Final Status Survey Report

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# Aberdeen Proving Grounds–Building 1103A Area, Aberdeen, Maryland

**PREPARED FOR:**

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Project Number: USA 2007-098
Contract W52P1J-08-D-0073
Delivery Order 1

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Rev 2
January 2011

# TABLE OF CONTENTS



# TABLES



# FIGURES

## FIGURES (Continued)



## APPENDICES

# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ALARA | As Low as Reasonable Achievable |
| APG | Aberdeen Proving Ground |
| ARL | Army Research Laboratory |
| CFR | Code of Federal Regulations |
| cm | centimeter |
| cpm | counts per minute |
| DCGL | derived concentration guideline level |
| $DCGL_{emc}$ | DCGL for small areas of elevated activity, used with the elevated measurement comparison |
| $DCGL_W$ | DCGL for average concentrations over a wide area, used with statistical tests |
| D&D | Decommission and Demolition |
| DP | decommissioning plan |
| dpm | disintegration per minute |
| DU | depleted uranium |
| FSS | Final Status Survey |
| GPS | Global Positioning System |
| MARRSIM | Multi-Agency Radiation Survey and Site Investigation Manual |
| NRC | Nuclear Regulatory Commission |
| pCi | picocuries |
| PIKA | PIKA International, Inc. |
| RSO | Radiation Safety Officer |
| SU | Survey Unit |
| QC | quality control |
| VSP | Visual Sample Plan |

# 1.0 INTRODUCTION

The Building 1103A Area is a former radioactive material processing and storage facility on Spesutie Island at Aberdeen Proving Ground (APG). Historical site activities involving depleted uranium (DU) have resulted in radiological contamination of the buildings and grounds. The Army Research Laboratory (ARL) has responsibility for this area and initiated the decommissioning process so that the area can be released from its Nuclear Regulatory Commission (NRC) radioactive materials license requirements.

This report documents the results of the final status survey (FSS) of the Building 1103A Area. The location of this area at APG is shown in Figure 1-1. (All figures are posted after the text of this report.) The general layout of the Building 1103A Area is shown in Figure 1-2. Historical activities involved the unloading of DU-contaminated targets in the central asphalt area; storage and staging of the targets in one of three vaults; cutting and machining of the targets in Building 1103A (and, to a lesser extent, BRL12); and storage and reloading of the resulting steel pieces in preparation for decontamination, disposal, or reuse.

## 1.1 Decontamination Activities

The decontamination and partial demolition of Building 1103A area were begun in August, 2009 and completed November, 2009, according to the decommissioning plan (DP; Cabrera, 2008) and the operations plan (PIKA, 2009). Several field changes to the plans were made. These are discussed in Section 2.3. The NRC was notified of these changes by the facility Radiation Safety Officer (RSO).

The decontamination and partial demolition of the area left the following structures in place: BRL12 vaults (north and south), the large vault, and Building 1103A. Wastes produced by the decommissioning were shipped to disposal facilities in Clive, Utah (Energy Solutions) and Grandview, Idaho (U.S. Ecology).

## 1.2 Licensing Background

The Building 1103A Area is under the control of the ARL and is subject to the requirements of NRC license No. SMB-141. The RSO for this license is Mr. Richard Markland, who oversaw the work which was performed by PIKA International, Inc. (PIKA). The goal of decommissioning and the FSS is to facilitate the release of the site for unrestricted use. The decommissioning and FSS plans were approved by the NRC in 2009.

# 2.0 FINAL STATUS SURVEY APPROACH

The FSS plan is reproduced in Appendix A. It is also found in the decommissioning plan (Cabrera, 2008). The survey plan is summarized below. Several field changes were made and these are also discussed.

There are 29 survey units in the Building 1103A area, as listed in Table 2-1. There are 5 land areas and 24 building areas. Survey unit locations are described more fully in Appendix B.

The contaminant of concern is depleted uranium (DU). Release limits (DCGLs) for DU are taken from the decommissioning plan. These are:

- Surface $DCGL_w$ – 100 disintegrations per minute (dpm) $\alpha$ /100 $cm^2$;
- Removable Surface $DCGL_w$ – 10 dpm $\alpha$ /100 $cm^2$; and
- Soils $DCGL_w$ – 230 picocuries (pCi) DU/gram.

## 2.1 Scanning Surveys

Building surfaces were scanned for beta radiation. Land areas were scanned for gamma radiation. Class 1 survey units were scanned over 100% of their areas. Class 2 survey units were scanned over at least 50% of their areas. Class 3 survey units were scanned over at least 25% of their areas.

An action level for beta scans, using a Ludlum model 43-37 detector, was set at 800 counts per minute (cpm). When this level was encountered, the area was investigated with alpha measurements and added as a new alpha static location to the static measurements.

Land areas were gamma-scanned using a low-energy scintillation detector (FIDLER). This has shown to be sensitive to uranium gamma rays and x-rays. Scan locations were continuously recorded using Global Positioning System (GPS) technology.

## Table 2-1
## Final Status Survey Units

| Survey Unit ID | Structure | Survey Unit Description | Surface Area ($m^2$) | MARSSIM Class* |
|---|---|---|---|---|
| 1 | North Area 1103A | BRL12 Yard | 552.8 | 1 |
| 2 | South Area | Large Vault Yard | 717.1 | 1 |
| 3 | East Area | Asphalt East Parking Lot | 432.0 | 2 |
| 4 | Perimeter Area | North, West, South Border | 1161.3 | 2 |
| 5 | 1103A | Floor North | 87.6 | 1 |
| 6 | 1103A | Floor South | 87.6 | 1 |
| 7 | 1103A | Interior Walls N & E | 85.7 | 1 |
| 8 | 1103A | Interior Walls W & S | 85.7 | 1 |
| 9 | 1103A | Ceiling North | 92.9 | 1 |
| 10 | 1103A | Ceiling South | 92.9 | 1 |
| 11 | 1103A | Exterior Wall - South | 51.1 | 1 |
| 12 | 1103A | Exterior Walls - N, E, & W | 125.4 | 1** |
| 12A | 1103A | Entrance Room Interior | 29.1 | 1 |
| 12B | 1103A | Entrance Room Exterior | 25.3 | 1** |
| 13 | 1103A | Roof | 185.8 | 1** |
| 14 | 1103A | Former Shop Area Floor | | 1 |
| 15 | BRL12 | Floor | 73.2 | 1 |
| 19 | BRL12 N Vault | Interior Fl, N & E Walls | 58.6 | 1 |
| 19A | BRL12 N Vault | Interior Ceil, W & S Walls | 58.6 | 1 |
| 19B | BRL12 N Vault | Roof & Exterior Walls | 112.6 | 2 |
| 20 | BRL12 S Vault | Interior Surfaces | 117.1 | 2 |
| 20A | BRL12 S Vault | Roof & Exterior Walls | 112.6 | 2 |
| 23 | Freestanding Vault | Floor, N & E Walls | 92.9 | 1 |
| 24 | Freestanding Vault | Ceiling, W & S Walls | 92.9 | 1 |
| 25 | Freestanding Vault | Exterior Walls & roof | 148.6 | 1** |
| 26 | 1103 B | Floor | 319.6 | 3 |
| 27 | 1103 B | Exterior N & W Walls | 140.3 | 2 |
| 28 | 1100 E | Exterior E Wall | 181.9 | 3 |
| 29 | 1100 F | Exterior E Wall | 57.6 | 3 |

* Multi-Agency Radiation Survey and Site Investigation Manual (NRC, 2000).
** Reclassified from 2 to 1.

## 2.2 Static Measurements

The number and locations of static measurements were determined using the Visual Sample Plan (VSP) software. Input parameters (e.g., Type 1 and 2 error rates) are given in the FSS plan (Appendix A). The results of the VSP runs are given in Appendix B1.

At each static measurement location, a 1.0 minute contact alpha count was taken and recorded, a smear was taken and analyzed, or a soil sample was taken. Occasionally, the specified location was not accessible. Attempts were made to find a suitable, adjacent location. If that was not possible, the location was skipped. Because extra locations are built into the selection process (and VSP), the loss of one or two locations was deemed acceptable.

Soil samples were collected from four land survey units. The fifth land area (SU 3) is covered with asphalt and was treated as a building surface for static measurements. U-238 was used as the radioisotope of concern. With the assumption that U238 is in equilibrium with its progeny Th-234 was used for the quantification of U-238, by gamma spectroscopy. A $DCGL_w$ of 230 pCi/g total DU is specified for evaluating soils for unrestricted release. It was assumed that 90.4% of the total activity is attributed to U-238, with a resulting nuclide-specific limit of 208 pCi/g.

## 2.3 Field Changes

After the decommission plan was completed and approved, the Army decided that building BRL12 would not be reused. It was decided to demolish this building but leave the two steel vaults intact (north vault and south vault). Therefore several survey units identified in the decommissioning plan for BRL12 were eliminated. These are:

- SU 16 BRL 12 central area interior walls;
- SU 18 BRL 12 central area ceiling;
- SU 21 BRL 12 exterior walls; and
- SU 22 BRL 12 roof.

Survey Unit 15, central area floor (Class 1), remained, as the concrete pad floor was not removed. Also, additional survey units were added to cover the exteriors of the two remaining vaults (SU 19B and SU 20A). These are Class 3 survey units.

Finally, four survey units were reclassified from Class 2 to Class 1 as the result of static alpha readings. Readings on the exteriors of the 1103A entrance room (SU12B) and other areas were found to exceed the $DCGL_w$. These were decontaminated, as needed, and reclassified as Class 1.

# 3.0 SURVEY RESULTS

Survey results are summarized below and collected data are given electronically in the appendices (on CD). Background data for the site are given in Table 3-1. Alpha and beta results are given as net counts (total minus background). Gamma data are uncorrected.

## 3.1 Scan Results

### Beta Scans

The beta scan results are summarized in Table 3-2. Data for Class 1 areas are plotted as cumulative probability plots in Figures 3-1 through 3-15. Results for all survey units are given in Appendix C. The table and figures show that the average net count rate fluctuates around zero cpm. In some cases, it is positive; in others, it is negative. This is attributed to the variability of background across the site. Note that the average of all survey unit averages is -5 cpm—very close to net zero count rate.

### Gamma Scans

Gamma scan data and GPS location data were used to create the color-coded map shown in Figure 3-16. The gamma data are summarized in Table 3-3, and discussed in Section 4.0.

## 3.2 Static Measurement Results

Alpha static measurements were made in 25 survey units. Data are given in Appendix B2. As shown in the Table 3-4 summary, readings in seven survey units exceeded the surface $DCGL_w$. These exceedences ranged from 105 to 179 dpm/100cm$^2$. Two of these survey units were investigated further. These surveys are documented in Appendix B4. Static results are discussed further in Section 4.

## Table 3-1
## Material Background Readings

| Type of Survey | Material | Background (cpm) |
|---|---|---|
| Alpha[1] | Concrete | 1.2 |
| | Metal | 1.0 |
| | Siding | 7.1 |
| | Wood | 1.0 |
| Beta[2] | Concrete | 201 |
| | Metal/Siding | 139 |
| | Wood | 151 |
| Gamma[3] | Soil | 8,560 |

Detectors used:
1. Ludlum model 43-93
2. Ludlum model 43-37
3. FIDLER

## Table 3-2
## Summary of Beta Scan Data

| Survey Unit | Class | cpm - net beta | |
|---|---|---|---|
| | | High | Average |
| 5 | 1 | 60 | -53 |
| 6 | 1 | 139 | -52 |
| 7 | 1 | 141 | -89 |
| 8 | 1 | 480 | 78 |
| 9 | 1 | 745 | -11 |
| 10 | 1 | 129 | -27 |
| 11 | 1 | 247 | 61 |
| 12 | 1* | 140 | -16 |
| 12A | 1 | 56 | -41 |
| 12B | 1* | 147 | 28 |
| 13 | 1* | 195 | 66 |
| 15 | 1 | 546 | -32 |
| 19 | 1 | 1,570 | 49 |
| 19A | 1 | 18 | -69 |
| 19B | 2 | 78 | -25 |
| 20 | 2 | 196 | -38 |

## Table 3-2 (Continued)
## Summary of Beta Scan Data

| Survey Unit | Class | cpm - net beta | |
|---|---|---|---|
| | | High | Average |
| 20A | 2 | 96 | -12 |
| 23 | 1 | 793 | 5 |
| 24 | 1 | 91 | -29 |
| 25 | 1* | 300 | 23 |
| 26 | 3 | 203 | 131 |
| 27 | 2 | 184 | 0 |
| 28 | 3 | 120 | -56 |
| 29 | 3 | 125 | -4 |
| | | **Average** | **-5** |

* Reclassified from 2 to 1.

## Table 3-3
## Gamma Scan Summary

| Survey Unit | Class | cpm gamma | | |
|---|---|---|---|---|
| | | High | Average | Sigma |
| 1 | 1 | 11,221 | 4,187 | 1,253 |
| 2 | 1 | 13,420 | 4,531 | 1,522 |
| 3 | 2 | 7,863 | 4,498 | 726 |
| 4 | 2 | 14,380 | 6,796 | 2,490 |
| 14 | 1 | 6,881 | 4,610 | 837 |
| Reference | n/a | * | 8,560 | * |

* Reference is based on a 10-minute reading at a background location.

## Table 3-4
## Summary of Static Measurement Results

| Survey Unit | No. of Measurements (note 1) | No. Above $DCGL_w$ (note 2) | No. Above $DCGL_{emc}$ (note 3) | No. Smears Above $DCGL_w$ (note 4) | PASS/FAIL (note 5) |
|---|---|---|---|---|---|
| 3 | 14 | 0 | n/a | 0 | PASS |
| 5 | 20 | 0 | n/a | 0 | PASS |
| 6 | 20 | 0 | n/a | 0 | PASS |
| 7 | 19 | 0 | n/a | 0 | PASS |
| 8 | 18 | 1 | 0 | 1 | PASS |
| 9 | 20 | 0 | n/a | 0 | PASS |
| 10 | 21 | 0 | n/a | 0 | PASS |
| 11 | 18 | 4 | 0 | 0 | PASS |
| 12 | 18 | 2 | 0 | 0 | PASS |
| 12A | 20 | 0 | n/a | 0 | PASS |
| 12B | 20 | 1 | 0 | 0 | PASS |
| 13 | 20 | 1 | 0 | 0 | PASS |
| 15 | 20 | 3 | 0 | 0 | PASS |
| 19 | 22 | 0 | n/a | 0 | PASS |
| 19A | 20 | 0 | n/a | 0 | PASS |
| 19B | 20 | 0 | n/a | 0 | PASS |
| 20 | 20 | 0 | n/a | 0 | PASS |
| 20A | 20 | 0 | n/a | 0 | PASS |
| 23 | 22 | 0 | n/a | 0 | PASS |
| 24 | 20 | 0 | n/a | 0 | PASS |
| 25 | 21 | 2 | 0 | 0 | PASS |
| 26 | 21 | 0 | n/a | 0 | PASS |
| 27 | 28 | 0 | n/a | 0 | PASS |
| 28 | 18 | 0 | n/a | 0 | PASS |
| 29 | 20 | 0 | n/a | 0 | PASS |

Note 1: VSP specified 20 or 21 readings for walls and floors (depending on shape); and 14 readings for outdoor land. Fewer readings indicate inaccessible locations. More readings indicate location(s) added when reaching the scanning action level. VSP specified 28 readings for SU 27.

Note 2: $DCGL_w$ is 100 dpm/100 $cm^2$ alpha.

Note 3: $DCGL_{emc}$ is calculated as $DCGL_w$ x [area factor]) This is only applied to readings above the $DCGL_w$.

Note 4: $DCGL_w$ (removable) is 10 dpm/100 $cm^2$ alpha. One smear in SU 8 exceeded $DCGL_w$ at 22 dpm.

Note 5: A survey unit passes if the data pass the Sign Test and both the $DCGL_{emc}$ and unity rule are not exceeded (see text).

## 3.3 Smear Results

Removable contamination was measured using cloth smears. As discussed above, a smear was taken at each static measurement location and counted in a low-level alpha/beta counter. Results are given in Appendix B3. Only one smear exceeded the removable $DCGL_w$. That result is discussed in Section 4.

## 3.4 Soil Sampling Results

Uranium levels in soil samples from four land areas were at background or slightly elevated levels. No samples exceeded the $DCGL_w$ for U-238. The highest level, from one sample in Survey Unit 4, was 20.5 pCi/g. A summary of the results is given in Table 3-5. All results are given in Appendix D.

**Table 3-5**
**Uranium in Soil Results Summary**

| | pCi U-238 / gram soil | |
|---|---|---|
| Survey Unit | Average | Maximum |
| 1 | 2.5 | 12.8 |
| 2 | 1.7 | 13.9 |
| 4 | 1.9 | 20.5 |
| 14 | 1.4 | 3.5 |

Note: SU 3 is covered in asphalt and was treated as a building surface for static measurements.

## Quality Control Samples

To ensure quality control of gamma spectroscopy, eight soil samples were split between the PIKA lab and a commercial laboratory–TestAmerica. This represents 15% of the 56 samples analyzed by PIKA. Comparisons of the two labs' results for U-238 are shown in Figure 3-17. This graph shows good agreement between the two laboratories.

# 4.0 ANALYSIS AND CONCLUSIONS

All survey units were scanned per the FSS plan. Static readings, smears, and soil samples were also taken. These results were compared to the release limits, as discussed below.

## 4.1 Alpha Statics

As discussed in Section 3.2, seven survey units had readings that exceeded the $DCGL_w$. The average static readings in these survey units were compared to the $DCGL_w$. The averages in all seven are below the $DCGL_w$.

Next, the Sign Test was used to evaluate static readings. This test limits the number of locations that can exceed the $DCGL_w$. For example, with 20 readings in a survey unit (n = 20), at least 14 must meet the release limit. That is, the critical value (S+) is 14. Critical values for other values of n are given in Table 4-1 (NRC, 2000). Survey unit 11 had 4 out of 18 readings above the $DCGL_w$. Yet the critical value was met (S+ equals 12).

**Table 4-1**
**Critical Values for Sign Test**

| Number of Measurements | Critical Value | Number of Elevated Readings Allowed |
|---|---|---|
| 14 | 10 | 4 |
| 18 | 12 | 6 |
| 20 | 14 | 6 |
| 21 | 14 | 7 |
| 22 | 15 | 7 |
| 28 | 18 | 10 |

Note: Probability of Type 1 error is set at 5%.

Next, an elevated measurement comparison was performed. Per MARSSIM, an elevated measurement should not exceed the $DCGL_{emc}$. This value is determined using an area factor that is applied to the $DCGL_w$.

Area factors were determined per the decommissioning plan. These are derived by determining the area that is elevated above the $DCGL_w$. Default area factors were calculated using the survey grid sizes from the VSP outputs in Appendix B1. This

assumes that the entire grid section is elevated—a worst case. For example, the survey grid in SU 25 is approximately 10 feet x 10 feet. For this area of about 9 $m^2$, the plan gives an area factor of 4, and a $DCGL_{emc}$ of 400 dpm/100 $cm^2$. Several survey units (SU 11 and 12) were evaluated for the actual elevated areas. Each had elevated areas of less than 4 $m^2$, allowing the use of an area factor of 9. These are discussed below.

Finally, the impact of multiple hot spots on the mean concentration in a survey unit must also be evaluated. This was performed using MARSSIM Equation 8-2 (NRC, 2000). The results showed that this unity rule was met in all cases.

More details are given below on eight survey units (further details are given in Appendix B2):

SU 8

This survey unit had one reading above the $DCGL_w$ at 123 dpm/100 $cm^2$. Using the default area factor of four, this reading is below the $DCGL_{emc}$ of 400 dpm/100 $cm^2$. The unity rule calculation came to 0.56, which satisfies the rule.

SU 11

As discussed above, survey unit 11 had 4 out of 18 readings above the $DCGL_w$. The Sign test's critical value was met since 6 readings above the $DCGL_w$ are allowed. The contaminated areas of the four locations were investigated and found to be less than 4$m^2$, resulting in an area factor of 9 and a $DCGL_{emc}$ of 900 dpm/100 $cm^2$. The maximum reading of 179 dpm/100 $cm^2$ is well below the $DCGL_{emc}$. The unity rule calculation came to 0.94. The investigation surveys are documented in Appendix B4.

SU 12

With only two readings above the $DCGL_w$, the Sign test is met. The contaminated areas of the two locations were investigated and found to be less than 4 $m^2$, resulting in an area factor of 9 and a $DCGL_{emc}$ of 900 dpm/100 $cm^2$. The maximum reading of 158 dpm/100 $cm^2$ is well below the $DCGL_{emc}$. The unity rule calculation came to 0.89. The investigation surveys are documented in Appendix B4.

SU 12B

With only one reading above the $DCGL_w$, the Sign test is met. The maximum reading of 105 dpm/100 $cm^2$ is below the $DCGL_{emc}$. The unity rule calculation came to 0.46.

SU 13

With only one reading above the $DCGL_w$, the Sign test is met. The maximum reading of 116 dpm/100 $cm^2$ is below the $DCGL_{emc}$. The unity rule calculation came to 0.56.

SU 15

Survey unit 15 had 3 out of 20 readings above the $DCGL_w$. Yet the Sign test's critical value was met (S+ equals 14). The maximum reading of 137 dpm/100 $cm^2$ is below the $DCGL_{emc}$. The unity rule calculation came to 0.96.

SU 25

With only two readings above the $DCGL_w$, the Sign test is met. The maximum reading of 118 dpm/100 $cm^2$ is below the $DCGL_{emc}$. The unity rule calculation came to 0.73.

Note that regulatory comments on this survey recommended a review of this survey unit's results. The comments and changes that were generated in this report are given in Appendix F.

SU 28

Regulatory comments on this survey unit prompted an investigation/re-survey. It was found that the steel siding surface of this SU exhibited a high alpha background. This material background had not been measured in the original survey. After applying the material background, all results are less than the $DCGL_w$. The comments, replies, and changes that were generated in this report are given in Appendix F. The investigation survey is documented in Appendix B4.

## 4.2 Smear Results

One smear in SU 8 exceeded the removable $DCGL_w$. This survey unit covers the interior walls of Building 1103A. The smear, from the south wall, read 22.1 dpm/100 $cm^2$. A

recount of the smear read 11.7 dpm/100 $cm^2$, still exceeding the $DCGL_w$ of 10 dpm/100 $cm^2$. The alpha static at this location read 73.7 dpm/100 $cm^2$.

Per MARSSIM, the average reading in the survey unit (1.05 dpm/100 $cm^2$) was compared to the $DCGL_w$, and is below that value. Next, the Sign Test was used to evaluate the survey unit. S+ is 19, and meets the critical value of 14. Next, the high reading was compared to the $DCGL_{emc}$ (40 dpm/100 $cm^2$; see above), and is below that value. Finally, the unity rule of MARSSIM Equation 8-2 (NRC, 2000) was performed. The equation produced a value of 0.63, which satisfies the rule.

## 4.3 Beta and Gamma Scans

The beta action level of 800 cpm was exceeded in one survey unit (SU 19, at 1570 cpm net) and was approached in another (SU 23, at 793 cpm net). In both cases, the elevated areas were investigated. Two additional static locations were included in SU 19, and one was added to SU 23.

Gamma scan count rate measurements are presented in Section 3.1 and Appendix C2. Over 12,000 readings were taken. The maximum reading, 14,380 cpm, was only 68% higher than the reference area (8,560 cpm), west of Building 1100E. Data were plotted and exhibited a distribution typical of natural radioactivity. Those histograms (count rate range versus number of readings within the range) are given in Appendix C2. The undisturbed soils on the site perimeter gave higher readings than the disturbed soils in the center area. Gamma levels in the center area (SUs 1 and 2) were similar to those over the asphalt in Survey Unit 3.

## 4.4 Soil Results

Uranium-238 concentrations in the soil are all less than the $DCGL_w$ (208 pCi/g). No further MARSSIM tests are required.

## 4.5 ALARA

NRC decommissioning guidance (10 Code of Federal Regulations (CFR) 20, Subpart E) specifies that residual radioactivity should be reduced to as low as reasonably achievable (ALARA) levels. For soils in land areas, we demonstrate ALARA by comparing the average concentration of U-238 in soil with a generic NRC guideline for residual uranium in soil. An NRC guidance paper [NRC, 1999] gives a guideline value of

14 pCi U-238/gram of soil. In contrast, the average site concentration of U-238 measured in soil is 1.9 pCi/g, well below the guideline value.

With regard to residual DU on surfaces, the demonstration of ALARA comes from the sequential stages of decontamination that were applied. The first stage was pressure washing of the surfaces. This removed most of the contamination, but did not remediate the most contaminated areas. This was followed by the second stage: high-pressure water jets. This removed contamination down to present levels, which meet the remediation goals.

At this point, a third stage of decontamination was evaluated: surface abrasion. Because some of the highest residual levels were on a steel surface (large vault roof), this stage would have consisted of grinding. This would have led to airborne contamination and the potential for internal exposures. It would have also required workers to work on a roof wearing respirators and protective clothing—a situation with inherent safety risks. A qualitative ALARA analysis resulted in the conclusion that these risks and possible radiation exposures were not warranted. The third stage was not implemented and the residual DU contamination was deemed to be ALARA.

## 4.6 Conclusions

The 29 survey units were surveyed for residual depleted uranium activity. All 29 were found to meet the requirements for unrestricted release from NRC licensing, based on the survey plan and NRC requirements. It is recommended that they be so released.

# 5.0 REFERENCES

Cabrera Services, Inc., 2008. Building 1103A Area Decommissioning Plan, Baltimore, MD, May.

NRC, 2000. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG-1575. U.S. Nuclear Regulatory Commission, U.S. Department of Defense, U.S. Environmental Protection Agency, and U.S. Department of Energy. August.

NRC, 1999. Supplemental Information on the Implementation of the Final Rule on Radiological Criteria for License Termination, U.S. Nuclear Regulatory Commission, Federal Register Vol. 64, No. 234. December 7.

PIKA International, Inc., 2009. Operations Plan, Decommissioning of Building 1103A Area, Stafford, TX, June.

