Setting	Instrument "As Found Reading"	Instrument Meter Reading
400 Kcpm	400 Kcpm	400 Kcpm
100 Kcpm	100 Kcpm	100 Kcpm
40 Kcpm	40 Kcpm	40 Kcpm
10 Kcpm	10 Kcpm	10 Kcpm
4 Kcpm	4 Kcpm	4 Kcpm
1 Kcpm	1 Kcpm	1 Kcpm
400 cpm	400 cpm	400 cpm
100 cpm	100 cpm	100 cpm

Reference Setting	Instrument "As Found Reading"	Integrated Counts (1-minute count)
400 Kcpm	+/- 10%	398642
40 Kcpm	+/- 10%	39869
4 Kcpm	+/- 10%	3988
400 cpm	+/- 10%	399

Calibrated By: [signature] Calibration Date: 4-22-08

Calibration Due: 4-22-09

Reviewed By: [signature] Date: 4/23/08

Certificate of Calibration

Voltage Plateau Form

Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

Detector Mfg.: Ludlum Model: 43-37 Serial No.: PR124946

Counter Mfg.: Ludlum Model: 2224 Serial No.: 146714

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 481-3 • Calibration of Radiation Detection Instruments & Devices

Alpha Threshold: 100 mV Beta Threshold: 4 mV Beta Window: 40 mV

Detector geometry to source: ☑ Face, ☐ Side, ☐ Below, ☐ Other:

Distance to source: ☑ Contact, ☐ 6-Inches, ☐ Other:

Alpha Source : ☑ Th230 @ 13,000 dpm (2/14/08) sn: 4098-03 ☐ Other:

Beta Source: ☑ Tc99 @ 16,800 dpm (2/14/08) sn: 4099-03 ☐ Other:

Count Time: 1 Minute

High Voltage	Alpha Source Counts		Beta Source Counts		Background Counts	
	Alpha	Beta	Alpha	Beta	Alpha	Beta
1650	1257	1553	13	4005	11	878
→ 1675	1165	1835	9	4220	9	1160
1700	1366	2234	17	4138	17	1445
1725	1530	2112	108	4409	34	1528

Comments: Recommended Operating High Voltage: 1675 volts

Calibrated By: [signature] Calibration Date: 4-22-08

Calibration Due: 4-22-09

Reviewed By: [signature] Date: 4/23/08

ERG Form 1.03B