# FIGURES

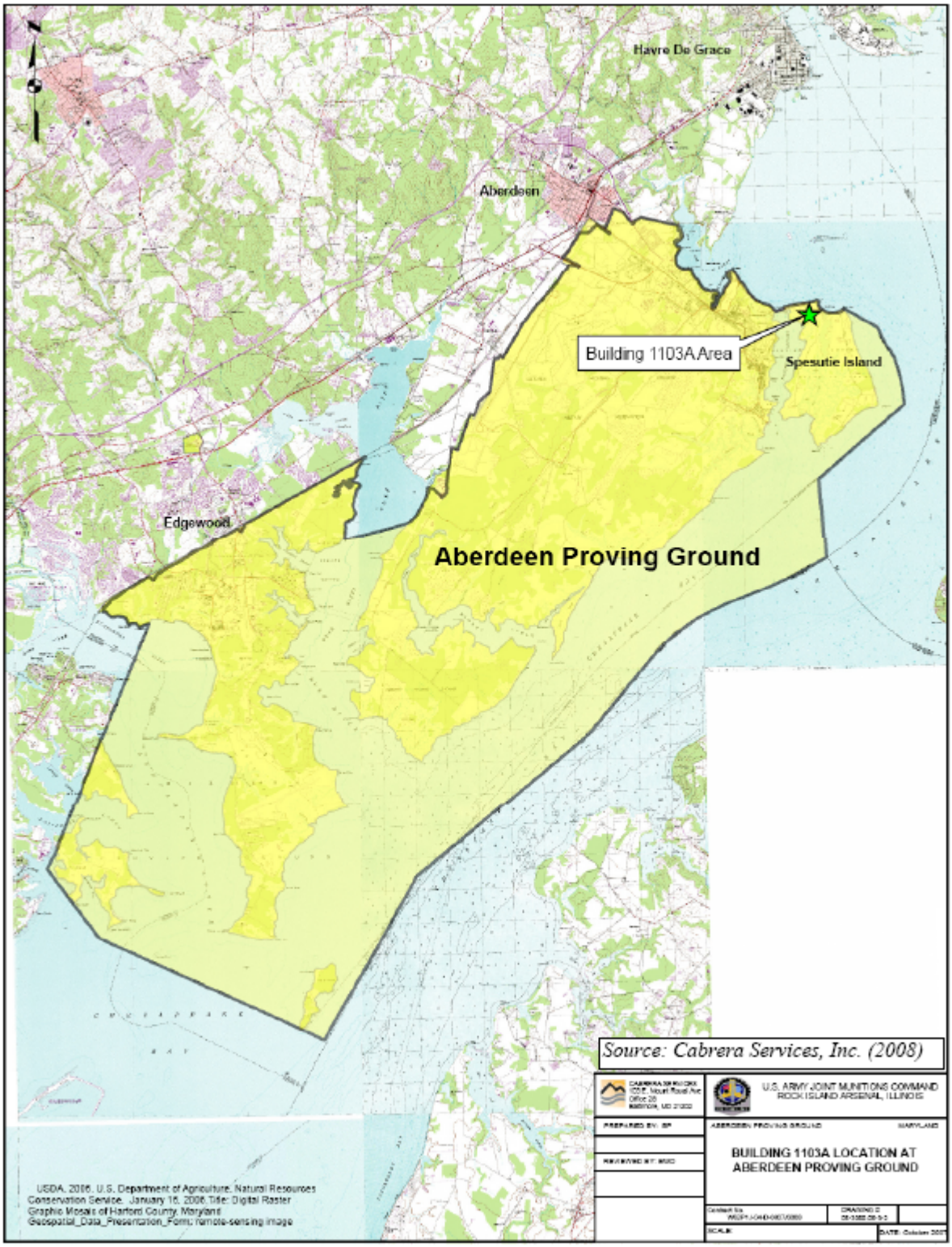


**Figure 1-1: Aberdeen Proving Ground**

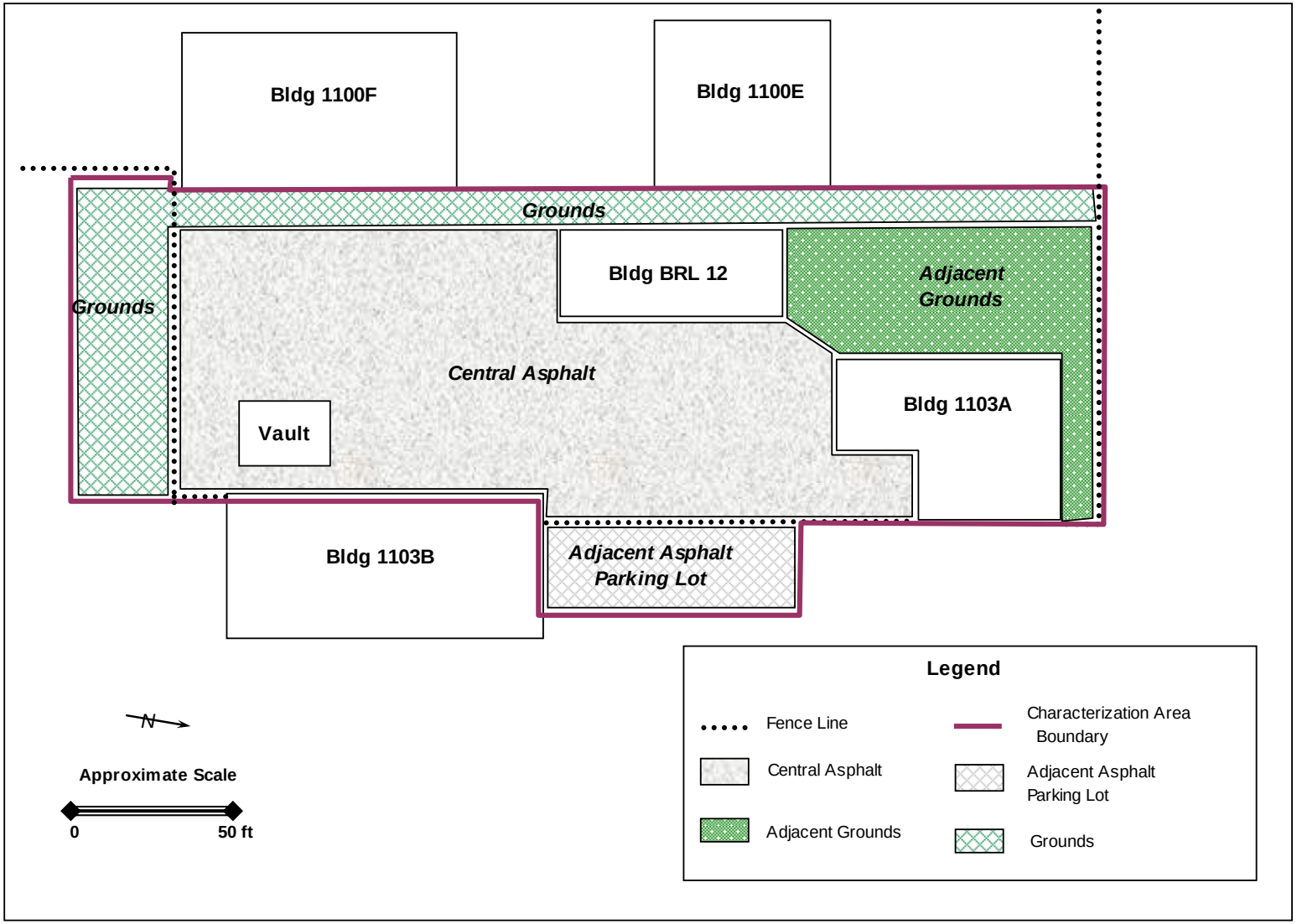


**Figure 1-2: Building 1103A Area Layout**

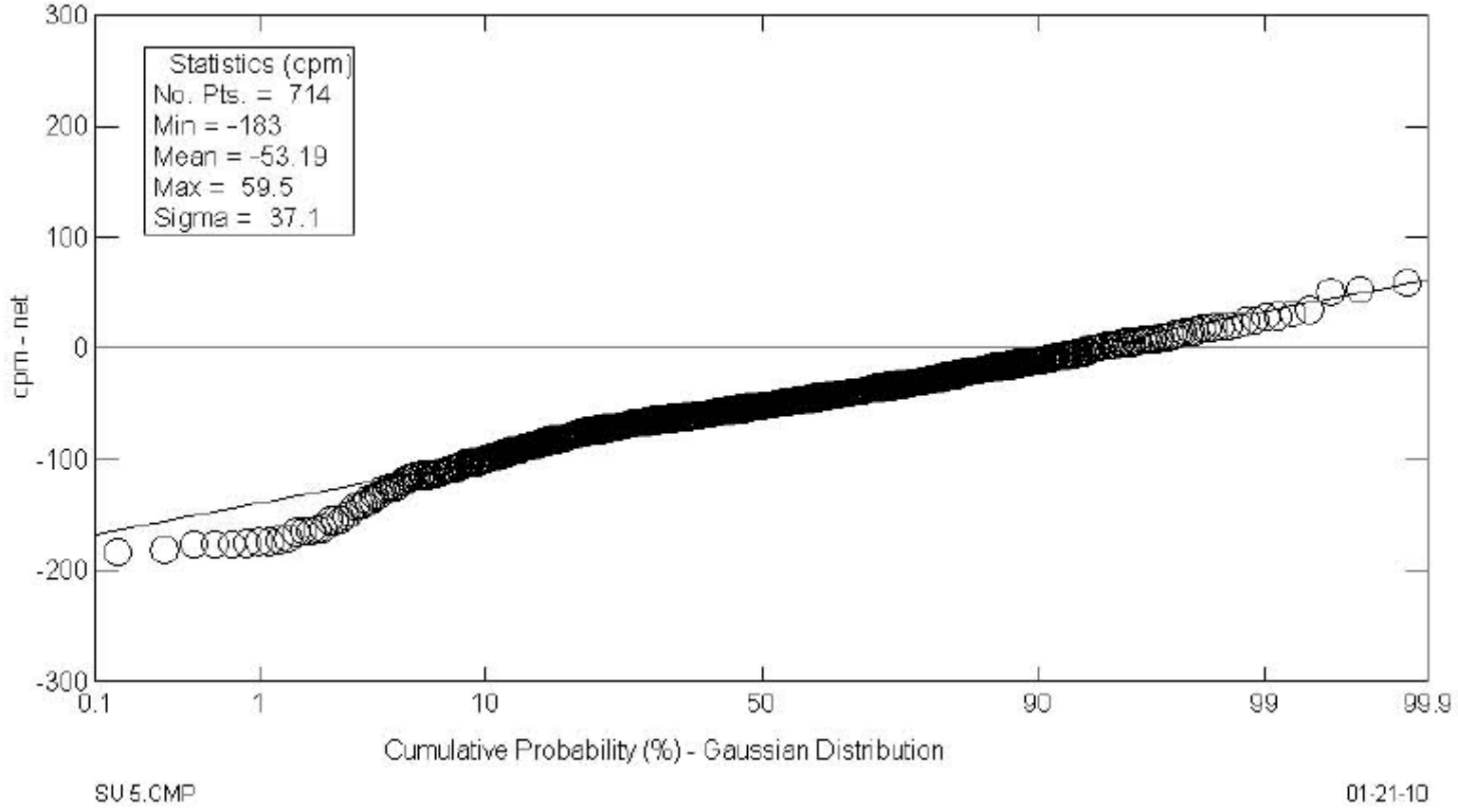


**Figure 3-1**
**Survey Unit 5 Beta Scan Data**

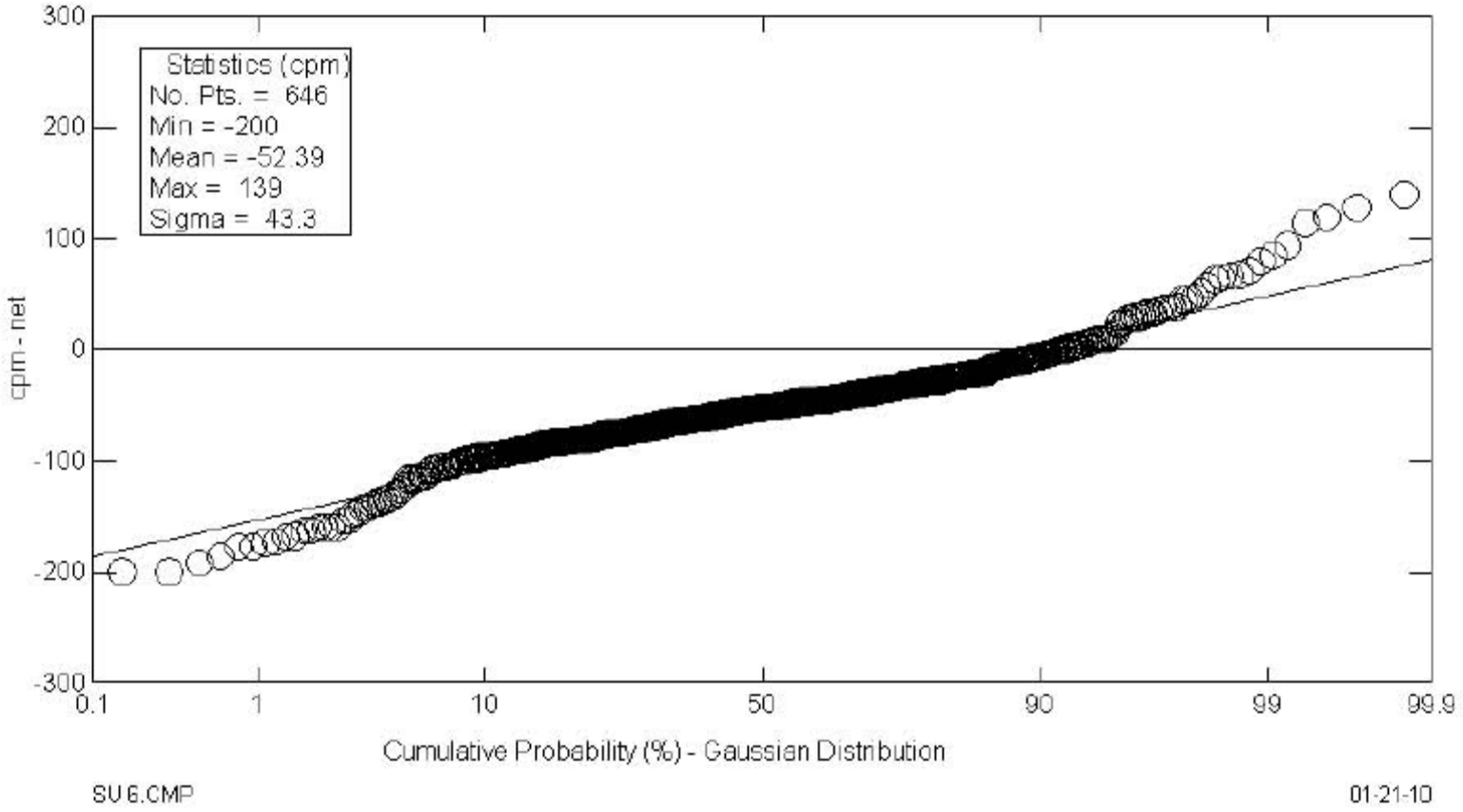


**Figure 3-2**
**Survey Unit 6 Beta Scan Data**

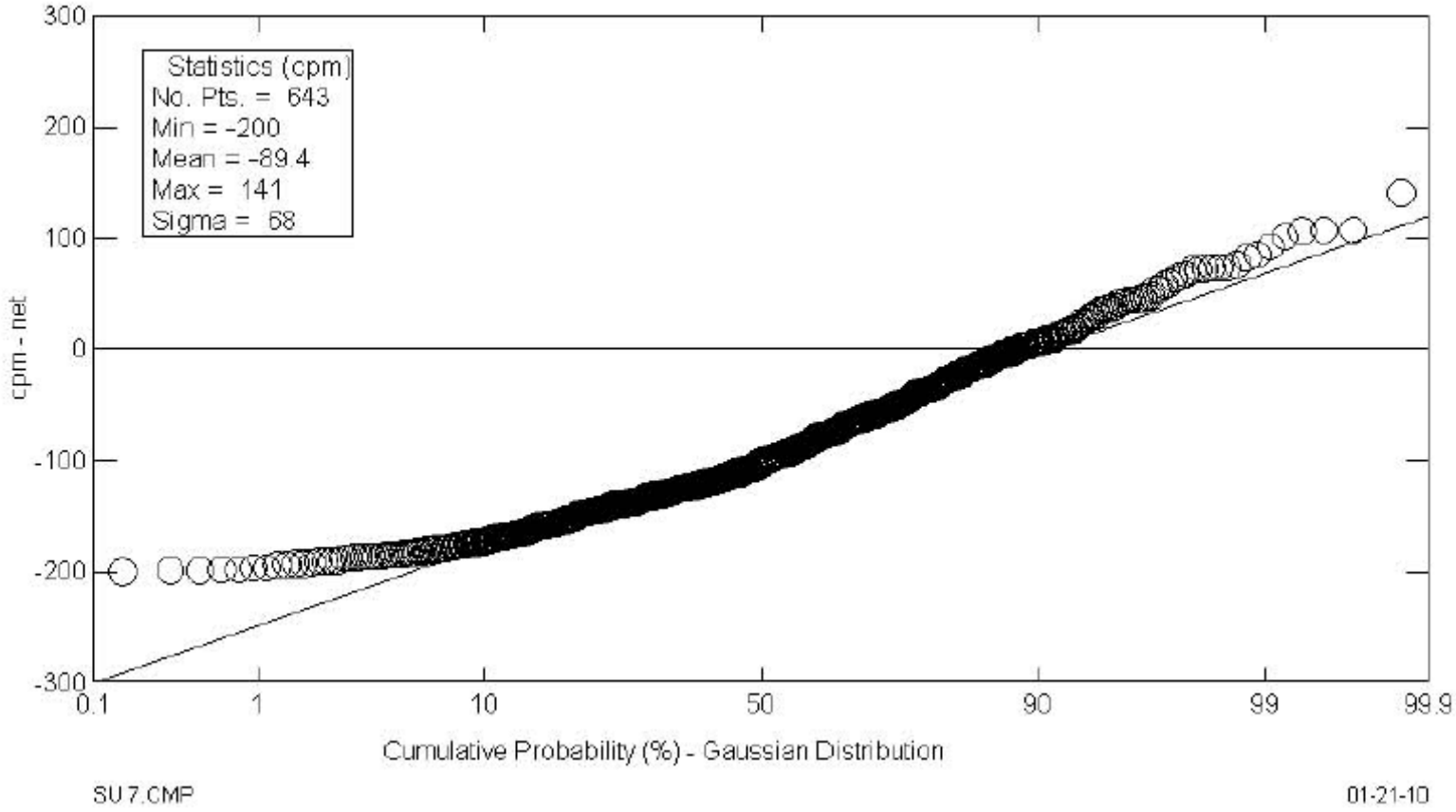


**Figure 3-3**
**Survey Unit 7 Beta Scan Data**

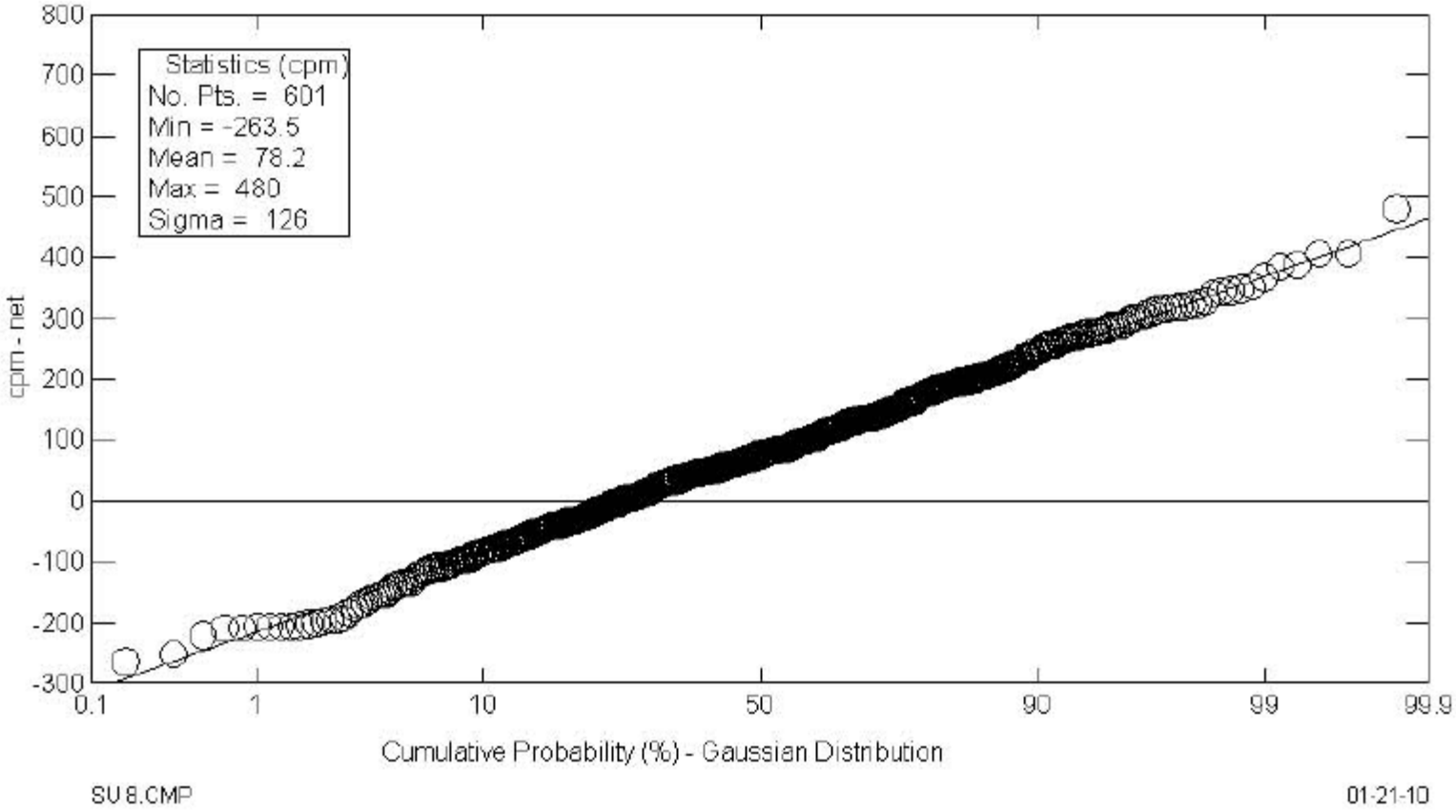


**Figure 3-4**
**Survey Unit 8 Beta Scan Data**

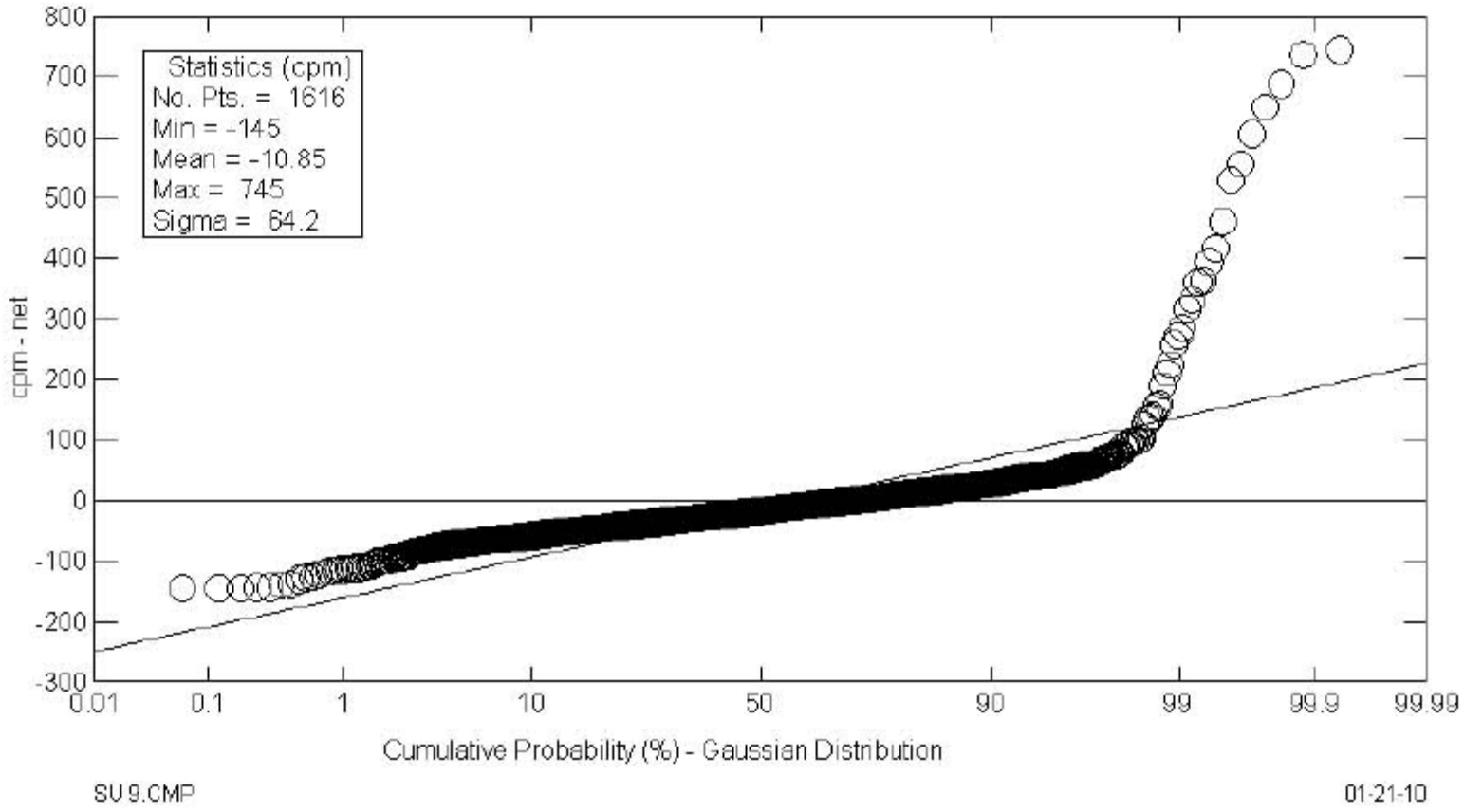


**Figure 3-5**
**Survey Unit 9 Beta Scan Data**

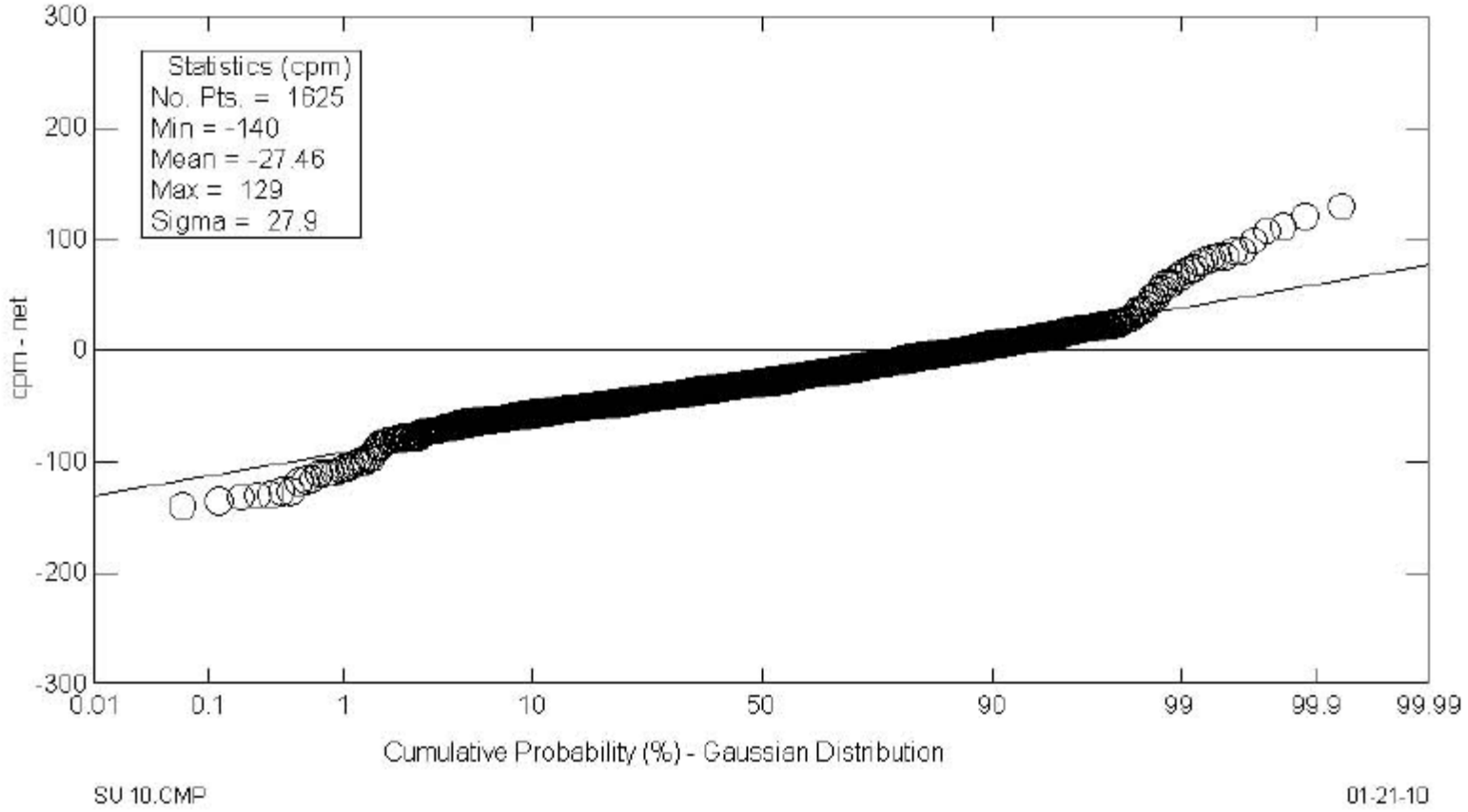


**Figure 3-6**
**Survey Unit 10 Beta Scan Data**

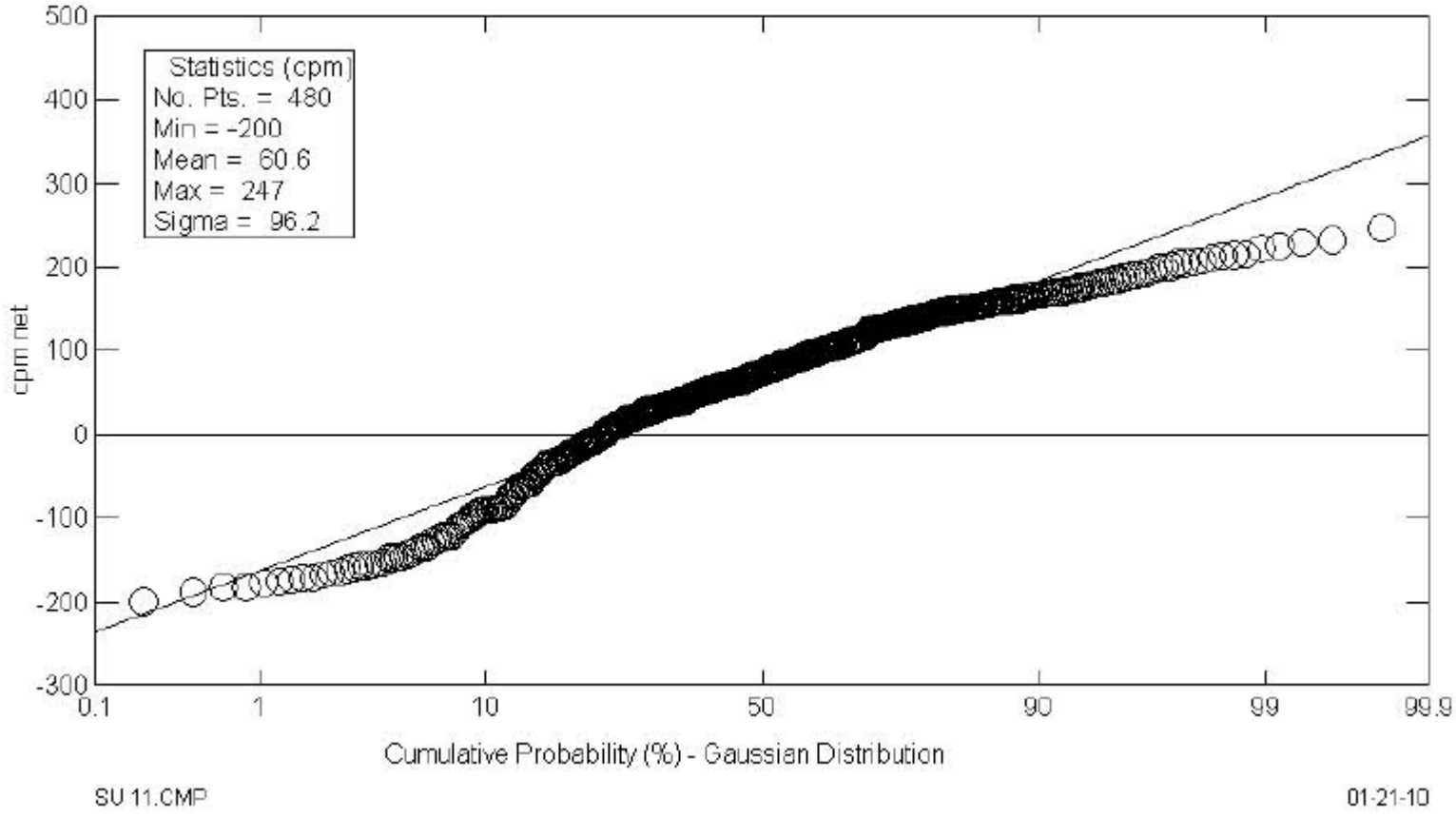


**Figure 3-7**
**Survey Unit 11 Beta Scan Data**

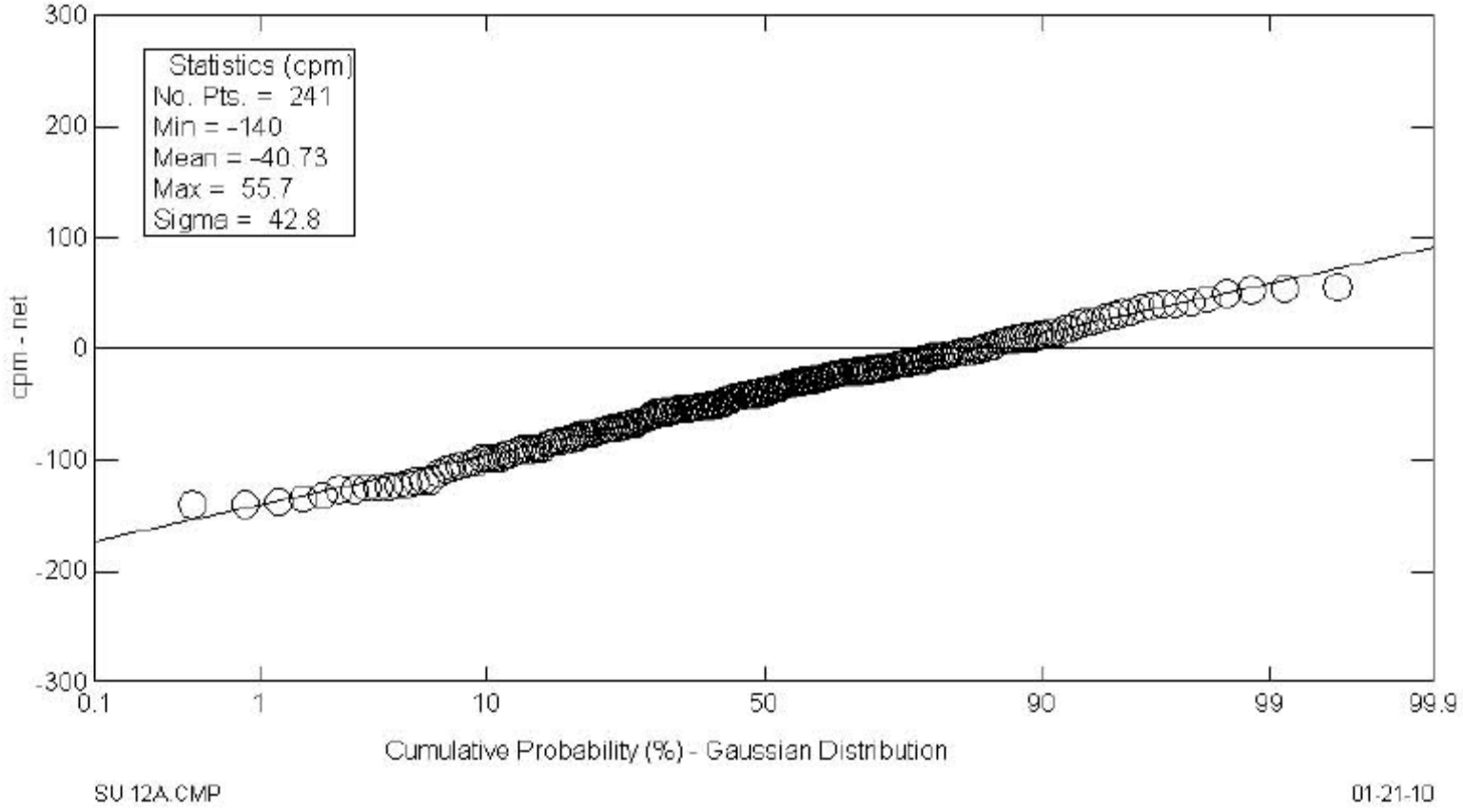


**Figure 3-8**
**Survey Unit 12A Beta Scan Data**

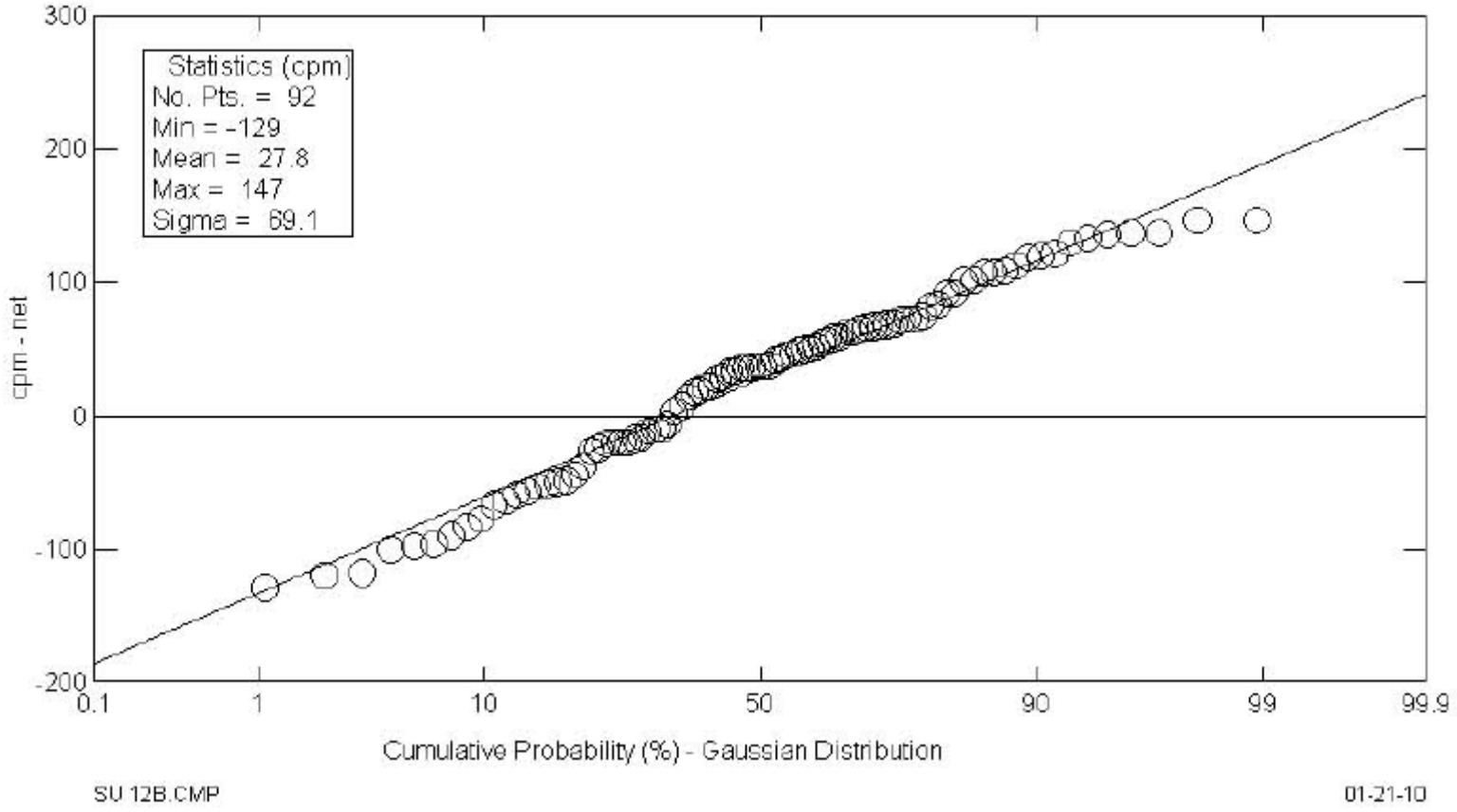


**Figure 3-9**
**Survey Unit 12B Beta Scan Data**

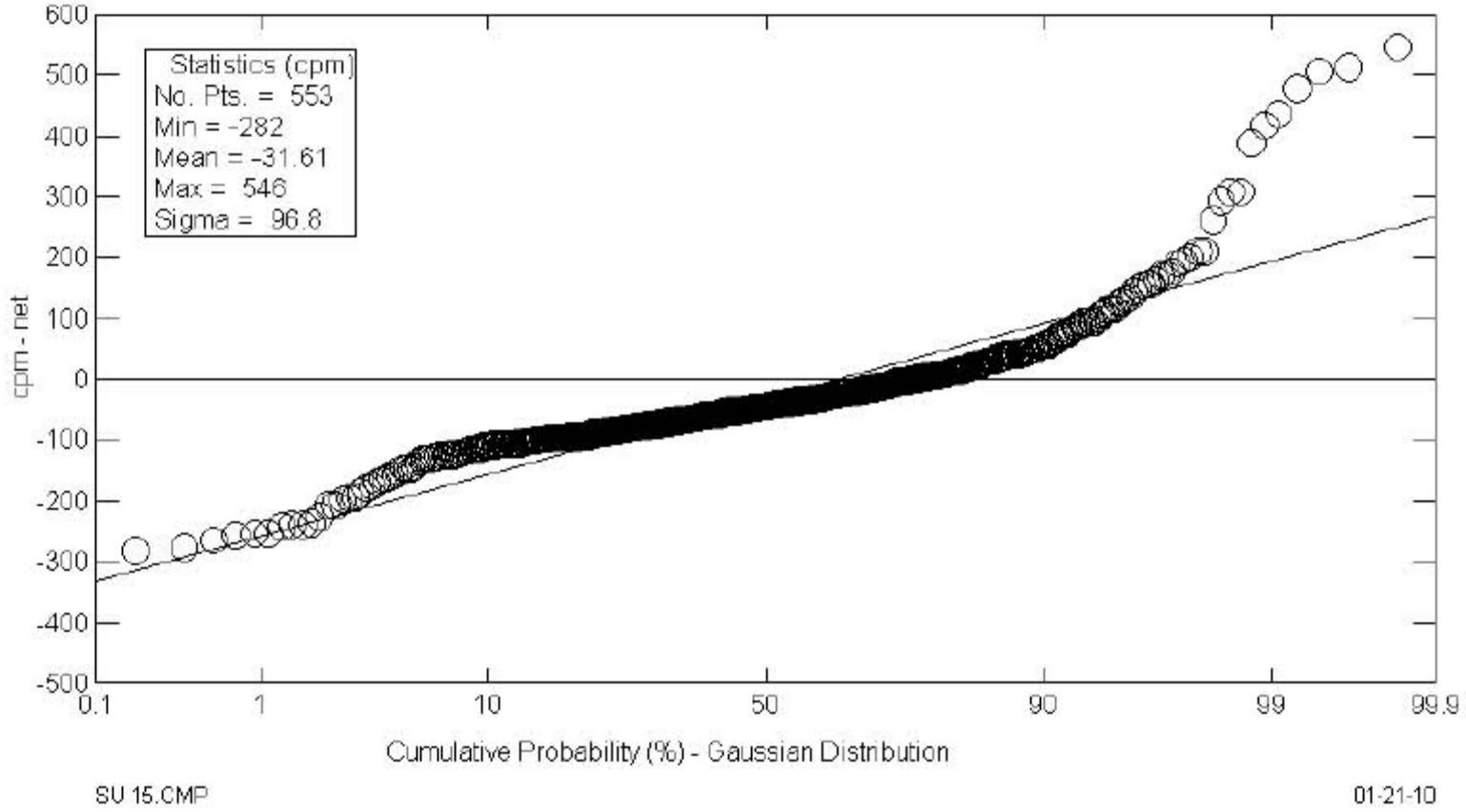


**Figure 3-10**
**Survey Unit 15 Beta Scan Data**

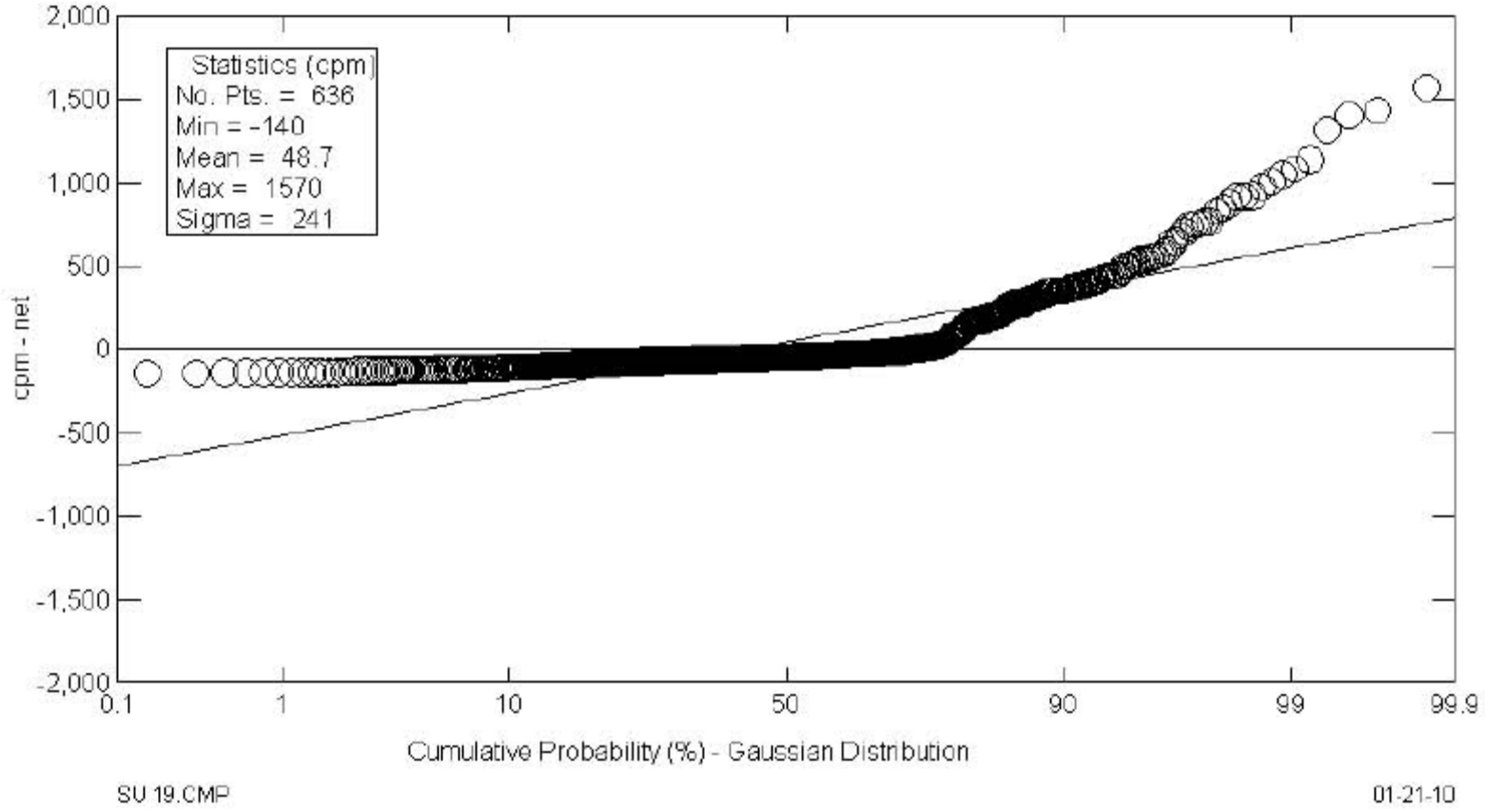


**Figure 3-11**
**Survey Unit 19 Beta Scan Data**

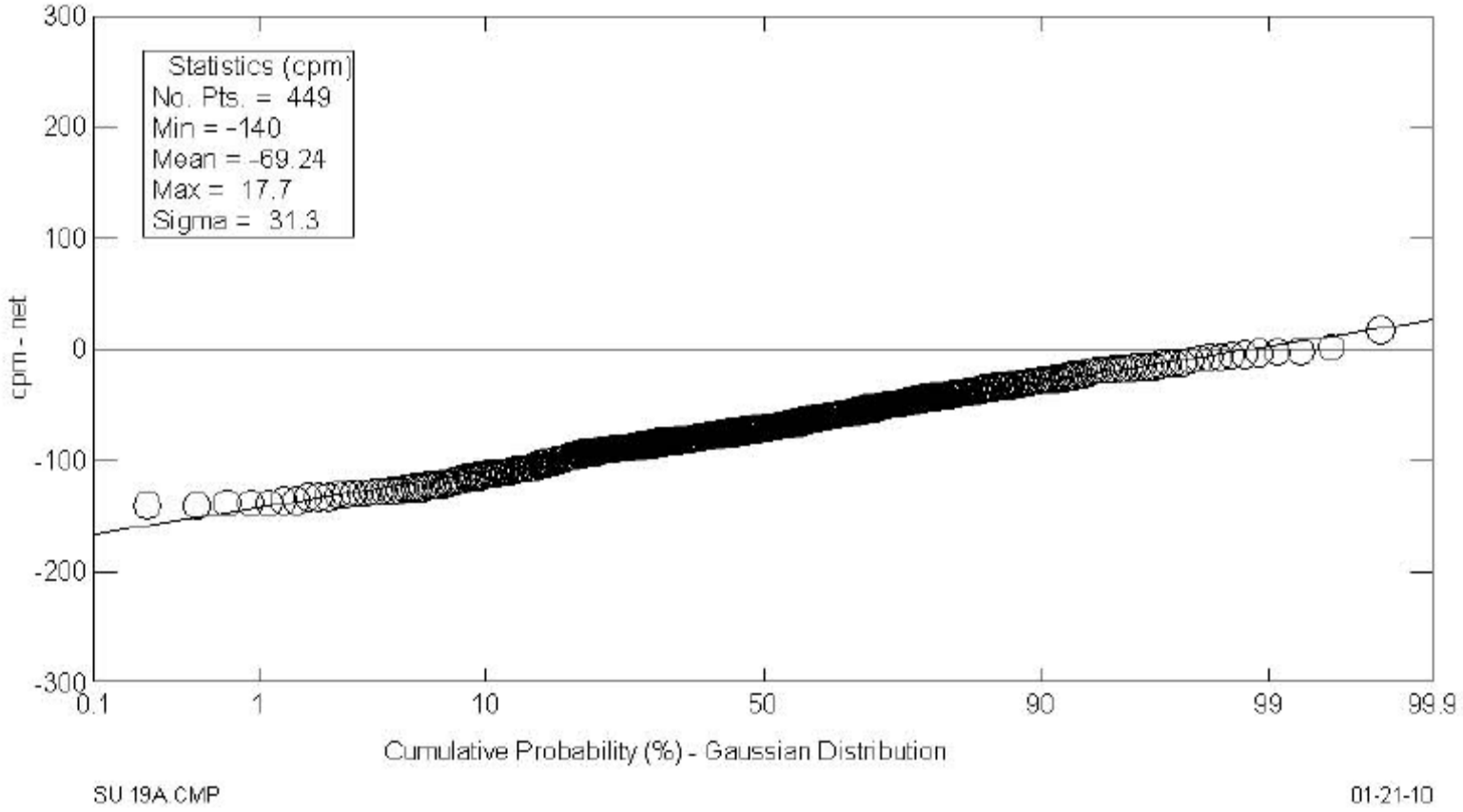


**Figure 3-12**
**Survey Unit 19A Beta Scan Data**

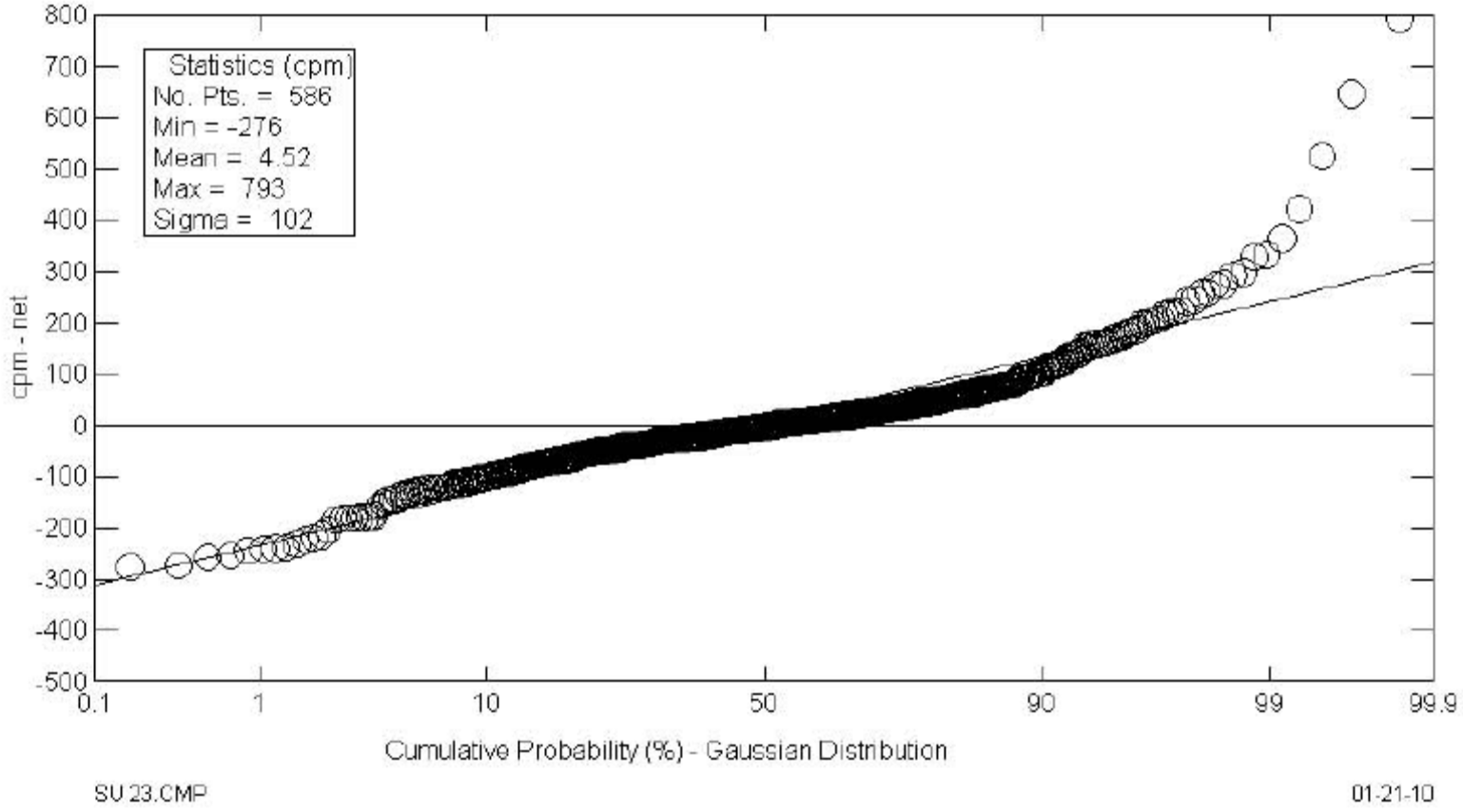


**Figure 3-13**
**Survey Unit 23 Beta Scan Data**

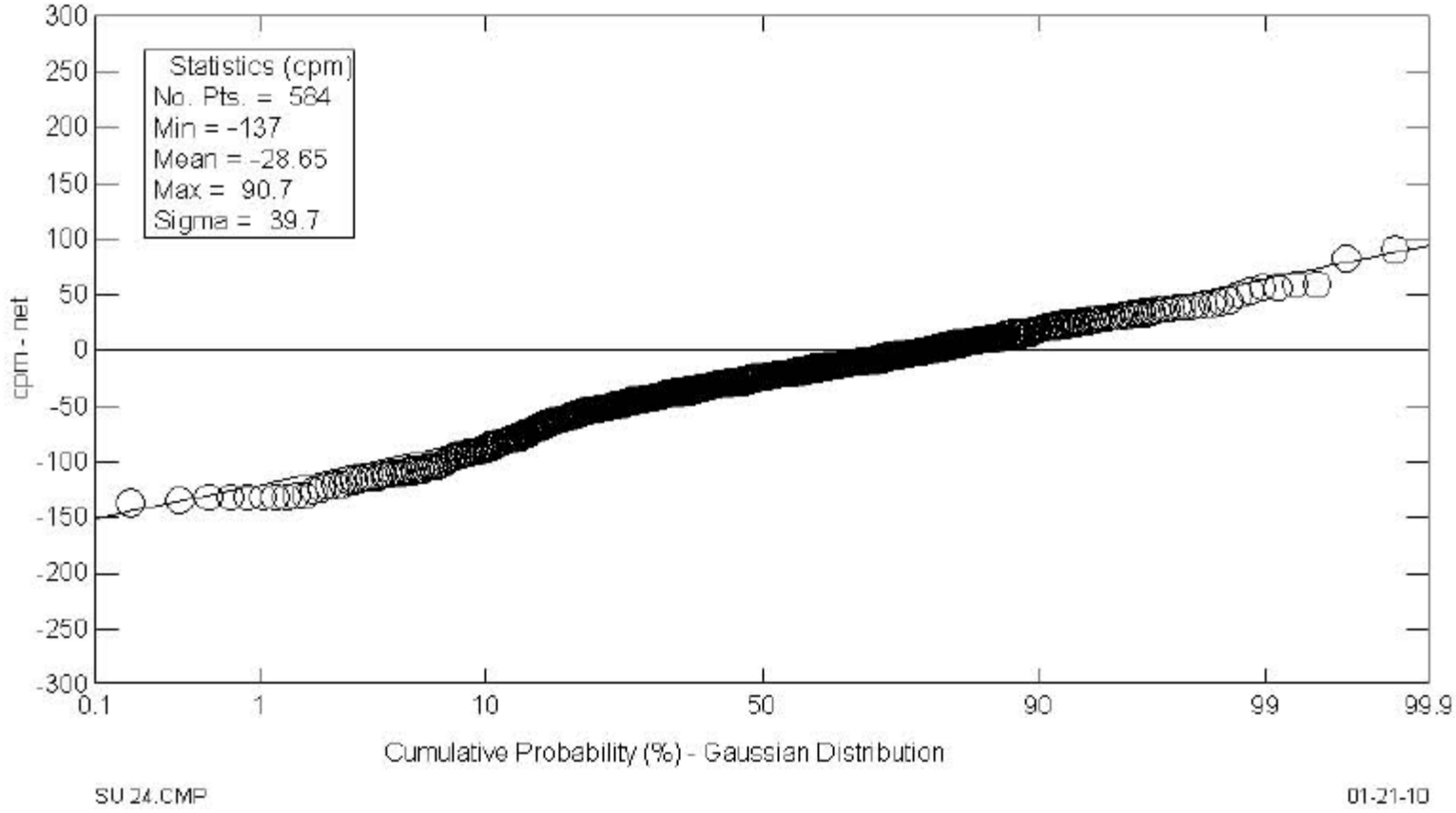


**Figure 3-14**
**Survey Unit 24 Beta Scan Data**

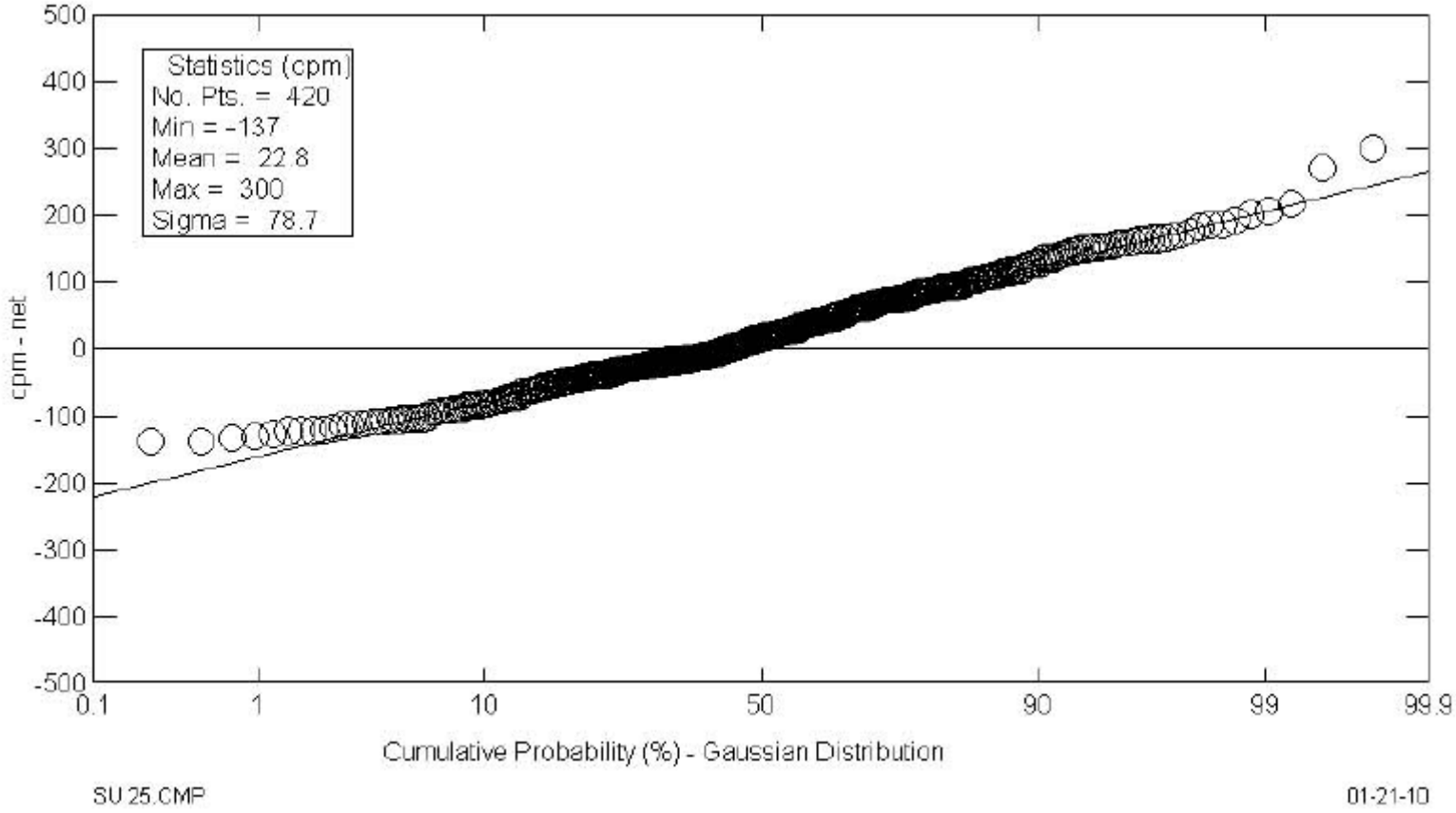


**Figure 3-15**
**Survey Unit 25 Beta Scan Data**

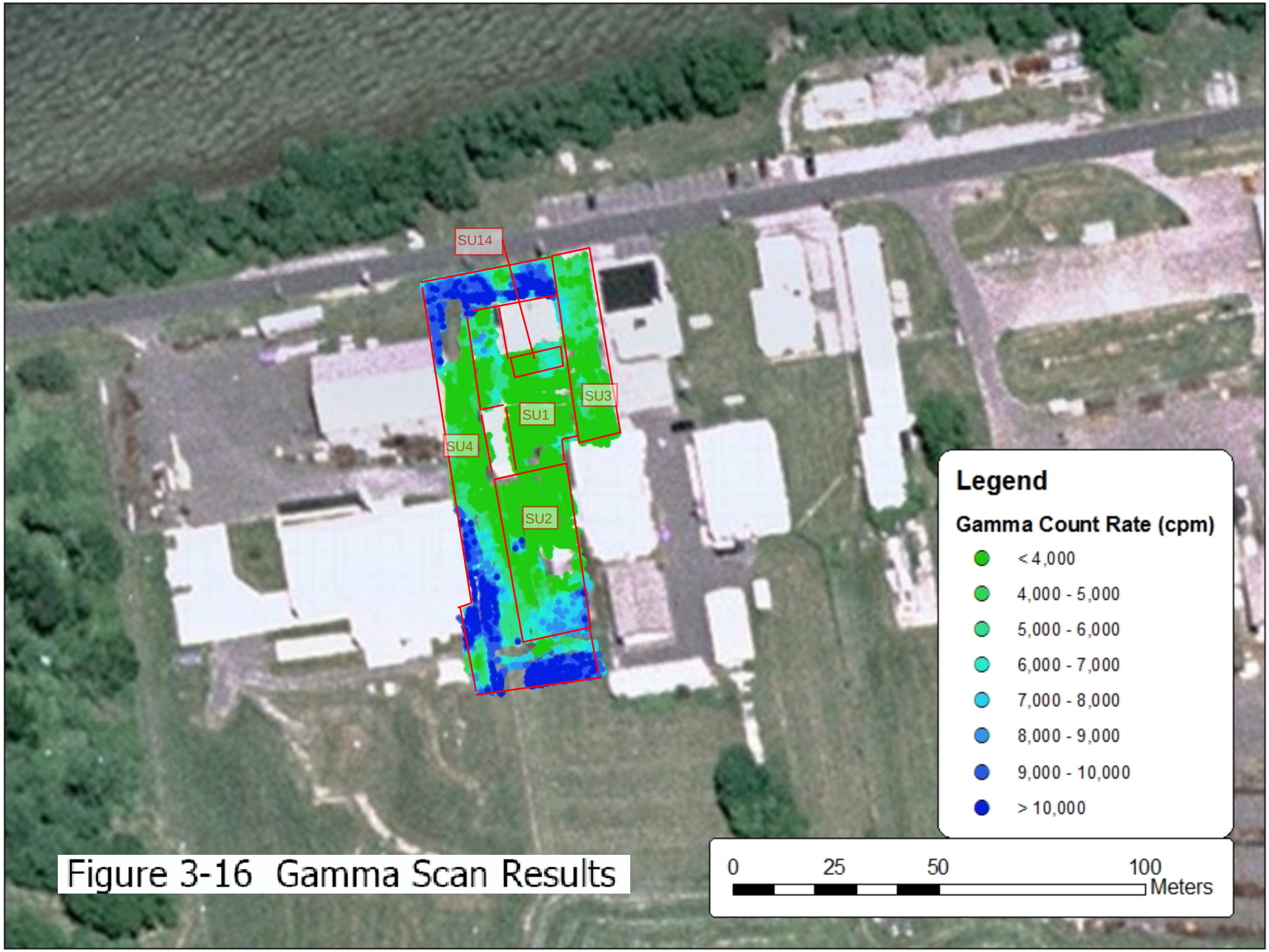


Figure 3-16 Gamma Scan Results

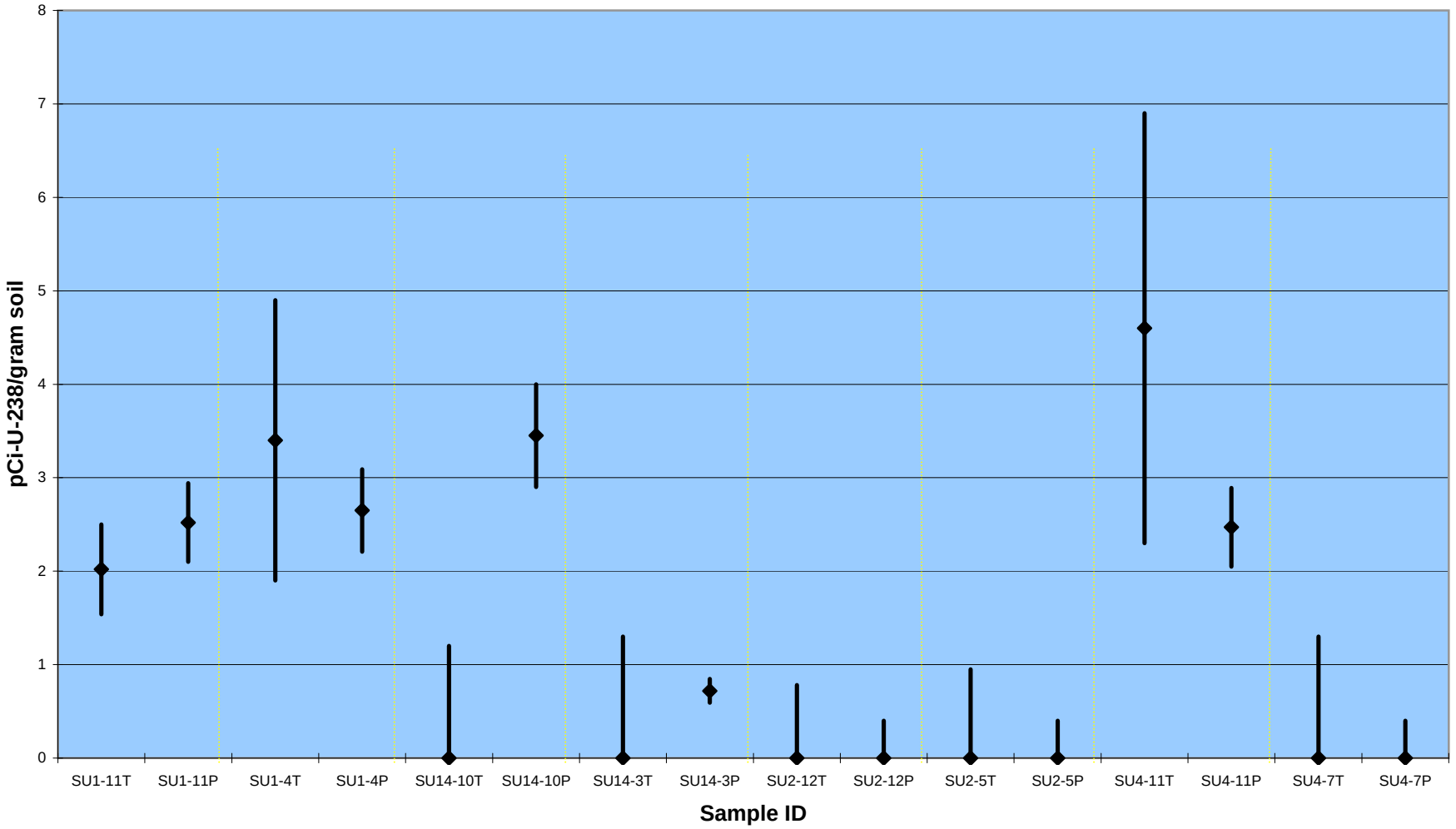


**Figure 3-17**
**QC Results for Gamma Spectroscopy**
Key: T = TestAmerica, P=PIKA Lab
Error bars: 2 sigma or MDA

# APPENDIX A

Final Status Survey Plan

# BUILDING 1103A AREA
# FINAL STATUS SURVEY PLAN

## REV. 0

## U.S. Army Research Laboratory
## Aberdeen Proving Ground, MD

Contract No. W52P1J-04-D-0007
Delivery Order No. 0006

***Submitted to:***
**U.S. Army Joint Munitions Command**
1 Rock Island Arsenal
Rock Island, IL 61299-6000

***Submitted by:***
**CABRERA SERVICES, INC.**
103 East Mount Royal Avenue
Baltimore, MD 21202

CABRERA SERVICES
RADIOLOGICAL · ENVIRONMENTAL · REMEDIATION

**February 2008**

# TABLE OF CONTENTS

# LIST OF TABLES



# LIST OF FIGURES



# APPENDICES

# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| **ANL** | Argonne National Laboratory |
| **APG** | Aberdeen Proving Grounds |
| **ARL** | Army Research Laboratory |
| **bkg** | background |
| **CABRERA** | Cabrera Services, Inc. |
| **CFR** | Code of Federal Regulations |
| **cm** | centimeter(s) |
| **$cm^2$** | square centimeter(s) |
| **cpm** | count(s) per minute |
| **DCGL** | Derived Concentration Guideline Level |
| **$DCGL_{EMC}$** | Derived Concentration Guideline Level used for elevated measurement comparison |
| **$DCGL_w$** | Derived Concentration Guideline Level used for non-parametric statistical test |
| **dpm** | disintegration(s) per minute |
| **DP** | Decommissioning Plan |
| **DQO** | Data Quality Objective |
| **DU** | Depleted Uranium |
| **FRER** | Fluence Rate to Exposure Rate |
| **FSS** | Final Status Survey |
| **FSSP** | Final Status Survey Plan |
| **GPS** | Global Positioning System |
| **GWS** | Gamma Walkover Survey |
| **$H_a$** | alternative hypothesis |
| **$H_0$** | null hypothesis |
| **HP** | Health Physicist |
| **in.** | inch(es) |
| **JMC** | Joint Munitions Command |
| **LBGR** | Lower Bound of the Gray Region |
| **m** | meter(s) |
| **$m^2$** | square meter(s) |
| **m/s** | meter(s) per second |
| **MARSSIM** | Multi-Agency Radiological Survey and Site Investigation Manual |
| **MDC** | Minimum Detectable Concentration |
| **MDCR** | Minimum Detectable Count Rate |
| **MDER** | Minimum Detectable Exposure Rate |
| **min** | minute(s) |
| **mrem/yr** | millirem(s) per year |
| **μR/hr** | microroentgens per hour |
| **NaI** | sodium iodide |
| **NIST** | National Institute of Standards and Technology |
| **NRC** | U.S. Nuclear Regulatory Commission |
| **P** | Probability |
| **pCi/g** | picocurie(s) per gram |
| **QA** | Quality Assurance |
| **QC** | Quality Control |
| **RDR** | Relative Detector Response |
| **ROC** | Radionuclide of Concern |
| **sec** | second(s) |
| **SOP** | Standard Operating Procedure |
| **SU** | Survey Unit |
| **TEDE** | Total Effective Dose Equivalent |
| **$^{137}Cs$** | cesium-137 |
| **$^{99}Tc$** | technetium-99 |
| **$^{230}Th$** | thorium-230 |
| **$^{234}Th$** | thorium-234 |
| **$^{234}U$** | uranium-234 |
| **$^{235}U$** | uranium-235 |
| **$^{238}U$** | uranium-238 |

## 1.0 INTRODUCTION

This *Final Status Survey Plan (FSSP)* has been prepared by Cabrera Services, Inc. (CABRERA), under contract to the U.S. Army Joint Munitions Command (JMC), to support the decommissioning of the Building 1103A Area at Aberdeen Proving Ground (APG). This *FSSP* addresses the applicable radiological surveys, sampling, and data analysis necessary to demonstrate that the Building 1103 Area is suitable for unrestricted release following completion of the decommissioning activities outlined in the *Building 1103A Area Decommissioning Plan (DP)*. The Building 1103A Area is under the control of the U.S. Army Research Laboratory (ARL), and is subject to the requirements of its U.S. Nuclear Regulatory Commission (NRC) license (No. SMB-141). The goal of decommissioning activities described in the *DP* is to facilitate the release of the site for unrestricted use.

The proposed derived concentration guideline levels (DCGLs) for soil and structures for the Building 1103A Area are based on the surface activity screening values published by the NRC in NUREG-5512: *Residual Radioactive Contamination from Decommissioning, Parameter Analysis,* Volume 3, Tables 5.19 (NRC, 1999), and a site-specific soil DCGL developed by Argonne National Laboratory (ANL) for the APG Transonic Range (ANL, 1999), which was contaminated with similar source material (i.e., depleted uranium [DU]). Implementation of this *FSSP* will provide the data necessary to demonstrate compliance with the DCGL for structure surfaces and outdoor areas. Specifically, when the DCGLs are applied to the final status survey (FSS) and the data obtained indicates that the requirements of this *FSSP* have been satisfied, the requirements in Title 10 of the Code of Federal Regulations (CFR) Part 20.1402 for unrestricted release are achieved (NRC, 2006).

## 2.0 SITE INFORMATION

The Building 1103A Area is a former radioactive material processing and storage facility on Spesutie Island at APG. Historical site activities involving DU have resulted in radiological contamination of the buildings and grounds. ARL has responsibility for this area and desires to initiate the decommissioning process so that the area can be released from its NRC Nuclear Materials License requirements.

The general layout of the Building 1103A Area is shown in Figure 2-1. Floor plans of the main buildings comprising this area (i.e., Building 1103A, Building BRL12, and the freestanding vault) are depicted in Figures 2-2 through 2-4, respectively. Historical activities involved the unloading of DU contaminated targets in the central asphalt area; storage and staging of the targets in one of the three vaults; cutting and machining of the targets in Building 1103A (and, to a lesser extent, BRL12); and storage and reloading of the resulting steel pieces in preparation for decontamination, disposal, or reuse.

A characterization survey was conducted at the site in May 2006 to determine the extent of radiological impact to the buildings and grounds. Upon completion of the survey, limited DU activities in the Building 1103A Area were temporarily resumed. Current activities are similar in nature to historical activities conducted at the site, and are being confined to Building 1103A only. It is expected that work involving DU will permanently cease in 2008, at which time the Army is expected to proceed with decommissioning the site.

### 2.1 Site Description

The Building 1103A Area consists of 3 primary structures: Building 1103A, Building BRL12, and a Freestanding Vault. The site also includes the land areas adjacent to and between these structures.

#### *2.1.1 Building 1103A*

Building 1103A houses the main machine shop used for the disassembly of firing range targets contaminated with DU. The Main Area of Building 1103A is constructed of cinder block exterior walls, a concrete slab floor, and a flat tar-and-chip roof. The ceiling is covered in some places with fiberboard. Under the same roof is a small Entry Area, which includes the furnace room, bathroom, meeting room, and changing room. The Entry Area has a drop-type acoustic tile ceiling, sheetrock walls, and tile flooring. The walls separating the Entry

and Main Areas consist of sheetrock, and are lined with steel plates on the side facing the Main Area.

On the south side of the building is a Shop Area, which is a wood-frame addition to the main building. This area has a concrete slab floor and a pitched shingle roof. Steel plates line the lower portion of the walls in this area, and fiberglass insulation is present between the wood studs and overhead beams.

Building 1103A contains functioning ventilation, electrical, water supply, and sewer systems. The ventilation system has fiber filters on the air intake vents and exposed ductwork attached to the ceiling. The electrical system panel is located in the Shop Area, and electrical conduit runs along the walls and ceiling throughout the building to supply energy to light fixtures and wall outlets. There is a full bathroom in the Entry Area with sink, toilet, and shower facilities. This area was used for personnel and equipment decontamination during building operations involving radioactive material.

### *2.1.2 Building BRL12*

Building BRL12 was built to provide additional space for machining operations associated with the dismantlement of DU-contaminated targets, as well as shielded storage space for staging the contaminated targets prior to disassembly. The main area (i.e., Central Room) of Building BRL12, where machining was performed, has a concrete floor, sheetrock walls (some of which are lined with steel), and acoustic tile ceiling. There are two air conditioning units mounted in the west wall of the building. The only utility system in the building is the electrical system, which is used to power the air conditioners, light fixtures, and wall outlets.

There are steel-lined storage vaults on the north and south ends of Building BRL12. Both vaults have concrete floors and steel-lined walls and ceilings. A single light fixture hangs from the ceiling in each vault. There is also a small office area situated between the main room and the north end vault. The office has sheetrock walls, tiled floor, and acoustic tile ceiling.

### *2.1.3 Freestanding Vault*

The Freestanding Vault is situated directly southeast of Building BRL12. Like the BRL12 end vaults, this vault was used for the storage of contaminated targets. It has a concrete floor, and the walls and ceiling are completely lined with steel. A single light fixture hangs from the ceiling. Attached to the southern end of the vault is a wooden tool shed where maintenance equipment such as a tractor and snow plow are stored.

### *2.1.4 Pavement and Grounds*

The impacted outdoor areas include approximately one-half acre of asphalt pavement between the buildings and vaults (i.e., Central Asphalt), the small parking lot east of the perimeter fence enclosing the Building 1103A Area (i.e., Adjacent Asphalt), and approximately one-half acre of grass-covered grounds within or adjacent to the Building 1103A Area (i.e., Grounds).

Central Asphalt

The Central Asphalt area, which extends from the south side of Building 1103A to the southern fence, was the site of loading, unloading, and staging of contaminated targets, as well as for the transfer of targets among the disassembly buildings and storage areas. On at least one occasion, contaminated items were dismantled on the asphalt in front of Building BRL12 by using an acetylene torch. The asphalt is cracked in many places, allowing for water seepage, and is prone to slight changes in elevation depending on the moisture content of the underlying soil. Small areas of yellow discoloration and/or DU fragments are present in several locations.

Adjacent Asphalt

The Adjacent Asphalt lies east of Building 1103A and north of Building 1103B. It is presently used as a parking lot for employees working in nearby buildings.

Grounds

The Grounds consist of the lawn adjacent to Building 1103A, as well as the grassy areas south and west of the central asphalt. Grounds were included in the survey to evaluate possible impacts due to airborne migration of DU-contaminated dust and/or waterborne migration of DU-contaminated runoff.

## 2.2 Previous Investigations

In 2006, CABRERA performed a characterization survey of potentially impacted buildings and grounds at the Building 1103A Area. Results of the structures surface contamination surveys and soils volumetric sample analyses completed during the characterization survey are presented in the *Building 1103A Area Characterization Survey Report* (CABRERA, 2007), and summarized below in Tables 2-1 through 2-7. Surface contamination results are presented in units of disintegrations per minute per 100 square centimeters (dpm/100 $cm^2$), and volumetric results are presented in units of picocuries per gram (pCi/g).

**Table 2-1: Building 1103A Direct Alpha Measurement Summary**

| Area | Location | Alpha Activity (dpm/100cm$^2$) | | |
|---|---|---|---|---|
| | | Average | Standard Deviation | Maximum |
| Main Area | Floor | 432 | 239 | 864 |
| | Interior Walls | 68 | 42 | 172 |
| | Ceiling | 10 | 8 | 26 |
| | Ceiling Horizontal Surfaces | 1,245 | 1,045 | 2,654 |
| Shop Area | Floor | 386 | 59 | 428 |
| | Interior Walls | 80 | 62 | 276 |
| | Ceiling | 33 | 15 | 52 |
| | Ceiling Horizontal Surfaces | 711 | 771 | 1562 |
| Entry Area | Floor | 87 | 73 | 236 |
| | Interior Walls | 8 | 7 | 20 |
| | Ceiling | * | * | * |
| | Ceiling Horizontal Surfaces | 375 | 301 | 812 |
| Exterior Walls | North Wall | 22 | 13 | 42 |
| | South Wall | 43 | 85 | 268 |
| | East Wall | 13 | 13 | 36 |
| | West Wall | 12 | 6 | 20 |

dpm/100 cm$^2$ = disintegrations per minute per 100 square centimeters

* = characterization survey measurements not obtained

**Table 2-2: Building 1103A Removable Alpha Measurement Summary**

| Area | Location | Alpha Activity (dpm/100cm$^2$) | | |
|---|---|---|---|---|
| | | Average | Standard Deviation | Maximum |
| Main Area | Floor | 60 | 36 | 124 |
| | Interior Walls | 28 | 25 | 88 |
| | Ceiling | 0.4 | 0.7 | 1.3 |
| | Ceiling Horizontal Surfaces | 284 | 198 | 644 |
| Shop Area | Floor | 7.0 | 1.5 | 8.0 |
| | Interior Walls | 16 | 13 | 56 |
| | Ceiling | 7.2 | 6.2 | 18 |
| | Ceiling Horizontal Surfaces | 159 | 145 | 315 |
| Entry Area | Floor | 7.8 | 7.0 | 20 |
| | Interior Walls | 2.2 | 1.3 | 4.3 |
| | Ceiling | * | * | * |
| | Ceiling Horizontal Surfaces | 68 | 69 | 179 |
| Exterior Walls | North Wall | 0.2 | 0.6 | 1.0 |
| | South Wall | 1.6 | 3.1 | 9.9 |
| | East Wall | 0.1 | 0.5 | 1.0 |
| | West Wall | 0.3 | 1.0 | 2.3 |

dpm/100 cm$^2$ = disintegrations per minute per 100 square centimeters

* = characterization survey measurements not obtained

**Table 2-3: Building BRL12 Direct Alpha Measurement Summary**

| Area | Location | Alpha Activity (dpm/100cm$^2$) | | |
|---|---|---|---|---|
| | | Average | Standard Deviation | Maximum |
| Central Room | Floor | 76 | 55 | 186 |
| | Interior Walls | 9 | 12 | 40 |
| | Ceiling | 19 | 15 | 36 |
| North Vault | Floor | 4,030 | 6,132 | 14,798 |
| | Interior Walls | -1 | 7 | 10 |
| | Ceiling | 0 | 0 | 0 |
| South Vault | Floor | 43 | 23 | 68 |
| | Interior Walls | 1 | 3 | 6 |
| | Ceiling | 4 | 0 | 4 |
| Office Area | Floor | 98 | * | 98 |
| | Interior Walls | ** | ** | ** |
| | Ceiling | ** | ** | ** |
| Exterior Walls | North Wall | 5 | 6 | 12 |
| | South Wall | 6 | 5 | 12 |
| | East Wall | 7 | 8 | 22 |
| | West Wall | 4 | 7 | 12 |

dpm/100 cm$^2$ = disintegrations per minute per 100 square centimeters

* = single measurement obtained

** = characterization survey measurements not obtained

**Table 2-4: Building BRL12 Removable Alpha Measurement Summary**

| Area | Location | Alpha Activity (dpm/100cm$^2$) | | |
|---|---|---|---|---|
| | | Average | Standard Deviation | Maximum |
| Central Room | Floor | 7.4 | 4.1 | 14 |
| | Interior Walls | 4.4 | 3.2 | 8.7 |
| | Ceiling | 0.7 | 0.9 | 1.3 |
| North Vault | Floor | 274 | 470 | 1,107 |
| | Interior Walls | 0.8 | 1.0 | 2.3 |
| | Ceiling | 0.4 | 0.6 | 0.8 |
| South Vault | Floor | 5.9 | 4.1 | 12 |
| | Interior Walls | 0.3 | 0.7 | 1.3 |
| | Ceiling | 1.4 | 1.5 | 2.4 |
| Office Area | Floor | 7.5 | * | 7.5 |
| | Interior Walls | ** | ** | ** |
| | Ceiling | ** | ** | ** |
| Exterior Walls | North Wall | 0.9 | 1.1 | 2.3 |
| | South Wall | 0.6 | 1.2 | 2.3 |
| | East Wall | 1.0 | 1.6 | 3.6 |
| | West Wall | 0.3 | 0.6 | 1.0 |

dpm/100 cm$^2$ = disintegrations per minute per 100 square centimeters

* = single measurement obtained

** = characterization survey measurements not obtained

**Table 2-5: Freestanding Vault Direct Alpha Measurement Summary**

| Area | Location | Alpha Activity (dpm/100cm$^2$) | | |
|---|---|---|---|---|
| | | Average | Standard Deviation | Maximum |
| Interior | Floor | 46 | 14 | 56 |
| | Interior Walls | 16 | 37 | 104 |
| | Ceiling | 1 | 1 | 2 |
| Exterior Walls | North Wall | 12 | 3 | 16 |
| | South Wall | 3 | 7 | 10 |
| | East Wall | 9 | 16 | 20 |
| | West Wall | 23 | 10 | 38 |

dpm/100 cm$^2$ = disintegrations per minute per 100 square centimeters

**Table 2-6: Freestanding Vault Removable Alpha Measurement Summary**

| Area | Location | Alpha Activity (dpm/100cm$^2$) | | |
|---|---|---|---|---|
| | | Average | Standard Deviation | Maximum |
| Interior | Floor | 3.0 | 2.6 | 4.8 |
| | Interior Walls | 3.3 | 4.2 | 12.6 |
| | Ceiling | 0.1 | 0.3 | 0.3 |
| Exterior Walls | North Wall | 1.2 | 0.7 | 2.3 |
| | South Wall | 0.1 | 0.8 | 1.3 |
| | East Wall | 1.5 | 1.1 | 2.3 |
| | West Wall | 0.3 | 0.6 | 0.8 |

dpm/100 cm$^2$ = disintegrations per minute per 100 square centimeters

**Table 2-7: Soil Sample Results Summary for Land Areas**

| Location | Maximum Soil Concentration (pCi/g) | |
|---|---|---|
| | $^{238}U$[1] | Total DU[2] |
| Average | 160 | 177 |
| Standard Deviation | 398 | 440 |
| Maximum | 1,740 | 1,925 |

pCi/g = picocuries per gram

[1] = $^{238}U$ concentration inferred from reported $^{234}Th$ concentration in biased soil samples.

[2] = Total DU concentration determined by dividing the $^{238}U$ concentration by 0.904 (i.e., assumed activity fraction of $^{238}U$ in DU).

## 3.0 FINAL STATUS SURVEY REQUIREMENTS

A FSS will be planned and conducted for each survey unit (SU) associated with impacted outdoor soil areas, outdoor solid surfaces (i.e., adjacent asphalt parking lot). The FSSP is prepared in accordance with the guidance presented in the *Multi-Agency Radiological Survey and Site Investigation Manual* (MARSSIM; NRC, 2000) and follows the data quality objective (DQO) process. This ensures that all impacted SUs are surveyed with the necessary rigor that corresponds with their respective contamination potential. The DQO process includes the following seven steps:

Step 1: State the problem

Step 2: Identify the decisions

Step 3: Identify inputs to the decisions

Step 4: Define the study boundaries

Step 5: Develop a decision rule

Step 6: Specify the decisions

Step 7: Optimize the survey design

The following sections provide the requirements for the planning phase of the FSS, including the identification of radionuclides of concern (ROCs) and DCGLs, classification and survey unit designations, survey planning parameters, instrumentation, measurement and sampling procedures, and the data quality assessments that will be implemented.

### 3.1 Radionuclides of Concern

ROCs known to be present in the Building 1103A Area are limited to DU isotopes consisting of uranium-234 ($^{234}$U), uranium-235 ($^{235}$U), and uranium-238 ($^{238}$U) and their short-lived decay progeny. The assumed DU composition is based on the isotopic uranium ratios routinely used for shipments of DU waste from APG (Barg, 1995). The activity fractions are calculated from the weight ratios and specific activities of each uranium isotope. The resulting composition consists of $^{234}$U, $^{235}$U, and $^{238}$U activity fractions of 0.084, 0.012, and 0.904, respectively. This composition is similar to the average activity fractions measured in three DU soil samples described in the ANL report *Derived Uranium Guideline for the*

*Depleted Uranium Study Area of the Transonic Range, Aberdeen Proving Ground, Maryland* (ANL, 1999).

## 3.2 Derived Concentration Guideline Levels

As described in MARSSIM (NRC, 2000), a DCGL is a derived radionuclide activity concentration that corresponds to a dose-based release criterion; and a $DCGL_W$ is the DCGL used in non-parametric statistical testing to evaluate compliance with the dose-based criterion across a wide area (i.e., SU). For this FSS, the release criterion is based on the 25 millirem per year (mrem/yr) total effective dose equivalent (TEDE) exposure limit specified in 10 CFR 20, Subpart E: *Radiological Criteria for License Termination* (NRC, 2006). The corresponding DCGLs for soil and structures are described below.

### *3.2.1 Soil $DCGL_W$*

A $DCGL_W$ of 230 pCi/g total DU will be used for evaluating soils at the Building 1103A Area. Of this total DU $DCGL_W$, 190 pCi/g is attributable to $^{238}U$. Therefore, if $^{238}U$ is used as the indicator parameter for evaluating soil sample results, the total DU $DCGL_W$ is not exceeded if the $^{238}U$ concentration does not exceed 190 pCi/g. These values were originally developed for use in decommissioning the APG Transonic Range (ANL, 1999), which was contaminated with source material similar to that at the Building 1103A Area. The total DU $DCGL_W$ is based on a resident-farmer exposure scenario, and represents the modeled radioactivity concentration corresponding to a potential dose of 25 mrem/yr over a 1,000-year period.

### *3.2.2 Structures $DCGL_W$*

The $DCGL_W$ for DU surface activity on structures is based on the screening values published in NUREG/CR-5512, Volume 3, Table 5.19 ($P_{crit}$ = 0.90; NRC, 1999). The primary method of obtaining surface activity measurements for both total and removable activity will be through use of alpha monitoring instrumentation. Therefore, the surface activity screening values have been calculated based on the total number of alpha particles emitted in each of the applicable radioactive decay chains and the percent contribution from each of the uranium isotopes present in DU, as shown in Table 3-1. The $DCGL_W$ is calculated using the following formula.

$$DCGL_W = \frac{1}{\left(\frac{f_1}{DCGL_1}\right) + \left(\frac{f_2}{DCGL_2}\right) + \left(\frac{f_3}{DCGL_3}\right)}$$

Where:

$DCGL_W$ = Combined gross activity DCGL
$f_{1,2,3}$ = Activity fraction of individual radionuclide
$DCGL_{1, 2, 3}$ = DCGL for individual radionuclide

**Table 3-1: Surface Activity $DCGL_W$**

| ROC | | NUREG/CR-5512 Screening Level (dpm/100 $cm^2$) | Total Alphas per Decay | Alpha Based Screening Level (dpm/100 $cm^2$) | DU Alpha $DCGL_W$ (dpm/100 $cm^2$) |
|---|---|---|---|---|---|
| DU | 90.4% $^{238}U$ | 101.0 | 1 | 101.0 | 100 |
| | 1.2% $^{235}U$ | 97.6 | 1 | 97.6 | |
| | 8.4% $^{234}U$ | 90.6 | 1 | 90.6 | |

dpm /100 $cm^2$ = disintegrations per minute per 100 square centimeters

As noted in NUREG/CR-5512 (NRC, 1999), the surface activity screening levels are based on the assumption that the fraction of removable surface contamination is ten percent. Therefore, the removable alpha activity limit applied to the FSS is 10 dpm/100 $cm^2$.

### 3.3 Area Classification Based on Contamination Potential

Based on historical site information and data obtained during the characterization survey, impacted areas at the Building 1103A Area have been subdivided into three categories based on contamination potential as either Class 1, 2, or 3, in accordance with MARSSIM (NRC, 2000). A description of each is provided below:

**Class 1:** Buildings or land areas that have a significant potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiological surveys) that exceeds the $DCGL_W$.

**Class 2:** Buildings or land areas, often contiguous to Class 1 areas, that have a potential for radioactive contamination but at levels less than the $DCGL_W$.

**Class 3:** Buildings or land areas that are expected to contain little or no residual contamination based on site operating history or previous radiological surveys.

Furthermore, outdoor solid surfaces, land areas, and buildings have been further subdivided into SUs, which provide the fundamental unit for demonstrating compliance with the applicable $DCGL_W$.

## 3.4 Identification of Survey Units

All impacted outdoor surfaces, land areas, and structures have been subdivided into Class 1, 2, or 3 SUs. Each SU represents a portion of the site with similar contamination potential. The MARSSIM-recommended SU sizes are provided in Table 3-2.

**Table 3-2: MARSSIM-Recommended Survey Unit Sizes**

| Class | Recommended Survey Area | |
|---|---|---|
| | Structures | Land Areas |
| 1 | Up to 100 $m^2$ | Up to 2,000 $m^2$ |
| 2 | 100 to 1,000 $m^2$ | 2,000 to 10,000 $m^2$ |
| 3 | No limit | No limit |

$m^2$ = square meters

Based on the results of characterization surveys and sampling performed, the remediation of land areas will require the removal of pavement in the Central Asphalt area and a six-inch layer of underlying soil. As a result of the asphalt removal, native soil will be exposed and the SUs will be established accordingly.

Land area SUs at the Building 1103A Area have been identified as indicated in Table 3-3. A map of the outdoor land area SUs is provided in Appendix A.

**Table 3-3: Land Area Survey Units**

| Area | Survey Unit | MARSSIM Classification | Matrix |
|---|---|---|---|
| Outdoor Area North | 1 | 1 | Soil |
| Outdoor Area South | 2 | 1 | Soil |
| Adjacent Asphalt Parking Lot | 3 | 2 | Pavement |
| Area Immediately Surrounding the Class 1 Outdoor Areas | 4 | 2 | Soil |

The remediation of structures will entail the removal of interior fixtures, such as overhead lighting, electrical conduit, ventilation ducting, suspended ceilings, etc. The Building 1103A Shop Area will be removed entirely, leaving behind the concrete floor slab. Similarly, the Storage Shed attached to the Freestanding Vault will be removed. Roofing shingles and tar roof surfacing will be removed from Building 1103A and Building BRL12 roofs, exposing the underlying solid surface for performance of FSS surveys. Remaining structure interior surfaces will be decontaminated, as necessary. The FSS structure SUs are identified in Table 3-4.

**Table 3-4: Structure Survey Units**

| Structure | Area | Survey Unit | MARSSIM Classification |
|---|---|---|---|
| 1103A | Floor North | 5 | 1 |
| | Floor South | 6 | 1 |
| | Interior Walls – North and East | 7 | 1 |
| | Interior Walls – West and South | 8 | 1 |
| | Ceiling North | 9 | 1 |
| | Ceiling South | 10 | 1 |
| | Exterior Wall – South | 11 | 1 |
| | Exterior Wall – North, East and West | 12 | 2 |
| | Roof | 13 | 2 |
| | Former Shop Area Concrete Slab | 14 | 1 |
| BRL12 | Central Area Floor | 15 | 1 |
| | Central Area Interior Walls - North and East | 16 | 2 |
| | Central Area Interior Walls – West and South | 17 | 2 |
| | Central Area Ceiling | 18 | 2 |
| | North Vault Interior Surfaces | 19 | 1 |
| | South Vault Interior Surfaces | 20 | 2 |
| | Exterior Walls | 21 | 3 |
| | Roof | 22 | 3 |
| Freestanding Vault | Floor, North and East Walls | 23 | 1 |
| | Ceiling, West and South Walls | 24 | 1 |
| | Exterior Walls and Roof | 25 | 2 |
| 1103B | Floor | 26 | 3 |
| | Exterior North and West Walls | 27 | 2 |
| 1100E | Exterior East Wall | 28 | 3 |
| 1100F | Exterior East Wall | 29 | 3 |

### 3.5 Background Reference Area and Materials

Although uranium isotopes present in DU are also present in the environment, the concentrations of uranium isotopes naturally present in soil represents a very small fraction of the soil $DCGL_W$. Therefore, the determination of background uranium concentration in soil is not necessary and will not be considered when comparing soil data with the $DCGL_W$ or when performing statistical tests. Soil sample data will be used for direct comparison with the soil $DCGL_W$ and for performance of the planned non-parametric Sign statistical test without correction for background uranium concentrations.

Structure SUs will also be evaluated using the non-parametric Sign test. Construction material-specific background measurements may be performed in areas of similar construction but without a history of radioactive material use. These material-specific background activity values may then be used to correct direct surface activity measurements for the contribution due to background and natural radioactivity in these materials. However, as a conservative measure, the material-specific background may be assumed to be zero. If used, material-specific background surface material count rates will be subtracted from SU count rates prior to converting the data to units of dpm/100 $cm^2$ for comparison with the applicable $DCGL_W$.

### 3.6 Reference System

A reference coordinate system will be utilized for FSS measurements and sampling locations. Direct measurements on structural surfaces will be referenced to prominent building features, or a grid system will be used similar to that implemented for the characterization surveys. Soil sample locations will be referenced to global positioning system (GPS) coordinates obtained using hand-held GPS units.

### 3.7 Survey Design

Structure surface contamination and DU concentrations in soil will be assessed by collecting the required number of systematic gross alpha surface activity measurements and soil samples within each SU. The Sign test will be used for demonstrating compliance with the applicable $DCGL_W$.

The statistical test (Sign test) is performed to evaluate the SU mean concentration relative to the null hypothesis ($H_0$). Simply stated, $H_0$ assumes the residual contamination in the SU exceeds the release criterion. Provided that the statistical test is satisfied at the desired confidence level, then $H_0$ is rejected and the alternate hypothesis ($H_a$), residual contamination

meets the release criterion, is accepted. The data needs for the statistical test will be determined through the processes in the following sections.

### *3.7.1 Number of Sample Locations for Survey Units*

The following sections describe the bases for and derivation of the minimum required measurements and samples per SU.

Estimation of Relative Shift

The relative shift describes the relationship of site residual radionuclide concentrations to the $DCGL_w$ and is calculated using the following equation:

$$\Delta/\sigma = \frac{DCGL_w - LBGR}{\sigma}$$

Where:

$DCGL_W$ = Applicable value from Section 3.2

LBGR = Lower bound of the gray region; normally established as the estimated mean activity within the survey unit, but may be adjusted to maximize survey design

$\sigma$ = Estimate of the standard deviation of the residual radioactivity, or the actual standard deviation obtained from characterization surveys and/or sampling

The DQOs are evaluated for each SU, and the decision errors are selected. The Type 1 error (or probability of incorrectly rejecting $H_0$ when it is true) is set at 0.05 (i.e., 5%). The Type 2 error (or probability of incorrectly accepting $H_0$ when it is false) is also set at 0.05. Once these parameters are established and the relative shift is determined, the number of data points required by the statistical test is calculated using MARSSIM Equation 5-2 (NRC, 2000), obtained directly from MARSSIM Table 5.5 (Sign test), or generated using *COMPASS*, *Visual Sample Plan* or *MARSSIM Power* software.

The $DCGL_W$ for soil radioactivity is 230 pCi/g. The LBGR is estimated to be 115 pCi/g, which represents half of the $DCGL_W$, as suggested in MARSSIM. Using an estimated coefficient of variation of 30% and the LBGR as an estimate of the sample mean, a standard deviation of 34.5 pCi/g is calculated. Using these values and the above equation, the relative shift is initially calculated to be 3.3. Because MARSSIM recommends a relative shift of

between 1 and 3, the LBGR was adjusted downward to achieve a value of 3.0. The corresponding number of samples, as specified in MARSSIM, Table 5.5, is 14.

For both buildings and outdoor solid surfaces (i.e., adjacent asphalt parking lot), the $DCGL_W$ for surface alpha radioactivity is 100 dpm/100 $cm^2$. The LBGR is conservatively estimated as 70 dpm alpha/100 $cm^2$. Using a coefficient of variation of 30% and the LBGR as an estimate of the sample mean, a standard deviation of 21 dpm/100 $cm^2$ is estimated. Using these values and the above equation, the relative shift is 1.4. The corresponding number of systematic direct measurement locations, as specified in MARSSIM, Table 5.5, is 20.

Adjustment of the Number of Samples and Direct Measurements Based on Scan Sensitivity

Once the minimum number of samples and direct measurements has been determined for each SU, the scan sensitivity for each Class 1 SU type is evaluated to verify that the sensitivity is sufficient to detect small elevated areas of activity (refer to MARSSIM Section 5.5.2.4). This only applies to Class 1 SUs, as elevated areas of activity are not expected in Class 2 or Class 3 SUs.

As discussed in Section 5.4, outdoor land area gamma scans will be performed using a 3-inch by 3=inch (3-in. x 3 in.) sodium iodide (NaI) detector with a DU scan sensitivity (minimum detectable concentration [MDC]) of 32.9 pCi/g. Because the actual scan sensitivity is lower than the soil $DCGL_W$, no further evaluation is required, and the previously calculated minimum number of samples (14) is confirmed to be acceptable.

Class 1 structure beta scans will be performed using a Ludlum Model 43-37 or Ludlum Model 43-68 gas proportional detectors. The beta scan minimum detectable count rates (MDCRs) for these two detectors are 397 and 185 counts per minute (cpm), respectively. Because both are higher than the structure alpha $DCGL_W$, an evaluation is required to determine whether the number of direct alpha measurements calculated is sufficient to detect elevated areas of activity. Using the higher scan MDCR, the need for adjustment is determined using MARSSIM, Equation 5-4, and the area factors listed in MARSSIM, Table 8.2. The actual beta scan MDCR is 397 cpm (rounded to 400 cpm for simplicity), and the corresponding area factor is 4. From MARSSIM, Table 8.2, this equates to an area of 9 square meters ($m^2$). Dividing the maximum SU size for a Class 1 structure, 100 $m^2$, by this area provides the adjusted number of direct measurements, 11 per SU, based on the scan sensitivity. This value is less than the minimum number of direct alpha surface activity measurements previously calculated (20); therefore, no additional direct alpha measurements are necessary.

Determining Measurement/Sampling Locations

Measurement and sampling locations will be established in either a random-start/systematic fashion for Class 1 and Class 2 SUs, or at randomly generated locations for Class 3 SUs. Random-start/systematic locations will follow the recommended guidance using a triangular sampling pattern to increase the probability of identifying small areas of residual activity. The linear spacing (L) between data points on a triangular grid pattern is determined by:

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

Where:

L = Triangular grid spacing between sample locations

A = Area of SU

N = Number of sample locations

And the spacing between rows is calculated as:

$$0.866 \times L$$

For land areas, a unique set of GPS coordinates will be generated for each sample location.

## 3.8 Integrated Survey Strategy

FSS data collected for structure surfaces consists of beta surface activity scans and direct measurements for alpha surface activity. Gamma scans will be performed on outdoor solid surfaces, such as paved areas, in lieu of beta surface activity scans. Smears samples, although not used in the final data quality assessment, will be collected from each direct alpha systematic and biased measurement location to measure removable alpha surface activity. FSS of open land areas will consist of gamma scans to identify locations of residual contamination, and soil samples analyzed for the ROCs. Additional biased measurements and samples will be obtained, as necessary, from locations where scans indicate the potential for elevated activity.

### *3.8.1 Surface Scans*

Surface gamma scans will be performed using NaI scintillation detectors over land areas and outdoor solid surfaces, such as paved areas. Surface scans in building SUs, as well as remaining Building 1103A Shop Area concrete pad will be performed using gas proportional

detectors for beta activity. Detectors will be coupled to ratemeters or ratemeter-scalers with audible indicators.

The recommended surface scan coverage of accessible survey unit areas, as discussed in MARSSIM, is provided in Table 3-5.

**Table 3-5: MARSSIM-Recommended FSS Scan Coverage**

| Class | Structures | Land Areas |
|---|---|---|
| 1 | 100% | 100% |
| 2 | 10 to 100% floors and lower walls<br>10 to 50% upper walls and ceilings | 10 to 100% |
| 3 | Judgmental | Judgmental |

### *3.8.2 Soil Sampling and Surface Activity Measurements*

FSS surface and subsurface soil samples will be collected from Class 1 land areas at pre-determined random-start/systematic locations. Additionally, biased samples will be collected from locations where elevated direct gamma radiation is detected by surface gamma scans. Soil samples will be maintained under formal chain-of-custody procedures. Surface soil systematic and biased samples will be analyzed for the ROCs, and results will be reported in units of pCi/g. If a systematic or biased surface soil sample result is greater than or equal to the soil $DCGL_W$, the subsurface sample from the same sample location will be submitted for analysis. For FSS of Class 2 land areas, only surface soil samples will be collected, and these will be analyzed in the same manner as the Class 1 soil samples. There are no Class 3 land area SUs identified in the Building 1103A Area.

FSS direct measurements to quantify total alpha activity on structure surfaces and outdoor solid surfaces will be performed at pre-determined random-start/systematic or random locations, as applicable. Additional biased direct alpha measurements will be performed at locations of elevated activity identified during the scan survey. Direct alpha measurements will be performed using gas proportional or scintillation detectors coupled to ratemeter-scalers.

Smear samples will be collected at each direct systematic or biased surface activity measurement location to quantify the alpha removable contamination within each structure SU. Direct and removable surface activity data will be converted to units of dpm/100 $cm^2$ for comparison to the removable alpha activity limit.

Specific FSS survey and sampling requirements for the various types of SUs at the Building 1103A Area are discussed in the following paragraphs.

Class 1 Land Area SUs

Class 1 land area SUs at the Building 1103A Area include the open area between Building 1103A, Building BRL12, and the Freestanding Vault. These include SUs 1 and 2 in Table 3-3. Following removal of the asphalt in the Central Asphalt Area, the entire area will be divided into two Class 1 survey units. A total of 14 surface and 14 subsurface systematic soil samples will be collected in each SU. A gamma scan will be performed over 100 percent of the affected area, and additional biased surface and subsurface soil samples will be collected, if necessary, based on the gamma scan results. The surface soil samples will be submitted immediately for analysis. Upon receipt and review of the analytical data, subsurface soil samples from locations where the associated surface soil sample analytical results exceed the soil $DCGL_W$ will also be submitted for analysis.

Class 2 Land Area SUs

The Class 2 land area SU surrounds the Class 1 SUs discussed in the previous paragraph. This is identified as SU 4 in Table 3-3. A total of 14 systematic surface soil samples will be collected in each of these SUs. A gamma scan will be performed over 10 to 100 percent of these areas, and additional biased sampling will be conducted, as necessary, based on the gamma scan results.

Class 3 Land Area SUs

There are no Class 3 land area SUs at the Building 1103A Area.

Class 1 Outdoor Solid Surface SUs

There are no Class 1 outdoor solid surface SUs at the Building 1103A Area.

Class 2 Outdoor Solid Surface SUs

A single Class 2 outdoor solid surface SU, the adjacent asphalt parking lot (SU 4), has been identified at the Building 1103A Area. A total of 20 systematic direct alpha measurements will be performed in each of the SUs. A smear will be obtained at each direct measurement location to assess removable contamination. A gamma scan with the NaI detector will be performed over 10 to 100 percent of the accessible surface area, and additional biased direct alpha measurements will be obtained, if necessary, based on the gamma scan results.

Class 3 Outdoor Solid Surface SUs

There are no Class 3 outdoor solid surface SUs at the Building 1103A Area.

Class 1 Structure SUs

Class 1 structure SUs include the concrete pad that remains following the demolition and removal of the Building 1103A Shop Area, as well as many structure surfaces associate with Buildings 1103A, BRL12, and the Freestanding Vault. A total of 20 systematic direct alpha measurements will be performed in each of these SUs. Additionally, a smear will be obtained at each direct alpha measurement location to assess removable alpha contamination. Surface activity beta scans will be performed over 100 percent of the accessible surface area. Additional biased direct alpha measurements will be obtained, if necessary, based on the results of the surface activity scans.

Class 2 Structure SUs

Class 2 structure SUs include portions of the Building BRL12 interior surfaces, portions of the Building 1103A and the Freestanding Vault exterior walls, as well as the roofs of these structures. A single Class 2 SU has also been identified for the Building 1103B north and west exterior wall surfaces. A total of 20 systematic direct alpha measurements will be performed in each of these SUs. Additionally, a smear will be obtained at each direct alpha measurement location to assess removable alpha contamination. Surface activity beta scans will be performed over 10 to 100 percent of the accessible surface area. Additional biased direct alpha measurements will be obtained, if necessary, based on the results of the surface activity scans.

Class 3 Structure SUs

Class 3 structures include the Building BRL12 exterior walls and roof and the Buildings 1100E and 1100F east exterior walls. A total of 20 random direct alpha measurements will be collected in each of the SUs. Additionally, a smear will be obtained at each direct alpha measurement location to assess removable alpha contamination. Surface activity beta scans will be performed over 10 percent of the accessible surface area in each SU at locations of greatest contamination potential.

# 4.0 SURVEY INSTRUMENTATION AND TECHNIQUES

This section describes the instrumentation and methodology that will be used for direct radiation measurement, smear survey collection, gamma scan survey (i.e., gamma walkover survey [GWS]), and volumetric sample analysis during the FSS of the Building 1103A Area. Specific survey and sampling requirements, including types of surveys and percent coverage, numbers and types of samples, and analytical tests to be performed are discussed in Section 3.8. The MDC and MDCR required for the building surface activity scans, integrated alpha surface activity measurements, and GWS are calculated in accordance with MARSSIM (NRC, 2000) and *NUREG-1507: Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, (NRC, 1998).

## 4.1 Surface Scan Surveys

Building surfaces and outdoor solid concrete surface SUs will be surveyed for radioactivity using direct surface scan and static measurement techniques. Surveys will be performed as described in the following sections and in accordance with the FSS contractor's standard operating procedures (SOPs).

### *4.1.1 Ludlum Model 43-37*

Surface scanning for radioactivity will be performed to identify locations of highest surface activity. Once identified, these locations may be further evaluated by performing integrated alpha activity measurements. Beta scans will be performed on floor surfaces and lower walls using a Ludlum Model 43-37 gas proportional detector (with an active area of 582 $cm^2$), or equivalent. The scan rate for the Ludlum Model 43-37 will not exceed six inches per second as an upper bounding scan rate, with a measurement interval of one observation per second (1/sec). The Ludlum Model 43-37 beta scan MDCR is indicated in Table 4-1. Details of the MDCR calculation for this instrument are presented in Appendix B.

Scans will be performed by moving the active area of the detector over the surface of interest, with the active area of the detector at a maximum height of 2 to 3 in. above the surface. During the scan survey in Class 1 SUs, if the surveyor observes a beta count rate higher than approximately twice the scan MDCR above background, the area will be identified as a potential location for additional biased integrated alpha measurements. During scan surveys in Class 2 and Class 3 SUs, if the surveyor observes a beta count rate higher than the scan MDCR, the area will be identified for additional biased integrated alpha measurements. Scan

assumptions and the action level to be used in identifying potential biased measurement locations using the Ludlum Model 43-37 are provided in Table 4-1.

### *4.1.2 Ludlum Model 43-68*

Some surfaces may not be readily scanned using the Ludlum Model 43-37 detector due to the large size of the detector. These areas may alternatively be scanned with a Ludlum Model 43-68 handheld gas proportional detector (with an active area of 126 $cm^2$), or equivalent. The beta scan assumptions, MDCR, and Class 1 action level for the Ludlum Model 43-68 are provided in Table 4-1. Details of the MDCR calculation for this instrument are presented in Appendix B.

**Table 4-1: Beta Surface Scan Sensitivity Assumptions**

| Detector Model No. | Probe Area ($cm^2$) | Probe Width (cm) | Beta Bkg. (cpm) | Observation Interval (observations/sec) | MDCR (cpm) | Class 1 Scan Action Level (cpm above bkg) |
|---|---|---|---|---|---|---|
| 43-37 | 582 | 15 | 1386 | 1 | 397 | 800 |
| 43-68 | 126 | 9 | 300 | 1 | 185 | 400 |

cm = centimeter(s)
bkg = background
sec = second(s)
$cm^2$ = square centimeter(s)
cpm = count(s) per minute

## 4.2 Integrated Direct Surface Measurements

Integrated direct measurements (i.e., static measurements) of surface alpha radioactivity will be performed to compare contaminant concentrations at discrete sampling locations to the building release criterion and facilitate statistical testing. If necessary, interior surfaces may be cleaned prior to surveying to remove dirt and grime that could shield alpha emissions from surfaces of interest. The cleaning implements used and the wastes generated during cleaning will be collected and stored onsite, then decontaminated and/or disposed in accordance with project waste management procedures. Integrated alpha activity measurements may be performed using the Ludlum Model 43-37 gas proportional detector, Ludlum Model 43-68 handheld gas proportional detector (operating in alpha mode only), Ludlum Model 43-89 handheld scintillation detector (with an active area of 126 $cm^2$), or equivalent. The estimated detector sensitivity and relevant assumptions are presented in Table 4-2.

Integrated alpha measurements will be performed in accordance with the FSS contractor's SOP. The net count rate at each location will be calculated as the difference between the measurement count rate and the background count rate.

**Table 4-2: Integrated Alpha Measurement Sensitivity Assumptions**

| Model No. | Count Time (min) | Bkg. Count Time (min) | Probe Area ($cm^2$) | Total Alpha Efficiency (cpm/dpm) | Alpha Background (cpm) | Alpha Static MDC[1] (dpm/100 $cm^2$) |
|---|---|---|---|---|---|---|
| 43-37 | 1 | 1 | 582 | 0.165 | 23 | 18 |
| 43-68 | 1 | 1 | 126 | 0.165 | 5 | 64 |
| 43-89 | 1 | 1 | 126 | 0.111 | 3 | 79 |

min = minute(s) cpm = count(s) per minute
Bkg = background dpm = disintegration(s) per minute
$cm^2$ = square centimeter(s)
[1]Static alpha measurements will be compared to the building surface $DCGL_W$ (100 dpm/100 $cm^2$).

## 4.3 Smear Sample Collection and Analysis

Smear samples will be collected at systematic and biased direct surface activity measurement locations to quantify transferable surface alpha radioactivity. Smear samples will be obtained in accordance with the FSS contractor's SOP and analyzed using a Ludlum Model 43-10-1 detector coupled to a Ludlum Model 2929 dual scaler, or equivalent.

Count times for smears will initially be set at 4 minutes for surface smear measurements and 20 minutes for background measurements. Count times may be adjusted, if necessary, in accordance with the OP. If necessary, smears will be allowed to decay for at least 24 hours to eliminate radon progeny prior to onsite measurement. Smears that must be counted immediately will be recounted after at least 24 hours of decay time, if necessary. The smear sample alpha MDC and relevant assumptions are provided in Table 4-3.

**Table 4-3: Removable Surface Activity (Smear) Sensitivity Assumptions**

| Instrument Model No. | Count Time (min) | Bkg. Count Time (min) | Probe Area ($cm^2$) | Alpha Efficiency (cpm /dpm) | Alpha Background (cpm) | Alpha MDC[1] (dpm/100 $cm^2$) |
|---|---|---|---|---|---|---|
| 2929 | 4 | 20 | Smear | 0.33 | 0.8 | 7 |

min = minute(s) cpm = count(s) per minute
Bkg = background dpm = disintegration(s) per minute
$cm^2$ = square centimeter(s)
[1]Smear measurements of alpha activity will be compared to the removable activity $DCGL_W$ (10 dpm/100 $cm^2$).

## 4.4 Gamma Scans

Outdoor gamma scans will be performed in accordance with the FSS contractor's SOP. Scan surveys on pavement and land areas will be performed using a Ludlum Model 44-20 three-inch by three-inch (3-in. x 3-in.) NaI detector coupled to a Ludlum Model 2221 ratemeter, or equivalent. This instrument will be enabled with a differential GPS so that activity measurements can be spatially referenced.

The MDC for DU in soil is provided in terms of pCi/g in Table 4-4. A more detailed evaluation of the MDC for the GWS instrumentation is presented in Appendix B.

**Table 4-4: Gamma Scan Survey Sensitivity Assumptions**

| Detector Model No. | Survey Speed (m/sec) | Bkg. (cpm) | Observation Interval (observations/sec) | MDCR[1] (cpm) | MDC (pCi/g) |
|---|---|---|---|---|---|
| 44-20 | 0.5 | 27,000 | 1 | 2,484 | 32.9 |

m = meter(s)
cpm = count(s) per minute
pCi/g = picocuries per gram
sec = second(s)
MDCR = minimum detectable count rate
MDC = minimum detectable concentration
[1] Assumes a surveyor efficiency of 50%

## 4.5 Volumetric Sample Collection and Analysis

Volumetric systematic and biased soil samples from land areas will be collected and submitted to an off-site laboratory for analysis by gamma spectroscopy. Samples will be collected in accordance with the FSS contractor's SOP and analyzed in accordance with the analytical laboratory's SOP. The analytical test methods used to analyze radionuclides in volumetric samples at the off-site laboratory will be verified as being able to achieve an MDC of 10% of the soil $DCGL_W$.

Soil samples will be collected using a hand auger or stainless steel trowel, and homogenized in a stainless steel bowl prior to containerization. During the homogenization of soil samples, twigs, stones, and other non-soil items will be removed from the sample material. The FSS contractor's SOPs will govern the handling, labeling, packaging, preservation, and shipping of samples, as well as sample chain of custody protocol. Field quality control (QC) samples (e.g., duplicate) will be collected and analyzed at a frequency of one per ten target samples. Laboratory QC samples will be prepared and analyzed in accordance with the analytical laboratory's *Quality Assurance Plan*.

## 5.0 SURVEY QUALITY ASSURANCE/QUALITY CONTROL

Activities associated with this work plan will be performed in accordance with written operating procedures and/or protocols to ensure consistent, repeatable results and to provide auditable documentation of activities. Topics addressed in project procedures and protocols include, but are not limited to, the following:

- Proper use of instrumentation,
- QC source and background checks, and
- Duplicate measurements.

Specific quality assurance (QA) and QC measures to be implemented during the FSS are described in this section.

### 5.1 Instrumentation Requirements

The Project Health Physicist (HP) will be responsible for selecting the instrumentation required to complete the FSS. Only instrumentation approved by the Project HP will be used to collect radiological data. The Project HP will be responsible for ensuring that individuals are appropriately trained to use the instrumentation and other equipment, and that the selected instrumentation meets the required detection sensitivities. Instrumentation will be operated in accordance with either a written operating procedure or manufacturers' manual, as determined by the Project HP. The procedure and/or manual will provide guidance to field personnel on the proper use and limitations of the instrument.

Instruments used during the FSS will have current calibration and maintenance records that will be maintained onsite for review and inspection. The records will include, at a minimum, the following types of information: description of equipment, equipment identification (model and serial number), manufacturer, date of last calibration, and calibration due date.

Instrumentation will be maintained and calibrated to manufacturers' specifications to ensure that the required traceability, sensitivity, accuracy, and precision of the equipment/instruments are maintained. Instruments will be calibrated at a facility possessing appropriate NRC and/or Agreement State licenses for performing calibrations using National Institute of Standards and Technology (NIST) traceable sources.

## 5.2 Instrument QC Source and Background Checks

The following subsections describe the techniques that will be used to evaluate accuracy and precision of measurements obtained using project instrumentation. Daily instrument response check data and calibration certificates for each instrument will be included in an appendix to the FSS Report.

### *5.2.1 Gross Gamma Instruments*

NaI detectors coupled to count rate meters and GPS systems will be used to perform gamma walkover surveys and integrated fixed location measurements, as well as to frisk equipment and personnel. Instruments will be calibrated at least annually at a facility possessing appropriate NRC and/or Agreement State licenses for performing calibrations using NIST-traceable standards.

Gross gamma instruments will be response-checked daily for QC purposes by comparing the instrument response to a cesium-137 ($^{137}$Cs) source. Response checks will consist of a one-minute integrated count of the $^{137}$Cs source positioned in a reproducible geometry (i.e., a jig). The acceptance criteria for these instrument response checks are +/- 20% of the mean response generated using ten initial source checks and ten measurements of ambient background. A response check outside these limits will be cause for evaluation of conditions (e.g., instrument operation, source/detector geometry), and the response check will be repeated once prior to field use of that instrument. Instruments that fail the second response check will be removed from service. During daily response checks, instruments will be inspected for physical damage, battery voltage levels, current calibration, and erroneous readings, in accordance with the FSS contractor's SOPs.

Background checks will be performed daily for each instrument. These checks will be performed to monitor fluctuations in ambient gamma background that could impact the interpretation of the gross gamma measurements, not to monitor the performance of the instruments. The results of the background measurements will be recorded and presented on a control chart.

### *5.2.2 Alpha/Beta Detectors and Smear Counter*

Alpha/beta detectors (e.g., Ludlum Models 43-68, 43-37, and 43-89) and a smear counter (Ludlum Model 2929) will be used to obtain quantitative measurements for final status survey purposes. These instruments will be calibrated at least annually at a facility possessing

appropriate NRC and/or Agreement State licenses for performing calibrations using NIST-traceable standards.

Instruments used for quantitative measurements will be response checked daily by comparing response to designated thorium–230 ($^{230}$Th) and technetium-99 ($^{99}$Tc) NIST-traceable sources and to ambient background. Response checks will consist of a one-minute count of the $^{230}$Th and $^{99}$Tc sources positioned in a reproducible geometry and location within the detector system. Background measurements will be performed in an identical fashion for a twenty-minute count, with the source removed. The acceptance criteria for these instrument response checks will be two and three-sigma of the mean response generated using ten initial source checks and ten measurements of ambient background. A response check outside the two-sigma range, but within the three-sigma range will be cause for a recount prior to further evaluation. A response check outside the two-sigma range on the second count or three-sigma range on the initial count will be cause for further evaluation prior to continued use. A response check outside these limits is cause for an evaluation of conditions (e.g., instrument operation, source/detector geometry) prior to further counts and/or removal of the instrument from service. Instruments must pass a response check prior to field use. During daily response checks, instruments used to obtain radiological data will also be inspected for physical damage, battery voltage levels, current calibration, and erroneous readings, in accordance with the FSS contractor's SOPs.

### 5.3 Duplicate Measurements

Duplicate measurements will be required for 10% of the total soil samples collected from all SUs. Duplicate measurements of radioactivity concentration will be compared to the initial analytical results by determining a z-score and comparing it against the performance criteria as follows.

The z-score for each data set will be calculated using the following equation:

$$Z\text{-score} = \frac{|\text{Sample} - \text{Duplicate}|}{\sqrt{\sigma^2_{\text{Sample}} + \sigma^2_{\text{Duplicate}}}}$$

Where:

Sample = First sample value (original),
Duplicate = Second sample value (duplicate),
$\sigma_{\text{Sample}}$ = $2\sigma$ counting uncertainty of the sample, and,
$\sigma_{\text{Duplicate}}$ = $2\sigma$ counting uncertainty of the duplicate.

The calculated z-score results will be compared to a performance criterion of less than or equal to 1.96. Calculated z-scores less than 1.96 will be considered acceptable, and values greater than 1.96 will be investigated for possible discrepancies in analytical precision, or for sources of disagreement with the following assumptions of the test:

- The sample measurement and duplicate or replicate measurement are of the same normally distributed population.
- The standard deviations, $\sigma_{Sample}$ and $\sigma_{Duplicate}$, represent the true standard deviation of the measured population.

# 6.0 DATA EVALUATION AND COMPLIANCE DEMONSTRATION

The data generated during the FSS will be reviewed to ensure that the quality and quantity are consistent with the FSSP and design assumptions. Data deemed to be acceptable will be used to evaluate compliance with the DCGLs established for this site, as described below.

## 6.1 Data Review and Investigation Thresholds

Analytical data received from the off-site laboratory will be reviewed to ensure that the data are of acceptable quality for its intended use. The following types of information will be evaluated:

- Correlation among the FSSP, chain-of-custody, and laboratory reports with respect to sample identification numbers and analytical methods;
- Whether project-specific MDCs were achieved;
- Instrumentation or cross-contamination issues that may have impacted the integrity and/or accuracy of reported results; and
- Comparison of QC sample data to project acceptability criteria.

The FSS measurement data for each SU will be evaluated by comparing the standard deviations of data sets with the assumptions used in establishing the number of data points for each SU. Individual and average data values will be compared with the applicable $DCGL_W$ for the SU, and proper survey area classification will be confirmed. Individual measurements in excess of the $DCGL_W$ for Class 1 and 2 areas will be further investigated by means of additional measurements and evaluation of background.

For Class 3 structure SUs, measurements in excess of 50% of the $DCGL_W$ will be investigated. This is less conservative than the recommendation provided in MARSSIM (NRC, 2000), which suggests that any measurements higher than the MDCR be investigated. However, a higher investigation threshold is necessary due to the low $DCGL_W$ values relative to background. Should a SU require further investigation, reclassification, remediation, and/or re-survey, a determination of the cause will be initiated, and the data conversion and assessment process will be repeated for new data sets.

## 6.2 Determining Compliance With DCGLs

As discussed in Section 3.2, both soil concentration and surface activity DCGLs have been developed for evaluation of the FSS data. These DCGLs address the mean activity concentration over a wide area (i.e., the $DCGL_W$), and also provide for small areas of elevated contamination in excess of the $DCGL_W$ (i.e., the $DCGL_{EMC}$). Demonstrations of compliance with both requirements for each SU are discussed in the following sections.

### *6.2.1 Land Area and Structure SUs*

Land area systematic soil samples and structure SU direct surface activity measurements will be evaluated using the Sign test. Individual sample activity values and the average SU activity will be calculated. If all values from the random or random-start/systematic locations for a SU are less than the guideline ($DCGL_w$ for Class 1 and 2 land and structure SUs; 50% of the $DCGL_w$ for Class 3 structure SUs), the SU satisfies the criterion and no further evaluation is necessary.

If the average activity value is greater than the guideline, the SU does not satisfy the criterion and further investigation, possible reclassification, remediation, and/or re-survey is required. If the average activity value is less than the guideline, but some individual values are greater, data evaluation using the Sign test will be performed, as follows:

1. List each of the sample results or SU measurements.
2. Subtract each measurement or sample result from the guideline value.
3. Discard all differences that are "0"; determine a revised sample size.
4. Count the number of positive differences; this value is the test statistic, S+.
5. Compare the value of S+ to the critical value in MARSSIM Table I.3 (NRC, 2000) for the appropriate sample size and decision level.

If S+ is greater than the critical value, the null hypothesis is rejected and the SU meets the established criteria. If S+ is less than or equal to the critical value, the null hypothesis is not rejected, and the SU does not meet the established criteria; investigation, remediation, reclassification, and/or re-survey should be performed, as appropriate.

### *6.2.2 Elevated Measurement Comparison Criteria*

Soil samples or direct surface activity measurement results from Class 1 SUs that exceed the $DCGL_W$ must also be evaluated for compliance with the $DCGL_{EMC}$[1]. The statistical tests for demonstrating compliance are such that some samples/measurements may exceed the $DCGL_W$, yet the null hypothesis may still be rejected. Therefore, both the statistically based and biased samples exceeding the $DCGL_W$ must be compared with a $DCGL_{EMC}$ that corresponds with the size of a given area of elevated activity, defined as the $DCGL_W$ times the Area Factor.

Default area factors for land SUs and structures, obtained from MARSSIM Table 5.6 and Table 5.7 (NRC, 2000), which will be applied to the FSS are provided in Table 6-1 and Table 6-2.

**Table 6-1: Land Survey Unit Area Factors**

| Area ($m^2$): | 1 | 3 | 10 | 30 | 100 | 300 | 1,000 | 3,000 | 10,000 |
|---|---|---|---|---|---|---|---|---|---|
| $^{238}U$ Area Factor: | 30.6 | 18.3 | 11.1 | 8.4 | 6.7 | 4.4 | 1.3 | 1.0 | 1.0 |

**Table 6-2: Structure Survey Unit Area Factors**

| Area ($m^2$): | 1 | 4 | 9 | 16 | 25 | 36 |
|---|---|---|---|---|---|---|
| $^{238}U$ Area Factor: | 35.7 | 9.0 | 4.0 | 2.2 | 1.4 | 1.0 |

When individual samples or measurements with elevated concentrations are less than the respective $DCGL_{EMC}$, the impact of multiple hot spots on the mean concentration in a SU must also be evaluated. This will be performed using MARSSIM Equation 8-2 (NRC, 2000). Any measurement that exceeds the $DCGL_W$ within a Class 2 or Class 3 SU will be investigated as discussed in Section 6.1, and may require reclassification of the SU.

[1] Soil sample and direct surface activity results from Class 2 and Class 3 survey units are not expected to exceed the $DCGL_W$. Therefore, the $DCGL_{EMC}$ does not apply to Class 2 and Class 3 survey units. A confirmed result from one of these survey units in excess of the $DCGL_W$ will typically require reclassification of all or part of the survey unit to Class 1.

## 7.0 REPORTING

The results of the FSS will be compiled into a detailed *FSS Report*. The contents of the report will provide all applicable data and documentation necessary to demonstrate the Building 1103A Area is suitable for unrestricted release in accordance with 10 CFR 20, Subpart E.

## 8.0 REFERENCES

ANL, 1999. *Derived Uranium Guidelines for the Depleted Uranium Study Area of the Transonic Range, Aberdeen Proving Ground, Maryland.* M. Picel and S. Kamboj, Argonne National Laboratory, Environmental Assessment Department. April 1999.

Barg, 1995. *Specific Manufacturing Capability Program, Depleted Uranium Constituents and Decay Heating.* Lockheed Idaho presentation. October 3, 1995.

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NRC, 2000. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM),* NUREG-1575. U.S. Nuclear Regulatory Commission, U.S. Department of Defense, U.S. Environmental Protection Agency, and U.S. Department of Energy. August 2000.

NRC, 2006. Title 10, Code of Federal Regulations, Part 20, Subpart E, January 2006.

# FIGURES

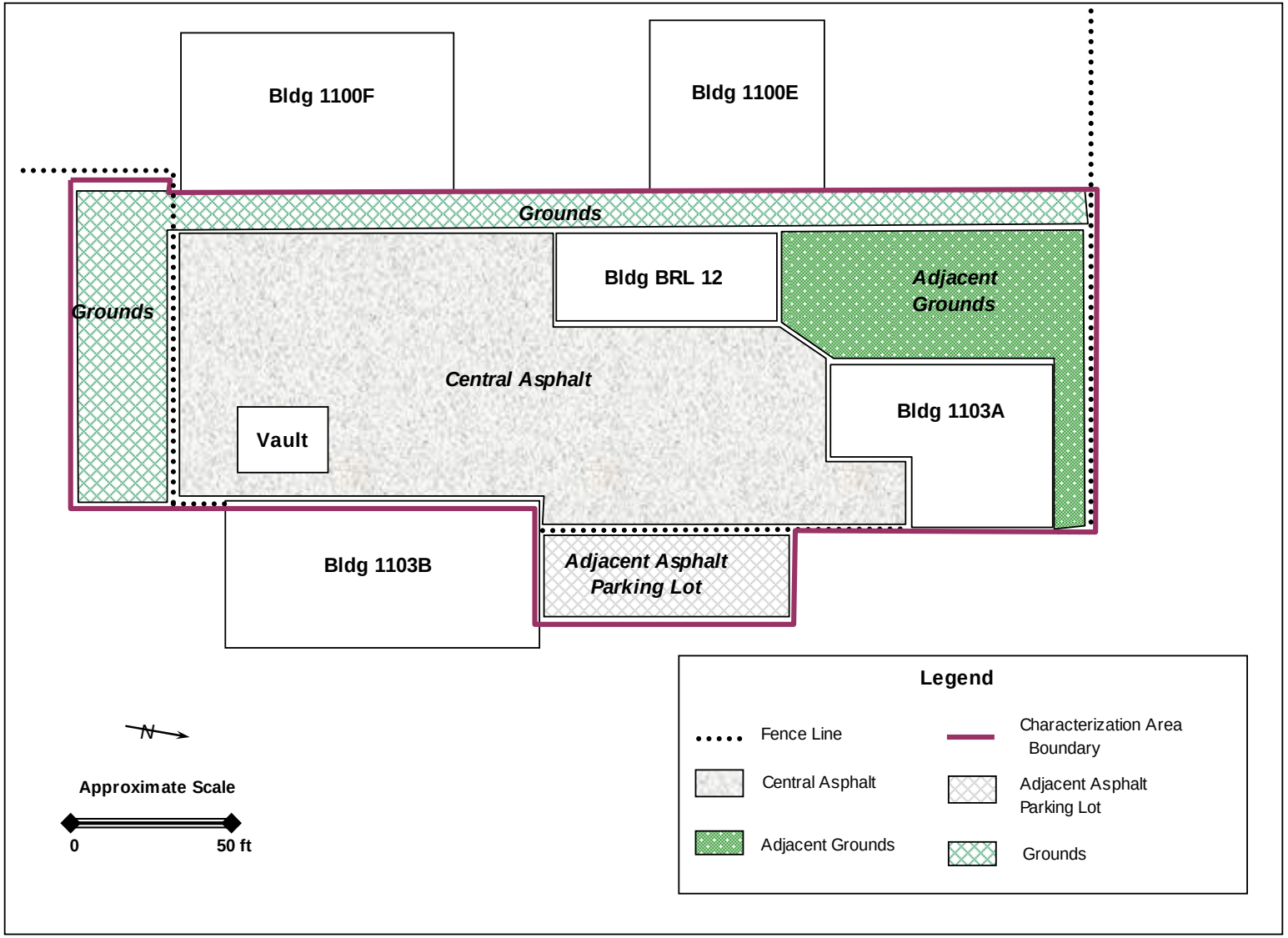



**FIGURE 2-1: BUILDING 1103A AREA LAYOUT**

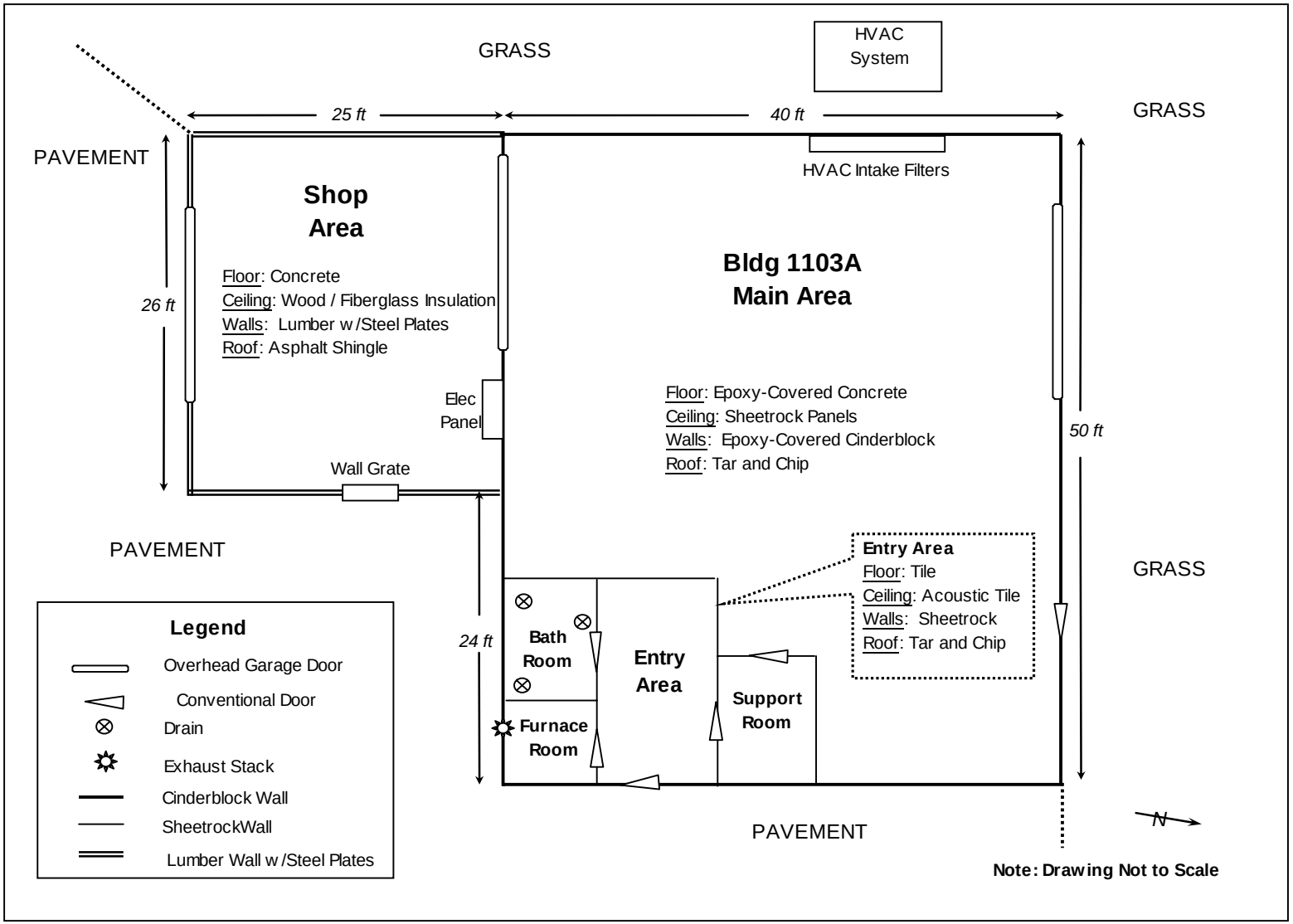



**FIGURE 2-2: BUILDING 1103A FLOOR PLAN**

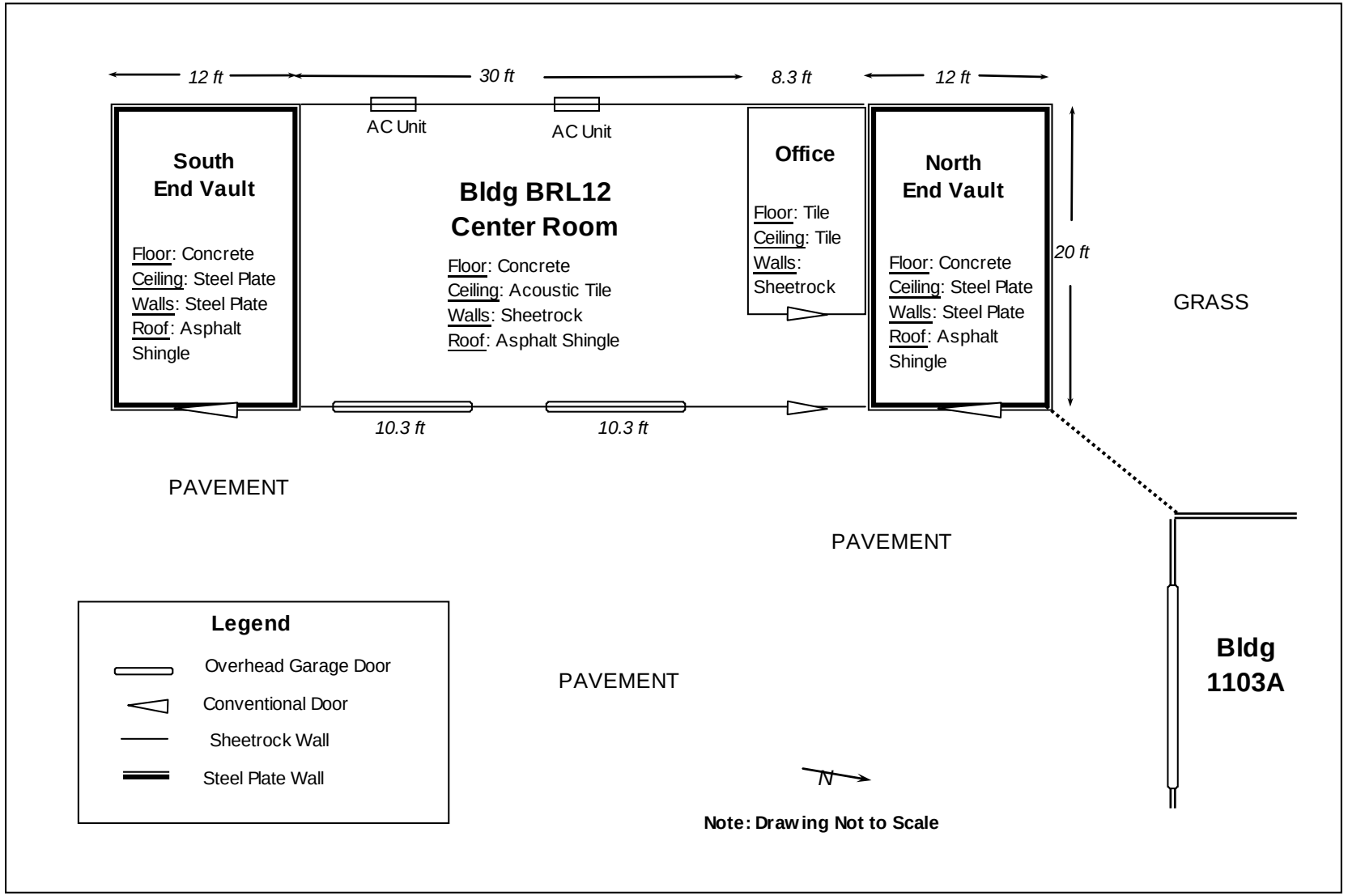



**FIGURE 2-3: BUILDING BRL12 FLOOR PLAN**

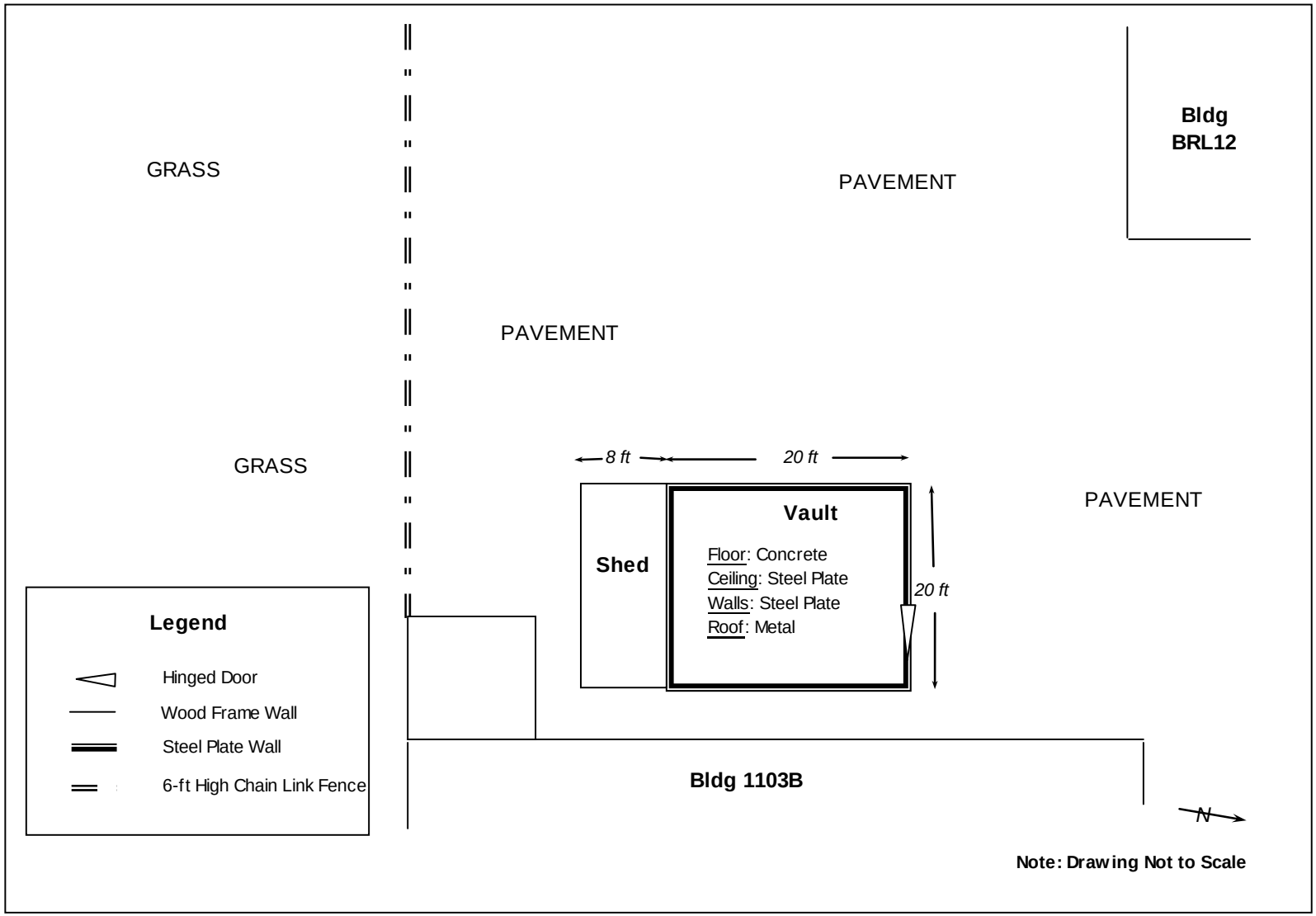
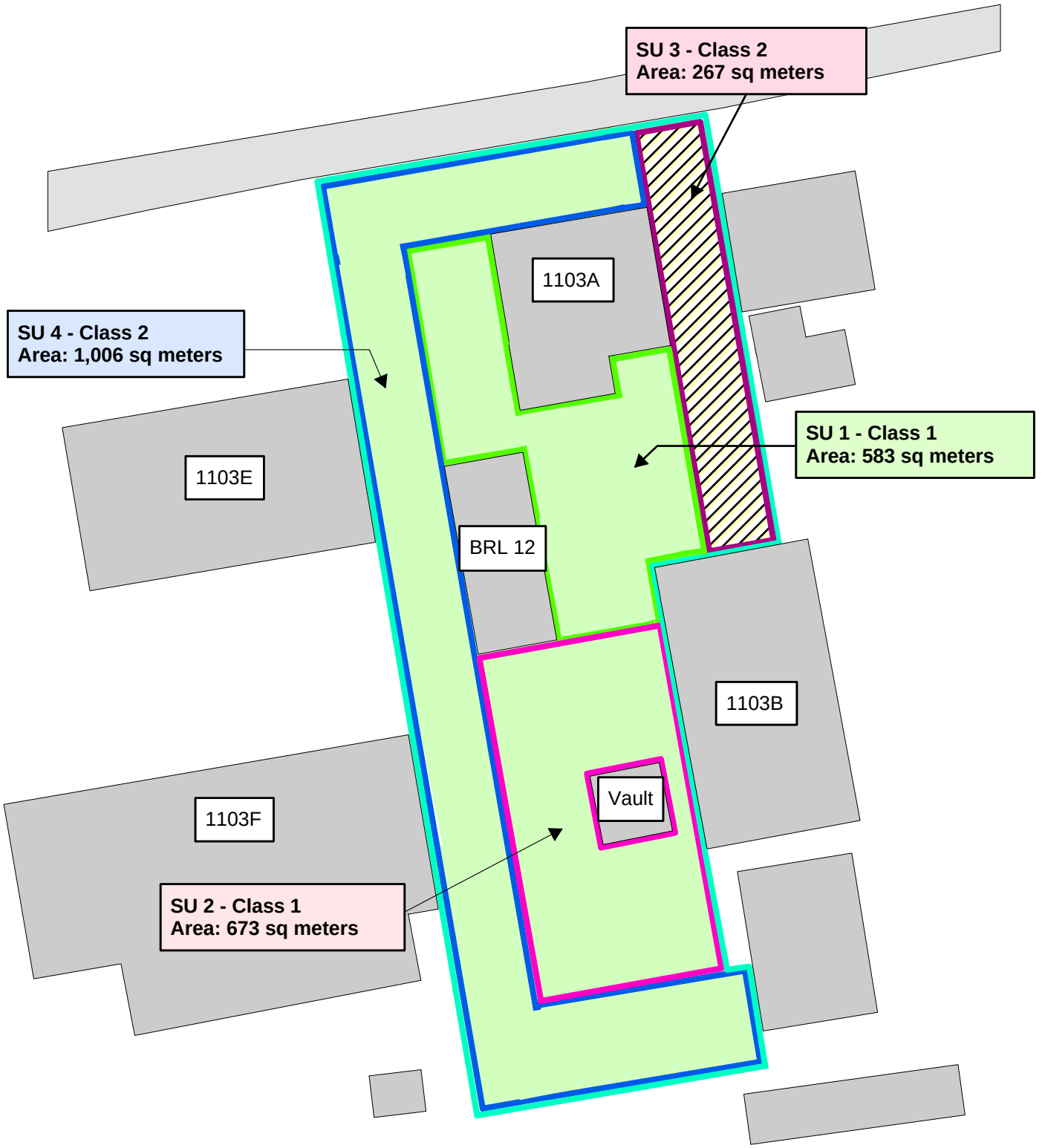



**FIGURE 2-4: FREESTANDING VAULT**

# APPENDIX A

# SURVEY UNIT MAPS




N

Building
Paved Parking Area
Road
Grass or Soil
Site Outline

SU 1 - Class 1 Outline
SU 2 - Class 1 Outline
SU 3 - Class 2 Outline
SU 4 - Class 2 Outline

CABRERA SERVICES
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OFFICE 2B
BALTIMORE, MD 21202

PREPARED BY: KJ

REVIEWED BY: BWD

Contract No: W52P1J-04-D-0007/0006

Project No: 05-3060.06

Date: Jan 2008

Scale

0 1.5 3 6 9 12 Meters

U.S. ARMY JOINT MUNITIONS COMMAND
ROCK ISLAND ARSENAL, ILLINOIS

Aberdeen Proving Ground Maryland

# Building 1103A Area Land Survey Unit Locations


N

- Building
- Paved Parking Area
- Road
- Grass or Soil
- Site Outline
- SU 1 - Class 1 Outline
- SU 2 - Class 1 Outline
- SU 3 - Class 2 Outline
- SU 4 - Class 2 Outline
- \+ Systematic Sample Location
- SO Surface Soil Sample
- SS Subsurface Soil Sample

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Scale

0 0.5 1 2 3 4 Meters

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# Building 1103A Area Survey Unit (SU) 1 Sample Locations


N

Building

Paved Parking Area

Grass or Soil

Site Outline

SU 1 - Class 1 Outline

SU 2 - Class 1 Outline

SU 3 - Class 2 Outline

SU 4 - Class 2 Outline

\+ Systematic Sample Location

SO Surface Soil Sample

SS Subsurface Soil Sample

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Scale

0 0.45 0.9 1.8 2.7 3.6 Meters

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# Building 1103A Area Survey Unit (SU) 2 Sample Locations


Building
Paved Parking Area
Road
Grass or Soil
Site Outline

SU 1 - Class 1 Outline
SU 3 - Class 2 Outline
SU 4 - Class 2 Outline
Systematic Sample Location
SA Surface Alpha Measurement

SM Smear Sample

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Date: Jan 2008
Scale
0 0.5 1 2 3 4 Meters

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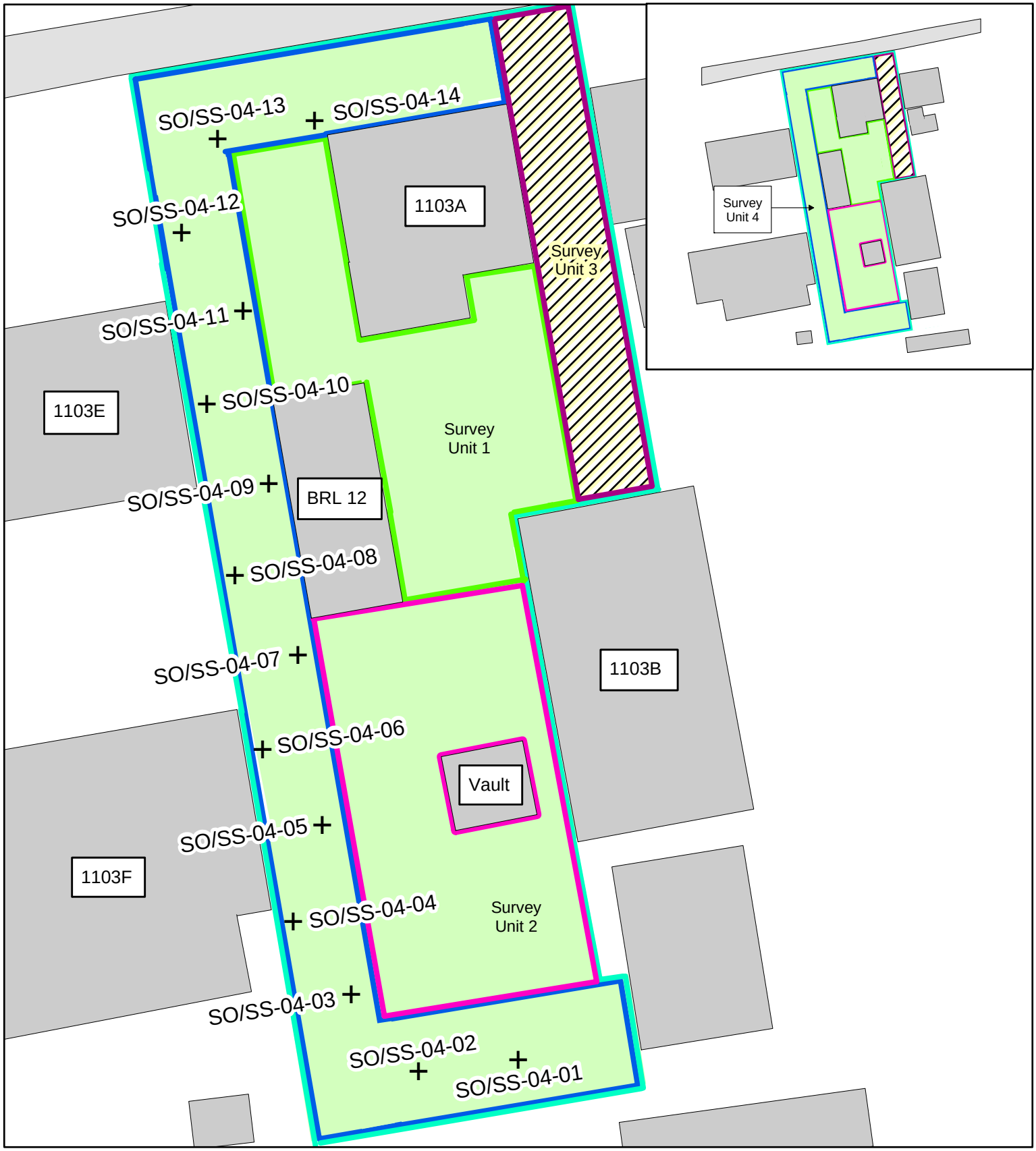
# Building 1103A Area Survey Unit (SU) 3 Sample Locations




N

Building

Paved Parking Area

Road

Grass or Soil

Site Outline

SU 1 - Class 1 Outline

SU 2 - Class 1 Outline

SU 3 - Class 2 Outline

SU 4 - Class 2 Outline

Systematic Sample Location

SO Surface Soil Sample

SS Subsurface Soil Sample

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Scale

0 1 2 4 6 8 Meters

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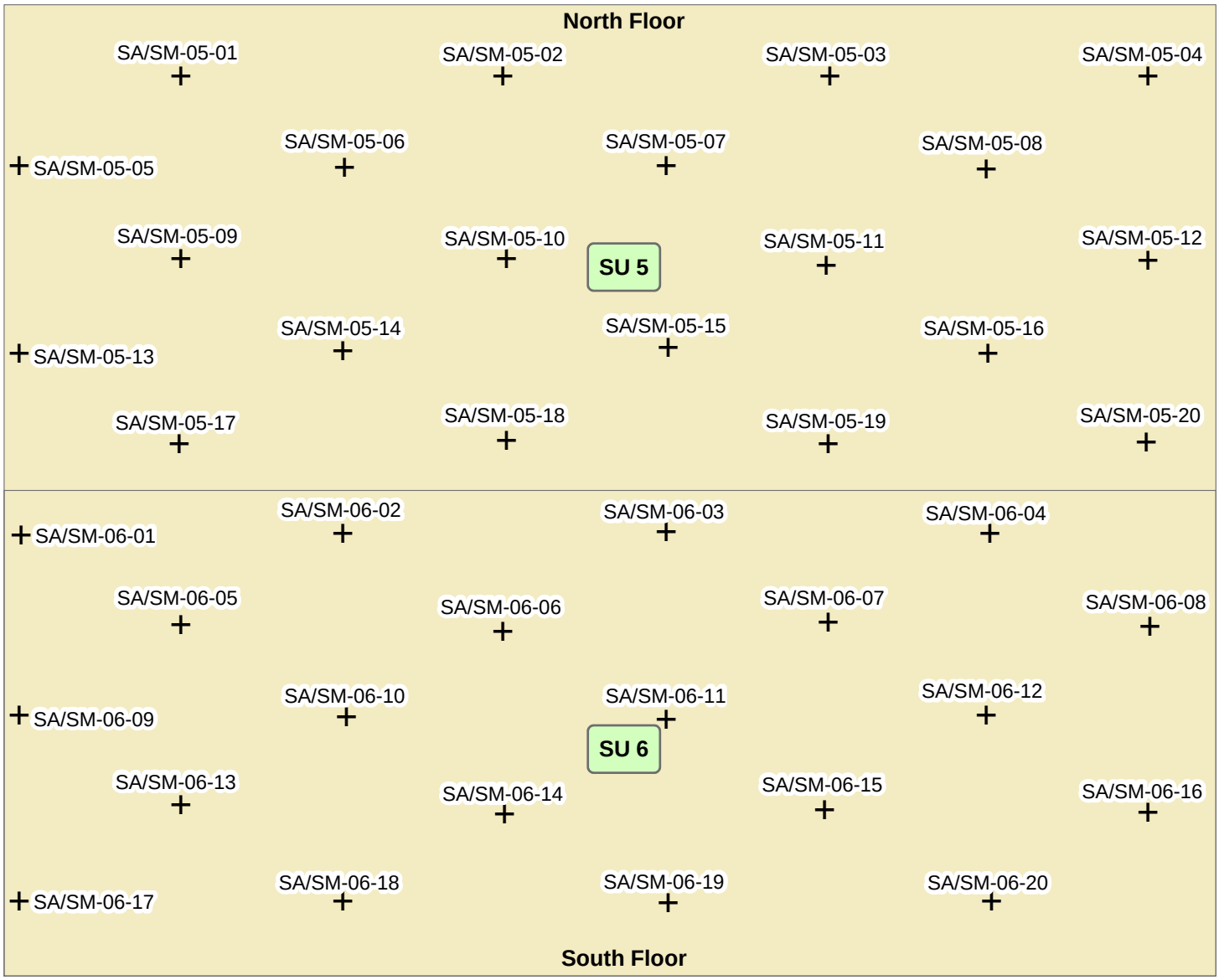
# Building 1103A Area Survey Unit (SU) 4 Sample Locations




+ Systematic Sample Location

SA Surface Alpha Measurement

SM Smear Sample

Interior Floor

SU 5 Survey Unit Class 1

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Scale 0 0.5 1 2 3 4 Feet

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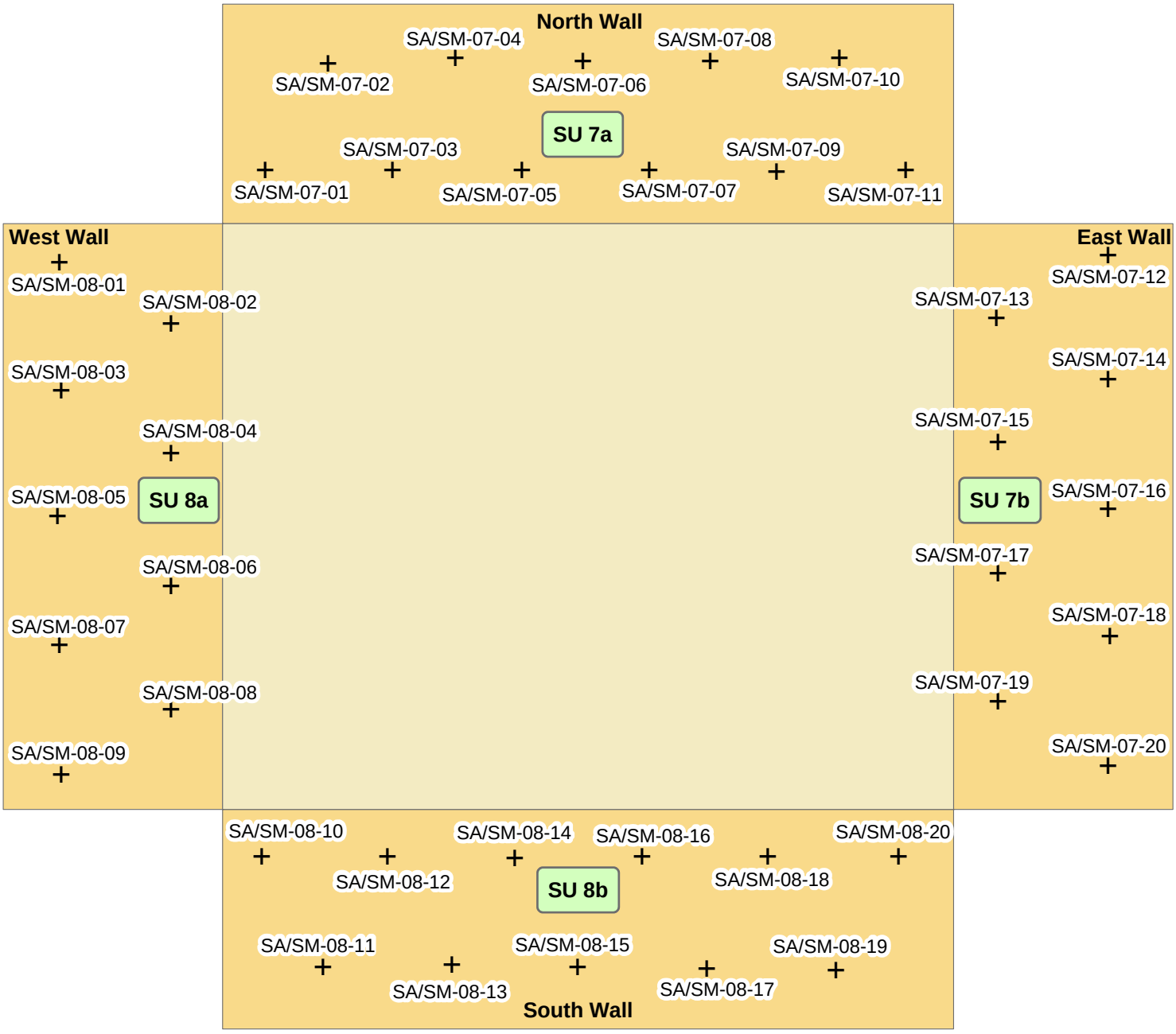
# Building 1103A Interior Floor Survey Unit Sample Locations




+ Systematic Sample Location

SA Surface Alpha Measurement

SM Smear Sample

Interior Floor

Interior Wall

SU 7a Survey Unit Class 1

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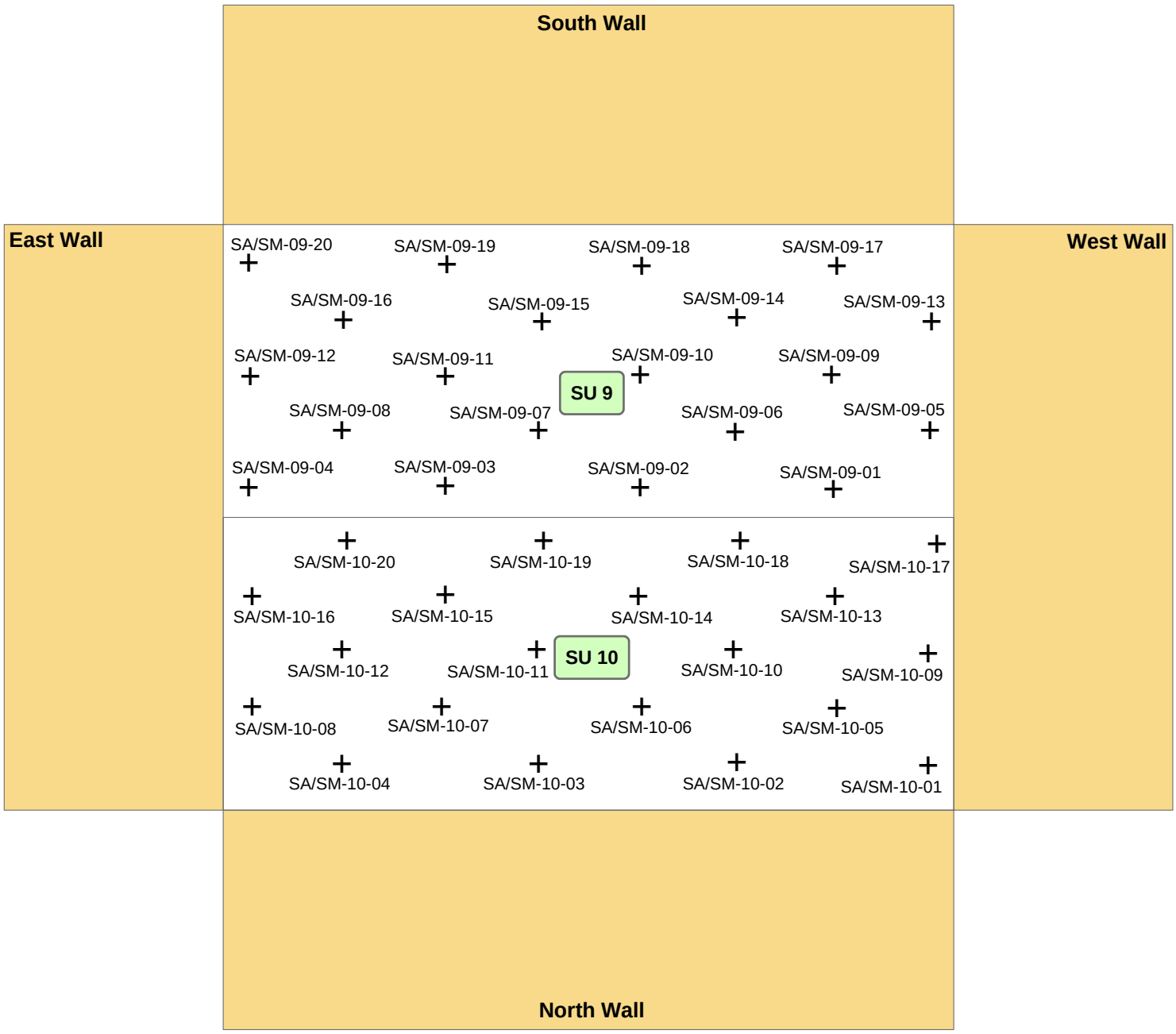
Scale 0 1 2 4 6 8 Feet

Aberdeen Proving Ground Maryland

# Building 1103A Interior Wall Survey Unit Sample Locations




+ Systematic Sample Location

SA Surface Alpha Measurement

SM Smear Sample

Interior Ceiling

Interior Wall

SU 9 Survey Unit Class 1

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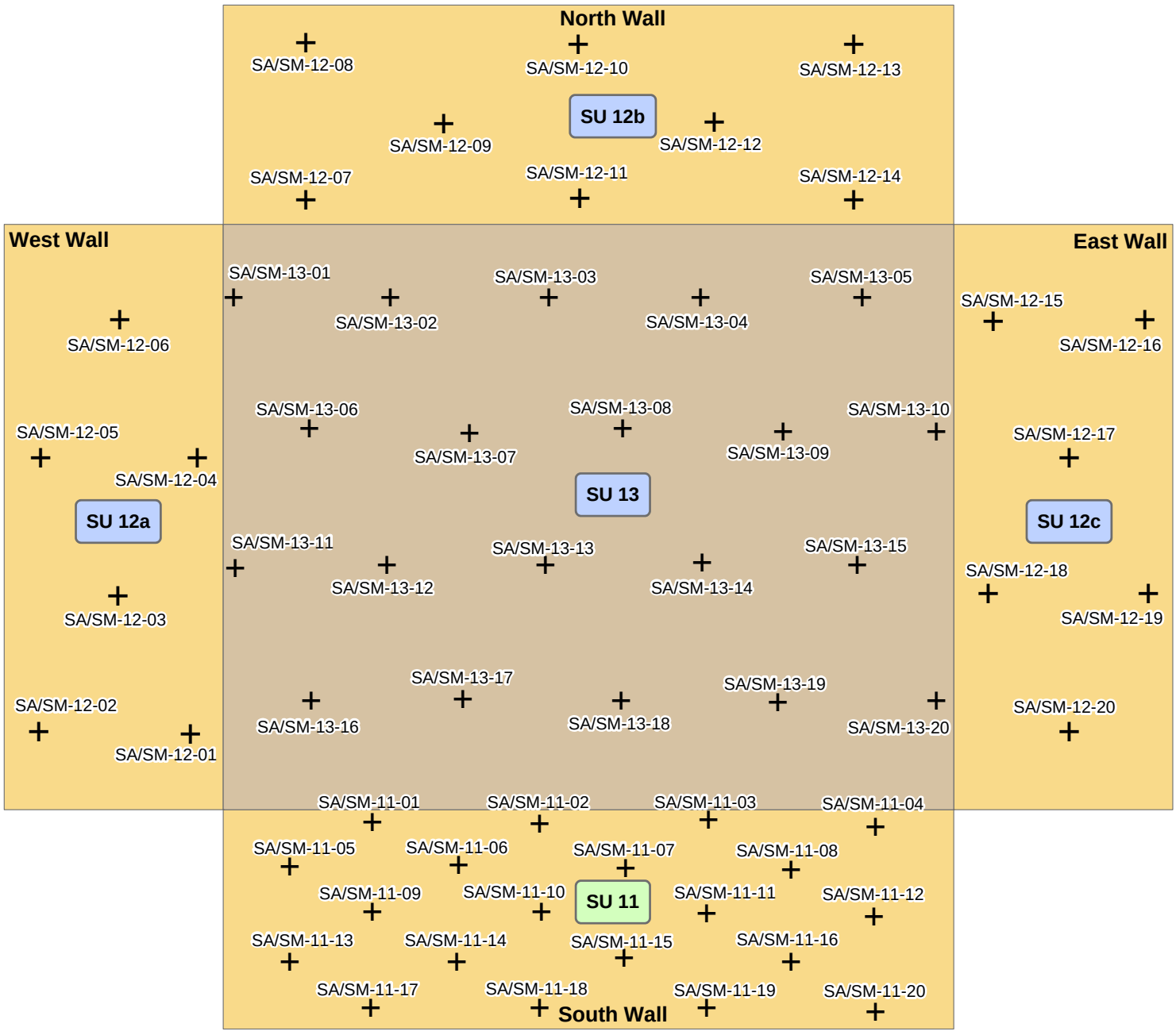
Scale 0 1 2 4 6 8 Feet

Aberdeen Proving Ground Maryland

# Building 1103A Interior Ceiling Survey Unit Sample Locations




+ Systematic Sample Location

SA Surface Alpha Measurement

SM Smear Sample

Exterior Roof

Exterior Wall

SU 11 Survey Unit Class 1

SU 13 Survey Unit Class 2

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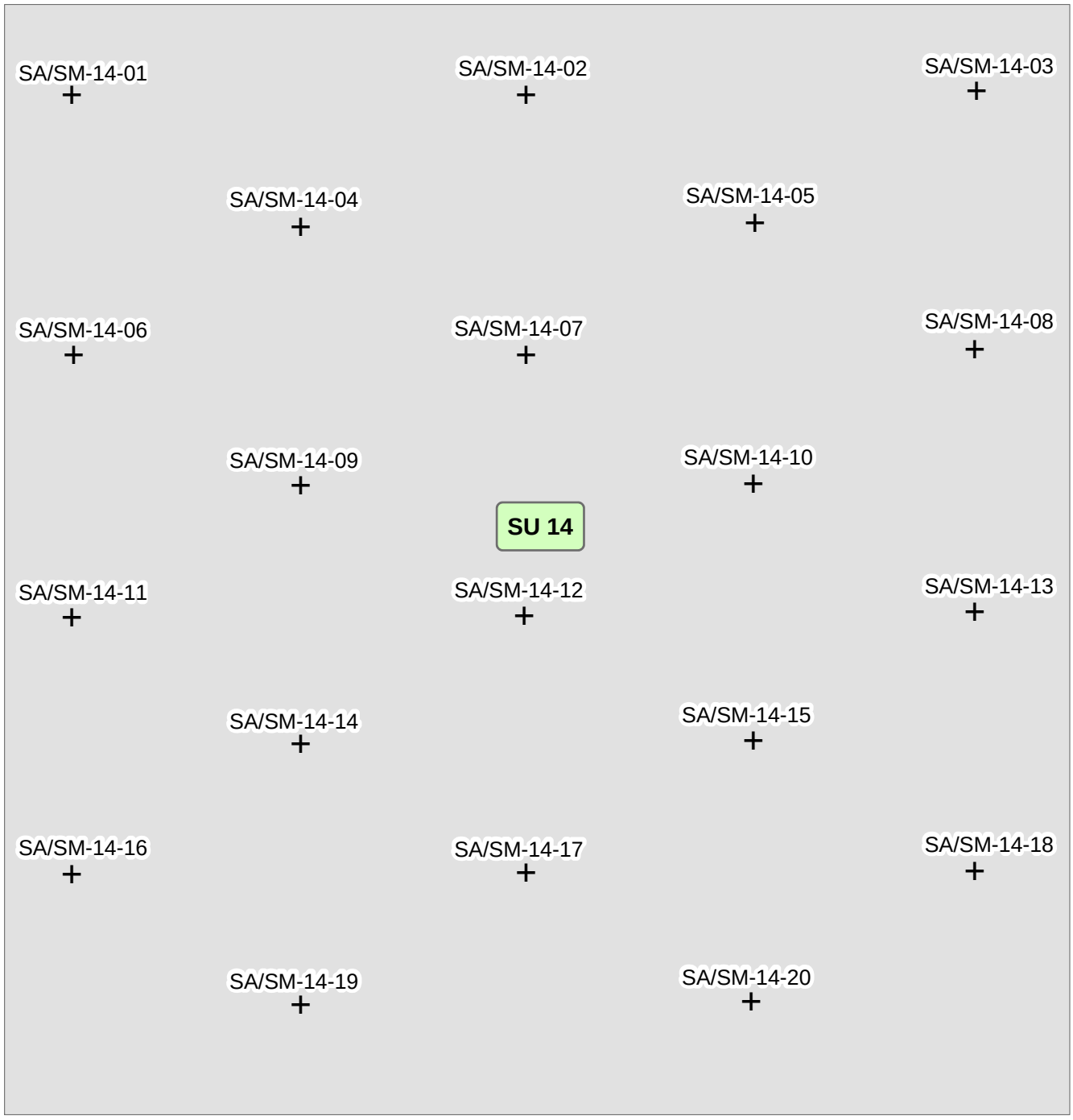
Project No: 05-3060.06

Date: Jan 2008

Scale 0 1 2 4 6 8 Feet

Aberdeen Proving Ground Maryland

# Building 1103A Exterior Survey Unit Sample Locations




+ Systematic Sample Location

SA Surface Alpha Measurement

SM Smear Sample

Concrete Floor Slab

SU 14 Survey Unit Class 1

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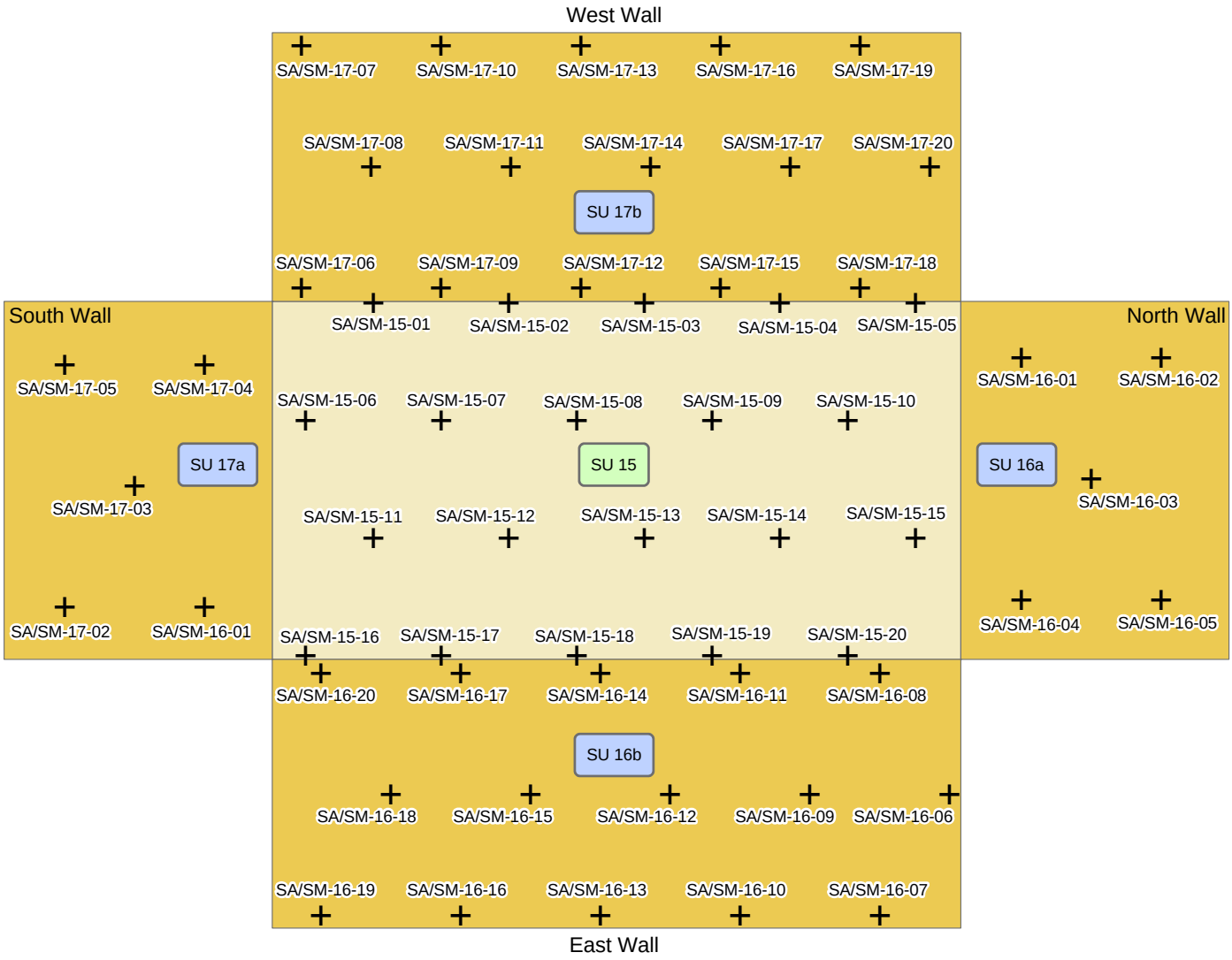
Scale 0 0.5 1 2 Feet

Aberdeen Proving Ground Maryland

# Former Shop Area Concrete Floor Slab Survey Unit Sample Locations




+ Systematic Sample Location

SA Surface Alpha Measurement

SM Smear Sample

Interior Floor

Interior Wall

SU 15 Survey Unit Class 1

SU 16a Survey Unit Class 2

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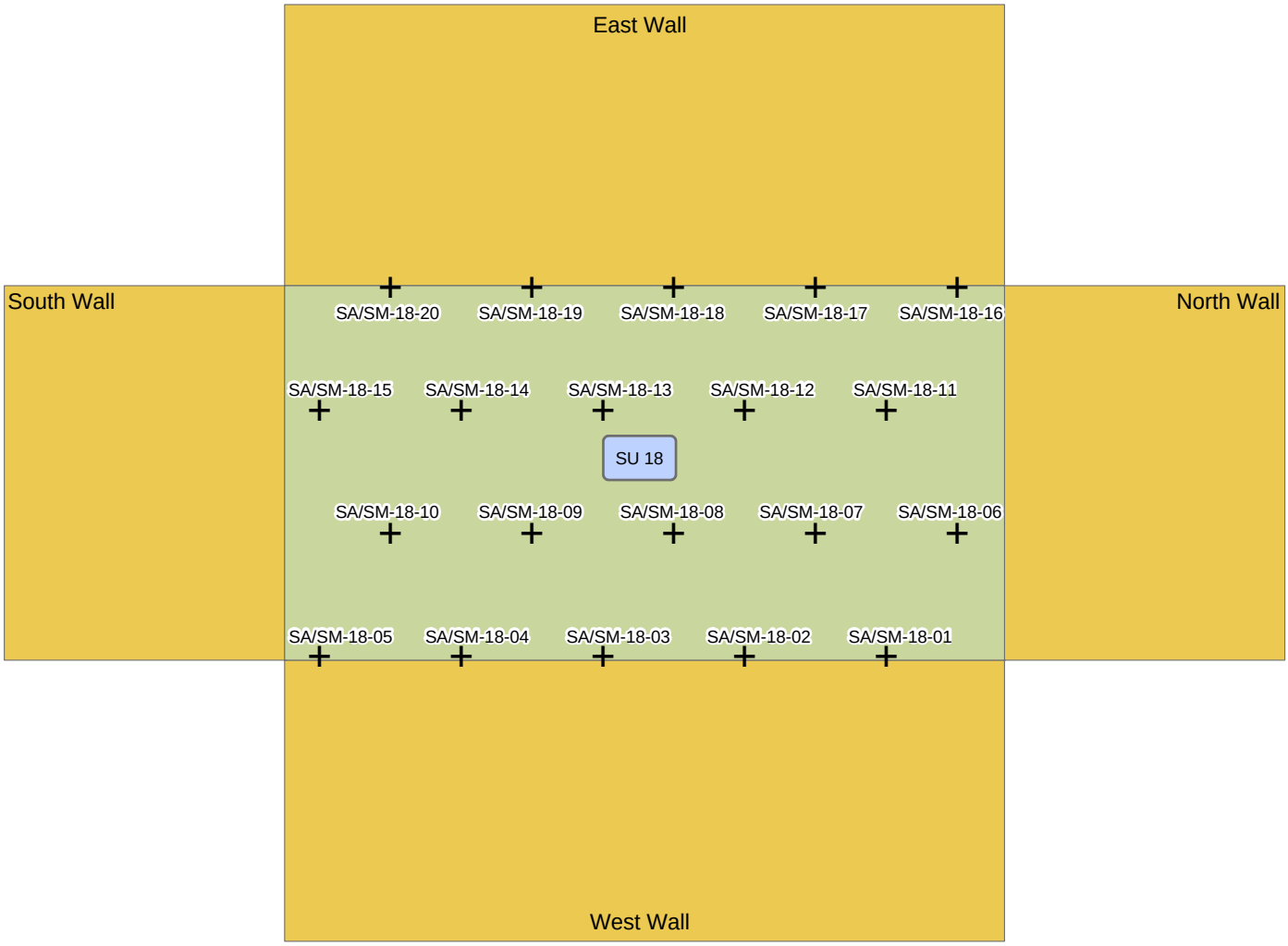
Scale 0 1.5 3 6 Feet

Aberdeen Proving Ground Maryland

# Building BRL 12 Interior Floor and Wall Survey Unit Sample Locations




| | | | |
|---|---|---|---|
| + | Systematic Sample Location | | Interior Ceiling |
| SA | Surface Alpha Measurement | | Interior Wall |
| SM | Smear Sample | SU 18 | Survey Unit Class 2 |

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Project No: 05-3060.06

Date: Jan 2008

Scale

0 1.5 3 6 Feet

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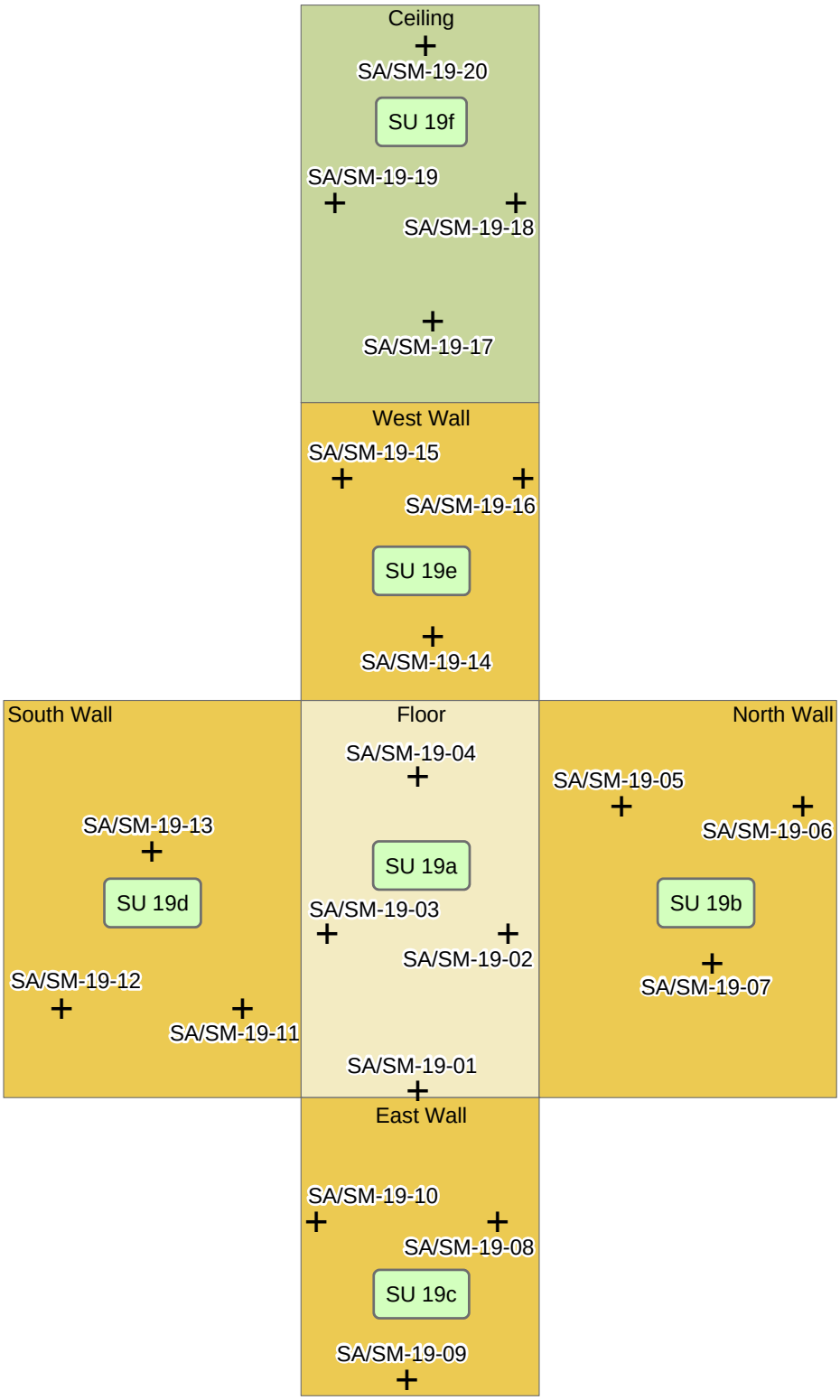
# Building BRL 12 Interior Ceiling Survey Unit Sample Locations




+ Systematic Sample Location

SA Surface Alpha Measurement

SM Smear Sample

Interior Ceiling

Interior Floor

Interior Wall

SU 19a Survey Unit Class 1

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Scale 0 1.5 3 6 Feet

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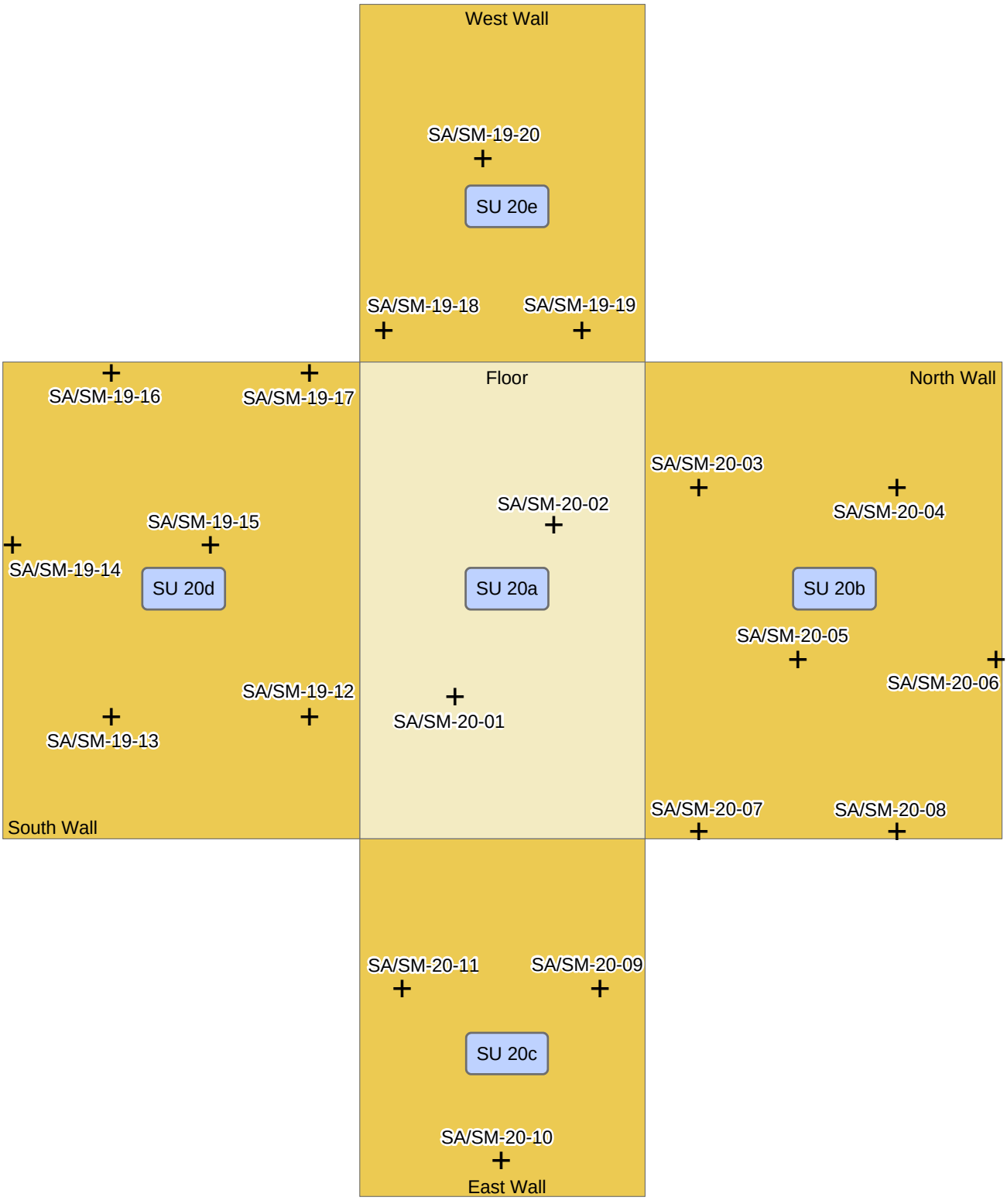
# North Vault Interior Survey Unit Sample Locations




| | | | |
|---|---|---|---|
| + | Systematic Sample Location | | Interior Floor |
| SA | Surface Alpha Measurement | | Interior Wall |
| SM | Smear Sample | SU 20a | Survey Unit Class 2 |

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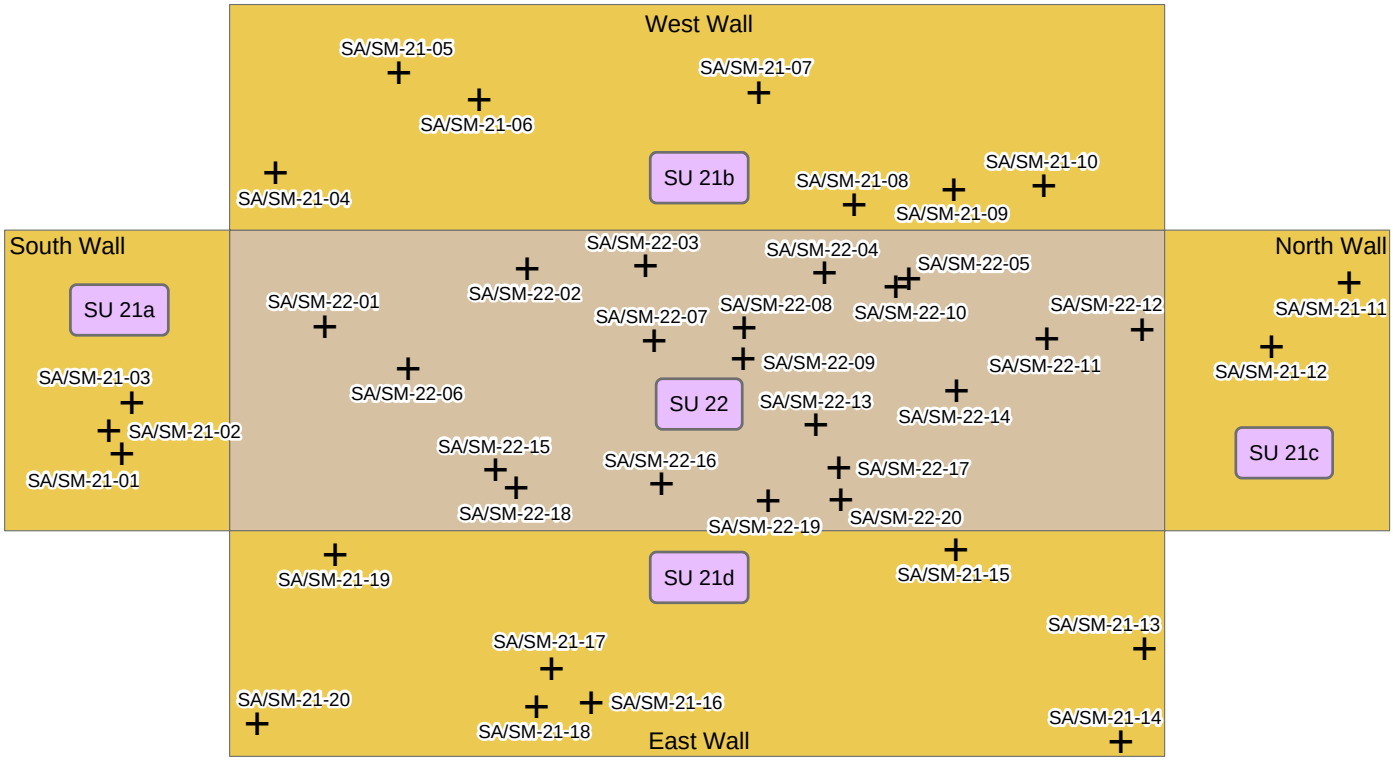
Project No: 05-3060.06
Date: Jan 2008
Scale
0 1 2 4 Feet

Aberdeen Proving Ground Maryland

# South Vault Interior Survey Unit Sample Locations




+ Systematic Sample Location

SA Surface Alpha Measurement

SM Smear Sample

Exterior Roof

Exterior Wall

SU 21a Survey Unit Class 3

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Project No: 05-3060.06

Date: Jan 2008

Scale 0 2 4 8 Feet

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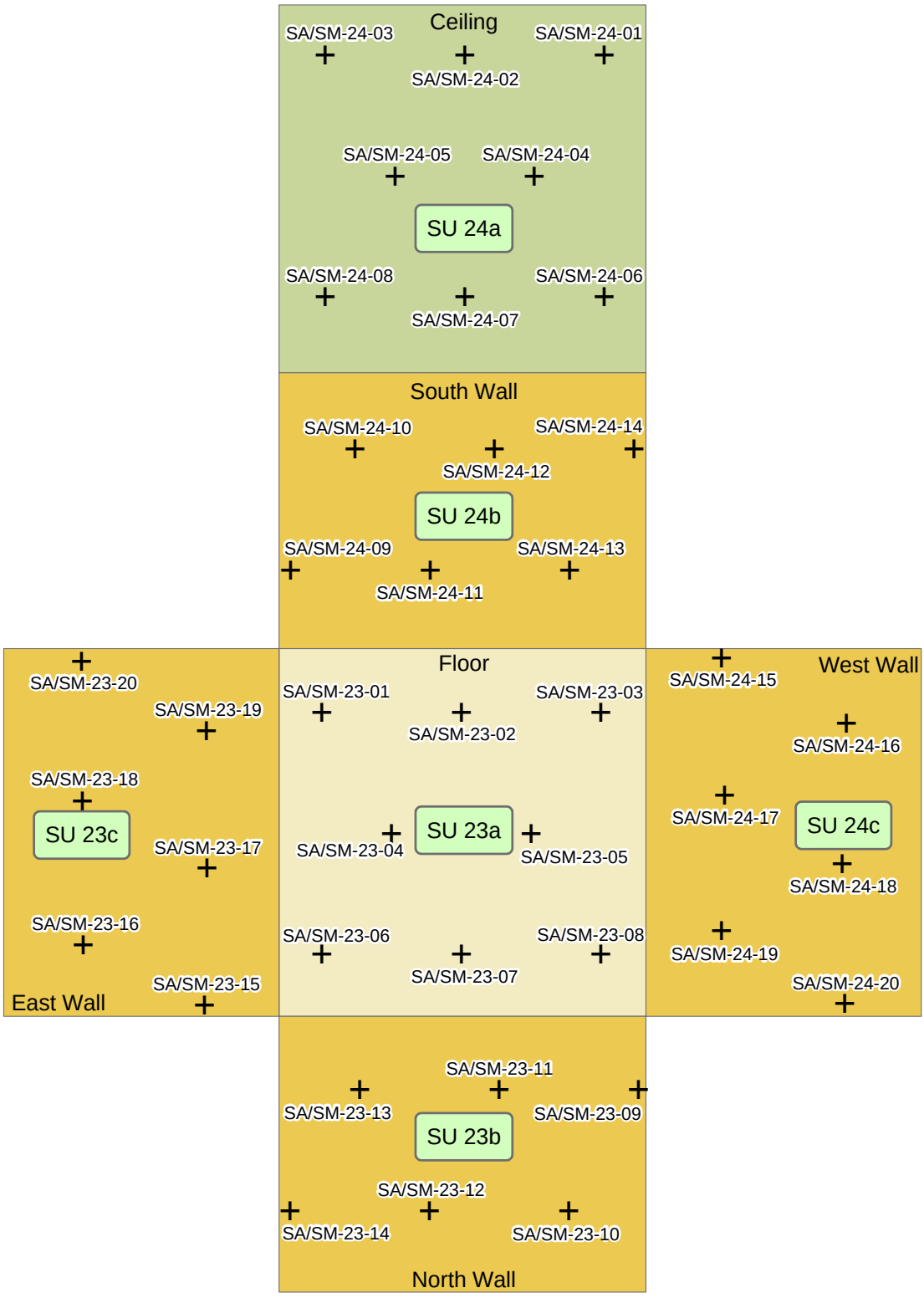
Aberdeen Proving Ground Maryland

# Building BRL 12 Exterior Survey Unit Sample Locations




+ Systematic Sample Location

SA Surface Alpha Measurement

SM Smear Sample

Interior Ceiling

Interior Floor

Interior Wall

SU 23a Survey Unit Class 1

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103 E. MT ROYAL AVE
OFFICE 2B
BALTIMORE, MD 21202

U.S. ARMY JOINT MUNITIONS COMMAND
ROCK ISLAND ARSENAL, ILLINOIS

PREPARED BY: KJ

REVIEWED BY: BWD

Contract No: W52P1J-04-D-0007/0006

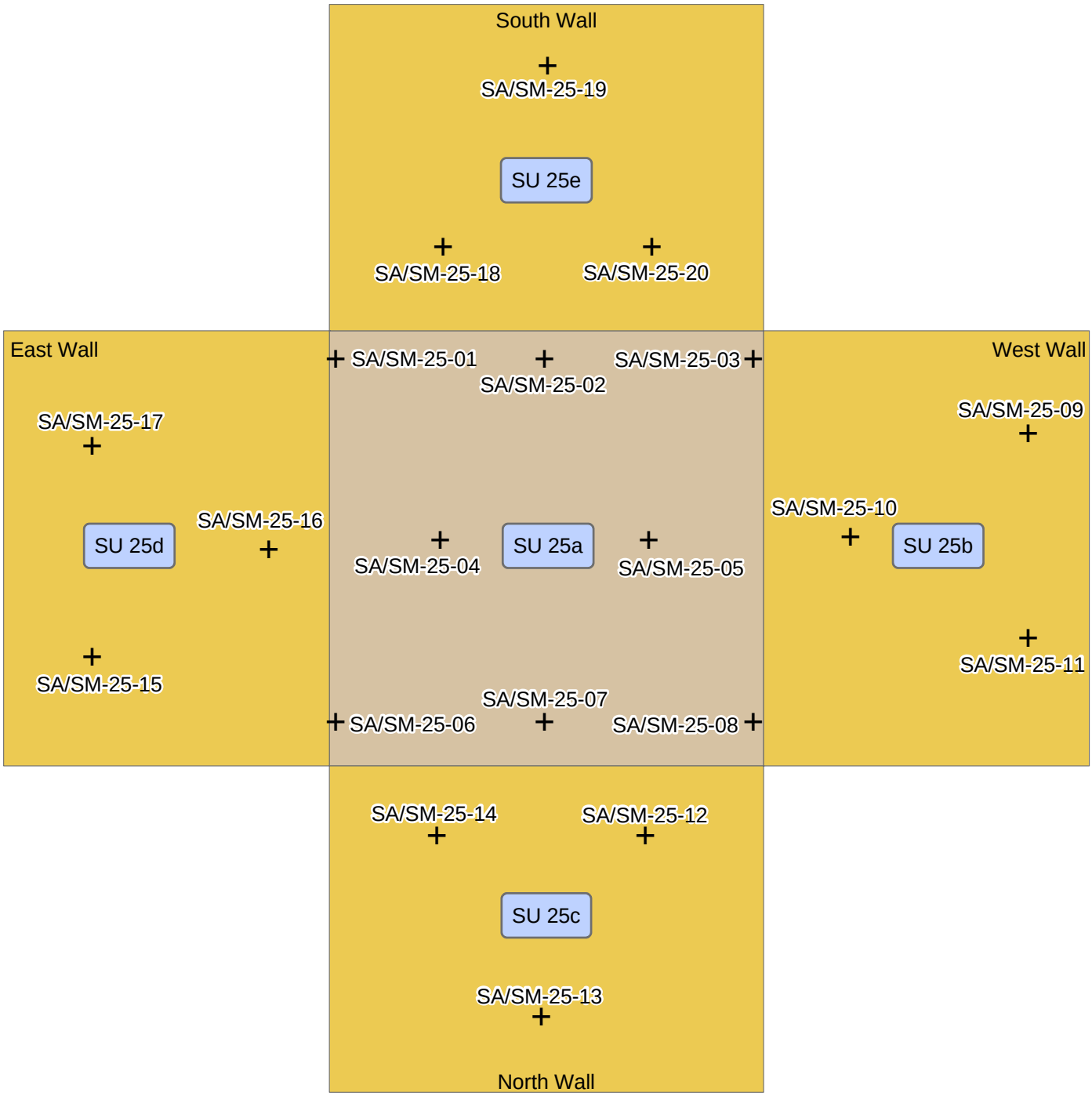
Project No: 05-3060.06

Date: Jan 2008

Scale 0 1.5 3 6 Feet

Aberdeen Proving Ground Maryland

# Freestanding Vault Interior Survey Unit Sample Locations




N

+ Systematic Sample Location

SA Surface Alpha Measurement

SM Smear Sample

Exterior Roof

Exterior Wall

SU 25a Survey Unit Class 2

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Contract No: W52P1J-04-D-0007/0006

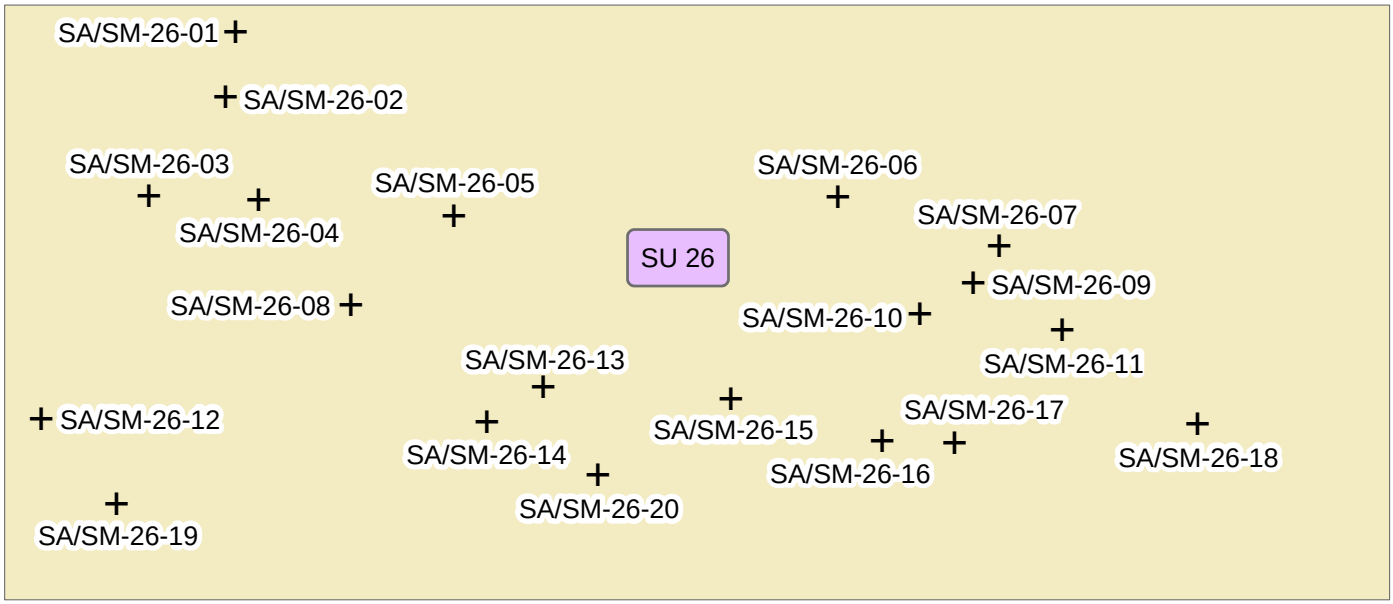
Project No: 05-3060.06

Date: Jan 2008

Scale 0 1 2 4 Feet

Aberdeen Proving Ground Maryland

# Freestanding Vault Exterior Surfaces Survey Unit Sample Locations




| | | | |
|---|---|---|---|
| + | Systematic Sample Location | | Interior Floor |
| SA | Surface Alpha Measurement | SU 26 | Survey Unit Class 3 |
| SM | Smear Sample | | |

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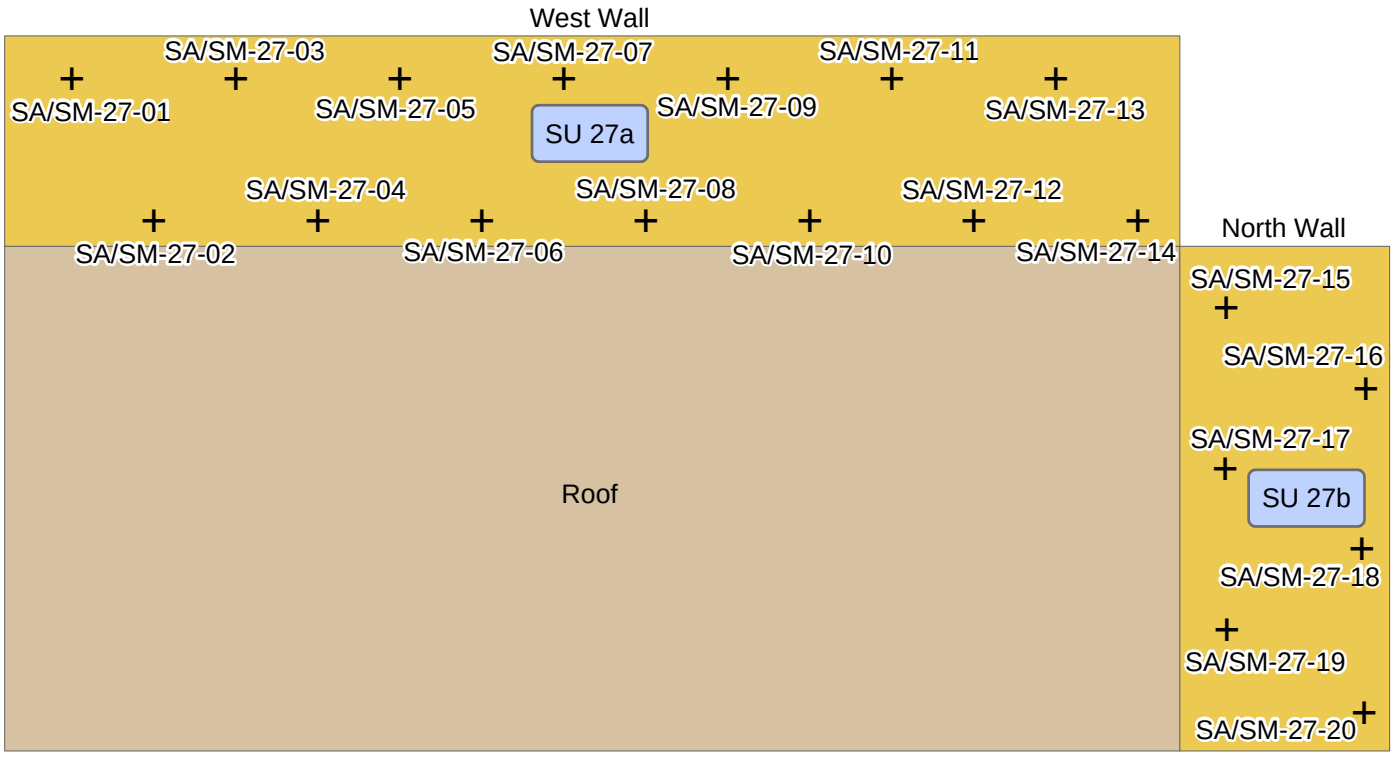
Project No: 05-3060.06
Date: Jan 2008
Scale
0 1.5 3 6 Feet

Aberdeen Proving Ground Maryland

# Building 1103B Interior Floor Survey Unit Sample Locations




| | | | |
|---|---|---|---|
| + | Systematic Sample Location | | Exterior Roof |
| SA | Surface Alpha Measurement | | Exterior Wall |
| SM | Smear Sample | SU 27a | Survey Unit Class 2 |

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Project No: 05-3060.06
Date: Jan 2008
Scale 0 2.5 5 10 Feet

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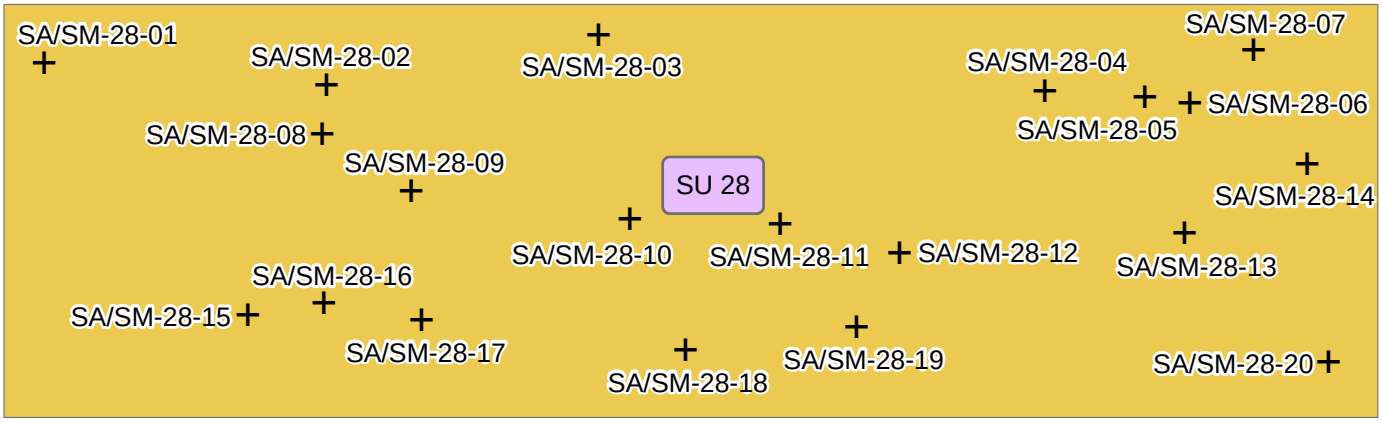
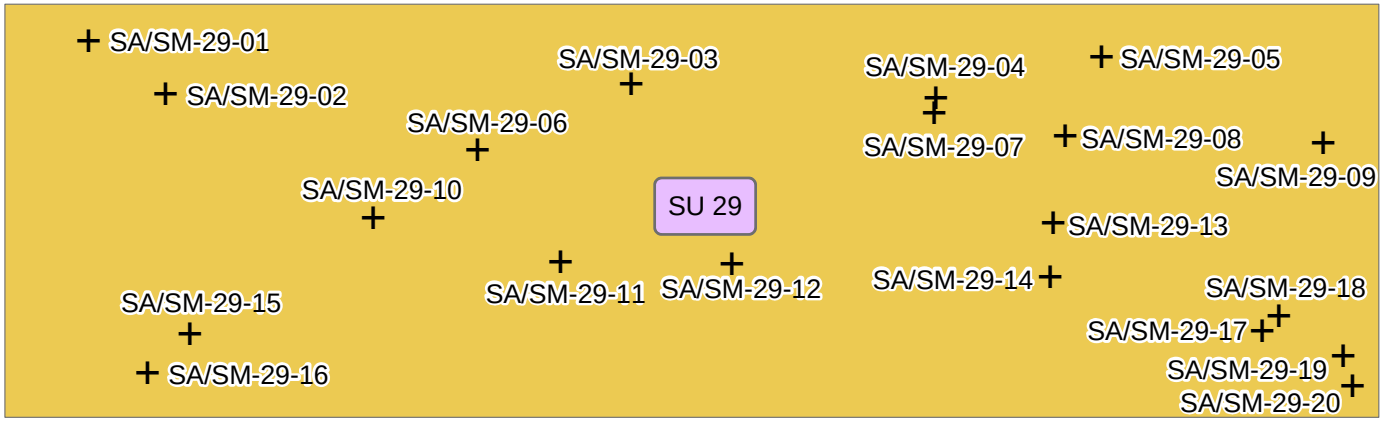
# Building 1103B Exterior Wall Survey Unit Sample Locations

Building 1100E
East Wall




Building 1100F
East Wall




+ Systematic Sample Location

SA Surface Alpha Measurement

SM Smear Sample

Exterior Wall

SU 28 Survey Unit Class 3

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Project No: 05-3060.06
Date: Jan 2008
Scale 0 1 2 4 Feet

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**Building 1100E and 1100F Exterior East Wall Survey Unit Sample Locations**

# APPENDIX B

# FIELD INSTRUMENT DETECTION SENSITIVITY

# FIELD INSTRUMENTATION DETECTION SENSITIVITY

## Introduction

This appendix describes the detection sensitivities for field instrumentation used during the final status survey (FSS) of the Building 1103A Area of the U.S. Army Research Laboratory (ARL) located at Aberdeen Proving Ground (APG) in Aberdeen, Maryland. This includes instruments used for gamma walkover surveys (GWS) of land areas, and instruments used for detection of contamination on building and/or structure surfaces through surface activity scans and direct measurements of total and removable surface contamination.

Radionuclides of concern (ROC) known to be present in the area are limited to depleted uranium (DU) isotopes (i.e., uranium-234 [$^{234}$U], uranium-235 [$^{235}$U], and uranium-238 [$^{238}$U]) and their short-lived decay progeny. DU composition is based on the isotopic uranium weight ratios routinely used for shipments of DU waste from APG (Barg, 1995). The activity fractions are calculated from the weight ratios and specific activities of each uranium isotope. The resulting composition consists of $^{234}$U, $^{235}$U, and $^{238}$U activity fractions of 0.084, 0.012, and 0.904, respectively. This composition is similar to the 0.190, 0.021, 0.790 average activity fractions measured in three DU soil samples described in the Argonne National Laboratory (ANL) report *Derived Uranium Guideline for the Depleted Uranium Study Area of the Transonic Range, Aberdeen Proving Ground, Maryland* (ANL, 1999).

The parent radionuclides in the two radioactive decay chains associated with DU, $^{238}$U and $^{235}$U, emit alpha particles. The daughter products in both chains decay by emission of alpha or beta particles, some with accompanying emission of gamma rays. The decay schemes for both are very well documented, and this knowledge is used in the design of the FSS and selection of appropriate survey instruments and analysis methods.

As presented in the following sections, the GWS minimum detectable concentration (MDC) for DU plus progeny in soil, using a 3”x3” sodium iodide (NaI) scintillation detector, is 32.9 picocuries per gram (pCi/g). The instrument scan minimum detectable count rate (MDCR), integrated or static measurement MDC, and the MDC for smear analysis are also presented in the following sections.

## Gamma Walkover Survey Detection Sensitivity

The GWS will be performed using a Ludlum 44-20 3-in.x 3-in. NaI scintillation detector or equivalent detector. The GWS is accomplished by walking at a speed of approximately 1.5 feet per second (0.5 meters per second) with the detector at a height of approximately 2 to 3 in. above the ground surface. Results are recorded in units of counts per minute (cpm). The determination of NaI detection sensitivity (i.e., MDC in soil) for DU is provided below. This evaluation assumes the contaminant is present in the upper 15 centimeters (cm) layer of soil with an area of 56 cm for modeling and calculation purposes.

The methodology used to determine the NaI scintillation detector scan MDC is based on the Nuclear Regulatory Commission (NRC) document, *NUREG-1507: Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, dated December 1997. Factors included in this analysis are the surveyor scan efficiency, index of sensitivity, natural background of the surveyed area, scan rate, detector-to-source geometry, areal extent of the hot spot, and energy and yield of gamma emissions.

The computer code *Microshield* was used to model the presence of a normalized 1 pCi/g of total DU with its 50-year decay progeny in soil with the further assumption that the activity is uniformly distributed to a depth of 15 cm and spread over a disk shaped area having a diameter of 56 cm. The non-contaminated soil cover has zero thickness (i.e., contamination is at the surface), and there is a 0.051-cm aluminum shield simulating the cover of the NaI detector to complete the model source term. The dose point is centered over the contaminated disk of soil. This model is consistent with the *NUREG-1507* methodology and provides for the calculation of a count rate-to-exposure rate ratio in terms of counts per minute (cpm) to microroentgens per hour (μR/hr). Additional details and discussion describing the *NUREG-1507* analysis methodology are described in that publication.

Fluence Rate to Exposure Rate (unitless)

The fluence rate to exposure rate (FRER) may be approximated by:

$$FRER \sim (1\ \mu R/hr)/\ (E_\gamma)\ (\mu_{en}/\rho)_{air}$$

Where:

$E_\gamma$ = energy of the gamma photon of concern, keV
$(\mu_{en}/\rho)_{air}$ = the mass energy absorption coefficient for air, $cm^2/g$

The FRER over a gamma energy range of 40 keV to 2 MeV is provided in Table 1.

**TABLE 1: FLUENCE TO EXPOSURE RATE (FRER)**

| $Energy_{\gamma}$, keV | $(\mu_{en}/\rho)_{air}$, $cm^2/g$ | FRER |
|---|---|---|
| 15 | 1.29 | 0.0517 |
| 20 | 0.516 | 0.0969 |
| 30 | 0.147 | 0.2268 |
| 40 | 0.064 | 0.3906 |
| 50 | 0.0384 | 0.5208 |
| 60 | 0.0292 | 0.5708 |
| 80 | 0.0236 | 0.5297 |
| 100 | 0.0231 | 0.4329 |
| 150 | 0.0251 | 0.2656 |
| 200 | 0.0268 | 0.1866 |
| 300 | 0.0288 | 0.1157 |
| 400 | 0.0296 | 0.0845 |
| 500 | 0.0297 | 0.0673 |
| 600 | 0.0296 | 0.0563 |
| 800 | 0.0289 | 0.0433 |
| 1,000 | 0.0280 | 0.0357 |
| 1,500 | 0.0255 | 0.0261 |
| 2,000 | 0.0234 | 0.0214 |

Probability of Interaction Through Detector End for a Given Energy

The probability, P, of a gamma ray interaction in the NaI scintillation crystal entering through the end of the crystal is given by:

$$\text{Probability (P)} = 1\text{-}e^{-(\mu/\rho)NaI(X)(\rho NaI)}$$

Where:

$(\mu/\rho)_{NaI}$ = the mass attenuation coefficient for NaI
X = the thickness through the bottom edge (end facing the soil) of the 3"x3" NaI crystal, 7.6cm
$\rho$ = the density of the NaI crystal, 3.67 $g/cm^3$

The probability of interaction in the NaI detector over the same energy range is provided in Table 2.

## TABLE 2: PROBABILITY OF INTERACTION (P)

| $Energy_{\gamma}$, keV | $(\mu/\rho)_{NaI}$, $cm^2/g$ | P |
|---|---|---|
| 15 | 47.4 | 1.00 |
| 20 | 22.3 | 1.00 |
| 30 | 7.45 | 1.00 |
| 40 | 19.3 | 1.00 |
| 50 | 10.7 | 1.00 |
| 60 | 6.62 | 1.00 |
| 80 | 3.12 | 1.00 |
| 100 | 1.72 | 1.00 |
| 150 | 0.625 | 1.00 |
| 200 | 0.334 | 1.00 |
| 300 | 0.167 | 0.99 |
| 400 | 0.117 | 0.96 |
| 500 | 0.0955 | 0.93 |
| 600 | 0.0826 | 0.90 |
| 800 | 0.0676 | 0.85 |
| 1,000 | 0.0586 | 0.80 |
| 1,500 | 0.0469 | 0.73 |
| 2,000 | 0.0413 | 0.68 |

Relative Detector Response

The relative detector response (RDR) by energy is determined by multiplying the FRER by the probability (P) of an interaction and is given by:

$$RDR = FRER \times P$$

The RDR for a NaI detector over the same energy range is provided in Table 3.

**TABLE 3: RELATIVE DETECTOR RESPONSE (RDR)**

| Energy$_\gamma$, keV | FRER | P | RDR |
|---|---|---|---|
| 15 | 0.0517 | 1.00 | 0.0517 |
| 20 | 0.0969 | 1.00 | 0.0969 |
| 30 | 0.2268 | 1.00 | 0.2268 |
| 40 | 0.3906 | 1.00 | 0.3906 |
| 50 | 0.5208 | 1.00 | 0.5208 |
| 60 | 0.5708 | 1.00 | 0.5708 |
| 80 | 0.5297 | 1.00 | 0.5297 |
| 100 | 0.4329 | 1.00 | 0.4329 |
| 150 | 0.2656 | 1.00 | 0.2656 |
| 200 | 0.1866 | 1.00 | 0.1866 |
| 300 | 0.1157 | 0.99 | 0.1146 |
| 400 | 0.0845 | 0.96 | 0.0812 |
| 500 | 0.0673 | 0.93 | 0.0626 |
| 600 | 0.0563 | 0.90 | 0.0507 |
| 800 | 0.0433 | 0.85 | 0.0367 |
| 1,000 | 0.0357 | 0.80 | 0.0287 |
| 1,500 | 0.0261 | 0.73 | 0.0191 |
| 2,000 | 0.0214 | 0.68 | 0.0146 |

Determination of CPM per μR/HR as a Function of Energy

The equivalent FRER, P, and RDR may be calculated for a NaI scintillation detector at the Cs-137 energy of 662 keV. Manufacturers of this equipment typically provide an instrument response in terms of cpm and μR/hr at the Cs-137 energy level. This point allows determination of the cpm per μR/hr and, ultimately, the activity concentration and minimum detection sensitivity in terms of pCi/g.

Based on measured counts in a known field it is estimated that a typical Ludlum Model 44-20 NaI response is 2,700 cpm/μR/hr. Using the same methodology as shown in the tables above, the FRER, P, and RDR can be calculated. The mass energy absorption coefficient for air and the mass attenuation coefficient for NaI are interpolated from tables in the *Radiological Health Handbook, Revised Edition*, dated January 1970, pages 139 and 140. These values are provided for Cs-137 in Table 4.

**TABLE 4: FRER, P, AND RDR FOR CS-137 GAMMA ENERGY (BA-137M)**

| $Energy_\gamma$, keV | FRER | $(\mu_{en}/\rho)_{air}$, $cm^2/g$ | $(\mu/\rho)_{NaI}$, $cm^2/g$ | P | RDR |
|---|---|---|---|---|---|
| 662 | 0.0514 | 0.0294 | 0.0780 | 0.89 | 0.0455 |

The detector response (in terms of cpm) to a different energy is based on the ratio of the RDR at that energy to the known Cs-137 energy RDR, as shown in the following equation:

$$\text{cpm}/\mu\text{R/hr}, E_i = (\text{cpm}_{Cs\text{-}137}) \times (RDR_{Ei}) / (RDR_{Cs\text{-}137})$$
$$= (2{,}700) \times (RDR_{Ei}) / (RDR_{Cs\text{-}137})$$

The NaI count rate over the same gamma energy range presented previously is provided in Table 5.

**Table 5: Count Rate ($E_i$) in cpm/μR/hr**

| $Energy_\gamma$, keV | $RDR_{Ei}$ | NaI Detector, $E_i$, cpm per μR/hr |
|---|---|---|
| 15 | 0.0517 | 3064 |
| 20 | 0.0969 | 5745 |
| 30 | 0.2268 | 13445 |
| 40 | 0.3906 | 23161 |
| 50 | 0.5208 | 30881 |
| 60 | 0.5708 | 33842 |
| 80 | 0.5297 | 31404 |
| 100 | 0.4329 | 25667 |
| 150 | 0.2656 | 15748 |
| 200 | 0.1866 | 11061 |
| 300 | 0.1146 | 6797 |
| 400 | 0.0812 | 4816 |
| 500 | 0.0626 | 3714 |
| 600 | 0.0507 | 3005 |
| 662 | 0.0455 | 2700 |
| 800 | 0.0367 | 2175 |
| 1,000 | 0.0287 | 17404 |
| 1,500 | 0.0191 | 1131 |
| 2,000 | 0.0146 | 867 |

Finally, the count rate to exposure rate ratio for the DU isotopes and progeny gamma emissions and the contribution to the total exposure rate are determined using the output of the *Microshield* runs and the count rate to exposure rate ratios from Table 5. The weighted cpm/µR/hr over the same energy range in previous tables is presented in Table 6.

**TABLE 6: WEIGHTED COUNT RATE TO EXPOSURE RATE IN CPM/µR/HR**

| keV | MicroShield Exposure Rate With Buildup (µR/hr ) | Count Rate to Exposure Rate (cpm/µR/hr) | Weighted Count Rate to Exposure Rate (cpm/µR/hr) |
|---|---|---|---|
| 15 | 7.662E-09 | 3064 | 0 |
| 20 | 6.224E-11 | 5745 | 0 |
| 30 | 4.751E*06 | 13445 | 8 |
| 40 | 8.301E-09 | 23161 | 0 |
| 50 | 7.223E-07 | 30881 | 3 |
| 60 | 3.724E-04 | 33842 | 1545 |
| 80 | 5.073E-05 | 31404 | 195 |
| 100 | 1.656E-03 | 25667 | 5212 |
| 150 | 1.272E-04 | 15748 | 246 |
| 200 | 6.157E-04 | 11061 | 835 |
| 300 | 1.432E-05 | 6797 | 12 |
| 400 | 1.608E-05 | 4816 | 9 |
| 500 | 2.927E-05 | 3714 | 13 |
| 600 | 1.416E-04 | 3005 | 52 |
| 800 | 1.023E-03 | 2175 | 273 |
| 1,000 | 3.968E-03 | 1704 | 829 |
| 1,500 | 1.162E-04 | 1131 | 16 |
| 2,000 | 1.873E-05 | 867 | 2 |
| **Total** | **8.155E-03** | | **9252** |

Scan MDC Value

The scan MDC is calculated using the *NUREG-1507* methodology, where the average number of background counts in a one second interval, $b_i$ , is cpm/60.

For the Ludlum 3" x 3" NaI scintillation detector and a background count rate of 27,000 cpm, the calculated background counts in a one second interval is:

$$b_i = (27{,}000 \text{ cpm}) / (60 \text{ sec/min}) = 450 \text{ counts}$$

The minimum detectable count rate (MDCR) is:

$$MDCR = (d') \times (b_i)^{0.5} \times (60 \text{ sec/min})$$

Where:

d' = 1.38 from *NUREG-1507* Table 6.1, which represents the rate of detection at a 95% true positive proportion with a false positive proportion of 60%.

The resulting MDCR is:

$$MDCR = (1.38) \times (450 \text{ counts/sec})^{0.5} \times (60 \text{ sec/min}) = 1{,}756 \text{ cpm}$$

The MDCR for the surveyor is represented as follows:

$$MDCR_{surveyor} = MDCR / (p)^{0.5}$$

Where:

P = surveyor efficiency, equal to 0.75 to 0.5 as given by *NUREG-1507* (0.5 is selected as a conservative choice).

The resulting surveyor MDCR is:

$$MDCR_{surveyor} = 1{,}756 / 0.707 = 2{,}484 \text{ cpm}$$

The minimum detectable exposure rate (MDER) for the surveyor, obtained from the $MDCR_{surveyor}$ divided by the Table 6 weighted count rate to exposure rate value of 9,252 cpm/μR/hr for DU and progeny, is:

$$MDER = (2{,}484 \text{ cpm}) / (9{,}252 \text{ cpm} / \mu R/hr) = 0.2685 \ \mu R/hr$$

The scan MDC is then equal to the ratio of the MDER in the field to the exposure rate determined for the normalized 1 pCi/g concentration of total DU, and is represented as follows:

$$\text{Scan MDC} = (\text{Normalized } DU_{\text{Total Conc}}) \times (\text{Exposure Rate } MDCR_{\text{Surveyor}}) / (\text{Exposure Rate}_{\text{normalized DU conc}})$$

The resulting scan MDC for the outdoor GWS is:

$$\text{Scan MDC} = (1 \text{ pCi/g}) \times (0.2685 \ \mu R/hr) / (8.155E\text{-}03 \ \mu R/hr) = \mathbf{32.9 \text{ pCi/g}}$$

## Building and/or Structure Surface Activity Measurements

As indicated in the work plan, building and/or structure surfaces will be surveyed using direct surface scan and static measurement techniques. Smears will also be obtained and analyzed to determine the amount of removable contamination present on a surface. Surveys will be performed in accordance with standard operating procedures.

Surface scans will be performed using instruments capable of measuring the beta emissions from the DU radionuclides. Since many of the interior building surfaces within the scope of this FSS are known to be contaminated, the scan survey will attempt to determine the distribution of contaminants, as well as identify areas of contamination significantly higher than other areas (hot spots). The results of the beta scan surveys will then be used to identify locations for collection of biased integrated or static alpha total surface activity measurements and collection of smears to determine the removable contamination fraction in these areas. Because many of the interior surfaces are known to be contaminated with DU, the postulated hot spot area for performance of scan surveys is 1 square meter ($m^2$).

For the purpose of building surface and/or structure FSS, a hot spot is defined as any area exhibiting greater than two times the instrument minimum detectable count rate (MDCR). Following completion of the beta scan surveys, integrated or static alpha measurements may be performed at systematic and/or biased locations, including hot spot areas identified through surface beta scans. Smears may also be obtained at these locations to determine the removable fraction of contamination present on the surface. Only the results of the integrated or static alpha measurements will be compared to the screening limits presented in the work plan.

Beta surface scans may be performed using a Ludlum Model 43-37 floor monitor (582 $cm^2$) gas proportional detector, Ludlum Model 43-68 hand-held gas proportional detector (126 $cm^2$), or equivalent instrumentation. Integrated or static surface activity measurements may be performed using the Ludlum Model 43-37 floor monitor, Ludlum Model 43-68 gas proportional detector, Ludlum Model 43-89 ZnS scintillation detector (126 $cm^2$), or equivalent instrumentation. Smears may be analyzed using a Ludlum Model 2929 scaler coupled to a Ludlum Model 43-10-1 scintillation detector. The following sections discuss the detection sensitivity for each of these instruments used for FSS surveys.

Beta Scan Minimum Detectable Count Rate

The detection sensitivity derived for instruments used to perform beta scans focuses on the information provided directly from the measurement and available to the surveyor for decisions regarding survey performance. Therefore, the beta scan sensitivity is derived in terms of the measurement MDCR. The MDCR is determined for the Ludlum Model 43-37 floor monitor and the Ludlum Model 43-68 gas proportional detector, using *MARSSIM* Equations 6-8 and 6-9.

The observed background count (*b'*) is defined as the number of background counts observed within the observation interval (*i*). The equation used for calculating *b'* is as follows:

$$b' = (\text{BCPM}) * (i) * (1 \text{ min}/60 \text{ sec}) = \text{counts/interval}$$

Where:

BCPM = instrument or reference area background count rate (cpm)
*i* = observation interval (seconds)

The minimum detectable number of net source counts in the interval is given by $s_i$. Therefore, for an ideal observer, the number of source counts required for a specified level of performance can be arrived at by multiplying the square root of the number of background counts by the detectability value associated with the desired performance ($d'$), as shown below:

$$s_i = d\sqrt{b'} \qquad \textit{MARSSIM Equation 6-8}$$

The MDCR is defined as the increase above background recognizable during a survey in a given period of time. The variable, *d*, is defined as the index of sensitivity and is dependent on the selected decision errors for Type I (alpha) and Type II (beta) errors. A true positive error (1–β) of 95% and a false positive error (alpha) of 60% may be selected to be consistent with NUREG 1507. The value of 1.38 was obtained from *NUREG 1507*, Table 6.1 (*MARSSIM* Table 6.5).

$$\text{MDCR (cpm)} = si \times (60/i) \qquad \textit{MARSSIM Equation 6-9}$$

The measurement interval (*i*) for both the Ludlum Model 43-37 and Ludlum Model 43-68 is one per second.

*Ludlum Model 43-68*

The background count rate for the Ludlum Model 43-68 reported by the manufacturer is 300 cpm (consistent with a typical concrete background count rate for this instrument).

$b'$ = (300 cpm) * (1) * (1 min/60 sec) = 5 counts in the 1 second observation interval

Using $d = 1.38$:

$$s_i = 1.38\sqrt{5}$$

$$s_i = 3.1$$

Thus, the Ludlum Model 43-68 beta scan MDCR is:

$$\text{MDCR (cpm)} = 3.1 \times (60/1) = 185 \text{ cpm (above background)}$$

The beta scan action level for identifying a hot spot would therefore be:

Scan Action Level (MDCR) = MDCR x 2

= 370 cpm above background

For simplicity and to aid in surveyor decisions, this value is rounded to **400 cpm above background**.

*Ludlum Model 43-37*

The beta scan MDCR for the Ludlum Model 43-37 floor monitor is same manner as the Ludlum Model 43-68 except the background is adjusted to account for the significant increase in detector area. This is accomplished simply by multiplying the Ludlum Model 43-68 background by the ratio of the Ludlum Model 43-37 detector area (582 $cm^2$) to the Ludlum Model 43-68 detector area (126 $cm^2$) or 4.6.

Ludlum Model 43-37 BCPM = 300 x 4.6 = 1386 cpm

Using this background count rate, the values and formulas from the previous section, the Ludlum Model 43-37 floor monitor beta scan MDCR is 397 cpm above background. Rounding for simplicity and ease, the MDCR is approximately 400 cpm above background, resulting in a beta scan action level for the Ludlum Model 43-37 of **800 cpm above background**.

Integrated (Static) Alpha Surface Activity Measurements

Integrated direct measurements (i.e., static measurements) of surface alpha contamination will be performed to compare contaminant concentrations at discrete sampling locations to the screening limit presented in the work plan.

Integrated alpha activity measurements will be performed using a Ludlum Model 43-37 gas proportional detector, Ludlum Model 43-68 gas proportional detector, Ludlum Model 43-89 handheld scintillation detector, or equivalent. Although the background count rates are slightly different, the parameters and static measurement requirements are very similar for the Ludlum Model 43-68 and Ludlum Model 43-89 detectors.

Since the background and gross (or sample) count times are the same for all three detectors, the following equation is used to determine instrument MDC:

$$\text{MDC (dpm/100cm}^2) = \frac{3 + 4.65\sqrt{(R_b)}}{\frac{[DA]}{100}[\varepsilon_i][\varepsilon_s]} \qquad \textit{MARSSIM Equation 6-7}$$

Where:

$\varepsilon_i$ = instrument efficiency (cpm/dpm)
$\varepsilon_s$ = surface efficiency (unitless)
$R_b$ = background count rate (cpm)
DA = detector area ($cm^2$)

For the purpose of this evaluation, instrument efficiency values ($\varepsilon_i$) were obtained from *NUREG 1507*, Table 4.4. Surface efficiency values ($\varepsilon_s$) were obtained from *NUREG 1507*, Table 5.5, for a sealed concrete surface with distributed alpha emitting radioactive source.

When using large area detectors, such as the detector associated with the Ludlum Model 43-37, it is typically not appropriate to account for detector area corrections. This is because the area of contamination is assumed to be much smaller than the detector area, on the order of 100 $cm^2$. However, since it is known that many interior surfaces are contaminated, and the postulated hot spot is much greater than the Ludlum Model 43-37 detector area, this correction is necessary and appropriate.

The integrated or static measurement MDC and assumptions used for each of the detectors are presented in Table 7. The MDC was determined using the above equation.

**TABLE 7: INTEGRATED/STATIC MEASUREMENT MDC AND ASSUMPTIONS**

| Ludlum Model No. | Count Time (min) | Bkg Count Time (min) | Detector Area ($cm^2$) | $\varepsilon_i$ (cpm/dpm) | $\varepsilon_s$ | α Bkg (cpm) | α Static MDC (dpm/100 $cm^2$) |
|---|---|---|---|---|---|---|---|
| 43-37 | 1 | 1 | 582 | 0.349 | 0.473 | 10 | 18 |
| 43-68 | 1 | 1 | 126 | 0.349 | 0.473 | 5 | 64 |
| 43-89 | 1 | 1 | 126 | 0.259 | 0.428 | 3 | 79 |

min = minutes
cpm = counts per minute
bkg = background
$cm^2$ = square centimeters
dpm = disintegrations per minute

Removable Contamination (Smear) Analysis MDC

Smear samples will be collected at biased building surface locations, as appropriate, to quantify transferable/removable surface alpha contamination. Samples of removable surface contamination are typically obtained by wiping a surface area of 100 $cm^2$ using a cloth or paper disc or other suitable media. These samples (smears) will be analyzed using a Ludlum 2929 scaler coupled to a Ludlum Model 43-10-1 scintillation detector. Since the background and gross (sample) count times for this instrument are typically different when analyzing smears for alpha emitting contamination, the following equation is used to determine the measurement MDC:

$$\text{Smear MDC (dpm/100 cm}^2) = \frac{3 + 3.29\sqrt{(R_b)(T_s)(1+\frac{T_s}{T_b})}}{(T_s)\,(\varepsilon_i)} \qquad \textit{NUREG 1507, Equation 3-11}$$

Where:

$\varepsilon_i$ = instrument efficiency (cpm/dpm)
$R_b$ = background count rate (cpm)
$T_b$ = background count time (minutes)
$T_s$ = sample count time (minutes)

The smear analysis MDC and assumptions are presented in Table 8.

**TABLE 8: SMEAR ANALYSIS MDC AND ASSUMPTIONS**

| Ludlum Model No. | Count Time (min) | Bkg Count Time (min) | Probe Area ($cm^2$) | α Efficiency (cpm/dpm) | α Bkg (cpm) | α Static MDC (dpm/100 $cm^2$) |
|---|---|---|---|---|---|---|
| 2929 | 4* | 20 | Smear | 0.33 | 0.8 | 7 |

min = minutes
cpm = counts per minute
$cm^2$ = square centimeters
dpm = disintegrations per minute

* Actual sample count time may be determined based on actual measured alpha background count rate and detector specific alpha efficiency. Background and sample count times may be adjusted to maintain a target MDC not greater than 10 dpm/100 $cm^2$ or 10% of the screening limit presented in the work plan.

## Summary

GWS sensitivity parameters, beta surface scan MDCRs, and static measurement and smear analysis MDCs have been calculated for each instrument to be used during the FSS. Calculation of MDCs for each instrument ensures that direct measurements are performed using radiation survey instrumentation sufficient to evaluate radiological conditions in accordance with the requirements of the work plan. Due to the potential variations of conditions in the field, parameters such as static measurement and smear count times may be adjusted onsite with the permission of the project Health Physicist.

# APPENDIX B

Appendix B1 Static and Sample Locations

Appendix B2 Static Results

Appendix B3 Smear Results

Appendix B4 Investigation Results

**Spreadsheets Provided on CD**

# APPENDIX B1

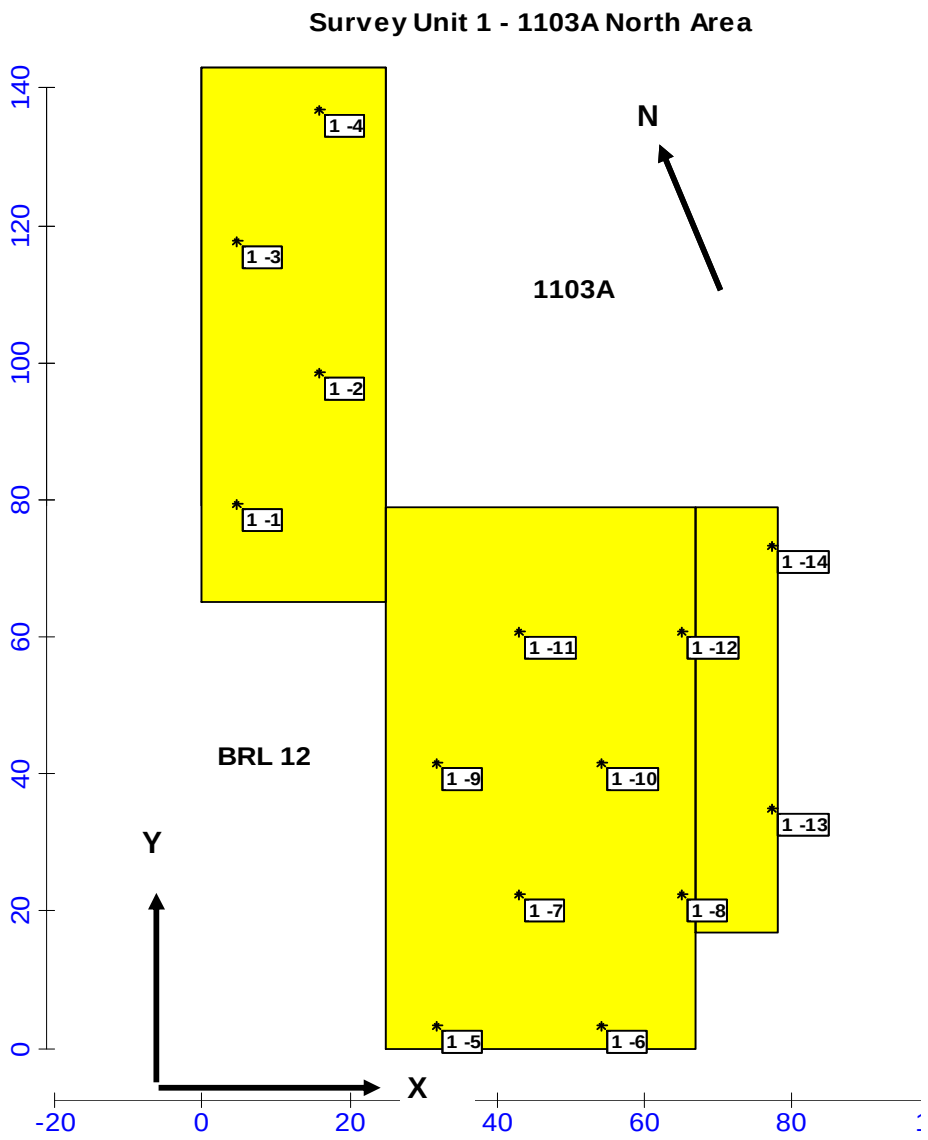
Static and Sample Locations

## APG Bldg 1103A Project - FSS Survey Unit Descriptions

| Survey Unit ID | Structure | Survey Unit Description | Horiz N-S (ft) | Horiz E-W (ft) | Wall Ht Low (ft) | Wall Ht High (ft) | Surface Area ($ft^2$) | Surface Area ($m^2$) | MARSSIM Class |
|---|---|---|---|---|---|---|---|---|---|
| 1 | North Area 1103A | BRL12 Yard | | | | | 5950 | 552.8 | 1 |
| 2 | South Area | Large Vault Yard | | | | | 7719 | 717.1 | 1 |
| 3 | East Area | Asphalt East Parking Lot | | | | | 4650 | 432.0 | 2 |
| 4 | Perimeter Area | North, West, South Border | | | | | 12500 | 1161.3 | 2 |
| 5 | 1103A | Floor North | 19.34 | 48.75 | n/a | n/a | 942.8 | 87.6 | 1 |
| 6 | 1103A | Floor South | 19.34 | 48.75 | n/a | n/a | 942.8 | 87.6 | 1 |
| 7 | 1103A | Interior Walls N & E | 38.67 | 48.75 | 10 | 12 | 923.0 | 85.7 | 1 |
| 8 | 1103A | Interior Walls W & S | 38.67 | 48.75 | 10 | 12 | 923.0 | 85.7 | 1 |
| 9 | 1103A | Ceiling North | 20 | 50 | n/a | n/a | 1000.0 | 92.9 | 1 |
| 10 | 1103A | Ceiling South | 20 | 50 | n/a | n/a | 1000.0 | 92.9 | 1 |
| 11 | 1103A | Exterior Wall - South | 0 | 50 | 10 | 12 | 550.0 | 51.1 | 1 |
| 12 | 1103A | Exterior Walls - N, E & W | 40 | 50 | 10 | 12 | 1350.0 | 125.4 | 2 |
| 12A | 1103A | Entrance Room Interior | 9 | 4.5 | 8.6 | n/a | 313.2 | 29.1 | 1 |
| 12B | 1103A | Entrance Room Exterior | 9 | 4.5 | 8.6 | n/a | 272.7 | 25.3 | 2 |
| 13 | 1103A | Roof | 40 | 50 | n/a | n/a | 2000.0 | 185.8 | 2 |
| 14 | 1103A | Former Shop Area Floor | | | | | | | 1 |
| 15 | BRL12 | Floor | 39.4 | 20 | 0 | | 788.0 | 73.2 | 1 |
| 19 | BRL12 N Vault | Interior Fl, N & E Walls | 12.2 | 20 | 12 | | 630.4 | 58.6 | 1 |
| 19A | BRL12 N Vault | Interior Ceil, W & S Walls | 12.2 | 20 | 12 | | 630.4 | 58.6 | 1 |
| 19B | BRL12 N Vault | Roof & Exterior Walls | 12.2 | 20 | 12 | | 1212.0 | 112.6 | 2 |
| 20 | BRL12 S Vault | Interior Surfaces | 12.2 | 20 | 12 | | 1260.8 | 117.1 | 2 |
| 20A | BRL12 S Vault | Roof & Exterior Walls | 12.2 | 20 | 12 | | 1212.0 | 112.6 | 2 |
| | | | | | | | | | |
| 23 | Freestanding Vault | Fl, N & E Walls | 20 | 20 | 15 | | 1000.0 | 92.9 | 1 |
| 24 | Freestanding Vault | Ceil, W & S Walls | 20 | 20 | 15 | | 1000.0 | 92.9 | 1 |
| 25 | Freestanding Vault | ext Walls & roof | 20 | 20 | 15 | | 1600.0 | 148.6 | 1* |
| 26 | 1103 B | Floor | 80 | 43 | | | 3440 | 319.6 | 3 |
| 27 | 1103 B | Exterior N & W Walls | 151 | | 10 | | 1510 | 140.3 | 2 |
| 28 | 1100 E | Exterior E Wall | 60.25 | n/a | 30 | 35 | 1958.125 | 181.9 | 3 |
| 29 | 1100 F | Exterior E Wall | 62 | | 10 | | 620 | 57.6 | 3 |
| | | | | | | | | | |
| * Reclassified from 2 to 1. | | | | | | | | | |

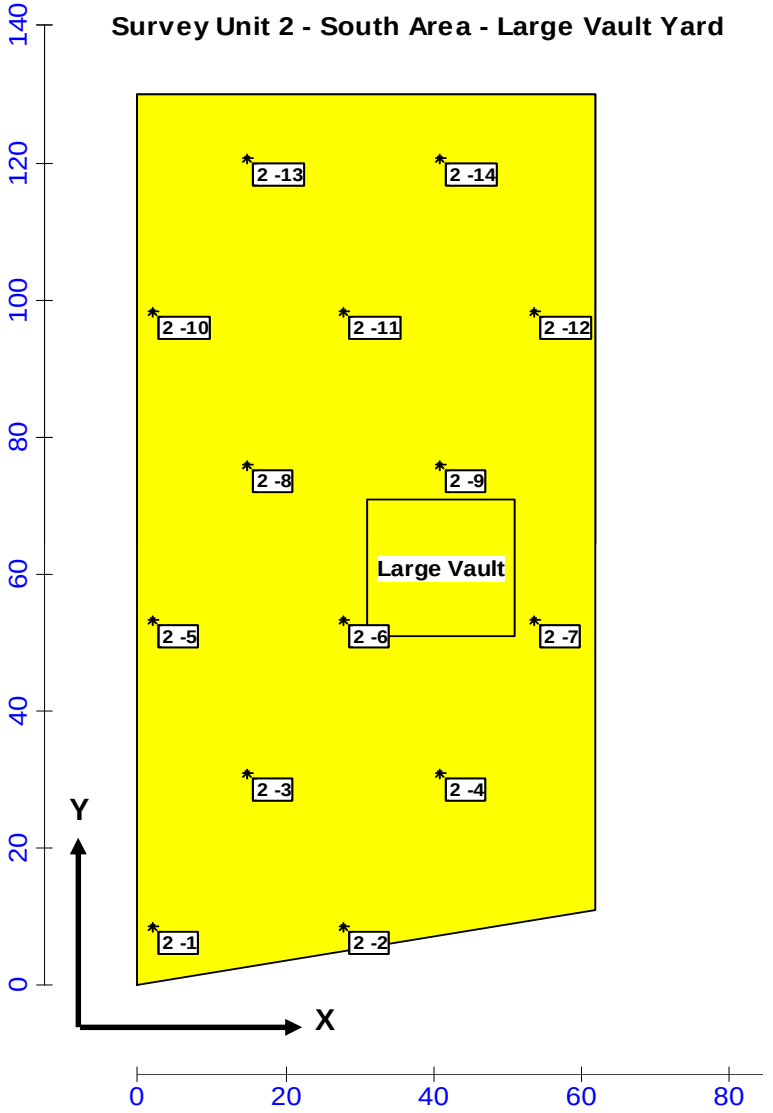
**APG Building 1103 A Project - FSS Outdoor Area Sampling & Measurement Locations**

| Measurement No. | Location | Dist. East (X Coord. ft.) | Dist North (Y Coord. ft.) |
|---|---|---|---|
| 1-1 | Ground | 4.7 | 79.3 |
| 1-2 | Ground | 15.8 | 98.5 |
| 1-3 | Ground | 4.7 | 117.7 |
| 1-4 | Ground | 15.8 | 136.9 |
| 1-5 | Ground | 31.9 | 3.2 |
| 1-6 | Ground | 54.1 | 3.2 |
| 1-7 | Ground | 43.0 | 22.4 |
| 1-8 | Ground | 65.2 | 22.4 |
| 1-9 | Ground | 31.9 | 41.6 |
| 1-10 | Ground | 54.1 | 41.6 |
| 1-11 | Ground | 43.0 | 60.8 |
| 1-12 | Ground | 65.2 | 60.8 |
| 1-13 | Ground | 77.4 | 35.0 |
| 1-14 | Ground | 77.4 | 73.4 |



**APG Building 1103 A Project - FSS Outdoor Area Sampling & Measurement Locations**

| Measurement No. | Location | Dist. East (X Coord. ft.) | Dist North (Y Coord. ft.) |
|---|---|---|---|
| 2 -1 | Ground | 1.9 | 8.6 |
| 2 -2 | Ground | 27.8 | 8.6 |
| 2 -3 | Ground | 14.9 | 31.1 |
| 2 -4 | Ground | 40.7 | 31.1 |
| 2 -5 | Ground | 1.9 | 53.5 |
| 2 -6 | Ground | 27.8 | 53.5 |
| 2 -7 | Ground | 53.7 | 53.5 |
| 2 -8 | Ground | 14.9 | 75.9 |
| 2 -9 | Ground | 40.7 | 75.9 |
| 2 -10 | Ground | 1.9 | 98.3 |
| 2 -11 | Ground | 27.8 | 98.3 |
| 2 -12 | Ground | 53.7 | 98.3 |
| 2 -13 | Ground | 14.9 | 120.7 |
| 2 -14 | Ground | 40.7 | 120.7 |



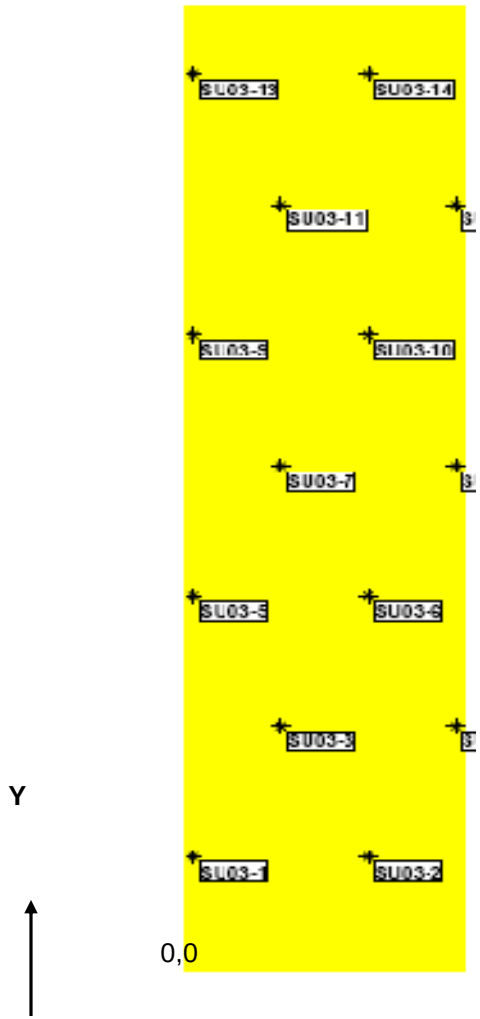

Area: Area 8

| X Coord | Y Coord | Label | Value | Type | Historical |
|---|---|---|---|---|---|

**APG Building 1103 A Project - FSS Outdoor Area Sampling & Measurement Locations**

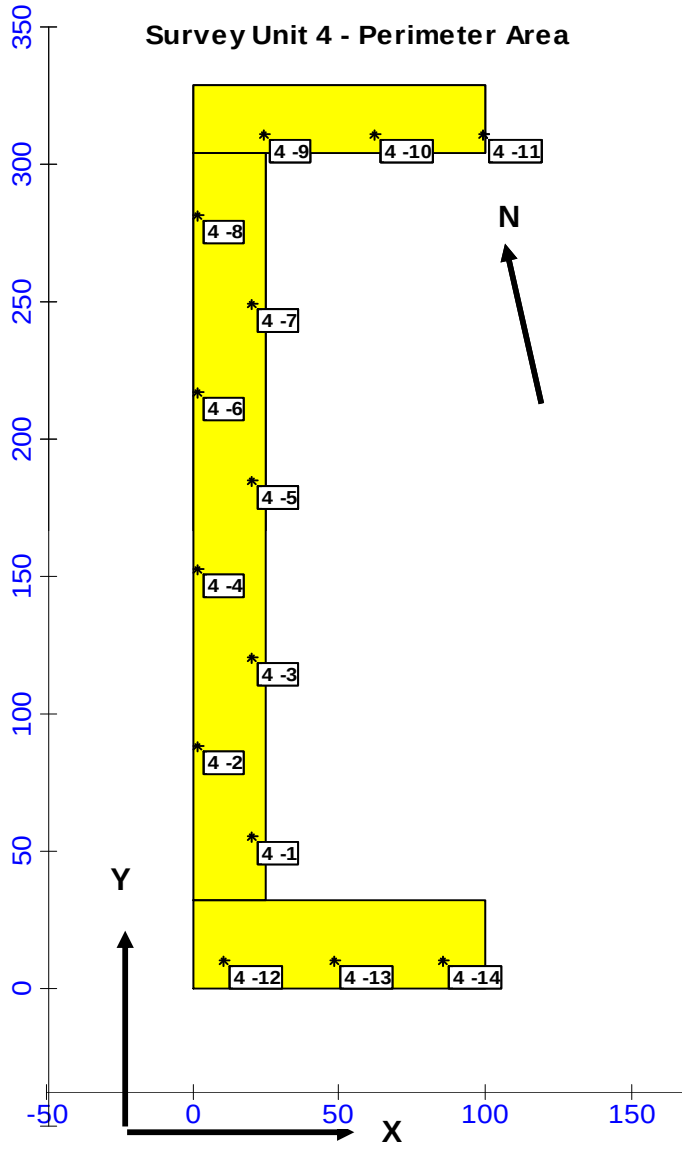
| Measurement No. | Location | Dist. East (X Coord. ft.) | Dist North (Y Coord. ft.) |
|---|---|---|---|
| 3 -1 | Ground | 1.1 | 14.2 |
| 3 -2 | Ground | 19.8 | 14.2 |
| 3 -3 | Ground | 10.5 | 30.4 |
| 3 -4 | Ground | 29.2 | 30.4 |
| 3 -5 | Ground | 1.1 | 46.6 |
| 3 -6 | Ground | 19.8 | 46.6 |
| 3 -7 | Ground | 10.5 | 62.8 |
| 3 -8 | Ground | 29.2 | 62.8 |
| 3 -9 | Ground | 1.1 | 79.0 |
| 3 -10 | Ground | 19.8 | 79.0 |
| 3 -11 | Ground | 10.5 | 95.2 |
| 3 -12 | Ground | 29.2 | 95.2 |
| 3 -13 | Ground | 1.1 | 111.4 |
| 3 -14 | Ground | 19.8 | 111.4 |

**Survey Unit 03. Ea**



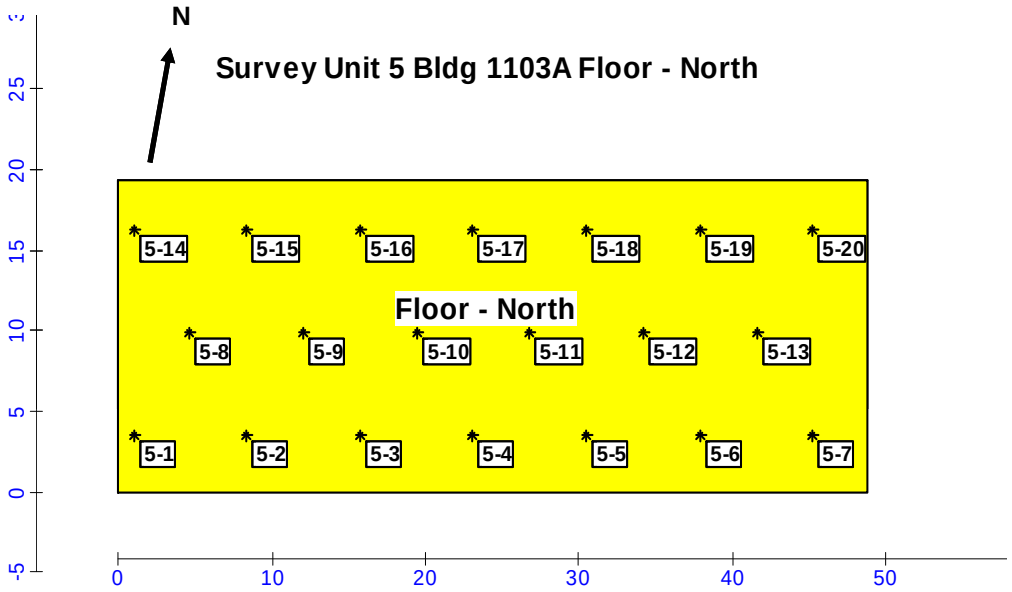
**APG Building 1103 A Project - FSS Outdoor Area Sampling & Measurement Locations**

| Measurement No. | Location | Dist. East (X Coord. ft.) | Dist North (Y Coord. ft.) |
|---|---|---|---|
| 4 -1 | Ground | 20.2 | 55.6 |
| 4 -2 | Ground | 1.6 | 87.9 |
| 4 -3 | Ground | 20.2 | 120.2 |
| 4 -4 | Ground | 1.6 | 152.4 |
| 4 -5 | Ground | 20.2 | 184.7 |
| 4 -6 | Ground | 1.6 | 217.0 |
| 4 -7 | Ground | 20.2 | 249.2 |
| 4 -8 | Ground | 1.6 | 281.5 |
| 4 -9 | Ground | 24.6 | 311.0 |
| 4 -10 | Ground | 61.9 | 311.0 |
| 4 -11 | Ground | 99.2 | 311.0 |
| 4 -12 | Ground | 10.9 | 10.3 |
| 4 -13 | Ground | 48.1 | 10.3 |
| 4 -14 | Ground | 85.4 | 10.3 |



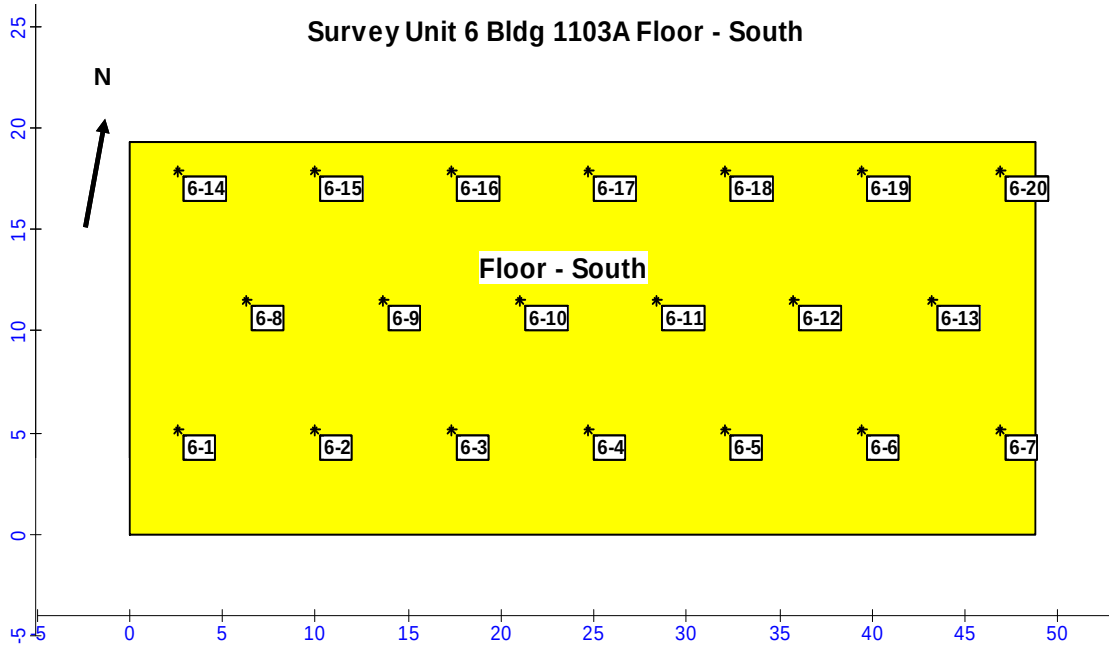
**APG Building 1103A - FSS Fixed Alpha Measurement Locations**

| Measurement No. | Location | Dist. East (X Coord. ft.) | Dist North (Y Coord. ft.) | Dist up Wall (Z coord ft.) |
|---|---|---|---|---|
| 5-1 | Floor | 1 | 3.5 | n/a |
| 5-2 | Floor | 8.4 | 3.5 | n/a |
| 5-3 | Floor | 15.7 | 3.5 | n/a |
| 5-4 | Floor | 23.1 | 3.5 | n/a |
| 5-5 | Floor | 30.5 | 3.5 | n/a |
| 5-6 | Floor | 37.9 | 3.5 | n/a |
| 5-7 | Floor | 45.2 | 3.5 | n/a |
| 5-8 | Floor | 4.7 | 9.9 | n/a |
| 5-9 | Floor | 12 | 9.9 | n/a |
| 5-10 | Floor | 19.4 | 9.9 | n/a |
| 5-11 | Floor | 26.8 | 9.9 | n/a |
| 5-12 | Floor | 34.2 | 9.9 | n/a |
| 5-13 | Floor | 41.6 | 9.9 | n/a |
| 5-14 | Floor | 1 | 16.3 | n/a |
| 5-15 | Floor | 8.4 | 16.3 | n/a |
| 5-16 | Floor | 15.7 | 16.3 | n/a |
| 5-17 | Floor | 23.1 | 16.3 | n/a |
| 5-18 | Floor | 30.5 | 16.3 | n/a |
| 5-19 | Floor | 37.9 | 16.3 | n/a |
| 5-20 | Floor | 45.2 | 16.3 | n/a |



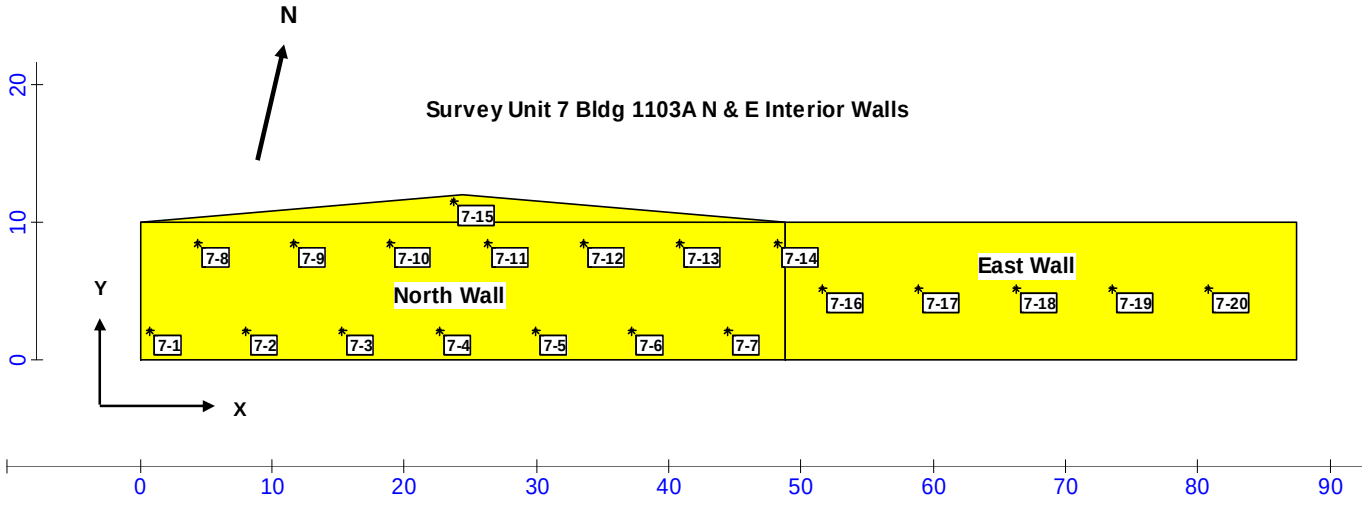
**APG Building 1103A - FSS Fixed Alpha Measurement Locations**

| Measurement No. | Location | Dist. East (X Coord. ft.) | Dist North (Y Coord. ft.) | Dist up Wall (Z coord ft.) |
|---|---|---|---|---|
| 6-1 | Floor | 2.6 | 5.1 | n/a |
| 6-2 | Floor | 10 | 5.1 | n/a |
| 6-3 | Floor | 17.3 | 5.1 | n/a |
| 6-4 | Floor | 24.7 | 5.1 | n/a |
| 6-5 | Floor | 32.1 | 5.1 | n/a |
| 6-6 | Floor | 39.5 | 5.1 | n/a |
| 6-7 | Floor | 46.8 | 5.1 | n/a |
| 6=8 | Floor | 6.3 | 11.5 | n/a |
| 6-9 | Floor | 13.6 | 11.5 | n/a |
| 6-10 | Floor | 21 | 11.5 | n/a |
| 6-11 | Floor | 28.4 | 11.5 | n/a |
| 6-12 | Floor | 35.8 | 11.5 | n/a |
| 6-13 | Floor | 43.2 | 11.5 | n/a |
| 6-14 | Floor | 2.6 | 17.9 | n/a |
| 6-15 | Floor | 10 | 17.9 | n/a |
| 6-16 | Floor | 17.3 | 17.9 | n/a |
| 6-17 | Floor | 24.7 | 17.9 | n/a |
| 6-18 | Floor | 32.1 | 17.9 | n/a |
| 6-19 | Floor | 39.5 | 17.9 | n/a |
| 6-20 | Floor | 46.8 | 17.9 | n/a |



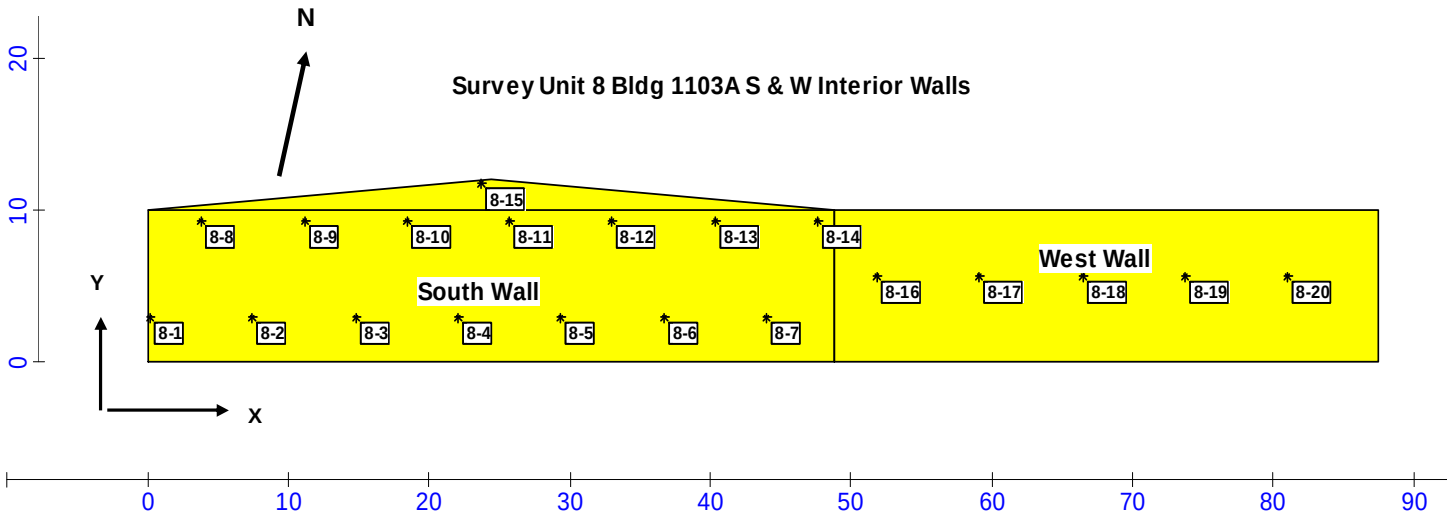
**APG Building 1103A - FSS Fixed Alpha Measurement Locations**

| Measurement No. | Location | Dist E X coord (ft) | Dist up Wall Y coord (ft) |
|---|---|---|---|
| 7-1 | N Wall | 0.7 | 2.2 |
| 7-2 | N Wall | 8 | 2.2 |
| 7-3 | N Wall | 15.3 | 2.2 |
| 7-4 | N Wall | 22.6 | 2.2 |
| 7-5 | N Wall | 29.9 | 2.2 |
| 7-6 | N Wall | 37.2 | 2.2 |
| 7-7 | N Wall | 44.5 | 2.2 |
| 7-8 | N Wall | 4.4 | 8.5 |
| 7-9 | N Wall | 11.7 | 8.5 |
| 7-10 | N Wall | 19 | 8.5 |
| 7-11 | N Wall | 26.3 | 8.5 |
| 7-12 | N Wall | 33.6 | 8.5 |
| 7-13 | N Wall | 40.9 | 8.5 |
| 7-14 | N Wall | 48.2 | 8.5 |
| 7-15 | N Wall | 23.8 | 11.6 |
| 7-16 | E Wall | 51.6 | 5.2 |
| 7-17 | E Wall | 58.9 | 5.2 |
| 7-18 | E Wall | 66.2 | 5.2 |
| 7-19 | E Wall | 73.5 | 5.2 |
| 7-20 | E Wall | 80.8 | 5.2 |



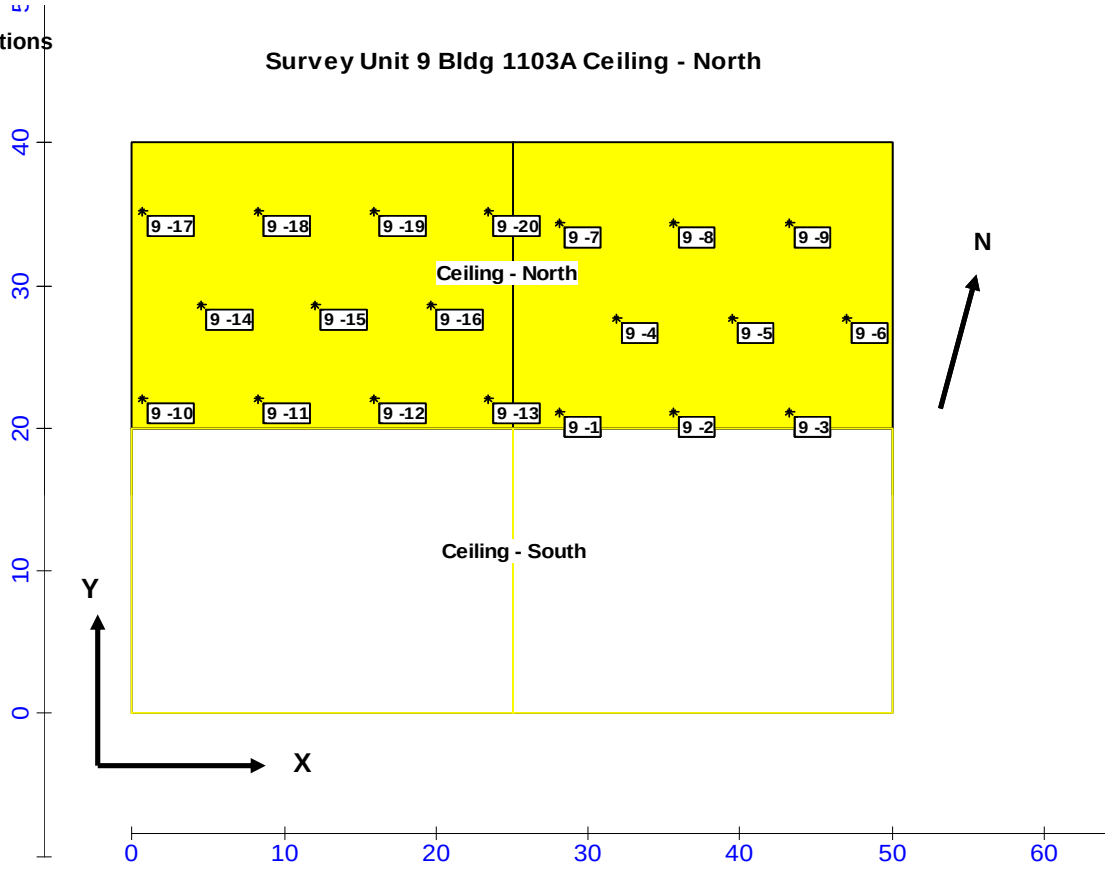
**APG Building 1103A - FSS Fixed Alpha Measurement Locations**

| Measurement No. | Location | Dist E X coord (ft) | Dist up Wall Y coord (ft) |
|---|---|---|---|
| 8-1 | S Wall | 0.2 | 2.9 |
| 8-2 | S Wall | 7.5 | 2.9 |
| 8-3 | S Wall | 14.8 | 2.9 |
| 8-4 | S Wall | 22.1 | 2.9 |
| 8-5 | S Wall | 29.4 | 2.9 |
| 8-6 | S Wall | 36.7 | 2.9 |
| 8-7 | S Wall | 44.0 | 2.9 |
| 8-8 | S Wall | 3.8 | 9.3 |
| 8-9 | S Wall | 11.1 | 9.3 |
| 8-10 | S Wall | 18.4 | 9.3 |
| 8-11 | S Wall | 25.7 | 9.3 |
| 8-12 | S Wall | 33.0 | 9.3 |
| 8-13 | S Wall | 40.3 | 9.3 |
| 8-14 | S Wall | 47.6 | 9.3 |
| 8-15 | S Wall | 23.7 | 11.8 |
| 8-16 | W Wall | 51.9 | 5.6 |
| 8-17 | W Wall | 59.2 | 5.6 |
| 8-18 | W Wall | 66.5 | 5.6 |
| 8-19 | W Wall | 73.8 | 5.6 |
| 8-20 | W Wall | 81.1 | 5.6 |



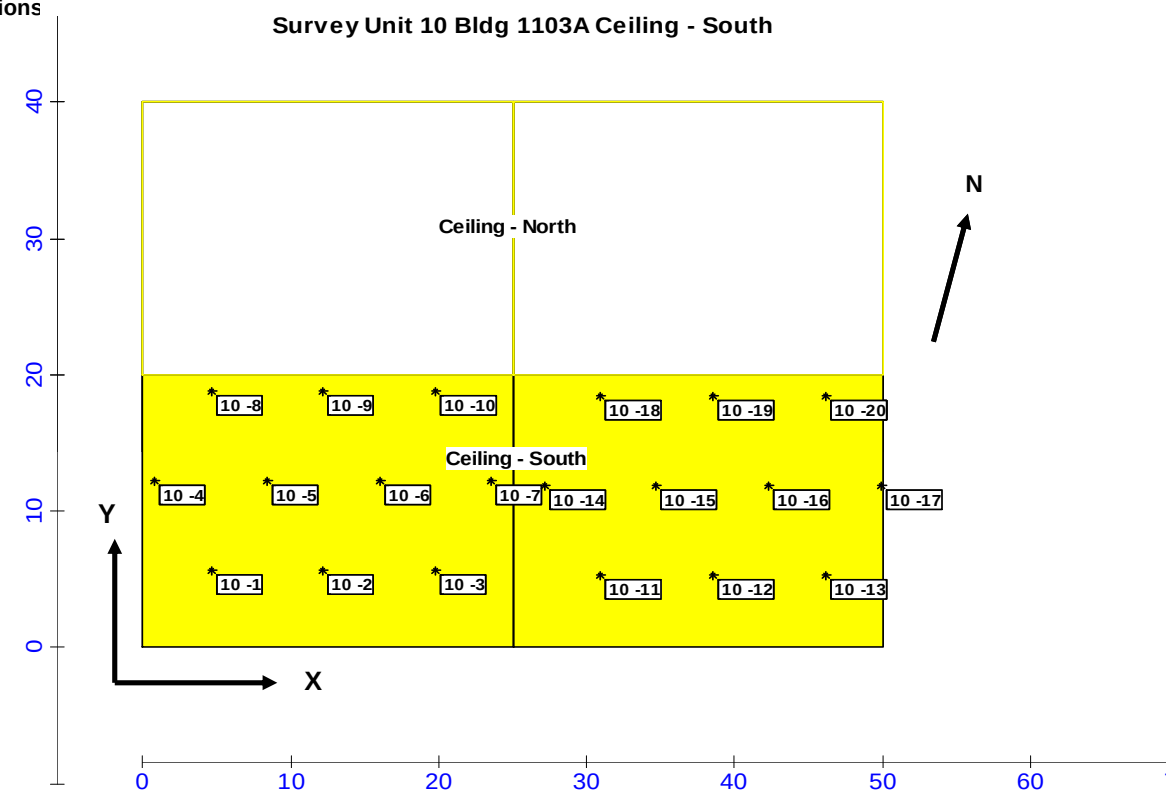
**APG Building 1103A - FSS Fixed Alpha Measurement Locations**

| Measurement No. | Location | Dist. East (X Coord. ft.) | Dist North (Y Coord. ft.) |
|---|---|---|---|
| 9 -1 | Ceiling | 28.0 | 21.2 |
| 9 -2 | Ceiling | 35.6 | 21.2 |
| 9 -3 | Ceiling | 43.2 | 21.2 |
| 9 -4 | Ceiling | 31.8 | 27.8 |
| 9 -5 | Ceiling | 39.4 | 27.8 |
| 9 -6 | Ceiling | 47.0 | 27.8 |
| 9 -7 | Ceiling | 28.0 | 34.4 |
| 9 -8 | Ceiling | 35.6 | 34.4 |
| 9 -9 | Ceiling | 43.2 | 34.4 |
| 9 -10 | Ceiling | 0.7 | 22.1 |
| 9 -11 | Ceiling | 8.3 | 22.1 |
| 9 -12 | Ceiling | 15.9 | 22.1 |
| 9 -13 | Ceiling | 23.5 | 22.1 |
| 9 -14 | Ceiling | 4.5 | 28.7 |
| 9 -15 | Ceiling | 12.1 | 28.7 |
| 9 -16 | Ceiling | 19.7 | 28.7 |
| 9 -17 | Ceiling | 0.7 | 35.3 |
| 9 -18 | Ceiling | 8.3 | 35.3 |
| 9-19 | Ceiling | 15.9 | 35.3 |
| 9-20 | Ceiling | 23.5 | 35.3 |



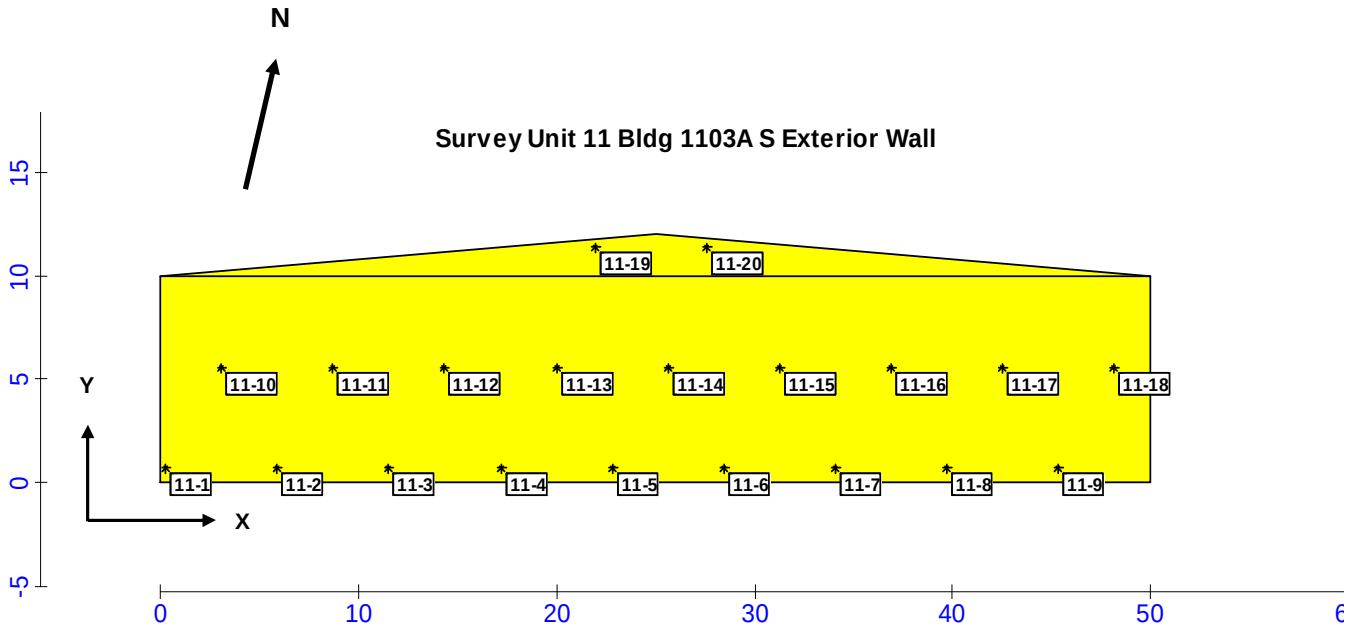
**APG Building 1103A - FSS Fixed Alpha Measurement Locations**

| Measurement No. | Location | Dist. East (X Coord. ft.) | Dist North (Y Coord. ft.) |
|---|---|---|---|
| 10 -1 | Ceiling | 4.6 | 5.7 |
| 10 -2 | Ceiling | 12.2 | 5.7 |
| 10 -3 | Ceiling | 19.8 | 5.7 |
| 10 -4 | Ceiling | 0.8 | 12.3 |
| 10 -5 | Ceiling | 8.4 | 12.3 |
| 10 -6 | Ceiling | 16.0 | 12.3 |
| 10 -7 | Ceiling | 23.6 | 12.3 |
| 10 -8 | Ceiling | 4.6 | 18.8 |
| 10 -9 | Ceiling | 12.2 | 18.8 |
| 10 -10 | Ceiling | 19.8 | 18.8 |
| 10 -11 | Ceiling | 30.9 | 5.3 |
| 10 -12 | Ceiling | 38.5 | 5.3 |
| 10 -13 | Ceiling | 46.1 | 5.3 |
| 10 -14 | Ceiling | 27.1 | 11.9 |
| 10 -15 | Ceiling | 34.7 | 11.9 |
| 10 -16 | Ceiling | 42.3 | 11.9 |
| 10 -17 | Ceiling | 49.9 | 11.9 |
| 10 -18 | Ceiling | 30.9 | 18.5 |
| 10 -19 | Ceiling | 38.5 | 18.5 |
| 10 -20 | Ceiling | 46.1 | 18.5 |



**APG Building 1103A - FSS Fixed Alpha Measurement Locations**

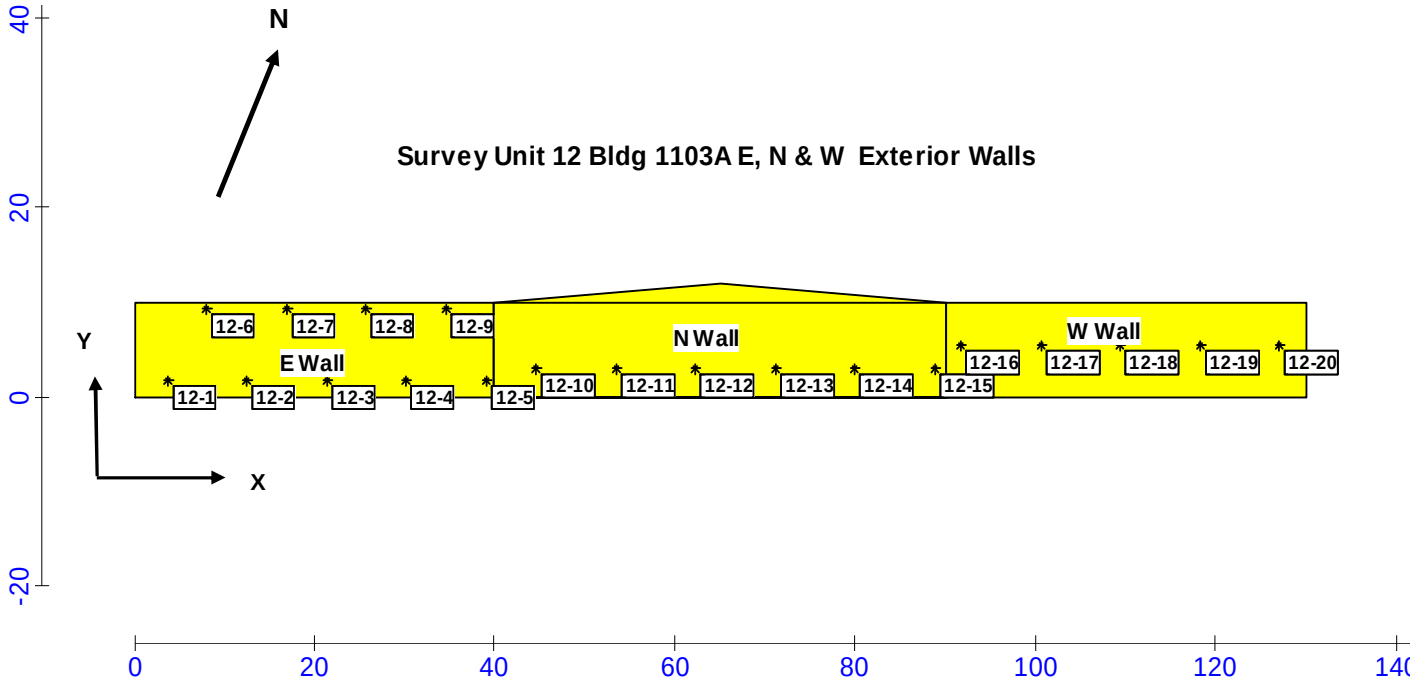
| Measurement No. | Location | Dist up Wall Y coord (ft) | DistEast X coord (ft) |
|---|---|---|---|
| 11-1 | S Wall | 0.7 | 0.3 |
| 11-2 | S Wall | 0.7 | 5.9 |
| 11-3 | S Wall | 0.7 | 11.5 |
| 11-4 | S Wall | 0.7 | 17.2 |
| 11-5 | S Wall | 0.7 | 22.8 |
| 11-6 | S Wall | 0.7 | 28.4 |
| 11-7 | S Wall | 0.7 | 34.1 |
| 11-8 | S Wall | 0.7 | 39.7 |
| 11-9 | S Wall | 0.7 | 45.3 |
| 11-10 | S Wall | 5.6 | 3.1 |
| 11-11 | S Wall | 5.6 | 8.7 |
| 11-12 | S Wall | 5.6 | 14.4 |
| 11-13 | S Wall | 5.6 | 20 |
| 11-14 | S Wall | 5.6 | 25.6 |
| 11-15 | S Wall | 5.6 | 31.3 |
| 11-16 | S Wall | 5.6 | 36.9 |
| 11-17 | S Wall | 5.6 | 42.5 |
| 11-18 | S Wall | 5.6 | 48.2 |
| 11-19 | S Wall | 11.4 | 21.9 |
| 11-20 | S Wall | 11.4 | 27.6 |




Area: Area 4

**APG Building 1103A - FSS Fixed Alpha Measurement Locations**

| Measurement No. | Location | Dist X coord (ft) | Dist up Wall Y coord (ft) |
|---|---|---|---|
| 12-1 | E Wall | 3.7 | 1.8 |
| 12-2 | E Wall | 12.5 | 1.8 |
| 12-3 | E Wall | 21.3 | 1.8 |
| 12-4 | E Wall | 30.2 | 1.8 |
| 12-5 | E Wall | 39.0 | 1.8 |
| 12-6 | E Wall | 8.1 | 9.4 |
| 12-7 | E Wall | 16.9 | 9.4 |
| 12-8 | E Wall | 25.8 | 9.4 |
| 12-9 | E Wall | 34.6 | 9.4 |
| 12-10 | N Wall | 44.6 | 3.0 |
| 12-11 | N Wall | 53.5 | 3.0 |
| 12-12 | N Wall | 62.3 | 3.0 |
| 12-13 | N Wall | 71.1 | 3.0 |
| 12-14 | N Wall | 79.9 | 3.0 |
| 12-15 | N Wall | 88.8 | 3.0 |
| 12-16 | W Wall | 91.7 | 5.5 |
| 12-17 | W Wall | 100.6 | 5.5 |
| 12-18 | W Wall | 109.4 | 5.5 |
| 12-19 | W Wall | 118.2 | 5.5 |
| 12-20 | W Wall | 127.1 | 5.5 |



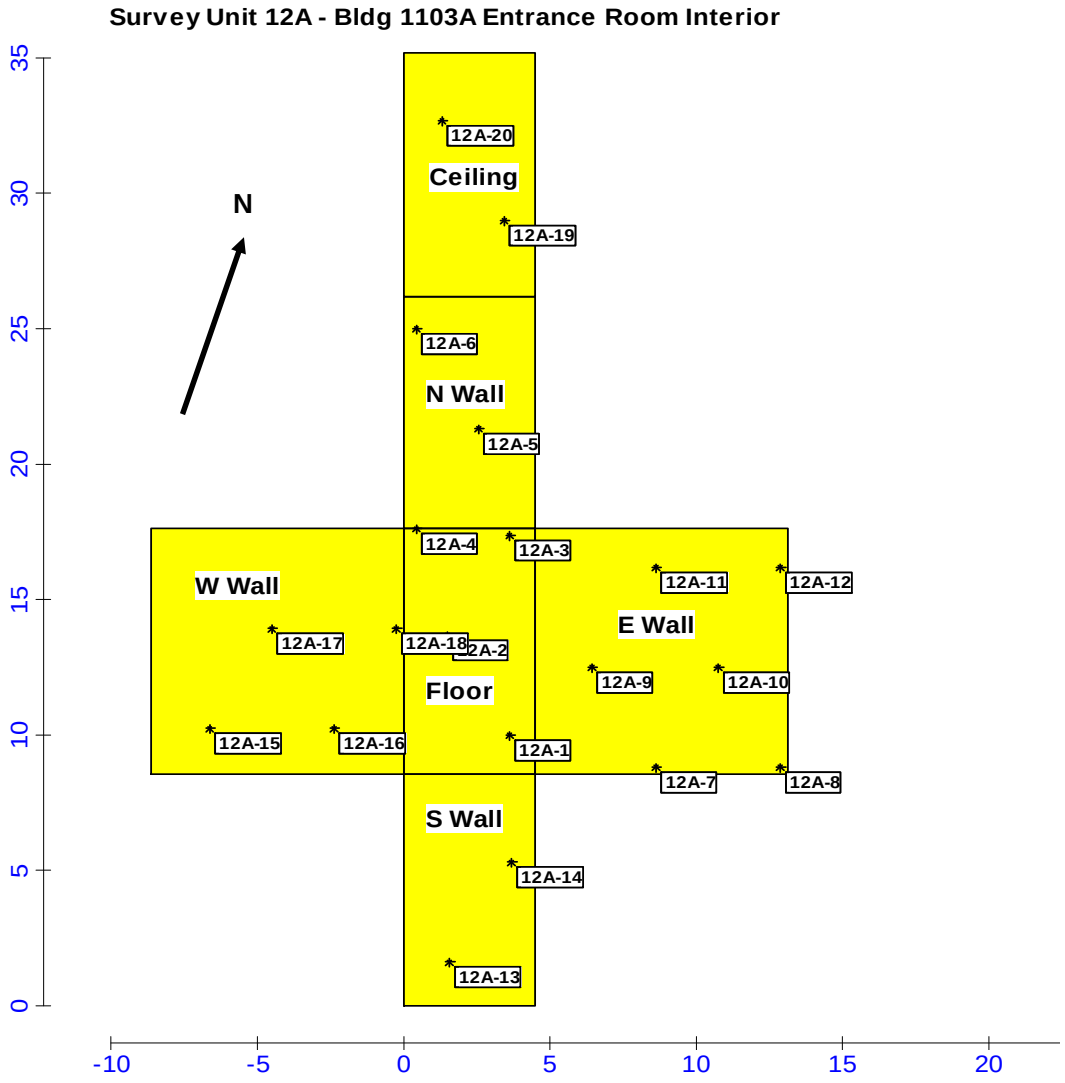

Area: Area 6

| X Coord | Y Coord | Label | Value | Type | Historical |
|---|---|---|---|---|---|
| 3.7 | 1.8 | 12-1 | | Syste | |
| 12.5 | 1.8 | 12-2 | | Syste | |

**FSS Fixed Alpha Measurement Locations**

| Measurement No. | Location | 2D X Coord. (ft) | 2 D Y Coord. (ft) | 3D Dist E X coord (ft) | 3D Dist N Y coord (ft) | 3D Dist Height Z coord (ft) |
|---|---|---|---|---|---|---|
| 12A-1 | Floor | 3.6 | 10.0 | 3.6 | 10.0 | 0.0 |
| 12A-2 | Floor | 1.5 | 13.7 | 1.5 | 13.7 | 0.0 |
| 12A-3 | Floor | 3.6 | 17.4 | 3.6 | 17.4 | 0.0 |
| 12A-4 | N Wall | 0.5 | 17.6 | 0.5 | 17.6 | 0.0 |
| 12A-5 | N Wall | 2.6 | 21.3 | 2.6 | 17.6 | 3.7 |
| 12A-6 | N Wall | 0.5 | 25.0 | 0.5 | 17.6 | 7.4 |
| 12A-7 | E Wall | 8.6 | 8.9 | 4.5 | 0.3 | 4.1 |
| 12A-8 | E Wall | 12.8 | 8.9 | 4.5 | 0.3 | 8.3 |
| 12A-9 | E Wall | 6.5 | 12.5 | 4.5 | 3.9 | 2.0 |
| 12A-10 | E Wall | 10.7 | 12.5 | 4.5 | 3.9 | 6.2 |
| 12A-11 | E Wall | 8.6 | 16.2 | 4.5 | 7.6 | 4.1 |
| 12A-12 | E Wall | 12.8 | 16.2 | 4.5 | 7.6 | 8.3 |
| 12A-13 | S Wall | 1.5 | 1.6 | 1.5 | 0.0 | 1.6 |
| 12A-14 | S Wall | 3.7 | 5.3 | 3.7 | 0.0 | 5.3 |
| 12A-15 | W Wall | -6.6 | 10.3 | 0.0 | 1.7 | 2.0 |
| 12A-16 | W Wall | -2.4 | 10.3 | 0.0 | 1.7 | 6.2 |
| 12A-17 | W Wall | -4.5 | 13.9 | 0.0 | 5.3 | 4.1 |
| 12A-18 | W Wall | -0.2 | 13.9 | 0.0 | 5.3 | 8.4 |
| 12A-19 | Ceiling | 3.5 | 29.0 | 3.5 | 2.8 | 8.6 |
| 12A-20 | Ceiling | 1.3 | 32.7 | 1.3 | 6.5 | 8.6 |

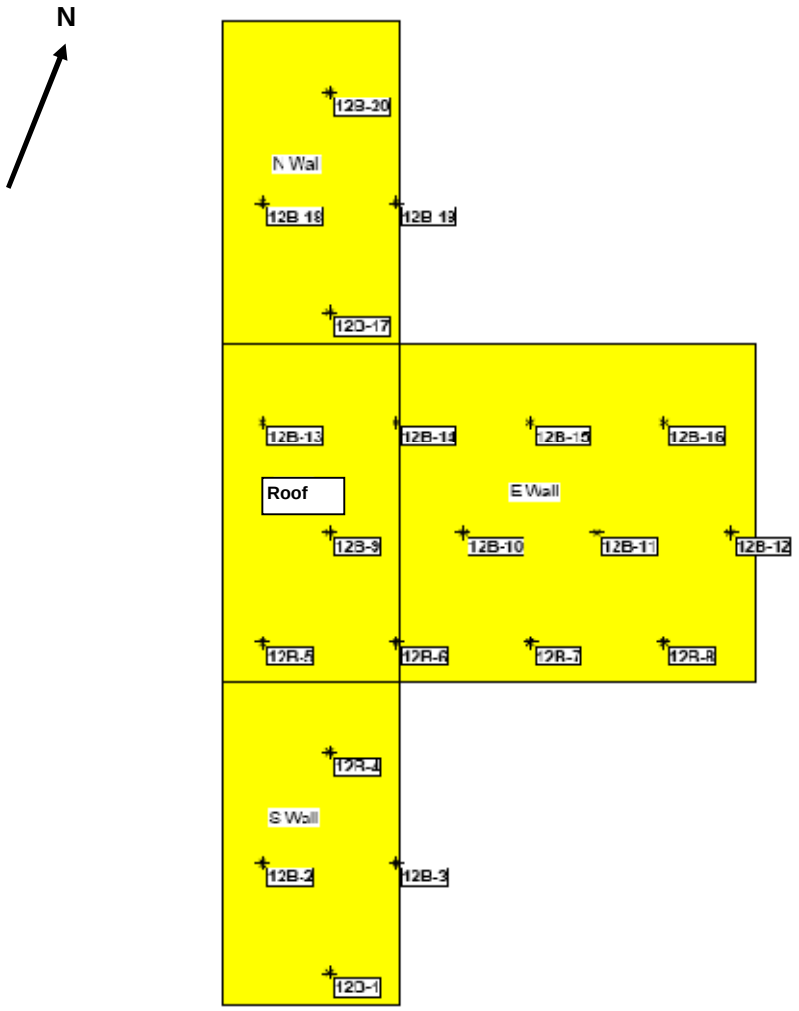
| Translation Rules From 2D to 3D Coordinates for Survey Unit 12A | | | |
|---|---|---|---|
| Translation Rules from 2D to 3D Coordinates | | | |
| **Surface** | **3D X** | **3D Y** | **3D Z** |
| Floor | 2DX | 2DY | 0 |
| N. Wall | 2DX | 17.6 | 2DY-17.6 |
| E. Wall | 4.5 | 2DY-8.6 | 2DX-4.5 |
| S. Wall | 2DX | 0 | 2DY |
| W. Wall | 0 | 2DY-8.6 | 8.6+2DX |
| Ceiling | 2DX | 2DY-26.2 | 8.6 |



**- FSS Fixed Alpha Measurement Locatior**

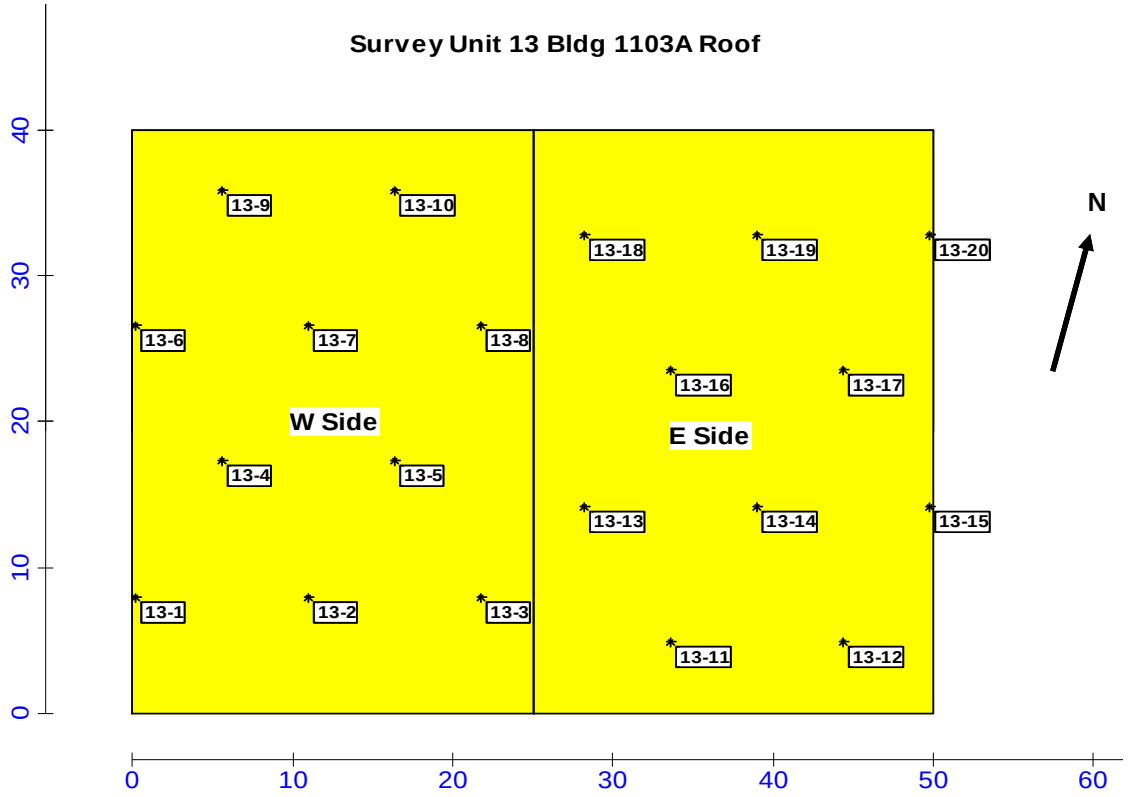
| Measurement No. | Location | Dist. North | Dist. East | Dist. Up Wall |
|---|---|---|---|---|
| 12B-1 | S Wall | x | 2.7 | 0.8 |
| 12B-2 | S Wall | x | 1.0 | 3.8 |
| 12B-3 | S Wall | x | 4.4 | 3.8 |
| 12B-4 | S Wall | x | 2.7 | 6.7 |
| 12B-5 | Roof | 1.0 | 1.0 | x |
| 12B-6 | Roof | 1.0 | 4.4 | x |
| 12B-7 | E Wall | 1.0 | x | 5.7 |
| 12B-8 | E Wall | 1.0 | x | 2.3 |
| 12B-9 | Roof | 4.0 | 2.7 | x |
| 12B-10 | E Wall | 4.0 | x | 7.0 |
| 12B-11 | E Wall | 4.0 | x | 3.6 |
| 12B-12 | E Wall | 4.0 | x | 0.2 |
| 12B-13 | Roof | 6.9 | 1.0 | x |
| 12B-14 | Roof | 6.9 | 4.4 | x |
| 12B-15 | E Wall | 6.9 | x | 5.3 |
| 12B-16 | E Wall | 6.9 | x | 1.9 |
| 12B-17 | N Wall | x | 2.7 | 7.8 |
| 12B-18 | N Wall | x | 1.0 | 4.8 |
| 12B-19 | N Wall | x | 4.4 | 4.8 |
| 12B-20 | N Wall | x | 2.7 | 1.9 |

**Survey Unit 12B Entry Room Exterior (1103A)**



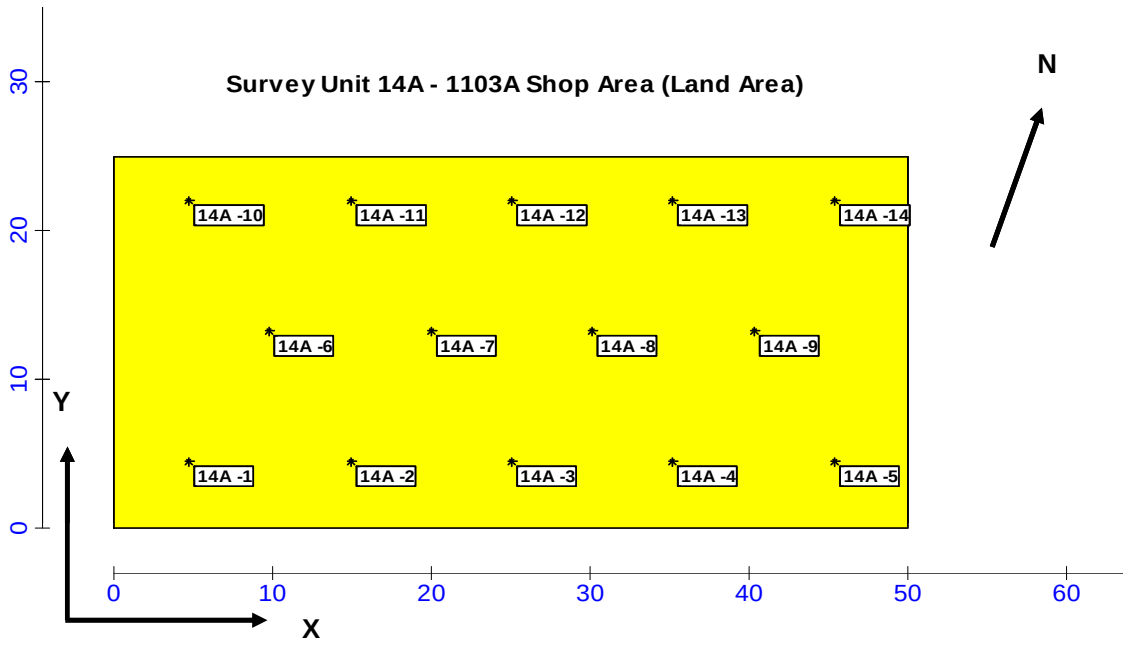
**APG Building 1103A - FSS Fixed Alpha Measurement Locations**

| Measurement No. | Location | Dist. East (X Coord. ft.) | Dist North (Y Coord. ft.) | Dist up Wall (Z coord ft.) |
|---|---|---|---|---|
| 13-1 | Roof | 0.3 | 8 | n/a |
| 13-2 | Roof | 11 | 8 | n/a |
| 13-3 | Roof | 21.8 | 8 | n/a |
| 13-4 | Roof | 5.6 | 17.3 | n/a |
| 13-5 | Roof | 16.4 | 17.3 | n/a |
| 13-6 | Roof | 0.3 | 26.6 | n/a |
| 13-7 | Roof | 11 | 26.6 | n/a |
| 13-8 | Roof | 21.8 | 26.6 | n/a |
| 13-9 | Roof | 5.6 | 35.9 | n/a |
| 13-10 | Roof | 16.4 | 35.9 | n/a |
| 13-11 | Roof | 33.6 | 4.9 | n/a |
| 13-12 | Roof | 44.4 | 4.9 | n/a |
| 13-13 | Roof | 28.2 | 14.2 | n/a |
| 13-14 | Roof | 39 | 14.2 | n/a |
| 13-15 | Roof | 49.7 | 14.2 | n/a |
| 13-16 | Roof | 33.6 | 23.5 | n/a |
| 13-17 | Roof | 44.4 | 23.5 | n/a |
| 13-18 | Roof | 28.2 | 32.8 | n/a |
| 13-19 | Roof | 39 | 32.8 | n/a |
| 13-20 | Roof | 49.7 | 32.8 | n/a |



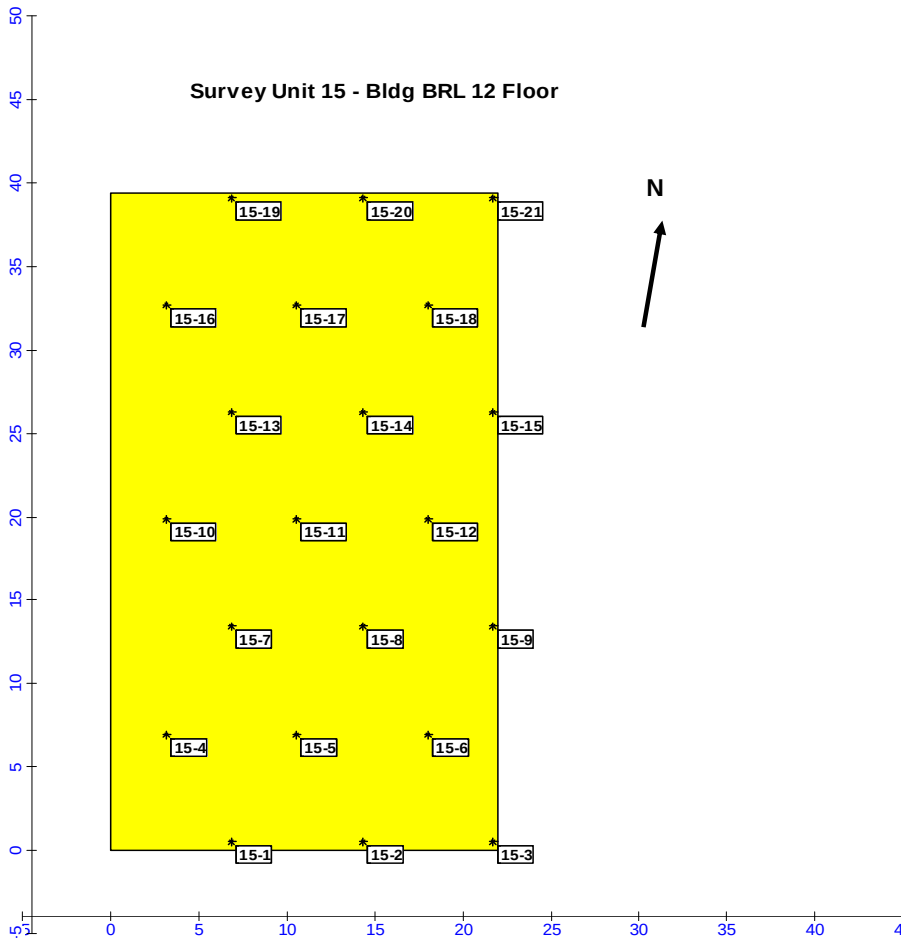
**APG Building 1103 A Project - FSS Outdoor Area Sampling & Measurement Locations**

| Measurement No. | Location | Dist. East (X Coord. ft.) | Dist North (Y Coord. ft.) |
|---|---|---|---|
| 14A -1 | Ground | 4.8 | 4.5 |
| 14A -2 | Ground | 14.9 | 4.5 |
| 14A -3 | Ground | 25.1 | 4.5 |
| 14A -4 | Ground | 35.2 | 4.5 |
| 14A -5 | Ground | 45.4 | 4.5 |
| 14A -6 | Ground | 9.9 | 13.3 |
| 14A -7 | Ground | 20 | 13.3 |
| 14A -8 | Ground | 30.2 | 13.3 |
| 14A -9 | Ground | 40.3 | 13.3 |
| 14A -10 | Ground | 4.8 | 22.1 |
| 14A -11 | Ground | 14.9 | 22.1 |
| 14A -12 | Ground | 25.1 | 22.1 |
| 14A -13 | Ground | 35.2 | 22.1 |
| 14A -14 | Ground | 45.4 | 22.1 |



**APG Building BRL12 - FSS Fixed Alpha Measurement Locations**

| Measurement No. | Location | Dist. East (X Coord. ft.) | Dist North (Y Coord. ft.) | Dist up Wall (Z coord ft.) |
|---|---|---|---|---|
| 15-1 | Floor | 6.8 | 0.6 | n/a |
| 15-2 | Floor | 14.3 | 0.6 | n/a |
| 15-3 | Floor | 21.7 | 0.6 | n/a |
| 15-4 | Floor | 3.1 | 7 | n/a |
| 15-5 | Floor | 10.6 | 7 | n/a |
| 15-6 | Floor | 18 | 7 | n/a |
| 15-7 | Floor | 6.8 | 13.4 | n/a |
| 15-8 | Floor | 14.3 | 13.4 | n/a |
| 15-9 | Floor | 21.7 | 13.4 | n/a |
| 15-10 | Floor | 3.1 | 19.9 | n/a |
| 15-11 | Floor | 10.6 | 19.9 | n/a |
| 15-12 | Floor | 18 | 19.9 | n/a |
| 15-13 | Floor | 6.8 | 26.3 | n/a |
| 15-14 | Floor | 14.3 | 26.3 | n/a |
| 15-15 | Floor | 21.7 | 26.3 | n/a |
| 15-16 | Floor | 3.1 | 32.7 | n/a |
| 15-17 | Floor | 10.6 | 32.7 | n/a |
| 15-18 | Floor | 18 | 32.7 | n/a |
| 15-19 | Floor | 6.8 | 39.2 | n/a |
| 15-20 | Floor | 14.3 | 39.2 | n/a |
| 15-21 | Floor | 21.7 | 39.2 | n/a |

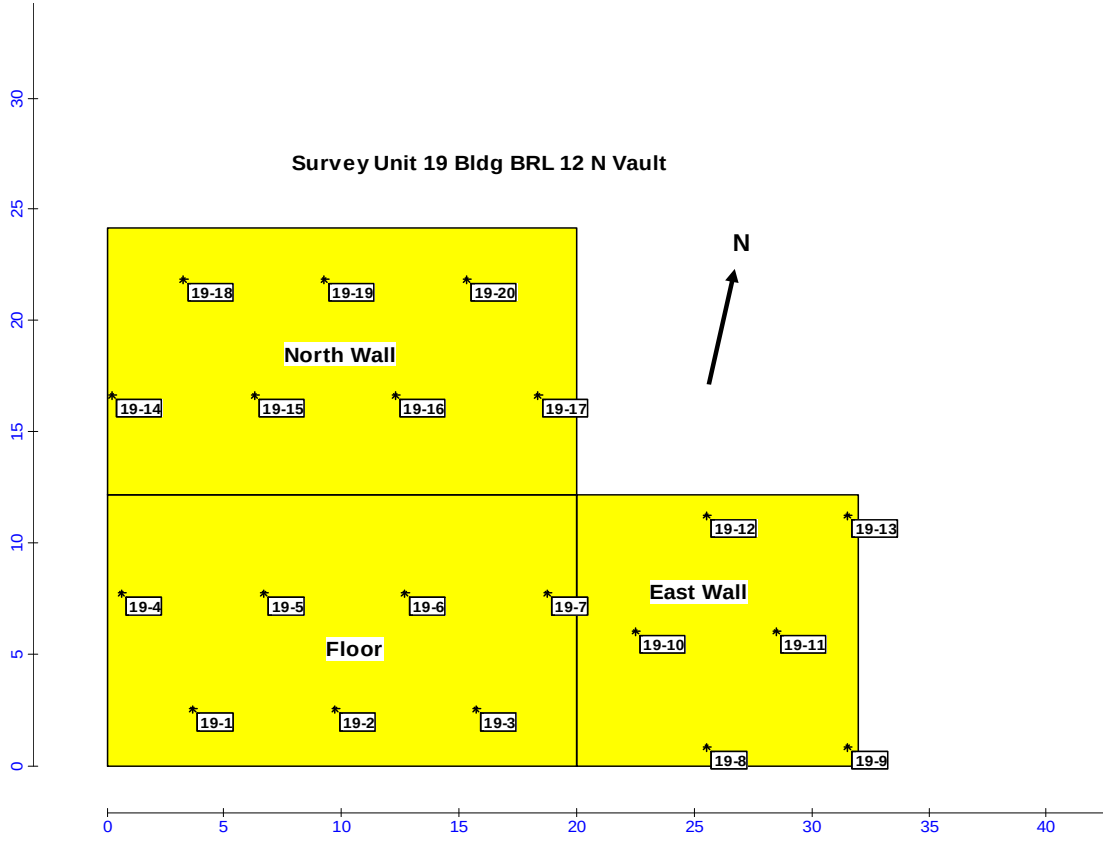


**APG Building BRL12, N Vault - FSS Fixed Alpha Measurement Locations**

| Measurement No. | Location | 2D X Coord. (ft) | 2 D Y Coord. (ft) | 3D Dist E X coord (ft) | 3D Dist N Y coord (ft) | 3D Dist up Wall Z coord (ft) |
|---|---|---|---|---|---|---|
| 19-1 | Floor | 3.7 | 2.5 | 3.7 | 2.5 | 0 |
| 19-2 | Floor | 9.7 | 2.5 | 9.7 | 2.5 | 0 |
| 19-3 | Floor | 15.7 | 2.5 | 15.7 | 2.5 | 0 |
| 19-4 | Floor | 0.7 | 7.8 | 0.7 | 7.8 | 0 |
| 19-5 | Floor | 6.7 | 7.8 | 6.7 | 7.8 | 0 |
| 19-6 | Floor | 12.7 | 7.8 | 12.7 | 7.8 | 0 |
| 19-7 | Floor | 18.7 | 7.8 | 18.7 | 7.8 | 0 |
| 19-8 | E Wall | 25.5 | 0.8 | 20 | 0.8 | 5.5 |
| 19-9 | E Wall | 31.6 | 0.8 | 20 | 0.8 | 11.6 |
| 19-10 | E Wall | 22.5 | 6 | 20 | 6 | 2.5 |
| 19-11 | E Wall | 28.5 | 6 | 20 | 6 | 8.5 |
| 19-12 | E Wall | 25.5 | 11.3 | 20 | 11.3 | 5.5 |
| 19-13 | E Wall | 31.6 | 11.3 | 20 | 11.3 | 11.6 |
| 19-14 | N Wall | 0.2 | 16.6 | 0.2 | 12.2 | 4.4 |
| 19-15 | N Wall | 6.3 | 16.6 | 6.3 | 12.2 | 4.4 |
| 19-16 | N Wall | 12.3 | 16.6 | 12.3 | 12.2 | 4.4 |
| 19-17 | N Wall | 18.3 | 16.6 | 18.3 | 12.2 | 4.4 |
| 19-18 | N Wall | 3.2 | 21.9 | 3.2 | 12.2 | 9.7 |
| 19-19 | N Wall | 9.3 | 21.9 | 9.3 | 12.2 | 9.7 |
| 19-20 | N Wall | 15.3 | 21.9 | 15.3 | 12.2 | 9.7 |

Translation Rules From 2D to 3D Coordinates for Survey Unit 19

| Surface | 3D X | 3D Y | 3D Z |
|---|---|---|---|
| Floor | 2DX | 2DY | 0 |
| E Wall | 20 | 2DY | 2DX-20 |
| N Wall | 2DX | 12.2 | 2DY-12.2 |

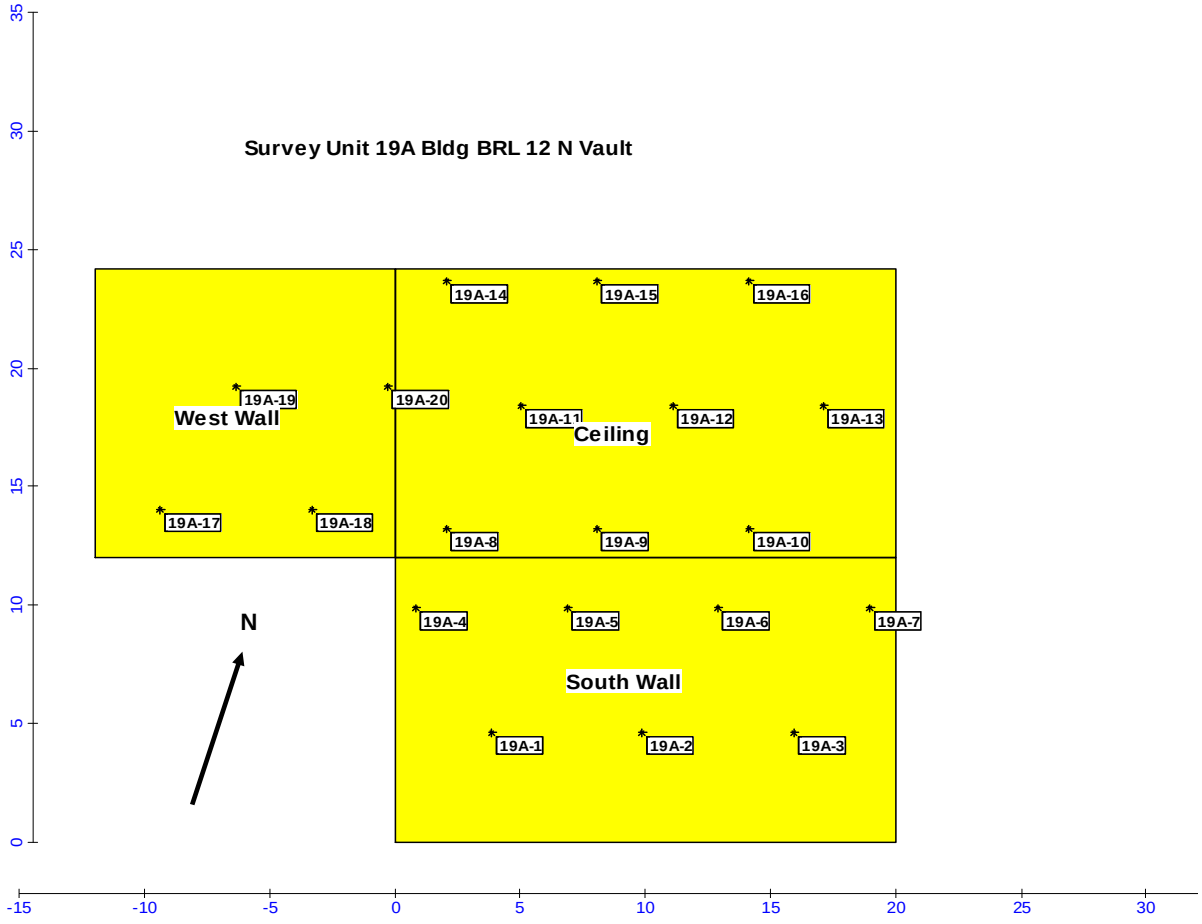


**FSS Fixed Alpha Measurement Locations**

| Measurement No. | Location | 2D X Coord. (ft) | 2 D Y Coord. (ft) | 3D Dist E X coord (ft) | 3D Dist N Y coord (ft) | 3D Dist Height Z coord (ft) |
|---|---|---|---|---|---|---|
| 19A-1 | S Wall | 3.9 | 4.6 | 3.9 | 0 | 4.6 |
| 19A-2 | S Wall | 9.9 | 4.6 | 9.9 | 0 | 4.6 |
| 19A-3 | S Wall | 15.9 | 4.6 | 15.9 | 0 | 4.6 |
| 19A-4 | S Wall | 0.8 | 9.9 | 0.8 | 0 | 9.9 |
| 19A-5 | S Wall | 6.9 | 9.9 | 6.9 | 0 | 9.9 |
| 19A-6 | S Wall | 12.9 | 9.9 | 12.9 | 0 | 9.9 |
| 19A-7 | S Wall | 18.9 | 9.9 | 18.9 | 0 | 9.9 |
| 19A-8 | Ceiling | 2 | 13.2 | 2 | 1.2 | 12 |
| 19A-9 | Ceiling | 8.1 | 13.2 | 8.1 | 1.2 | 12 |
| 19A-10 | Ceiling | 14.1 | 13.2 | 14.1 | 1.2 | 12 |
| 19A-11 | Ceiling | 5.1 | 18.5 | 5.1 | 6.5 | 12 |
| 19A-12 | Ceiling | 11.1 | 18.5 | 11.1 | 6.5 | 12 |
| 19A-13 | Ceiling | 17.1 | 18.5 | 17.1 | 6.5 | 12 |
| 19A-14 | Ceiling | 2 | 23.7 | 2 | 11.7 | 12 |
| 19A-15 | Ceiling | 8.1 | 23.7 | 8.1 | 11.7 | 12 |
| 19A-16 | Ceiling | 14.1 | 23.7 | 14.1 | 11.7 | 12 |
| 19A-17 | W Wall | -9.4 | 14 | 0 | 2 | 2.6 |
| 19A-18 | W Wall | -3.3 | 14 | 0 | 2 | 8.7 |
| 19A-19 | W Wall | -6.3 | 19.2 | 0 | 7.2 | 5.7 |
| 19A-20 | W Wall | -0.3 | 19.2 | 0 | 7.2 | 11.7 |

Translation Rules From 2D to 3D Coordinates for Survey Unit 19A

| Surface | 3D X | 3D Y | 3D Z |
|---|---|---|---|
| S Wall | 2DX | 0 | 2DY |
| Ceiling | 2DX | 2DY-12 | 12 |
| W Wall | 0 | 2DY-12 | 12+2Dx |

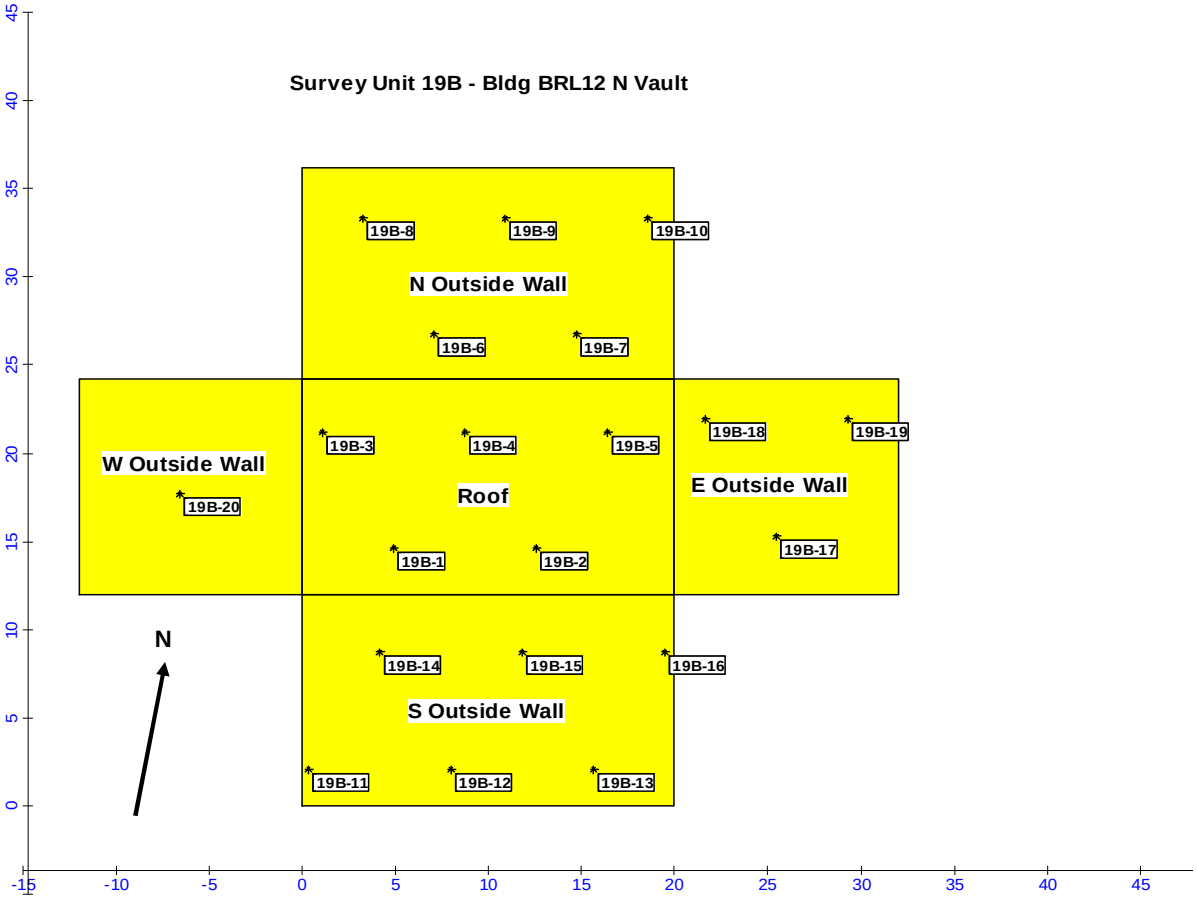


**FSS Fixed Alpha Measurement Locations**

| Measurement No. | Location | 2D X Coord. (ft) | 2 D Y Coord. (ft) | 3D Dist E X coord (ft) | 3D Dist N Y coord (ft) | 3D Dist Height Z coord (ft) |
|---|---|---|---|---|---|---|
| 19B-1 | Roof | 6 | 27.3 | 6 | 15.3 | 12 |
| 19B-2 | Roof | 15.4 | 27.3 | 15.4 | 15.3 | 12 |
| 19B-3 | Roof | 9.1 | 33.4 | 9.1 | 21.4 | 12 |
| 19B-4 | Roof | 18.5 | 33.4 | 18.5 | 21.4 | 12 |
| 19B-5 | Roof | 4.4 | 41.5 | 4.4 | 29.5 | 12 |
| 19B-6 | N Wall | 7.1 | 26.8 | 7.1 | 12.2 | 9.4 |
| 19B-7 | N Wall | 14.7 | 26.8 | 14.7 | 12.2 | 9.4 |
| 19B-8 | N Wall | 3.2 | 33.4 | 3.2 | 12.2 | 2.8 |
| 19B-9 | N Wall | 10.9 | 33.4 | 10.9 | 12.2 | 2.8 |
| 19B-10 | N Wall | 18.6 | 33.4 | 18.6 | 12.2 | 2.8 |
| 19B-11 | S Wall | 0.3 | 2.1 | 0.3 | 0 | 2.1 |
| 19B-12 | S Wall | 8 | 2.1 | 8 | 0 | 2.1 |
| 19B-13 | S Wall | 15.7 | 2.1 | 15.7 | 0 | 2.1 |
| 19B-14 | S Wall | 4.2 | 8.7 | 4.2 | 0 | 8.7 |
| 19B-15 | S Wall | 11.8 | 8.7 | 11.8 | 0 | 8.7 |
| 19B-16 | S Wall | 19.5 | 8.7 | 19.5 | 0 | 8.7 |
| 19B-17 | E Wall | 25.5 | 15.3 | 20 | 3.3 | 6.5 |
| 19B-18 | E Wall | 21.7 | 22 | 20 | 10 | 10.3 |
| 19B-19 | E Wall | 29.3 | 22 | 20 | 10 | 2.7 |
| 19B-20 | W Wall | -6.6 | 17.7 | 0 | 5.7 | 5.4 |

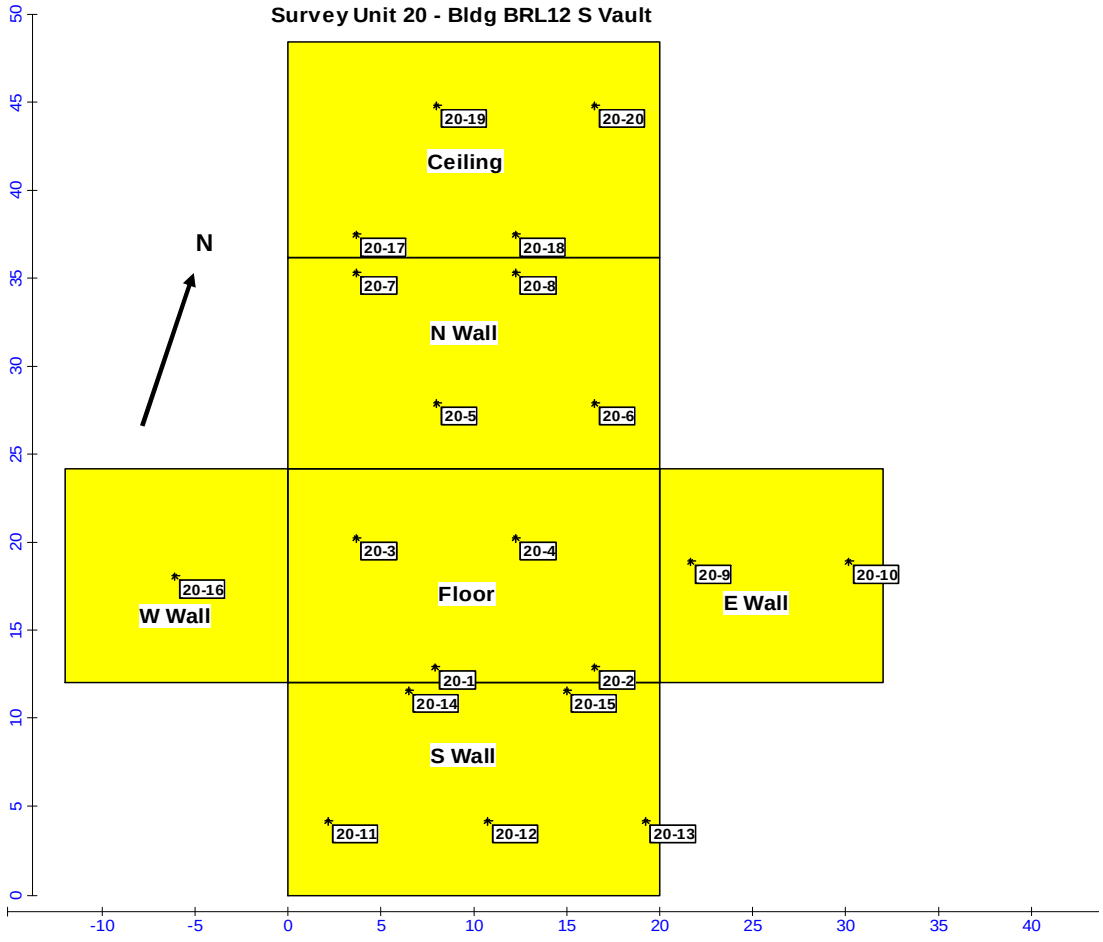
Translation Rules From 2D to 3D Coordinates for Survey Unit 19B

| Translation Rules from 2D to 3D Coordinates | | | |
|---|---|---|---|
| **Surface** | **3D X** | **3D Y** | **3D Z** |
| Roof | 2DX | 2DY-12 | 12 |
| N. Wall | 2DX | 12.2 | 36.2-2DY |
| S. Wall | 2DX | 0 | 2DY |



**FSS Fixed Alpha Measurement Locations**

| Measurement No. | Location | 2D X Coord. (ft) | 2 D Y Coord. (ft) | 3D Dist E X coord (ft) | 3D Dist N Y coord (ft) | 3D Dist Height Z coord (ft) |
|---|---|---|---|---|---|---|
| 20-1 | Floor | 8 | 12.9 | 8 | 12.9 | 0 |
| 20-2 | Floor | 16.5 | 12.9 | 16.5 | 12.9 | 0 |
| 20-3 | Floor | 3.7 | 20.3 | 3.7 | 20.3 | 0 |
| 20-4 | Floor | 12.2 | 20.3 | 12.2 | 20.3 | 0 |
| 20-5 | N Wall | 8 | 27.9 | 8 | 12.2 | 8.3 |
| 20-6 | N Wall | 16.5 | 27.9 | 16.5 | 12.2 | 8.3 |
| 20-7 | N Wall | 3.7 | 35.3 | 3.7 | 12.2 | 0.9 |
| 20-8 | N Wall | 12.3 | 35.3 | 12.3 | 12.2 | 0.9 |
| 20-9 | E Wall | 21.6 | 19 | 20 | 7 | 10.6 |
| 20-10 | E Wall | 30.2 | 19 | 20 | 7 | 2 |
| 20-11 | S Wall | 2.2 | 4.2 | 2.2 | 0 | 4.2 |
| 20-12 | S Wall | 10.7 | 4.2 | 10.7 | 0 | 4.2 |
| 20-13 | S Wall | 19.3 | 4.2 | 19.3 | 0 | 4.2 |
| 20-14 | S Wall | 6.5 | 11.6 | 6.5 | 0 | 11.6 |
| 20-15 | S Wall | 15 | 11.6 | 15 | 0 | 11.6 |
| 20-16 | W Wall | -6 | 18.1 | 0 | 6.1 | 6 |
| 20-17 | Ceiling | 3.7 | 37.5 | 3.7 | 10.9 | 12 |
| 20-18 | Ceiling | 12.2 | 37.5 | 12.2 | 10.9 | 12 |
| 20-19 | Ceiling | 8 | 44.9 | 8 | 3.5 | 12 |
| 20-20 | Ceiling | 16.5 | 44.9 | 16.5 | 3.5 | 12 |




Translation Rules From 2D to 3D Coordinates for Survey Unit 19B

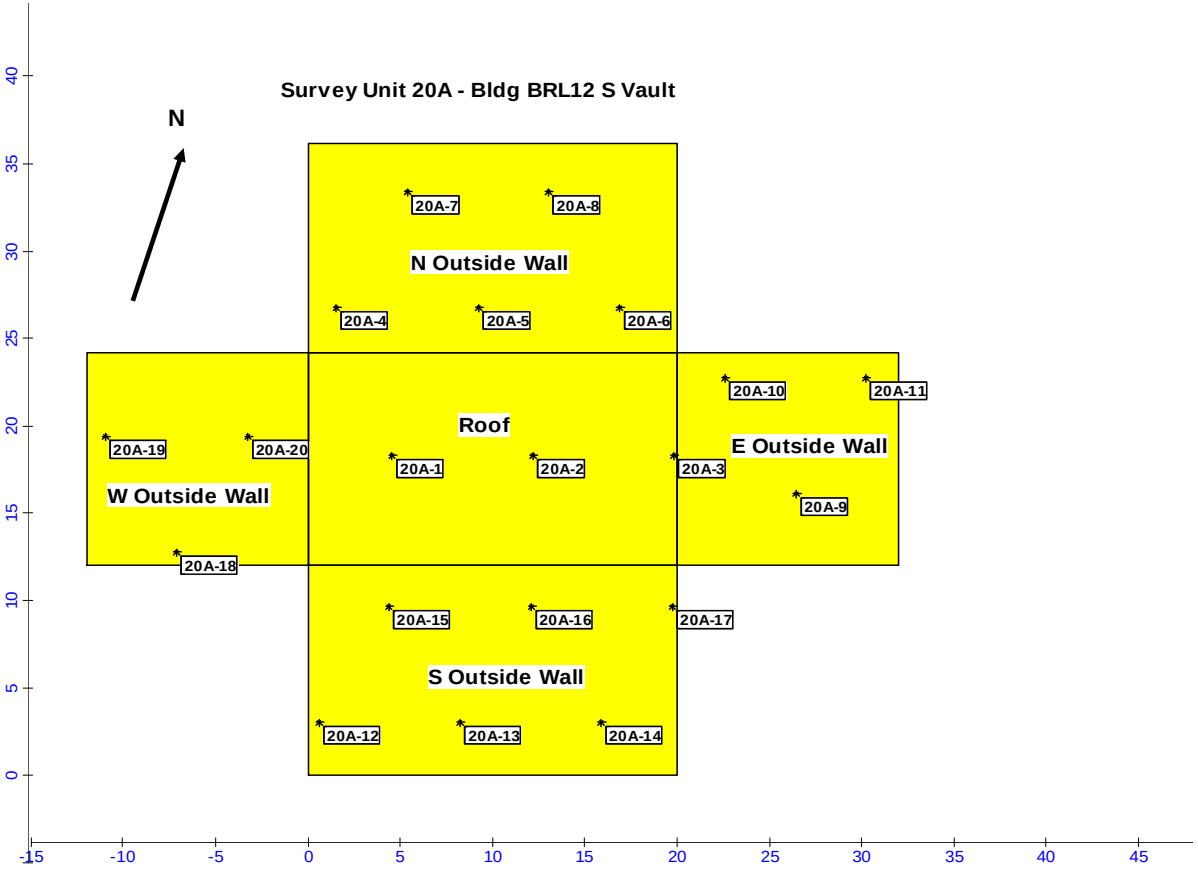
| Translation Rules from 2D to 3D Coordinates | | | |
|---|---|---|---|
| **Surface** | **3D X** | **3D Y** | **3D Z** |
| Floor | 2DX | 2DY | 0 |
| N. Wall | 2DX | 12.2 | 36.2-2DY |
| E. Wall | 20 | 2DY-12 | 32-2-DX |
| S. Wall | 2DX | 0 | 2DY |
| W. Wall | 0 | 2DY-12 | 12+2DX |
| Ceiling | 2DX | 48.4-2DY | 12 |

**FSS Fixed Alpha Measurement Locations**

| Measurement No. | Location | 2D X Coord. (ft) | 2 D Y Coord. (ft) | 3D Dist E X coord (ft) | 3D Dist N Y coord (ft) | 3D Dist Height Z coord (ft) |
|---|---|---|---|---|---|---|
| 20A-1 | Roof | 4.5 | 18.3 | 4.5 | 6.3 | 12 |
| 20A-2 | Roof | 12.2 | 18.3 | 12.2 | 6.3 | 12 |
| 20A-3 | Roof | 19.9 | 18.3 | 19.9 | 6.3 | 12 |
| 20A-4 | N Wall | 1.6 | 26.7 | 1.6 | 12.2 | 9.5 |
| 20A-5 | N Wall | 9.2 | 26.7 | 9.2 | 12.2 | 9.5 |
| 20A-6 | N Wall | 16.9 | 26.7 | 16.9 | 12.2 | 9.5 |
| 20A-7 | N Wall | 5.4 | 33.4 | 5.4 | 12.2 | 2.8 |
| 20A-8 | N Wall | 13.1 | 33.4 | 13.1 | 12.2 | 2.8 |
| 20A-9 | E Wall | 26.4 | 16.1 | 20 | 4.1 | 5.6 |
| 20A-10 | E Wall | 22.6 | 22.7 | 20 | 10.7 | 9.4 |
| 20A-11 | E Wall | 30.3 | 22.7 | 20 | 10.7 | 1.7 |
| 20A-12 | S Wall | 0.6 | 3 | 0.6 | 0 | 3 |
| 20A-13 | S Wall | 8.3 | 3 | 8.3 | 0 | 3 |
| 20A-14 | S Wall | 15.9 | 3 | 15.9 | 0 | 3 |
| 20A-15 | S Wall | 4.4 | 9.7 | 4.4 | 0 | 9.7 |
| 20A-16 | S Wall | 12.1 | 9.7 | 12.1 | 0 | 9.7 |
| 20A-17 | S Wall | 19.8 | 9.7 | 19.8 | 0 | 9.7 |
| 20A-18 | W Wall | -7.1 | 12.8 | 0 | 0.8 | 4.9 |
| 20A-19 | W Wall | -10.9 | 19.4 | 0 | 7.4 | 1.1 |
| 20A-20 | W Wall | -3.3 | 19.4 | 0 | 7.4 | 8.7 |

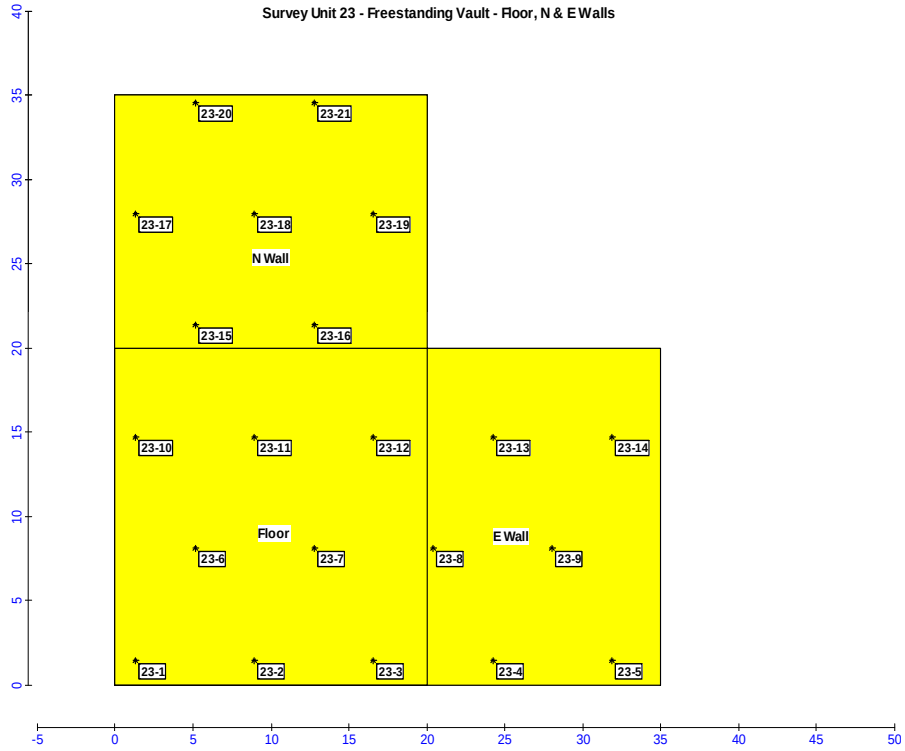
Translation Rules From 2D to 3D Coordinates for Survey Unit 19B

| Translation Rules from 2D to 3D Coordinates | | | |
|---|---|---|---|
| **Surface** | **3D X** | **3D Y** | **3D Z** |
| Roof | 2DX | 2DY-12 | 20 |
| N. Wall | 2DX | 12.2 | 36.2-2DY |
| E. Wall | 20 | 2DY-12 | 32-2-DX |



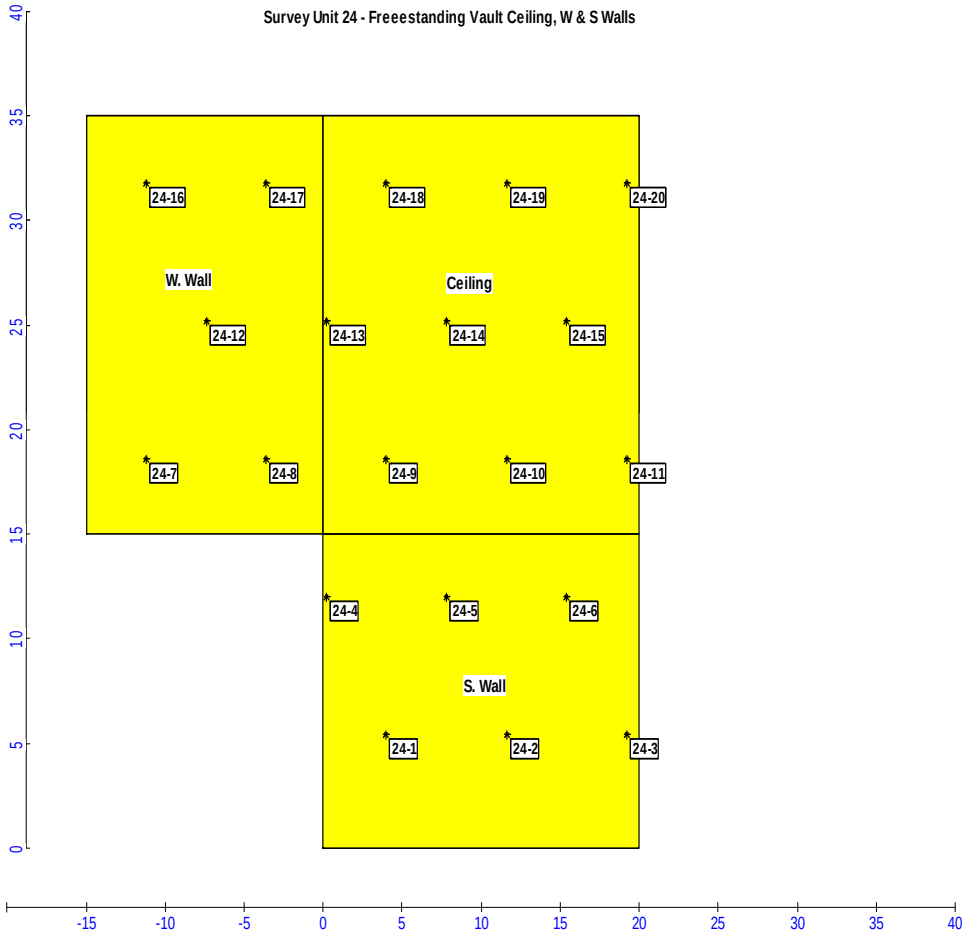
| Measurement No. | Location | Dist. East (ft) | Dist. North (ft) | Dist. Up Wall (ft) |
|---|---|---|---|---|
| 23-4 | East Wall | n/a | 1.5 | 4.2 |
| 23-5 | East Wall | n/a | 1.5 | 11.9 |
| 23-8 | East Wall | n/a | 8.1 | 0.4 |
| 23-9 | East Wall | n/a | 8.1 | 8 |
| 23-13 | East Wall | n/a | 14.7 | 4.2 |
| 23-14 | East Wall | n/a | 14.7 | 11.9 |
| | | | | |
| 23-1 | Floor | 1.3 | 1.5 | n/a |
| 23-2 | Floor | 8.9 | 1.5 | n/a |
| 23-3 | Floor | 16.6 | 1.5 | n/a |
| 23-6 | Floor | 5.1 | 8.1 | n/a |
| 23-7 | Floor | 12.8 | 8.1 | n/a |
| 23-10 | Floor | 1.3 | 14.7 | n/a |
| 23-11 | Floor | 8.9 | 14.7 | n/a |
| 23-12 | Floor | 16.6 | 14.7 | n/a |
| | | | | |
| 23-15 | North Wall | 5.1 | n/a | 1.4 |
| 23-16 | North Wall | 12.8 | n/a | 1.4 |
| 23-17 | North Wall | 1.3 | n/a | 8 |
| 23-18 | North Wall | 8.9 | n/a | 8 |
| 23-19 | North Wall | 16.6 | n/a | 8 |
| 23-20 | North Wall | 5.1 | n/a | 14.6 |
| 23-21 | North Wall | 12.8 | n/a | 14.6 |

**LOCATIONS FOR FIXED ALPHAS** **SU-23 - LARGE VAULT, Part 1**



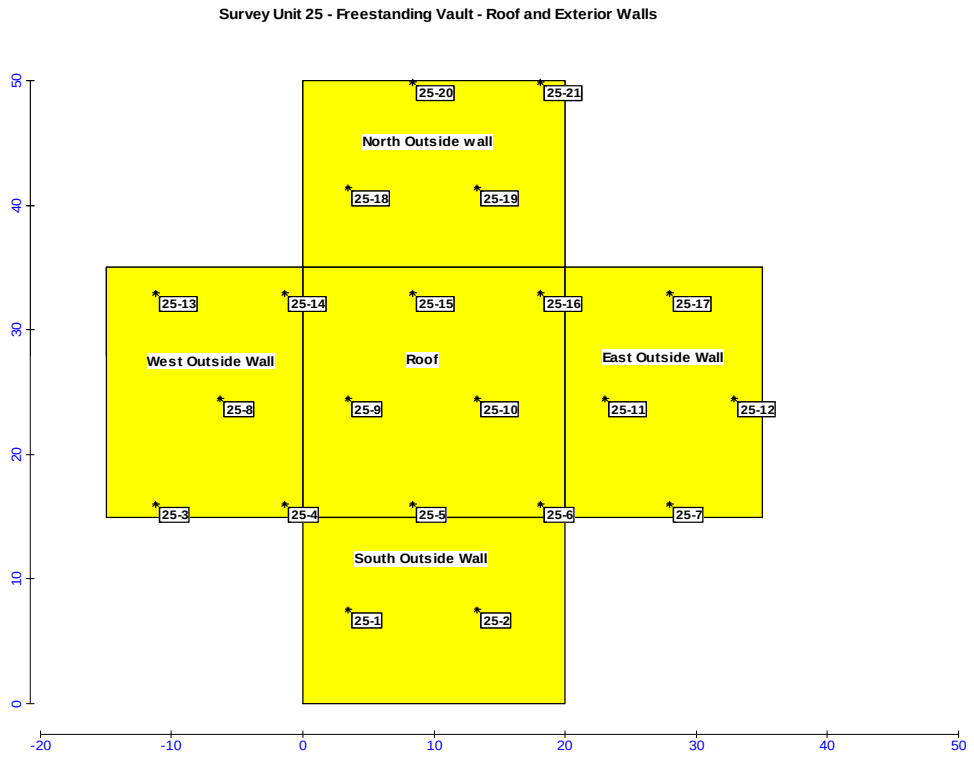
| Measurement No. | Location | Dist. East (ft) | Dist. North (ft) | Dist. Up Wall (ft) |
|---|---|---|---|---|
| 24-9 | Ceiling | 4.0 | 3.6 | n/a |
| 24-10 | Ceiling | 11.6 | 3.6 | n/a |
| 24-11 | Ceiling | 19.2 | 3.6 | n/a |
| 24-13 | Ceiling | 0.2 | 10.2 | n/a |
| 24-14 | Ceiling | 7.8 | 10.2 | n/a |
| 24-15 | Ceiling | 15.4 | 10.2 | n/a |
| 24-18 | Ceiling | 4.0 | 16.8 | n/a |
| 24-19 | Ceiling | 11.6 | 16.8 | n/a |
| 24-20 | Ceiling | 19.2 | 16.8 | n/a |
| | | | | |
| 24-1 | South Wall | 4.0 | n/a | 5.5 |
| 24-2 | South Wall | 11.6 | n/a | 5.5 |
| 24-3 | South Wall | 19.2 | n/a | 5.5 |
| 24-4 | South Wall | 0.2 | n/a | 12.0 |
| 24-5 | South Wall | 7.8 | n/a | 12.0 |
| 24-6 | South Wall | 15.4 | n/a | 12.0 |
| | | | | |
| 24-7 | West Wall | n/a | 3.6 | 3.8 |
| 24-8 | West Wall | n/a | 3.6 | 11.4 |
| 24-12 | West Wall | n/a | 10.2 | 7.6 |
| 24-16 | West Wall | n/a | 16.8 | 3.8 |
| 24-17 | West Wall | n/a | 16.8 | 11.4 |

**LOCATIONS FOR FIXED ALPHAS** **SU-24 - LARGE VAULT, Part 2**



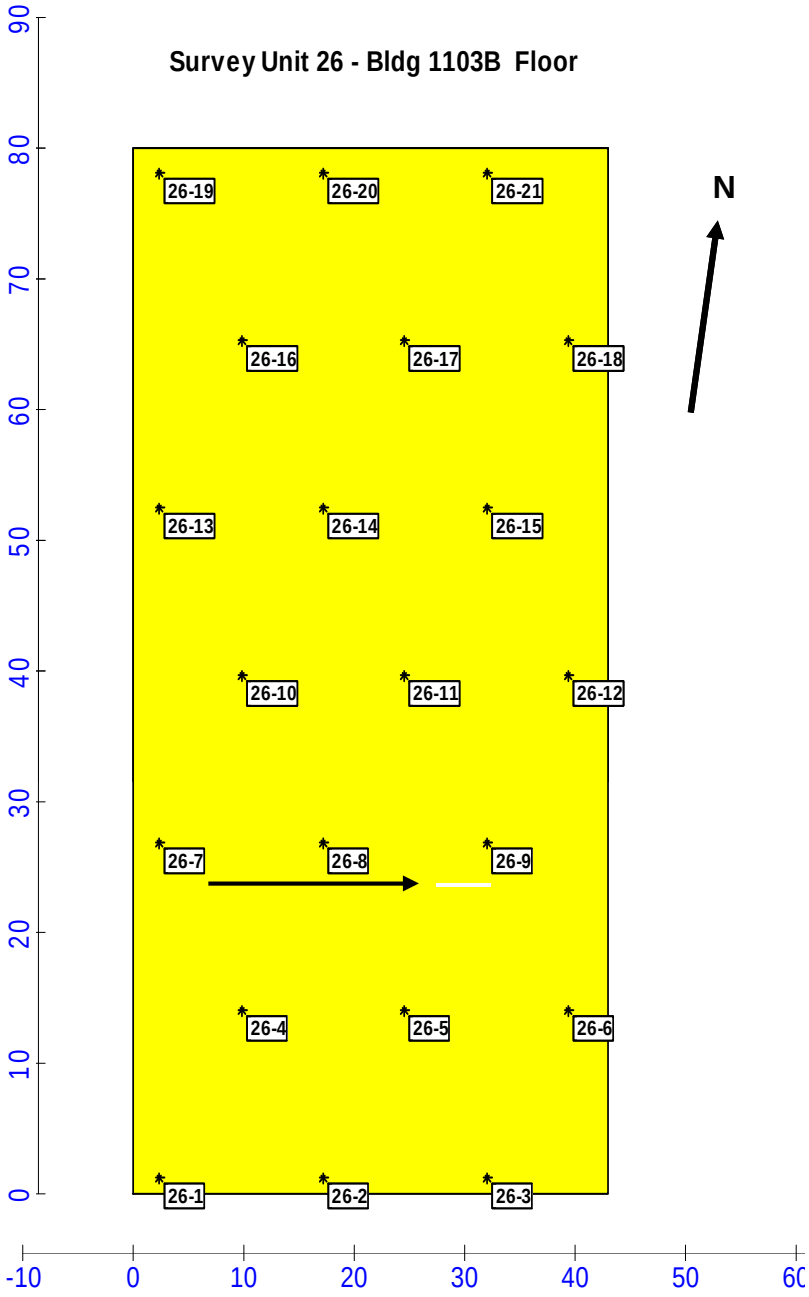
| Measurement No. | Location | Dist. East (ft) | Dist. North (ft) | Dist. Up Wall (ft) |
|---|---|---|---|---|
| 25-7 | E. Wall | n/a | 1.0 | 7.1 |
| 25-11 | E. Wall | n/a | 9.5 | 12.0 |
| 25-12 | E. Wall | n/a | 9.5 | 2.2 |
| 25-17 | E. Wall | n/a | 18.0 | 7.1 |
| | | | | |
| 25-18 | N. Wall | 3.5 | n/a | 8.5 |
| 25-19 | N. Wall | 13.3 | n/a | 8.5 |
| 25-20 | N. Wall | 8.4 | n/a | 0.1 |
| 25-21 | N. Wall | 18.2 | n/a | 0.1 |
| | | | | |
| 25-5 | Roof | 8.4 | 1.0 | n/a |
| 25-6 | Roof | 18.2 | 1.0 | n/a |
| 25-9 | Roof | 3.5 | 9.5 | n/a |
| 25-10 | Roof | 13.3 | 9.5 | n/a |
| 25-15 | Roof | 8.4 | 18.0 | n/a |
| 25-16 | Roof | 18.2 | 18.0 | n/a |
| | | | | |
| 25-1 | S. Wall | 3.5 | n/a | 7.6 |
| 25-2 | S. Wall | 13.3 | n/a | 7.6 |
| | | | | |
| 25-3 | W. Wall | n/a | 1.0 | 3.8 |
| 25-4 | W. Wall | n/a | 1.0 | 13.6 |
| 25-8 | W. Wall | n/a | 9.5 | 8.7 |
| 25-13 | W. Wall | n/a | 18.0 | 3.8 |
| 25-14 | W. Wall | n/a | 18.0 | 13.6 |

**LOCATIONS FOR FIXED ALPHAS** **SU-25 - LARGE VAULT, Part 3**



**APG Building 1103 A Project - FSS Fixed Alpha Measurement Locations**

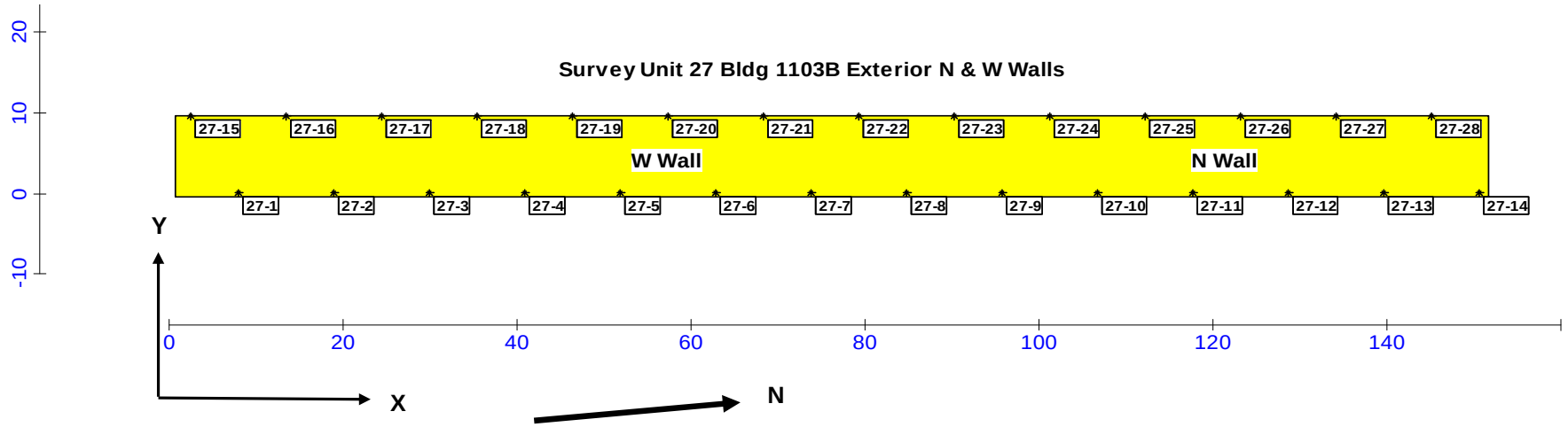
| . | Location | Dist. East (X Coord. ft.) | Dist North (Y Coord. ft.) |
|---|---|---|---|
| 26-1 | Floor | 2.5 | 1.1 |
| 26-2 | Floor | 17.3 | 1.1 |
| 26-3 | Floor | 32.1 | 1.1 |
| 26-4 | Floor | 9.9 | 13.9 |
| 26-5 | Floor | 24.7 | 13.9 |
| 26-6 | Floor | 39.5 | 13.9 |
| 26-7 | Floor | 2.5 | 26.7 |
| 26-8 | Floor | 17.3 | 26.7 |
| 26-9 | Floor | 32.1 | 26.7 |
| 26-10 | Floor | 9.9 | 39.6 |
| 26-11 | Floor | 24.7 | 39.6 |
| 26-12 | Floor | 39.5 | 39.6 |
| 26-13 | Floor | 2.5 | 52.4 |
| 26-14 | Floor | 17.3 | 52.4 |
| 26-15 | Floor | 32.1 | 52.4 |
| 26-16 | Floor | 9.9 | 65.2 |
| 26-17 | Floor | 24.7 | 65.2 |
| 26-18 | Floor | 39.5 | 65.2 |
| 26-19 | Floor | 2.5 | 78 |
| 26-20 | Floor | 17.3 | 78 |
| 26-21 | Floor | 32.1 | 78 |




Area: Area 4

| X Coord | Y Coord | Label |
|---|---|---|
| 2.5 | 1.1 | 26-1 |
| 17.3 | 1.1 | 26-2 |
| 32.1 | 1.1 | 26-3 |
| 9.9 | 13.9 | 26-4 |
| 24.7 | 13.9 | 26-5 |
| 39.5 | 13.9 | 26-6 |
| 2.5 | 26.7 | 26-7 |
| 17.3 | 26.7 | 26-8 |
| 32.1 | 26.7 | 26-9 |
| 9.9 | 39.6 | 26-10 |
| 24.7 | 39.6 | 26-11 |
| 39.5 | 39.6 | 26-12 |
| 2.5 | 52.4 | 26-13 |
| 17.3 | 52.4 | 26-14 |
| 32.1 | 52.4 | 26-15 |
| 9.9 | 65.2 | 26-16 |
| 24.7 | 65.2 | 26-17 |
| 39.5 | 65.2 | 26-18 |
| 2.5 | 78 | 26-19 |
| 17.3 | 78 | 26-20 |
| 32.1 | 78 | 26-21 |

APG Building 1103 A Project - FSS Fixed Alpha Measurement Locations

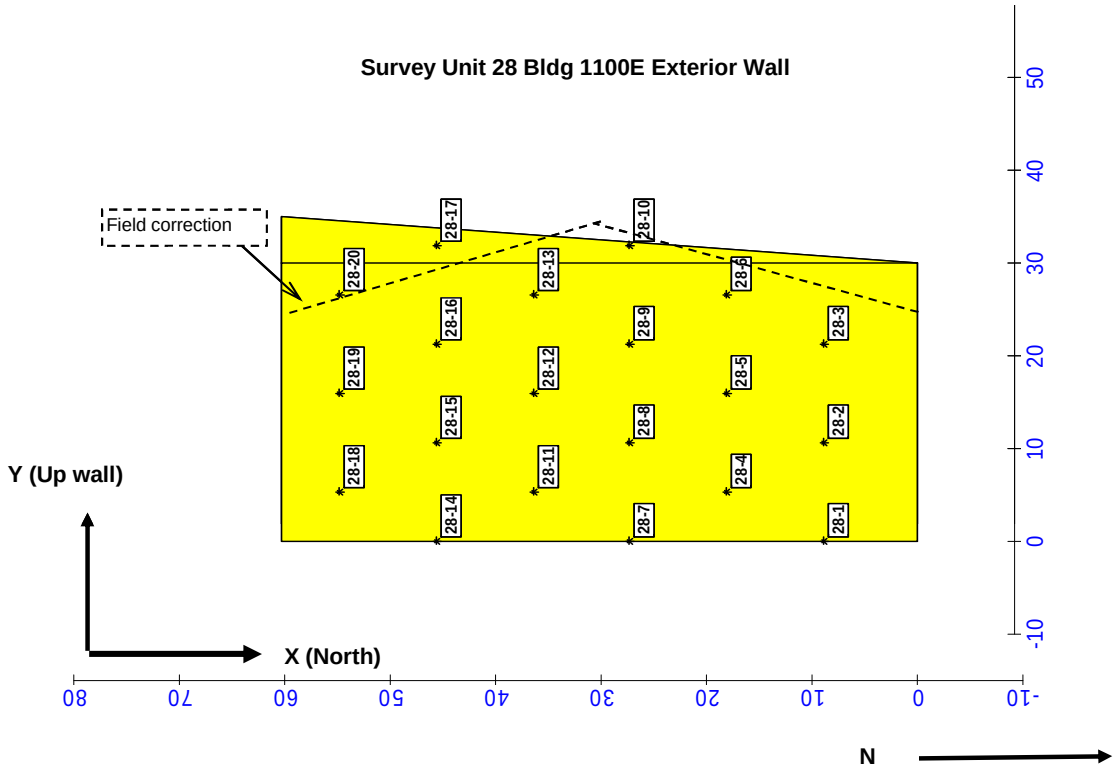



| Measurement No. | Location | X Coord. (ft.) | Y Up Wall Coord. (ft.) |
|---|---|---|---|
| 27-1 | Wall | 7.9 | 0.1 |
| 27-2 | Wall | 18.9 | 0.1 |
| 27-3 | Wall | 29.9 | 0.1 |
| 27-4 | Wall | 40.9 | 0.1 |
| 27-5 | Wall | 51.9 | 0.1 |
| 27-6 | Wall | 62.8 | 0.1 |
| 27-7 | Wall | 73.8 | 0.1 |
| 27-8 | Wall | 84.8 | 0.1 |
| 27-9 | Wall | 95.8 | 0.1 |
| 27-10 | Wall | 106.8 | 0.1 |
| 27-11 | Wall | 117.7 | 0.1 |
| 27-12 | Wall | 128.7 | 0.1 |
| 27-13 | Wall | 139.7 | 0.1 |
| 27-14 | Wall | 150.7 | 0.1 |

| Measurement No. | Location | X Coord. (ft.) | Y Up Wall Coord. (ft.) |
|---|---|---|---|
| 27-15 | Wall | 2.4 | 9.6 |
| 27-16 | Wall | 13.4 | 9.6 |
| 27-17 | Wall | 24.4 | 9.6 |
| 27-18 | Wall | 35.4 | 9.6 |
| 27-19 | Wall | 46.4 | 9.6 |
| 27-20 | Wall | 57.3 | 9.6 |
| 27-21 | Wall | 68.3 | 9.6 |
| 27-22 | Wall | 79.3 | 9.6 |
| 27-23 | Wall | 90.3 | 9.6 |
| 27-24 | Wall | 101.3 | 9.6 |
| 27-25 | Wall | 112.3 | 9.6 |
| 27-26 | Wall | 123.2 | 9.6 |
| 27-27 | Wall | 134.2 | 9.6 |
| 27-28 | Wall | 145.2 | 9.6 |

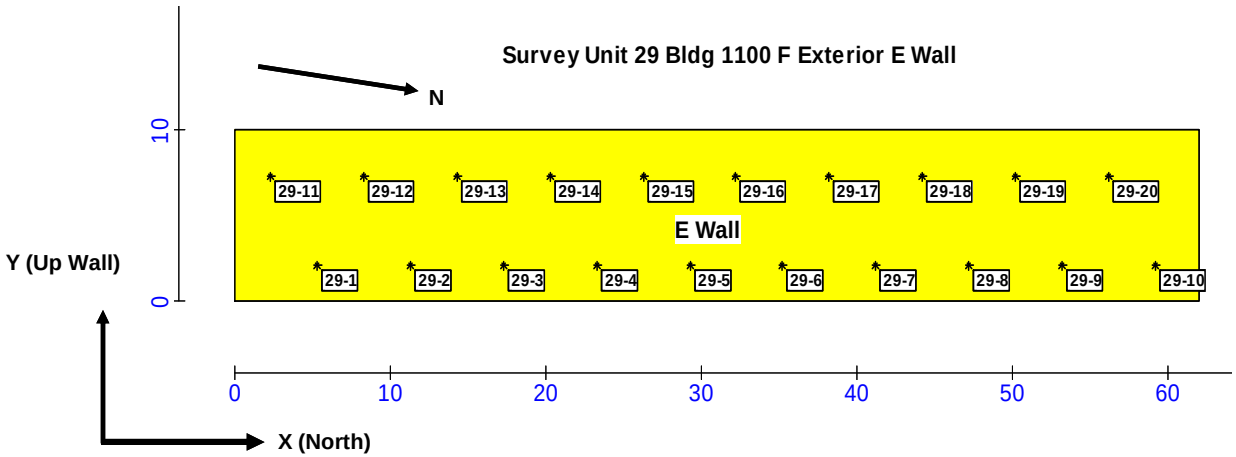
**APG Building 1103 A Project - FSS Fixed Alpha Measurement Locations**

| Measurement No. | Location | Dist Up Wall (Y Coord. ft.) | Dist. North (X Coord. ft.) |
|---|---|---|---|
| 28-1 | E Wall | 0.1 | 8.8 |
| 28-2 | E Wall | 10.7 | 8.8 |
| 28-3 | E Wall | 21.4 | 8.8 |
| 28-4 | E Wall | 5.4 | 18 |
| 28-5 | E Wall | 16.1 | 18 |
| 28-6 | E Wall | 26.7 | 18 |
| 28-7 | E Wall | 0.1 | 27.2 |
| 28-8 | E Wall | 10.7 | 27.2 |
| 28-9 | E Wall | 21.4 | 27.2 |
| 28-10 | E Wall | 32 | 27.2 |
| 28-11 | E Wall | 5.4 | 36.4 |
| 28-12 | E Wall | 16.1 | 36.4 |
| 28-13 | E Wall | 26.7 | 36.4 |
| 28-14 | E Wall | 0.1 | 45.6 |
| 28-15 | E Wall | 10.7 | 45.6 |
| 28-16 | E Wall | 21.4 | 45.6 |
| 28-17 | E Wall | 32 | 45.6 |
| 28-18 | E Wall | 5.4 | 54.8 |
| 28-19 | E Wall | 16.1 | 54.8 |
| 28-20 | E Wall | 26.7 | 54.8 |



**APG Building 1103 A Project - FSS Fixed Alpha Measurement Locations**

| Measurement No. | Location | Dist. North (X Coord. ft.) | Dist Up Wall (Y Coord. ft.) |
|---|---|---|---|
| 29-1 | E Wall | 5.3 | 2.1 |
| 29-2 | E Wall | 11.3 | 2.1 |
| 29-3 | E Wall | 17.3 | 2.1 |
| 29-4 | E Wall | 23.3 | 2.1 |
| 29-5 | E Wall | 29.3 | 2.1 |
| 29-6 | E Wall | 35.2 | 2.1 |
| 29-7 | E Wall | 41.2 | 2.1 |
| 29-8 | E Wall | 47.2 | 2.1 |
| 29-9 | E Wall | 53.2 | 2.1 |
| 29-10 | E Wall | 59.2 | 2.1 |
| 29-11 | E Wall | 2.3 | 7.3 |
| 29-12 | E Wall | 8.3 | 7.3 |
| 29-13 | E Wall | 14.3 | 7.3 |
| 29-14 | E Wall | 20.3 | 7.3 |
| 29-15 | E Wall | 26.3 | 7.3 |
| 29-16 | E Wall | 32.3 | 7.3 |
| 29-17 | E Wall | 38.2 | 7.3 |
| 29-18 | E Wall | 44.2 | 7.3 |
| 29-19 | E Wall | 50.2 | 7.3 |
| 29-20 | E Wall | 56.2 | 7.3 |



# APPENDIX B2

Static Results

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 9.4 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | East parking lot |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-3 | 3~1 | 11/23/09 | 2 | N/A | 9 | N/A | 73.79 | | |
| SU-3 | 3~2 | 11/23/09 | 2 | N/A | 4 | N/A | 21.08 | | |
| SU-3 | 3~3 | 11/23/09 | 2 | N/A | 6 | N/A | 42.16 | | |
| SU-3 | 3~4 | 11/23/09 | 2 | N/A | 3 | N/A | 10.54 | | |
| SU-3 | 3~5 | 11/23/09 | 2 | N/A | 5 | N/A | 31.62 | | |
| SU-3 | 3~6 | 11/23/09 | 2 | N/A | 3 | N/A | 10.54 | | |
| SU-3 | 3~7 | 11/23/09 | 2 | N/A | 7 | N/A | 52.71 | | |
| SU-3 | 3~8 | 11/23/09 | 2 | N/A | 4 | N/A | 21.08 | | |
| SU-3 | 3~9 | 11/23/09 | 2 | N/A | 4 | N/A | 21.08 | | |
| SU-3 | 3~10 | 11/23/09 | 2 | N/A | 4 | N/A | 21.08 | | |
| SU-3 | 3~11 | 11/23/09 | 2 | N/A | 11 | N/A | 94.87 | | |
| SU-3 | 3~12 | 11/23/09 | 2 | N/A | 5 | N/A | 31.62 | | |
| SU-3 | 3~13 | 11/23/09 | 2 | N/A | 1 | N/A | -10.54 | | |
| SU-3 | 3~14 | 11/23/09 | 2 | N/A | 4 | N/A | 21.08 | | |

| | |
|---|---|
| Model 2360 | 193654 |
| Detector 43-93 | 236970 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 7.8 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | 1103A Floor |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-5 | 5~1 | 11/02/09 | 0 | N/A | 1 | N/A | 8.78 | | |
| SU-5 | 5~2 | 11/02/09 | 0 | N/A | 3 | N/A | 26.35 | | |
| SU-5 | 5~3 | 11/02/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-5 | 5~4 | 11/02/09 | 0 | N/A | 2 | N/A | 17.57 | | |
| SU-5 | 5~5 | 11/02/09 | 0 | N/A | 1 | N/A | 8.78 | | |
| SU-5 | 5~6 | 11/02/09 | 0 | N/A | 1 | N/A | 8.78 | | |
| SU-5 | 5~7 | 11/02/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-5 | 5~8 | 11/02/09 | 0 | N/A | 3 | N/A | 26.35 | | |
| SU-5 | 5~9 | 11/02/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-5 | 5~10 | 11/02/09 | 0 | N/A | 2 | N/A | 17.57 | | |
| SU-5 | 5~11 | 11/02/09 | 0 | N/A | 2 | N/A | 17.57 | | |
| SU-5 | 5~12 | 11/02/09 | 0 | N/A | 3 | N/A | 26.35 | | |
| SU-5 | 5~13 | 11/02/09 | 0 | N/A | 3 | N/A | 26.35 | | |
| SU-5 | 5~14 | 11/02/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-5 | 5~15 | 11/02/09 | 0 | N/A | 4 | N/A | 35.14 | | |
| SU-5 | 5~16 | 11/02/09 | 0 | N/A | 5 | N/A | 43.92 | | |
| SU-5 | 5~17 | 11/02/09 | 0 | N/A | 1 | N/A | 8.78 | | |
| SU-5 | 5~18 | 11/02/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-5 | 5~19 | 11/02/09 | 0 | N/A | 1 | N/A | 8.78 | | |
| SU-5 | 5~20 | 11/02/09 | 0 | N/A | 1 | N/A | 8.78 | | |

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 9.4 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | 1103A Floor |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-6 | 6~1 | 11/12/09 | 3 | N/A | 1 | N/A | -21.08 | | |
| SU-6 | 6~2 | 11/12/09 | 3 | N/A | 8 | N/A | 52.71 | | |
| SU-6 | 6~3 | 11/12/09 | 3 | N/A | 2 | N/A | -10.54 | | |
| SU-6 | 6~4 | 11/12/09 | 3 | N/A | 3 | N/A | 0.00 | | |
| SU-6 | 6~5 | 11/12/09 | 3 | N/A | 1 | N/A | -21.08 | | |
| SU-6 | 6~6 | 11/12/09 | 3 | N/A | 4 | N/A | 10.54 | | |
| SU-6 | 6~7 | 11/12/09 | 3 | N/A | 2 | N/A | -10.54 | | |
| SU-6 | 6~8 | 11/12/09 | 3 | N/A | 2 | N/A | -10.54 | | |
| SU-6 | 6~9 | 11/12/09 | 3 | N/A | 1 | N/A | -21.08 | | |
| SU-6 | 6~10 | 11/12/09 | 3 | N/A | 3 | N/A | 0.00 | | |
| SU-6 | 6~11 | 11/12/09 | 3 | N/A | 2 | N/A | -10.54 | | |
| SU-6 | 6~12 | 11/12/09 | 3 | N/A | 0 | N/A | -31.62 | | |
| SU-6 | 6~13 | 11/12/09 | 3 | N/A | 0 | N/A | -31.62 | | |
| SU-6 | 6~14 | 11/12/09 | 3 | N/A | 0 | N/A | -31.62 | | |
| SU-6 | 6~15 | 11/12/09 | 3 | N/A | 4 | N/A | 10.54 | | |
| SU-6 | 6~16 | 11/12/09 | 3 | N/A | 2 | N/A | -10.54 | | |
| SU-6 | 6~17 | 11/12/09 | 3 | N/A | 3 | N/A | 0.00 | | |
| SU-6 | 6~18 | 11/12/09 | 3 | N/A | 2 | N/A | -10.54 | | |
| SU-6 | 6~19 | 11/12/09 | 3 | N/A | 1 | N/A | -21.08 | | |
| SU-6 | 6~20 | 11/12/09 | 3 | N/A | 2 | N/A | -10.54 | | |

| | |
|---|---|
| Model 2360 | 193654 |
| Detector 43-93 | 236970 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 7.8 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | 1103A Walls |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-7 | 7~1 | 11/02/09 | 0 | N/A | 3 | N/A | 26.35 | | |
| SU-7 | 7~2 | 11/02/09 | 0 | N/A | inaccessible | N/A | | | |
| SU-7 | 7~3 | 11/02/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-7 | 7~4 | 11/02/09 | 0 | N/A | 3 | N/A | 26.35 | | |
| SU-7 | 7~5 | 11/02/09 | 0 | N/A | 8 | N/A | 70.27 | | |
| SU-7 | 7~6 | 11/02/09 | 0 | N/A | 4 | N/A | 35.14 | | |
| SU-7 | 7~7 | 11/02/09 | 0 | N/A | 6 | N/A | 52.71 | | |
| SU-7 | 7~8 | 11/02/09 | 0 | N/A | 6 | N/A | 52.71 | | |
| SU-7 | 7~9 | 11/02/09 | 0 | N/A | 4 | N/A | 35.14 | | |
| SU-7 | 7~10 | 11/02/09 | 0 | N/A | 2 | N/A | 17.57 | | |
| SU-7 | 7~11 | 11/02/09 | 0 | N/A | 5 | N/A | 43.92 | | |
| SU-7 | 7~12 | 11/02/09 | 0 | N/A | 2 | N/A | 17.57 | | |
| SU-7 | 7~13 | 11/02/09 | 0 | N/A | 2 | N/A | 17.57 | | |
| SU-7 | 7~14 | 11/02/09 | 0 | N/A | 1 | N/A | 8.78 | | |
| SU-7 | 7~15 | 11/02/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-7 | 7~16 | 11/02/09 | 0 | N/A | 3 | N/A | 26.35 | | |
| SU-7 | 7~17 | 11/02/09 | 0 | N/A | 2 | N/A | 17.57 | | |
| SU-7 | 7~18 | 11/02/09 | 0 | N/A | 1 | N/A | 8.78 | | |
| SU-7 | 7~19 | 11/02/09 | 0 | N/A | 1 | N/A | 8.78 | | |
| SU-7 | 7~20 | 11/02/09 | 0 | N/A | 0 | N/A | 0.00 | | |

| | |
|---|---|
| Model 2360 | 193654 |
| Detector 43-93 | 236970 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 7.8 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | 1103A Walls |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Unity Calc. |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-8 | 8~1 | 11/02/09 | 0 | N/A | 4 | N/A | 35.14 | | |
| SU-8 | 8~2 | 11/02/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-8 | 8~3 | 11/02/09 | 0 | N/A | 4 | N/A | 35.14 | | |
| SU-8 | 8~4 | 11/02/09 | 0 | N/A | 3 | N/A | 26.35 | | |
| SU-8 | 8~5 | 11/02/09 | 0 | N/A | 2 | N/A | 17.57 | | |
| SU-8 | 8~6 | 11/02/09 | 0 | N/A | inaccessible | N/A | | | |
| SU-8 | 8~7 | 11/02/09 | 0 | N/A | 14 | N/A | 122.98 | | 0.23 |
| SU-8 | 8~8 | 11/02/09 | 0 | N/A | 2 | N/A | 17.57 | | |
| SU-8 | 8~9 | 11/02/09 | 0 | N/A | 1 | N/A | 8.78 | | |
| SU-8 | 8~10 | 11/02/09 | 0 | N/A | 3 | N/A | 26.35 | | |
| SU-8 | 8~11 | 11/02/09 | 0 | N/A | 2 | N/A | 17.57 | | |
| SU-8 | 8~12 | 11/02/09 | 0 | N/A | inaccessible | N/A | | | |
| SU-8 | 8~13 | 11/02/09 | 0 | N/A | 3 | N/A | 26.35 | | |
| SU-8 | 8~14 | 11/02/09 | 0 | N/A | 1 | N/A | 8.78 | | |
| SU-8 | 8~15 | 11/02/09 | 0 | N/A | 3 | N/A | 26.35 | | |
| SU-8 | 8~16 | 11/02/09 | 0 | N/A | 2 | N/A | 17.57 | | |
| SU-8 | 8~17 | 11/02/09 | 0 | N/A | 1 | N/A | 8.78 | | |
| SU-8 | 8~18 | 11/02/09 | 0 | N/A | 5 | N/A | 43.92 | | |
| SU-8 | 8~19 | 11/02/09 | 0 | N/A | 7 | N/A | 61.49 | | |
| SU-8 | 8~20 | 11/02/09 | 0 | N/A | 4 | N/A | 35.14 | | |
| | | | | | | | 29.77 | ave | 0.30 |
| | | | | | | | | sum | 0.56 |

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 9.4 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | 1103A ceiling |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-9 | 9~1 | 11/13/09 | 1 | N/A | 0 | N/A | -10.54 | | |
| SU-9 | 9~2 | 11/13/09 | 1 | N/A | 2 | N/A | 10.54 | | |
| SU-9 | 9~3 | 11/13/09 | 1 | N/A | 3 | N/A | 21.08 | | |
| SU-9 | 9~4 | 11/13/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-9 | 9~5 | 11/13/09 | 1 | N/A | 3 | N/A | 21.08 | | |
| SU-9 | 9~6 | 11/13/09 | 1 | N/A | 2 | N/A | 10.54 | | |
| SU-9 | 9~7 | 11/13/09 | 1 | N/A | 0 | N/A | -10.54 | | |
| SU-9 | 9~8 | 11/13/09 | 1 | N/A | 3 | N/A | 21.08 | | |
| SU-9 | 9~9 | 11/13/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-9 | 9~10 | 11/13/09 | 1 | N/A | 0 | N/A | -10.54 | | |
| SU-9 | 9~11 | 11/13/09 | 1 | N/A | 0 | N/A | -10.54 | | |
| SU-9 | 9~12 | 11/13/09 | 1 | N/A | 0 | N/A | -10.54 | | |
| SU-9 | 9~13 | 11/13/09 | 1 | N/A | 0 | N/A | -10.54 | | |
| SU-9 | 9~14 | 11/13/09 | 1 | N/A | 2 | N/A | 10.54 | | |
| SU-9 | 9~15 | 11/13/09 | 1 | N/A | 0 | N/A | -10.54 | | |
| SU-9 | 9~16 | 11/13/09 | 1 | N/A | 2 | N/A | 10.54 | | |
| SU-9 | 9~17 | 11/13/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-9 | 9~18 | 11/13/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-9 | 9~19 | 11/13/09 | 1 | N/A | 2 | N/A | 10.54 | | |
| SU-9 | 9~20 | 11/13/09 | 1 | N/A | 1 | N/A | 0.00 | | |

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 9.4 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | 1103A ceiling |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-10 | 10~1 | 11/13/09 | 1 | N/A | 0 | N/A | -10.54 | | |
| SU-10 | 10~2 | 11/13/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-10 | 10~3 | 11/13/09 | 1 | N/A | 2 | N/A | 10.54 | | |
| SU-10 | 10~4 | 11/13/09 | 1 | N/A | 4 | N/A | 31.62 | | |
| SU-10 | 10~5 | 11/13/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-10 | 10~6 | 11/13/09 | 1 | N/A | 2 | N/A | 10.54 | | |
| SU-10 | 10~7 | 11/13/09 | 1 | N/A | 0 | N/A | -10.54 | | |
| SU-10 | 10~8 | 11/13/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-10 | 10~9 | 11/13/09 | 1 | N/A | 5 | N/A | 42.16 | | |
| SU-10 | 10~10 | 11/13/09 | 1 | N/A | 2 | N/A | 10.54 | | |
| SU-10 | 10~11 | 11/13/09 | 1 | N/A | 0 | N/A | -10.54 | | |
| SU-10 | 10~12 | 11/13/09 | 1 | N/A | 0 | N/A | -10.54 | | |
| SU-10 | 10~13 | 11/13/09 | 1 | N/A | 0 | N/A | -10.54 | | |
| SU-10 | 10~14 | 11/13/09 | 1 | N/A | 0 | N/A | -10.54 | | |
| SU-10 | 10~15 | 11/13/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-10 | 10~16 | 11/13/09 | 1 | N/A | 3 | N/A | 21.08 | | |
| SU-10 | 10~17 | 11/13/09 | 1 | N/A | 0 | N/A | -10.54 | | |
| SU-10 | 10~18 | 11/13/09 | 1 | N/A | 0 | N/A | -10.54 | | |
| SU-10 | 10~19 | 11/13/09 | 1 | N/A | 3 | N/A | 21.08 | | |
| SU-10 | 10~20 | 11/13/09 | 1 | N/A | 3 | N/A | 21.08 | | |
| SU-10 | Investigation for scan data | 11/13/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-10 | Investigation for scan data | 11/13/09 | 1 | N/A | 2 | N/A | 9.41 | | |
| SU-10 | Investigation for scan data | 11/13/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-10 | Investigation for scan data | 11/13/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-10 | Investigation for scan data | 11/13/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-10 | Investigation for scan data | 11/13/09 | 1 | N/A | 0 | N/A | -9.41 | | |
| SU-10 | Investigation for scan data | 11/13/09 | 1 | N/A | 3 | N/A | 18.82 | | |

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 9.4 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | 1103A Exterior |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Unity Calc. |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-11 | 11~1 | 11/17/09 | 2 | N/A | 8 | N/A | 63.25 | | |
| SU-11 | 11~2 | 11/17/09 | 2 | N/A | 3 | N/A | 10.54 | | |
| SU-11 | 11~3 | 11/17/09 | 2 | N/A | 19 | N/A | 179.20 | | 0.14 |
| SU-11 | 11~4 | 11/17/09 | 2 | N/A | 2 | N/A | 0.00 | | |
| SU-11 | 11~5 | 11/17/09 | 2 | N/A | 3 | N/A | 10.54 | | |
| SU-11 | 11~6 | 11/17/09 | 2 | N/A | 8 | N/A | 63.25 | | |
| SU-11 | 11~7 | 11/17/09 | 2 | N/A | 1 | N/A | -10.54 | | |
| SU-11 | 11~8 | 11/17/09 | 2 | N/A | 13 | N/A | 115.95 | | 0.07 |
| SU-11 | 11~9 | 11/17/09 | 2 | N/A | 16 | N/A | 147.58 | | 0.10 |
| SU-11 | 11~10 | 11/17/09 | 2 | N/A | 5 | N/A | 31.62 | | |
| SU-11 | 11~11 | 11/17/09 | 2 | N/A | 14 | N/A | 126.49 | | 0.08 |
| SU-11 | 11~12 | 11/17/09 | 2 | N/A | 5 | N/A | 31.62 | | |
| SU-11 | 11~13 | 11/17/09 | 2 | N/A | 5 | N/A | 31.62 | | |
| SU-11 | 11~14 | 11/17/09 | 2 | N/A | 9 | N/A | 73.79 | | |
| SU-11 | 11~15 | 11/17/09 | 2 | N/A | 4 | N/A | 21.08 | | |
| SU-11 | 11~16 | 11/17/09 | 2 | N/A | 4 | N/A | 21.08 | | |
| SU-11 | 11~17 | 11/17/09 | 2 | N/A | 6 | N/A | 42.16 | | |
| SU-11 | 11~18 | 11/17/09 | 2 | N/A | 4 | N/A | 21.08 | | |
| SU-11 | 11~19 | 11/17/09 | 2 | N/A | inaccessible | N/A | | | |
| SU-11 | 11~20 | 11/17/09 | 2 | N/A | inaccessible | N/A | | | |
| | | | | | | | 54.46 | ave | 0.54 |
| | | | | | | | | sum | 0.94 |

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 9.4 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | 1103A Exterior |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Unity Calc. |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-12 | 12~1 | 11/16/09 | 1 | N/A | 4 | N/A | 31.62 | | |
| SU-12 | 12~2 | 11/16/09 | 1 | N/A | inaccessible | N/A | | | |
| SU-12 | 12~3 | 11/16/09 | 1 | N/A | 7 | N/A | 63.25 | | |
| SU-12 | 12~4 | 11/16/09 | 1 | N/A | 4 | N/A | 31.62 | | |
| SU-12 | 12~5 | 11/16/09 | 1 | N/A | 5 | N/A | 42.16 | | |
| SU-12 | 12~6 | 11/16/09 | 1 | N/A | inaccessible | N/A | | | |
| SU-12 | 12~7 | 11/16/09 | 1 | N/A | 3 | N/A | 21.08 | | |
| SU-12 | 12~8 | 11/16/09 | 1 | N/A | 16 | N/A | 158.12 | | 0.09 |
| SU-12 | 12~9 | 11/16/09 | 1 | N/A | 9 | N/A | 84.33 | | |
| SU-12 | 12~10 | 11/16/09 | 1 | N/A | 7 | N/A | 63.25 | | |
| SU-12 | 12~11 | 11/16/09 | 1 | N/A | 4 | N/A | 31.62 | | |
| SU-12 | 12~12 | 11/16/09 | 1 | N/A | 10 | N/A | 94.87 | | |
| SU-12 | 12~13 | 11/16/09 | 1 | N/A | 7 | N/A | 63.25 | | |
| SU-12 | 12~14 | 11/16/09 | 1 | N/A | inaccessible | N/A | | | |
| SU-12 | 12~15 | 11/16/09 | 1 | N/A | 8 | N/A | 73.79 | | |
| SU-12 | 12~16 | 11/16/09 | 1 | N/A | 4 | N/A | 31.62 | | |
| SU-12 | 12~17 | 11/16/09 | 1 | N/A | 8 | N/A | 73.79 | | |
| SU-12 | 12~18 | 11/16/09 | 1 | N/A | 9 | N/A | 84.33 | | |
| SU-12 | 12~19 | 11/16/09 | 1 | N/A | 8 | N/A | 73.79 | | |
| SU-12 | 12~20 | 11/16/09 | 1 | N/A | 12 | N/A | 115.95 | | 0.04 |
| | | | | | | | 75.55 | ave | 0.76 |
| | | | | | | | | sum | 0.89 |

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 9.4 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | 1103A Foyer Interior |

| dpm/100 $cm^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 $cm^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-12A | 12A-1 | 11/12/09 | 3 | N/A | 3 | N/A | 0.00 | | |
| SU-12A | 12A-2 | 11/12/09 | 3 | N/A | 4 | N/A | 10.54 | | |
| SU-12A | 12A-3 | 11/12/09 | 3 | N/A | 8 | N/A | 52.71 | | |
| SU-12A | 12A-4 | 11/12/09 | 3 | N/A | 3 | N/A | 0.00 | | |
| SU-12A | 12A-5 | 11/12/09 | 3 | N/A | 2 | N/A | -10.54 | | |
| SU-12A | 12A-6 | 11/12/09 | 3 | N/A | 2 | N/A | -10.54 | | |
| SU-12A | 12A-7 | 11/12/09 | 3 | N/A | 3 | N/A | 0.00 | | |
| SU-12A | 12A-8 | 11/12/09 | 3 | N/A | 4 | N/A | 10.54 | | |
| SU-12A | 12A-9 | 11/12/09 | 3 | N/A | 1 | N/A | -21.08 | | |
| SU-12A | 12A-10 | 11/12/09 | 3 | N/A | 0 | N/A | -31.62 | | |
| SU-12A | 12A-11 | 11/12/09 | 3 | N/A | 3 | N/A | 0.00 | | |
| SU-12A | 12A-12 | 11/12/09 | 3 | N/A | 1 | N/A | -21.08 | | |
| SU-12A | 12A-13 | 11/12/09 | 3 | N/A | 3 | N/A | 0.00 | | |
| SU-12A | 12A-14 | 11/12/09 | 3 | N/A | 2 | N/A | -10.54 | | |
| SU-12A | 12A-15 | 11/12/09 | 3 | N/A | 4 | N/A | 10.54 | | |
| SU-12A | 12A-16 | 11/12/09 | 3 | N/A | 3 | N/A | 0.00 | | |
| SU-12A | 12A-17 | 11/12/09 | 3 | N/A | 2 | N/A | -10.54 | | |
| SU-12A | 12A-18 | 11/12/09 | 3 | N/A | 4 | N/A | 10.54 | | |
| SU-12A | 12A-19 | 11/12/09 | 3 | N/A | 4 | N/A | 10.54 | | |
| SU-12A | 12A-20 | 11/12/09 | 3 | N/A | 0 | N/A | -31.62 | | |

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 4.7 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | 1103A Foyer Ext. |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Unity Calc. |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-12B | 12B-1 | 11/17/09 | 2 | N/A | 2 | N/A | 0.00 | | |
| SU-12B | 12B-2 | 11/17/09 | 2 | N/A | 2 | N/A | 0.00 | | |
| SU-12B | 12B-3 | 11/17/09 | 2 | N/A | 4 | N/A | 10.54 | | |
| SU-12B | 12B-4 | 11/17/09 | 2 | N/A | 6 | N/A | 21.08 | | |
| SU-12B | 12B-5 | 11/17/09 | 2 | N/A | 16 | N/A | 73.79 | | |
| SU-12B | 12B-6 | 11/17/09 | 2 | N/A | 22 | N/A | 105.41 | | 0.20 |
| SU-12B | 12B-7 | 11/17/09 | 2 | N/A | 5 | N/A | 15.81 | | |
| SU-12B | 12B-8 | 11/17/09 | 2 | N/A | 1 | N/A | -5.27 | | |
| SU-12B | 12B-9 | 11/17/09 | 2 | N/A | 16 | N/A | 73.79 | | |
| SU-12B | 12B-10 | 11/17/09 | 2 | N/A | 5 | N/A | 15.81 | | |
| SU-12B | 12B-11 | 11/17/09 | 2 | N/A | 6 | N/A | 21.08 | | |
| SU-12B | 12B-12 | 11/17/09 | 2 | N/A | 3 | N/A | 5.27 | | |
| SU-12B | 12B-13 | 11/17/09 | 2 | N/A | 8 | N/A | 31.62 | | |
| SU-12B | 12B-14 | 11/17/09 | 2 | N/A | 16 | N/A | 73.79 | | |
| SU-12B | 12B-15 | 11/17/09 | 2 | N/A | 15 | N/A | 68.52 | | |
| SU-12B | 12B-16 | 11/17/09 | 2 | N/A | 1 | N/A | -5.27 | | |
| SU-12B | 12B-17 | 11/17/09 | 2 | N/A | 2 | N/A | 0.00 | | |
| SU-12B | 12B-18 | 11/17/09 | 2 | N/A | 4 | N/A | 10.54 | | |
| SU-12B | 12B-19 | 11/17/09 | 2 | N/A | 3 | N/A | 5.27 | | |
| SU-12B | 12B-20 | 11/17/09 | 2 | N/A | 2 | N/A | 0.00 | | |
| | | | | | | | 26.09 | ave. | 0.26 |
| | | | | | | | | sum | 0.46 |

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 9.4 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | 1103A |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Unity Calc. |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-13 | 13-1 | 11/17/09 | 2 | N/A | 8 | N/A | 63.25 | | |
| SU-13 | 13-2 | 11/17/09 | 2 | N/A | 6 | N/A | 42.16 | | |
| SU-13 | 13-3 | 11/17/09 | 2 | N/A | 0 | N/A | -21.08 | | |
| SU-13 | 13-4 | 11/17/09 | 2 | N/A | 6 | N/A | 42.16 | | |
| SU-13 | 13-5 | 11/17/09 | 2 | N/A | 5 | N/A | 31.62 | | |
| SU-13 | 13-6 | 11/17/09 | 2 | N/A | 3 | N/A | 10.54 | | |
| SU-13 | 13-7 | 11/17/09 | 2 | N/A | 2 | N/A | 0.00 | | |
| SU-13 | 13-8 | 11/17/09 | 2 | N/A | 6 | N/A | 42.16 | | |
| SU-13 | 13-9 | 11/17/09 | 2 | N/A | 6 | N/A | 42.16 | | |
| SU-13 | 13-10 | 11/17/09 | 2 | N/A | 6 | N/A | 42.16 | | |
| SU-13 | 13-11 | 11/17/09 | 2 | N/A | 7 | N/A | 52.71 | | |
| SU-13 | 13-12 | 11/17/09 | 2 | N/A | 13 | N/A | 115.95 | | 0.20 |
| SU-13 | 13-13 | 11/17/09 | 2 | N/A | 4 | N/A | 21.08 | | |
| SU-13 | 13-14 | 11/17/09 | 2 | N/A | 8 | N/A | 63.25 | | |
| SU-13 | 13-15 | 11/17/09 | 2 | N/A | 1 | N/A | -10.54 | | |
| SU-13 | 13-16 | 11/17/09 | 2 | N/A | 4 | N/A | 21.08 | | |
| SU-13 | 13-17 | 11/17/09 | 2 | N/A | 10 | N/A | 84.33 | | |
| SU-13 | 13-18 | 11/17/09 | 2 | N/A | 4 | N/A | 21.08 | | |
| SU-13 | 13-19 | 11/17/09 | 2 | N/A | 3 | N/A | 10.54 | | |
| SU-13 | 13-20 | 11/17/09 | 2 | N/A | 6 | N/A | 42.16 | | |
| | | | | | | | 35.84 | ave | 0.36 |
| | | | | | | | | sum | 0.56 |

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 9.4 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | BRL12 Pad |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Unity Calc. |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-15 | 15-1 | 11/17/09 | 2 | N/A | 3 | N/A | 10.54 | | |
| SU-15 | 15-2 | 11/17/09 | 2 | N/A | 12 | N/A | 105.41 | | 0.17 |
| SU-15 | 15-3 | 11/17/09 | 2 | N/A | 9 | N/A | 73.79 | | |
| SU-15 | 15-4 | 11/17/09 | 2 | N/A | 7 | N/A | 52.71 | | |
| SU-15 | 15-5 | 11/17/09 | 2 | N/A | 8 | N/A | 63.25 | | |
| SU-15 | 15-6 | 11/17/09 | 2 | N/A | 15 | N/A | 137.04 | | 0.25 |
| SU-15 | 15-7 | 11/17/09 | 2 | N/A | 12 | N/A | 105.41 | | 0.17 |
| SU-15 | 15-8 | 11/17/09 | 2 | N/A | 4 | N/A | 21.08 | | |
| SU-15 | 15-9 | 11/17/09 | 2 | N/A | 5 | N/A | 31.62 | | |
| SU-15 | 15-10 | 11/17/09 | 2 | N/A | 2 | N/A | 0.00 | | |
| SU-15 | 15-11 | 11/17/09 | 2 | N/A | 3 | N/A | 10.54 | | |
| SU-15 | 15-12 | 11/17/09 | 2 | N/A | 4 | N/A | 21.08 | | |
| SU-15 | 15-13 | 11/17/09 | 2 | N/A | 7 | N/A | 52.71 | | |
| SU-15 | 15-14 | 11/17/09 | 2 | N/A | 1 | N/A | -10.54 | | |
| SU-15 | 15-15 | 11/17/09 | 2 | N/A | 7 | N/A | 52.71 | | |
| SU-15 | 15-16 | 11/17/09 | 2 | N/A | 4 | N/A | 21.08 | | |
| SU-15 | 15-17 | 11/17/09 | 2 | N/A | 1 | N/A | -10.54 | | |
| SU-15 | 15-18 | 11/17/09 | 2 | N/A | 4 | N/A | 21.08 | | |
| SU-15 | 15-19 | 11/17/09 | 2 | N/A | 1 | N/A | -10.54 | | |
| SU-15 | 15-20 | 11/17/09 | 2 | N/A | 3 | N/A | 10.54 | | |
| | | | | | | | 37.95 | ave | 0.38 |
| | | | | | | | | sum | 0.96 |

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 4.7 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | BRL12 N Vault |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-19 | 19-1 | 11/17/09 | 2 | N/A | 1 | N/A | -5.27 | | |
| SU-19 | 19-2 | 11/17/09 | 2 | N/A | 1 | N/A | -5.27 | | |
| SU-19 | 19-3 | 11/17/09 | 2 | N/A | 2 | N/A | 0.00 | | |
| SU-19 | 19-4 | 11/17/09 | 2 | N/A | 3 | N/A | 5.27 | | |
| SU-19 | 19-5 | 11/17/09 | 2 | N/A | 4 | N/A | 10.54 | | |
| SU-19 | 19-6 | 11/17/09 | 2 | N/A | 4 | N/A | 10.54 | | |
| SU-19 | 19-7 | 11/17/09 | 2 | N/A | 3 | N/A | 5.27 | | |
| SU-19 | 19-8 | 11/17/09 | 2 | N/A | 0 | N/A | -10.54 | | |
| SU-19 | 19-9 | 11/17/09 | 2 | N/A | 3 | N/A | 5.27 | | |
| SU-19 | 19-10 | 11/17/09 | 2 | N/A | 3 | N/A | 5.27 | | |
| SU-19 | 19-11 | 11/17/09 | 2 | N/A | 1 | N/A | -5.27 | | |
| SU-19 | 19-12 | 11/17/09 | 2 | N/A | 3 | N/A | 5.27 | | |
| SU-19 | 19-13 | 11/17/09 | 2 | N/A | 6 | N/A | 21.08 | | |
| SU-19 | 19-14 | 11/17/09 | 2 | N/A | 2 | N/A | 0.00 | | |
| SU-19 | 19-15 | 11/17/09 | 2 | N/A | 6 | N/A | 21.08 | | |
| SU-19 | 19-16 | 11/17/09 | 2 | N/A | 5 | N/A | 15.81 | | |
| SU-19 | 19-17 | 11/17/09 | 2 | N/A | 2 | N/A | 0.00 | | |
| SU-19 | 19-18 | 11/17/09 | 2 | N/A | 5 | N/A | 15.81 | | |
| SU-19 | 19-19 | 11/17/09 | 2 | N/A | 3 | N/A | 5.27 | | |
| SU-19 | 19-20 | 11/17/09 | 2 | N/A | 1 | N/A | -5.27 | | |
| SU-19 | Investigation for 19F24 | 11/19/09 | 0 | N/A | 4 | N/A | 18.82 | | |
| SU-19 | Investigation for 19F24 | 11/19/09 | 0 | N/A | 5 | N/A | 23.53 | | |
| SU-19 | Investigation for 19F25 | 11/19/09 | 0 | N/A | 2 | N/A | 9.41 | | |
| SU-19 | Investigation for 19F25 | 11/19/09 | 0 | N/A | 5 | N/A | 23.53 | | |
| SU-19 | Investigation for 19F25 | 11/19/09 | 0 | N/A | 2 | N/A | 9.41 | | |

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 4.7 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | BRL12 N Vault |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU 19-A | 19A-1 | 11/18/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU 19-A | 19A-2 | 11/18/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU 19-A | 19A-3 | 11/18/09 | 1 | N/A | 2 | N/A | 5.27 | | |
| SU 19-A | 19A-4 | 11/18/09 | 1 | N/A | 0 | N/A | -5.27 | | |
| SU 19-A | 19A-5 | 11/18/09 | 1 | N/A | 0 | N/A | -5.27 | | |
| SU 19-A | 19A-6 | 11/18/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU 19-A | 19A-7 | 11/18/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU 19-A | 19A-8 | 11/18/09 | 1 | N/A | 0 | N/A | -5.27 | | |
| SU 19-A | 19A-9 | 11/18/09 | 1 | N/A | 0 | N/A | -5.27 | | |
| SU 19-A | 19A-10 | 11/18/09 | 1 | N/A | 3 | N/A | 10.54 | | |
| SU 19-A | 19A-11 | 11/18/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU 19-A | 19A-12 | 11/18/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU 19-A | 19A-13 | 11/18/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU 19-A | 19A-14 | 11/18/09 | 1 | N/A | 2 | N/A | 5.27 | | |
| SU 19-A | 19A-15 | 11/18/09 | 1 | N/A | 3 | N/A | 10.54 | | |
| SU 19-A | 19A-16 | 11/18/09 | 1 | N/A | 4 | N/A | 15.81 | | |
| SU 19-A | 19A-17 | 11/18/09 | 1 | N/A | 2 | N/A | 5.27 | | |
| SU 19-A | 19A-18 | 11/18/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU 19-A | 19A-19 | 11/18/09 | 1 | N/A | 0 | N/A | -5.27 | | |
| SU 19-A | 19A-20 | 11/18/09 | 1 | N/A | 0 | N/A | -5.27 | | |

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 4.7 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | BRL12 N Vault |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-19B | 19B-1 | 11/17/09 | 2 | N/A | 3 | N/A | 5.3 | | |
| SU-19B | 19B-2 | 11/17/09 | 2 | N/A | 6 | N/A | 21.1 | | |
| SU-19B | 19B-3 | 11/17/09 | 2 | N/A | 3 | N/A | 5.3 | | |
| SU-19B | 19B-4 | 11/17/09 | 2 | N/A | 1 | N/A | -5.3 | | |
| SU-19B | 19B-5 | 11/17/09 | 2 | N/A | 2 | N/A | 0.0 | | |
| SU-19B | 19B-6 | 11/17/09 | 2 | N/A | 2 | N/A | 0.0 | | |
| SU-19B | 19B-7 | 11/17/09 | 2 | N/A | 2 | N/A | 0.0 | | |
| SU-19B | 19B-8 | 11/17/09 | 2 | N/A | 1 | N/A | -5.3 | | |
| SU-19B | 19B-9 | 11/17/09 | 2 | N/A | 2 | N/A | 0.0 | | |
| SU-19B | 19B-10 | 11/17/09 | 2 | N/A | 3 | N/A | 5.3 | | |
| SU-19B | 19B-11 | 11/17/09 | 2 | N/A | 2 | N/A | 0.0 | | |
| SU-19B | 19B-12 | 11/17/09 | 2 | N/A | 5 | N/A | 15.8 | | |
| SU-19B | 19B-13 | 11/17/09 | 2 | N/A | 2 | N/A | 0.0 | | |
| SU-19B | 19B-14 | 11/17/09 | 2 | N/A | 3 | N/A | 5.3 | | |
| SU-19B | 19B-15 | 11/17/09 | 2 | N/A | 2 | N/A | 0.0 | | |
| SU-19B | 19B-16 | 11/17/09 | 2 | N/A | 3 | N/A | 5.3 | | |
| SU-19B | 19B-17 | 11/17/09 | 2 | N/A | 4 | N/A | 10.5 | | |
| SU-19B | 19B-18 | 11/17/09 | 2 | N/A | 4 | N/A | 10.5 | | |
| SU-19B | 19B-19 | 11/17/09 | 2 | N/A | 2 | N/A | 0.0 | | |
| SU-19B | 19B-20 | 11/17/09 | 2 | N/A | 4 | N/A | 10.5 | | |

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 4.7 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | BRL12 S Vault |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-20 | 20-1 | 11/18/09 | 1 | N/A | 6 | N/A | 26.35 | | |
| SU-20 | 20-2 | 11/18/09 | 1 | N/A | 5 | N/A | 21.08 | | |
| SU-20 | 20-3 | 11/18/09 | 1 | N/A | 2 | N/A | 5.27 | | |
| SU-20 | 20-4 | 11/18/09 | 1 | N/A | 4 | N/A | 15.81 | | |
| SU-20 | 20-5 | 11/18/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-20 | 20-6 | 11/18/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-20 | 20-7 | 11/18/09 | 1 | N/A | 0 | N/A | -5.27 | | |
| SU-20 | 20-8 | 11/18/09 | 1 | N/A | 11 | N/A | 52.71 | | |
| SU-20 | 20-9 | 11/18/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-20 | 20-10 | 11/18/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-20 | 20-11 | 11/18/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-20 | 20-12 | 11/18/09 | 1 | N/A | 5 | N/A | 21.08 | | |
| SU-20 | 20-13 | 11/18/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-20 | 20-14 | 11/18/09 | 1 | N/A | 3 | N/A | 10.54 | | |
| SU-20 | 20-15 | 11/18/09 | 1 | N/A | 0 | N/A | -5.27 | | |
| SU-20 | 20-16 | 11/18/09 | 1 | N/A | 0 | N/A | -5.27 | | |
| SU-20 | 20-17 | 11/18/09 | 1 | N/A | 2 | N/A | 5.27 | | |
| SU-20 | 20-18 | 11/18/09 | 1 | N/A | 0 | N/A | -5.27 | | |
| SU-20 | 20-19 | 11/18/09 | 1 | N/A | 0 | N/A | -5.27 | | |
| SU-20 | 20-20 | 11/18/09 | 1 | N/A | 2 | N/A | 5.27 | | |

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 4.7 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | BRL12 S Vault |

| dpm/100 $cm^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 $cm^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-20A | 20A-1 | 11/17/09 | 2 | N/A | 1 | N/A | -5.27 | | |
| SU-20A | 20A-2 | 11/17/09 | 2 | N/A | 5 | N/A | 15.81 | | |
| SU-20A | 20A-3 | 11/17/09 | 2 | N/A | 9 | N/A | 36.89 | | |
| SU-20A | 20A-4 | 11/17/09 | 2 | N/A | 4 | N/A | 10.54 | | |
| SU-20A | 20A-5 | 11/17/09 | 2 | N/A | 5 | N/A | 15.81 | | |
| SU-20A | 20A-6 | 11/17/09 | 2 | N/A | 4 | N/A | 10.54 | | |
| SU-20A | 20A-7 | 11/17/09 | 2 | N/A | 1 | N/A | -5.27 | | |
| SU-20A | 20A-8 | 11/17/09 | 2 | N/A | 4 | N/A | 10.54 | | |
| SU-20A | 20A-9 | 11/17/09 | 2 | N/A | 1 | N/A | -5.27 | | |
| SU-20A | 20A-10 | 11/17/09 | 2 | N/A | 3 | N/A | 5.27 | | |
| SU-20A | 20A-11 | 11/17/09 | 2 | N/A | 3 | N/A | 5.27 | | |
| SU-20A | 20A-12 | 11/17/09 | 2 | N/A | 4 | N/A | 10.54 | | |
| SU-20A | 20A-13 | 11/17/09 | 2 | N/A | 1 | N/A | -5.27 | | |
| SU-20A | 20A-14 | 11/17/09 | 2 | N/A | 1 | N/A | -5.27 | | |
| SU-20A | 20A-15 | 11/17/09 | 2 | N/A | 3 | N/A | 5.27 | | |
| SU-20A | 20A-16 | 11/17/09 | 2 | N/A | 4 | N/A | 10.54 | | |
| SU-20A | 20A-17 | 11/17/09 | 2 | N/A | 0 | N/A | -10.54 | | |
| SU-20A | 20A-18 | 11/17/09 | 2 | N/A | 5 | N/A | 15.81 | | |
| SU-20A | 20A-19 | 11/17/09 | 2 | N/A | 1 | N/A | -5.27 | | |
| SU-20A | 20A-20 | 11/17/09 | 2 | N/A | 3 | N/A | 5.27 | | |

| | |
|---|---|
| Model 2360 | 193654 |
| Detector 43-93 | 198509 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 3.9 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | Freestanding Vault |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-23 | 23-1 | 09/16/09 | 1 | N/A | 3 | N/A | 8.78 | | |
| SU-23 | 23-2 | 09/16/09 | 1 | N/A | 4 | N/A | 13.18 | | |
| SU-23 | 23-3 | 09/16/09 | 1 | N/A | 5 | N/A | 17.57 | | |
| SU-23 | 23-4 | 09/16/09 | 1 | N/A | 3 | N/A | 8.78 | | |
| SU-23 | 23-5 | 09/16/09 | 1 | N/A | 2 | N/A | 4.39 | | |
| SU-23 | 23-6 | 09/16/09 | 1 | N/A | 10 | N/A | 39.53 | | |
| SU-23 | 23-7 | 09/16/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-23 | 23-8 | 09/16/09 | 1 | N/A | 2 | N/A | 4.39 | | |
| SU-23 | 23-9 | 09/16/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-23 | 23-10 | 09/16/09 | 1 | N/A | 4 | N/A | 13.18 | | |
| SU-23 | 23-11 | 09/16/09 | 1 | N/A | 4 | N/A | 13.18 | | |
| SU-23 | 23-12 | 09/16/09 | 1 | N/A | 3 | N/A | 8.78 | | |
| SU-23 | 23-13 | 09/16/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-23 | 23-14 | 09/16/09 | 1 | N/A | 0 | N/A | -4.39 | | |
| SU-23 | 23-15 | 09/17/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-23 | 23-16 | 09/17/09 | 0 | N/A | 2 | N/A | 8.78 | | |
| SU-23 | 23-17 | 09/17/09 | 0 | N/A | 1 | N/A | 4.39 | | |
| SU-23 | 23-18 | 09/17/09 | 0 | N/A | 1 | N/A | 4.39 | | |
| SU-23 | 23-19 | 09/17/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-23 | 23-20 | 09/17/09 | 0 | N/A | 1 | N/A | 4.39 | | |
| SU-23 | 23-21 | 09/17/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-23 | Investigation for 23F32 | 11/24/09 | 1 | N/A | 4 | N/A | 11.76 | | |

| | |
|---|---|
| Model 2360 | 193654 |
| Detector 43-93 | 198509 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 4.7 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | Freestanding Vault |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-24 | 24-1 | 09/17/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-24 | 24-2 | 09/17/09 | 0 | N/A | 1 | N/A | 5.26 | | |
| SU-24 | 24-3 | 09/17/09 | 0 | N/A | 1 | N/A | 5.26 | | |
| SU-24 | 24-4 | 09/17/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-24 | 24-5 | 09/17/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-24 | 24-6 | 09/17/09 | 0 | N/A | 1 | N/A | 5.26 | | |
| SU-24 | 24-7 | 09/17/09 | 0 | N/A | 1 | N/A | 5.26 | | |
| SU-24 | 24-8 | 09/17/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-24 | 24-9 | 09/17/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-24 | 24-10 | 09/17/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-24 | 24-11 | 09/17/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-24 | 24-12 | 09/17/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-24 | 24-13 | 09/17/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-24 | 24-14 | 09/17/09 | 0 | N/A | 1 | N/A | 5.26 | | |
| SU-24 | 24-15 | 09/17/09 | 0 | N/A | 1 | N/A | 5.26 | | |
| SU-24 | 24-16 | 09/17/09 | 0 | N/A | 1 | N/A | 5.26 | | |
| SU-24 | 24-17 | 09/17/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-24 | 24-18 | 09/17/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-24 | 24-19 | 09/17/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-24 | 24-20 | 09/17/09 | 0 | N/A | 0 | N/A | 0.00 | | |

| | |
|---|---|
| Model 2360 | 193654 |
| Detector 43-93 | 198509 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 3.9 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | Freestanding Vault |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Unity Calc. |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-25 | 25-1 | 11/19/09 | 0 | N/A | 1 | N/A | 4.39 | | |
| SU-25 | 25-2 | 11/19/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-25 | 25-3 | 11/19/09 | 0 | N/A | 1 | N/A | 4.39 | | |
| SU-25 | 25-4 | 11/19/09 | 0 | N/A | 1 | N/A | 4.39 | | |
| SU-25 | 25-5 | 11/19/09 | 0 | N/A | 1 | N/A | 4.39 | | |
| SU-25 | 25-6 | 11/19/09 | 0 | N/A | 16 | N/A | 70.27 | | |
| SU-25 | 25-7 | 11/19/09 | 0 | N/A | 13 | N/A | 57.10 | | |
| SU-25 | 25-8 | 11/19/09 | 0 | N/A | 24 | N/A | 105.41 | | 0.18 |
| SU-25 | 25-9 | 11/19/09 | 0 | N/A | 3 | N/A | 13.18 | | |
| SU-25 | 25-10 | 11/19/09 | 0 | N/A | 8 | N/A | 35.14 | | |
| SU-25 | 25-11 | 11/19/09 | 0 | N/A | 22 | N/A | 96.63 | | |
| SU-25 | 25-12 | 11/19/09 | 0 | N/A | 5 | N/A | 21.96 | | |
| SU-25 | 25-13 | 11/19/09 | 0 | N/A | 4 | N/A | 17.57 | | |
| SU-25 | 25-14 | 11/19/09 | 0 | N/A | 4 | N/A | 17.57 | | |
| SU-25 | 25-15 | 11/19/09 | 0 | N/A | 0 | N/A | 0.00 | | |
| SU-25 | 25-16 | 11/19/09 | 0 | N/A | 27 | N/A | 118.59 | | 0.21 |
| SU-25 | 25-17 | 11/19/09 | 0 | N/A | 14 | N/A | 61.49 | | |
| SU-25 | 25-18 | 11/19/09 | 0 | N/A | 1 | N/A | 4.39 | | |
| SU-25 | 25-19 | 11/19/09 | 0 | N/A | 5 | N/A | 21.96 | | |
| SU-25 | 25-20 | 11/19/09 | 0 | N/A | 6 | N/A | 26.35 | | |
| SU-25 | 25-21 | 11/19/09 | 0 | N/A | 8 | N/A | 35.14 | | |
| | | | | | | | **34.30** | ave | 0.34 |
| | | | | | | | | sum | 0.73 |

| | |
|---|---|
| Model 2360 | 193654 |
| Detector 43-93 | 236970 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 9.4 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | 1103B floor |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-26 | 26-1 | 10/21/09 | 2 | N/A | 0 | N/A | -21.06 | | |
| SU-26 | 26-2 | 10/21/09 | 2 | N/A | 1 | N/A | -10.53 | | |
| SU-26 | 26-3 | 10/21/09 | 2 | N/A | 3 | N/A | 10.53 | | |
| SU-26 | 26-4 | 10/21/09 | 2 | N/A | 0 | N/A | -21.06 | | |
| SU-26 | 26-5 | 10/21/09 | 2 | N/A | 4 | N/A | 21.06 | | |
| SU-26 | 26-6 | 10/21/09 | 2 | N/A | 2 | N/A | 0.00 | | |
| SU-26 | 26-7 | 10/21/09 | 2 | N/A | 0 | N/A | -21.06 | | |
| SU-26 | 26-8 | 10/21/09 | 2 | N/A | 0 | N/A | -21.06 | | |
| SU-26 | 26-9 | 10/21/09 | 2 | N/A | 1 | N/A | -10.53 | | |
| SU-26 | 26-10 | 10/21/09 | 2 | N/A | 2 | N/A | 0.00 | | |
| SU-26 | 26-11 | 10/21/09 | 2 | N/A | 1 | N/A | -10.53 | | |
| SU-26 | 26-12 | 10/21/09 | 2 | N/A | 1 | N/A | -10.53 | | |
| SU-26 | 26-13 | 10/21/09 | 2 | N/A | 2 | N/A | 0.00 | | |
| SU-26 | 26-14 | 10/21/09 | 2 | N/A | 2 | N/A | 0.00 | | |
| SU-26 | 26-15 | 10/21/09 | 2 | N/A | 2 | N/A | 0.00 | | |
| SU-26 | 26-16 | 10/21/09 | 2 | N/A | 2 | N/A | 0.00 | | |
| SU-26 | 26-17 | 10/21/09 | 2 | N/A | 0 | N/A | -21.06 | | |
| SU-26 | 26-18 | 10/21/09 | 2 | N/A | 0 | N/A | -21.06 | | |
| SU-26 | 26-19 | 10/21/09 | 2 | N/A | 1 | N/A | -10.53 | | |
| SU-26 | 26-20 | 10/21/09 | 2 | N/A | 1 | N/A | -10.53 | | |
| SU-26 | 26-21 | 10/21/09 | 2 | N/A | 1 | N/A | -10.53 | | |

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 4.7 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | 1103B Exterior |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-27 | 27~1 | 11/05/09 | 3 | N/A | 5 | N/A | 10.54 | | |
| SU-27 | 27~2 | 11/05/09 | 3 | N/A | 14 | N/A | 57.98 | | |
| SU-27 | 27~3 | 11/05/09 | 3 | N/A | 18 | N/A | 79.06 | | |
| SU-27 | 27~4 | 11/05/09 | 3 | N/A | 11 | N/A | 42.16 | | |
| SU-27 | 27~5 | 11/05/09 | 3 | N/A | 5 | N/A | 10.54 | | |
| SU-27 | 27~6 | 11/05/09 | 3 | N/A | 17 | N/A | 73.79 | | |
| SU-27 | 27~7 | 11/05/09 | 3 | N/A | 12 | N/A | 47.44 | | |
| SU-27 | 27~8 | 11/05/09 | 3 | N/A | 15 | N/A | 63.25 | | |
| SU-27 | 27~9 | 11/05/09 | 3 | N/A | 4 | N/A | 5.27 | | |
| SU-27 | 27~10 | 11/05/09 | 3 | N/A | 1 | N/A | -10.54 | | |
| SU-27 | 27-11 | 11/16/09 | 1 | N/A | 3 | N/A | 10.54 | | |
| SU-27 | 27-12 | 11/16/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-27 | 27-13 | 11/16/09 | 1 | N/A | 1 | N/A | 0.00 | | |
| SU-27 | 27-14 | 11/16/09 | 1 | N/A | 8 | N/A | 36.89 | | |
| SU-27 | 27-15 | 11/16/09 | 1 | N/A | 5 | N/A | 21.08 | | |
| SU-27 | 27-16 | 11/16/09 | 1 | N/A | 5 | N/A | 21.08 | | |
| SU-27 | 27-17 | 11/16/09 | 1 | N/A | 12 | N/A | 57.98 | | |
| SU-27 | 27-18 | 11/16/09 | 1 | N/A | 5 | N/A | 21.08 | | |
| SU-27 | 27-19 | 11/16/09 | 1 | N/A | 10 | N/A | 47.44 | | |
| SU-27 | 27-20 | 11/16/09 | 1 | N/A | 6 | N/A | 26.35 | | |
| SU-27 | 27-21 | 11/16/09 | 1 | N/A | 6 | N/A | 26.35 | | |
| SU-27 | 27-22 | 11/16/09 | 1 | N/A | 14 | N/A | 68.52 | | |
| SU-27 | 27-23 | 11/16/09 | 1 | N/A | 9 | N/A | 42.16 | | |
| SU-27 | 27-24 | 11/16/09 | 1 | N/A | 12 | N/A | 57.98 | | |
| SU-27 | 27-25 | 11/16/09 | 1 | N/A | 4 | N/A | 15.81 | | |
| SU-27 | 27-26 | 11/16/09 | 1 | N/A | 10 | N/A | 47.44 | | |
| SU-27 | 27-27 | 11/16/09 | 1 | N/A | 9 | N/A | 42.16 | | |

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 4.7 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | 1103B Exterior |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-27 | 27-28 | 11/16/09 | 1 | N/A | 7 | N/A | 28.24 | | |
| | | | | | | | 33.95 | ave | |

| | |
|---|---|
| Model 2360 | 225173 |
| Detector 43-93 | 237000 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 4.7 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | 1100E Exterior |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-28 | 28~1 | 11/16/09 | 7.1 | N/A | 2 | N/A | -26.88 | | |
| SU-28 | 28~2 | 11/16/09 | 7.1 | N/A | 11 | N/A | 20.56 | | |
| SU-28 | 28~3 | 11/16/09 | 7.1 | N/A | 11 | N/A | 20.56 | | |
| SU-28 | 28~4 | 11/16/09 | 7.1 | N/A | 7 | N/A | -0.53 | | |
| SU-28 | 28~5 | 11/16/09 | 7.1 | N/A | 13 | N/A | 31.10 | | |
| SU-28 | 28~6 | 11/16/09 | 7.1 | N/A | 20 | N/A | 67.99 | | |
| SU-28 | 28~7 | 11/16/09 | 7.1 | N/A | 7 | N/A | -0.53 | | |
| SU-28 | 28~8 | 11/16/09 | 7.1 | N/A | 3 | N/A | -21.61 | | |
| SU-28 | 28~9 | 11/16/09 | 7.1 | N/A | 12 | N/A | 25.83 | | |
| SU-28 | 28~10 | 11/16/09 | 7.1 | N/A | 6 | N/A | -5.80 | | |
| SU-28 | 28~11 | 11/16/09 | 7.1 | N/A | 5 | N/A | -11.07 | | |
| SU-28 | 28~12 | 11/16/09 | 7.1 | N/A | 5 | N/A | -11.07 | | |
| SU-28 | 28~13 | 11/16/09 | 7.1 | N/A | 17 | N/A | 52.18 | | |
| SU-28 | 28~14 | 11/16/09 | 7.1 | N/A | 3 | N/A | -21.61 | | |
| SU-28 | 28~15 | 11/16/09 | 7.1 | N/A | 13 | N/A | 31.10 | | |
| SU-28 | 28~16 | 11/16/09 | 7.1 | N/A | 18 | N/A | 57.45 | | |
| SU-28 | 28~17 | 11/16/09 | 7.1 | N/A | inaccessible | N/A | | | |
| SU-28 | 28~18 | 11/16/09 | 7.1 | N/A | 5 | N/A | -11.07 | | |
| SU-28 | 28~19 | 11/16/09 | 7.1 | N/A | 11 | N/A | 20.56 | | |
| SU-28 | 28~20 | 11/16/09 | 7.1 | N/A | inaccessible | N/A | | | |
| SU-28 | Investigation of 28~6 | 12/20/10 | 7.1 | N/A | 14 | N/A | 32.47 | | |
| SU-28 | Investigation of 28~6 | 12/20/10 | 7.1 | N/A | 22 | N/A | 70.12 | | |
| SU-28 | Investigation of 28~6 | 12/20/10 | 7.1 | N/A | 22 | N/A | 70.12 | | |
| SU-28 | Investigation of 28~6 | 12/20/10 | 7.1 | N/A | 12 | N/A | 23.06 | | |
| SU-28 | Investigation of 28~6 | 12/20/10 | 7.1 | N/A | 14 | N/A | 32.47 | | |
| SU-28 | Investigation of 28~6 | 12/20/10 | 7.1 | N/A | 12 | N/A | 23.06 | | |
| | | | | | | | 19.52 | ave | |

| | |
|---|---|
| Model 2360 | 193682 |
| Detector 43-93 | 236970 |
| Static Count Time (min) | 1.0 |
| Background Count Time (min) | 1.0 |
| α Efficiency Correction Factor | 4.4 |
| Area Correction Factor | 1.12 |

| | |
|---|---|
| **Structure** | 1100F Exterior |

| dpm/100 cm$^2$ | |
|---|---|
| > α Flag | > β Flag |
| 100 | N/A |

| Survey Unit ID | Measurement No. | Date | Field Background (cpm) | | Static Counts (cpm) | | Static (dpm/100 cm$^2$) | | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | |
| SU-29 | 29~1 | 11/05/09 | 3 | N/A | 3 | N/A | 0.00 | | |
| SU-29 | 29~2 | 11/05/09 | 3 | N/A | 4 | N/A | 4.98 | | |
| SU-29 | 29~3 | 11/05/09 | 3 | N/A | 4 | N/A | 4.98 | | |
| SU-29 | 29~4 | 11/05/09 | 3 | N/A | 3 | N/A | 0.00 | | |
| SU-29 | 29~5 | 11/05/09 | 3 | N/A | 10 | N/A | 34.84 | | |
| SU-29 | 29~6 | 11/05/09 | 3 | N/A | 3 | N/A | 0.00 | | |
| SU-29 | 29~7 | 11/05/09 | 3 | N/A | 4 | N/A | 4.98 | | |
| SU-29 | 29~8 | 11/05/09 | 3 | N/A | 3 | N/A | 0.00 | | |
| SU-29 | 29~9 | 11/05/09 | 3 | N/A | 3 | N/A | 0.00 | | |
| SU-29 | 29~10 | 11/05/09 | 3 | N/A | 4 | N/A | 4.98 | | |
| SU-29 | 29~11 | 11/05/09 | 3 | N/A | 8 | N/A | 24.89 | | |
| SU-29 | 29~12 | 11/05/09 | 3 | N/A | 8 | N/A | 24.89 | | |
| SU-29 | 29~13 | 11/05/09 | 3 | N/A | 5 | N/A | 9.96 | | |
| SU-29 | 29~14 | 11/05/09 | 3 | N/A | 5 | N/A | 9.96 | | |
| SU-29 | 29~15 | 11/05/09 | 3 | N/A | 7 | N/A | 19.91 | | |
| SU-29 | 29~16 | 11/05/09 | 3 | N/A | 6 | N/A | 14.93 | | |
| SU-29 | 29~17 | 11/05/09 | 3 | N/A | 3 | N/A | 0.00 | | |
| SU-29 | 29~18 | 11/05/09 | 3 | N/A | 3 | N/A | 0.00 | | |
| SU-29 | 29~19 | 11/05/09 | 3 | N/A | 1 | N/A | -9.96 | | |
| SU-29 | 29~20 | 11/05/09 | 3 | N/A | 6 | N/A | 14.93 | | |
| | | | | | | | 8.21 | ave | |

# APPENDIX B3

Smear Results

# Aberdeen Proving Ground - Building 1103A Final Status Survey Results

| Ludlum 2929 SN 196230 Cal Due 11/25/10 | |
|---|---|
| α eff | β eff |
| 0.2905 | 0.3364 |

| Sample Count Time (min) | Daily Bkg Count Time (min) |
|---|---|
| 4.0 | 40.0 |

| | | | | | | | | | | | | dpm/100 cm² | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | α Flag | β Flag | |
| | | | | | | | | | | | | 10 | 100 | |
| seq. # | Sample ID# | Date | Background Total Counts* | | Sample Total Counts | | Background (cpm) | | Sample Counts (cpm) | | Sample (dpm/100 cm²) | | > a flag | > β flag | Tech. Initial |
| | | | α | β | α | β | α | β | α | β | α | β | FLAG | FLAG | |
| 327 | APG-1103A-SU-3-01 | 12/10/2009 | 5 | 2369 | 0 | 266 | 0.1 | 59.2 | 0.00 | 67 | -0.4 | 22 | | | CWG |
| 328 | APG-1103A-SU-3-02 | 12/10/2009 | 5 | 2369 | 0 | 230 | 0.1 | 59.2 | 0.00 | 58 | -0.4 | -5 | | | CWG |
| 329 | APG-1103A-SU-3-03 | 12/10/2009 | 5 | 2369 | 5 | 224 | 0.1 | 59.2 | 1.25 | 56 | 3.9 | -10 | | | CWG |
| 330 | APG-1103A-SU-3-04 | 12/10/2009 | 5 | 2369 | 0 | 264 | 0.1 | 59.2 | 0.00 | 66 | -0.4 | 20 | | | CWG |
| 331 | APG-1103A-SU-3-05 | 12/10/2009 | 5 | 2369 | 1 | 202 | 0.1 | 59.2 | 0.25 | 51 | 0.4 | -26 | | | CWG |
| 332 | APG-1103A-SU-3-06 | 12/10/2009 | 5 | 2369 | 1 | 237 | 0.1 | 59.2 | 0.25 | 59 | 0.4 | 0 | | | CWG |
| 333 | APG-1103A-SU-3-07 | 12/10/2009 | 5 | 2369 | 1 | 256 | 0.1 | 59.2 | 0.25 | 64 | 0.4 | 14 | | | CWG |
| 334 | APG-1103A-SU-3-08 | 12/10/2009 | 5 | 2369 | 3 | 245 | 0.1 | 59.2 | 0.75 | 61 | 2.2 | 6 | | | CWG |
| 335 | APG-1103A-SU-3-09 | 12/10/2009 | 5 | 2369 | 0 | 250 | 0.1 | 59.2 | 0.00 | 63 | -0.4 | 10 | | | CWG |
| 336 | APG-1103A-SU-3-10 | 12/10/2009 | 5 | 2369 | 0 | 207 | 0.1 | 59.2 | 0.00 | 52 | -0.4 | -22 | | | CWG |
| 337 | APG-1103A-SU-3-11 | 12/10/2009 | 5 | 2369 | 2 | 235 | 0.1 | 59.2 | 0.50 | 59 | 1.3 | -1 | | | CWG |
| 338 | APG-1103A-SU-3-12 | 12/10/2009 | 5 | 2369 | 0 | 238 | 0.1 | 59.2 | 0.00 | 60 | -0.4 | 1 | | | CWG |
| 339 | APG-1103A-SU-3-13 | 12/10/2009 | 5 | 2369 | 2 | 260 | 0.1 | 59.2 | 0.50 | 65 | 1.3 | 17 | | | CWG |
| 340 | APG-1103A-SU-3-14 | 12/10/2009 | 5 | 2369 | 4 | 240 | 0.1 | 59.2 | 1.00 | 60 | 3.0 | 2 | | | CWG |
| | | | | | | | | | | | | | | | |
| 10 | APG-1103A-SU-15-01 | 12/4/2009 | 13 | 2398 | 1 | 221 | 0.3 | 60.0 | 0.25 | 55 | -0.3 | -14 | | | CWG |
| 11 | APG-1103A-SU-15-02 | 12/4/2009 | 13 | 2398 | 2 | 272 | 0.3 | 60.0 | 0.50 | 68 | 0.6 | 24 | | | CWG |
| 12 | APG-1103A-SU-15-03 | 12/4/2009 | 13 | 2398 | 1 | 223 | 0.3 | 60.0 | 0.25 | 56 | -0.3 | -12 | | | CWG |
| 13 | APG-1103A-SU-15-04 | 12/4/2009 | 13 | 2398 | 1 | 211 | 0.3 | 60.0 | 0.25 | 53 | -0.3 | -21 | | | CWG |
| 14 | APG-1103A-SU-15-05 | 12/4/2009 | 13 | 2398 | 3 | 256 | 0.3 | 60.0 | 0.75 | 64 | 1.5 | 12 | | | CWG |
| 15 | APG-1103A-SU-15-06 | 12/4/2009 | 13 | 2398 | 2 | 219 | 0.3 | 60.0 | 0.50 | 55 | 0.6 | -15 | | | CWG |
| 16 | APG-1103A-SU-15-07 | 12/4/2009 | 13 | 2398 | 2 | 250 | 0.3 | 60.0 | 0.50 | 63 | 0.6 | 8 | | | CWG |
| 17 | APG-1103A-SU-15-08 | 12/4/2009 | 13 | 2398 | 0 | 262 | 0.3 | 60.0 | 0.00 | 66 | -1.1 | 16 | | | CWG |
| 18 | APG-1103A-SU-15-09 | 12/4/2009 | 13 | 2398 | 4 | 221 | 0.3 | 60.0 | 1.00 | 55 | 2.3 | -14 | | | CWG |
| 19 | APG-1103A-SU-15-10 | 12/4/2009 | 13 | 2398 | 1 | 263 | 0.3 | 60.0 | 0.25 | 66 | -0.3 | 17 | | | CWG |
| 20 | APG-1103A-SU-15-11 | 12/4/2009 | 13 | 2398 | 0 | 235 | 0.3 | 60.0 | 0.00 | 59 | -1.1 | -4 | | | CWG |
| 21 | APG-1103A-SU-15-12 | 12/4/2009 | 13 | 2398 | 1 | 247 | 0.3 | 60.0 | 0.25 | 62 | -0.3 | 5 | | | CWG |
| 22 | APG-1103A-SU-15-13 | 12/4/2009 | 13 | 2398 | 3 | 228 | 0.3 | 60.0 | 0.75 | 57 | 1.5 | -9 | | | CWG |
| 23 | APG-1103A-SU-15-14 | 12/4/2009 | 13 | 2398 | 0 | 240 | 0.3 | 60.0 | 0.00 | 60 | -1.1 | 0 | | | CWG |
| 24 | APG-1103A-SU-15-15 | 12/4/2009 | 13 | 2398 | 1 | 202 | 0.3 | 60.0 | 0.25 | 51 | -0.3 | -28 | | | CWG |
| 25 | APG-1103A-SU-15-16 | 12/4/2009 | 13 | 2398 | 3 | 228 | 0.3 | 60.0 | 0.75 | 57 | 1.5 | -9 | | | CWG |
| 26 | APG-1103A-SU-15-17 | 12/4/2009 | 13 | 2398 | 0 | 218 | 0.3 | 60.0 | 0.00 | 55 | -1.1 | -16 | | | CWG |
| 27 | APG-1103A-SU-15-18 | 12/4/2009 | 13 | 2398 | 0 | 245 | 0.3 | 60.0 | 0.00 | 61 | -1.1 | 4 | | | CWG |
| 28 | APG-1103A-SU-15-19 | 12/4/2009 | 13 | 2398 | 4 | 231 | 0.3 | 60.0 | 1.00 | 58 | 2.3 | -7 | | | CWG |
| 29 | APG-1103A-SU-15-20 | 12/4/2009 | 13 | 2398 | 2 | 240 | 0.3 | 60.0 | 0.50 | 60 | 0.6 | 0 | | | CWG |
| 30 | APG-1103A-SU-15-21 | 12/4/2009 | 13 | 2398 | 0 | 230 | 0.3 | 60.0 | 0.00 | 58 | -1.1 | -7 | | | CWG |
| | | | | | | | | | | | | | | | |
| 31 | APG-1103A-SU-19-01 | 12/10/2009 | 5 | 2369 | 2 | 238 | 0.1 | 59.2 | 0.50 | 60 | 1.3 | 1 | | | CWG |

## Aberdeen Proving Ground - Building 1103A Final Status Survey Results

| Ludlum 2929 SN 196230 Cal Due 11/25/10 | |
|---|---|
| α eff | β eff |
| 0.2905 | 0.3364 |

| Sample Count Time (min) | Daily Bkg Count Time (min) |
|---|---|
| 4.0 | 40.0 |

| | | | | | | | | | | | | dpm/100 cm$^2$ α Flag 10 | dpm/100 cm$^2$ β Flag 100 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| seq. # | Sample ID# | Date | Background Total Counts* | | Sample Total Counts | | Background (cpm) | | Sample Counts (cpm) | | Sample (dpm/100 cm$^2$) | | > a flag | > β flag | Tech. Initial |
| | | | α | β | α | β | α | β | α | β | α | β | FLAG | FLAG | |
| 32 | APG-1103A-SU-19-02 | 12/10/2009 | 5 | 2369 | 0 | 223 | 0.1 | 59.2 | 0.00 | 56 | -0.4 | -10 | | | CWG |
| 33 | APG-1103A-SU-19-03 | 12/10/2009 | 5 | 2369 | 0 | 221 | 0.1 | 59.2 | 0.00 | 55 | -0.4 | -12 | | | CWG |
| 34 | APG-1103A-SU-19-04 | 12/10/2009 | 5 | 2369 | 2 | 256 | 0.1 | 59.2 | 0.50 | 64 | 1.3 | 14 | | | CWG |
| 35 | APG-1103A-SU-19-05 | 12/10/2009 | 5 | 2369 | 0 | 241 | 0.1 | 59.2 | 0.00 | 60 | -0.4 | 3 | | | CWG |
| 36 | APG-1103A-SU-19-06 | 12/10/2009 | 5 | 2369 | 0 | 229 | 0.1 | 59.2 | 0.00 | 57 | -0.4 | -6 | | | CWG |
| 37 | APG-1103A-SU-19-07 | 12/10/2009 | 5 | 2369 | 0 | 284 | 0.1 | 59.2 | 0.00 | 71 | -0.4 | 35 | | | CWG |
| 38 | APG-1103A-SU-19-08 | 12/10/2009 | 5 | 2369 | 2 | 233 | 0.1 | 59.2 | 0.50 | 58 | 1.3 | -3 | | | CWG |
| 39 | APG-1103A-SU-19-09 | 12/10/2009 | 5 | 2369 | 0 | 257 | 0.1 | 59.2 | 0.00 | 64 | -0.4 | 15 | | | CWG |
| 40 | APG-1103A-SU-19-10 | 12/10/2009 | 5 | 2369 | 0 | 248 | 0.1 | 59.2 | 0.00 | 62 | -0.4 | 8 | | | CWG |
| 41 | APG-1103A-SU-19-11 | 12/10/2009 | 5 | 2369 | 2 | 234 | 0.1 | 59.2 | 0.50 | 59 | 1.3 | -2 | | | CWG |
| 42 | APG-1103A-SU-19-12 | 12/10/2009 | 5 | 2369 | 1 | 248 | 0.1 | 59.2 | 0.25 | 62 | 0.4 | 8 | | | CWG |
| 43 | APG-1103A-SU-19-13 | 12/10/2009 | 5 | 2369 | 1 | 252 | 0.1 | 59.2 | 0.25 | 63 | 0.4 | 11 | | | CWG |
| 44 | APG-1103A-SU-19-14 | 12/10/2009 | 5 | 2369 | 0 | 218 | 0.1 | 59.2 | 0.00 | 55 | -0.4 | -14 | | | CWG |
| 45 | APG-1103A-SU-19-15 | 12/10/2009 | 5 | 2369 | 2 | 257 | 0.1 | 59.2 | 0.50 | 64 | 1.3 | 15 | | | CWG |
| 46 | APG-1103A-SU-19-16 | 12/10/2009 | 5 | 2369 | 4 | 254 | 0.1 | 59.2 | 1.00 | 64 | 3.0 | 13 | | | CWG |
| 47 | APG-1103A-SU-19-17 | 12/10/2009 | 5 | 2369 | 1 | 228 | 0.1 | 59.2 | 0.25 | 57 | 0.4 | -7 | | | CWG |
| 48 | APG-1103A-SU-19-18 | 12/10/2009 | 5 | 2369 | 0 | 242 | 0.1 | 59.2 | 0.00 | 61 | -0.4 | 4 | | | CWG |
| 49 | APG-1103A-SU-19-19 | 12/10/2009 | 5 | 2369 | 0 | 224 | 0.1 | 59.2 | 0.00 | 56 | -0.4 | -10 | | | CWG |
| 50 | APG-1103A-SU-19-20 | 12/10/2009 | 5 | 2369 | 1 | 227 | 0.1 | 59.2 | 0.25 | 57 | 0.4 | -7 | | | CWG |
| | | | | | | | | | | | | | | | |
| 51 | APG-1103A-SU-19B-01 | 12/10/2009 | 5 | 2369 | 2 | 229 | 0.1 | 59.2 | 0.50 | 57 | 1.3 | -6 | | | CWG |
| 52 | APG-1103A-SU-19B-02 | 12/10/2009 | 5 | 2369 | 2 | 238 | 0.1 | 59.2 | 0.50 | 60 | 1.3 | 1 | | | CWG |
| 53 | APG-1103A-SU-19B-03 | 12/10/2009 | 5 | 2369 | 3 | 236 | 0.1 | 59.2 | 0.75 | 59 | 2.2 | -1 | | | CWG |
| 54 | APG-1103A-SU-19B-04 | 12/10/2009 | 5 | 2369 | 2 | 268 | 0.1 | 59.2 | 0.50 | 67 | 1.3 | 23 | | | CWG |
| 55 | APG-1103A-SU-19B-05 | 12/10/2009 | 5 | 2369 | 0 | 265 | 0.1 | 59.2 | 0.00 | 66 | -0.4 | 21 | | | CWG |
| 56 | APG-1103A-SU-19B-06 | 12/10/2009 | 5 | 2369 | 1 | 254 | 0.1 | 59.2 | 0.25 | 64 | 0.4 | 13 | | | CWG |
| 57 | APG-1103A-SU-19B-07 | 12/10/2009 | 5 | 2369 | 2 | 247 | 0.1 | 59.2 | 0.50 | 62 | 1.3 | 8 | | | CWG |
| 58 | APG-1103A-SU-19B-08 | 12/10/2009 | 5 | 2369 | 1 | 235 | 0.1 | 59.2 | 0.25 | 59 | 0.4 | -1 | | | CWG |
| 59 | APG-1103A-SU-19B-09 | 12/10/2009 | 5 | 2369 | 0 | 230 | 0.1 | 59.2 | 0.00 | 58 | -0.4 | -5 | | | CWG |
| 60 | APG-1103A-SU-19B-10 | 12/10/2009 | 5 | 2369 | 0 | 240 | 0.1 | 59.2 | 0.00 | 60 | -0.4 | 2 | | | CWG |
| 61 | APG-1103A-SU-19B-11 | 12/10/2009 | 5 | 2369 | 2 | 248 | 0.1 | 59.2 | 0.50 | 62 | 1.3 | 8 | | | CWG |
| 62 | APG-1103A-SU-19B-12 | 12/10/2009 | 5 | 2369 | 2 | 253 | 0.1 | 59.2 | 0.50 | 63 | 1.3 | 12 | | | CWG |
| 63 | APG-1103A-SU-19B-13 | 12/10/2009 | 5 | 2369 | 2 | 232 | 0.1 | 59.2 | 0.50 | 58 | 1.3 | -4 | | | CWG |
| 64 | APG-1103A-SU-19B-14 | 12/10/2009 | 5 | 2369 | 1 | 247 | 0.1 | 59.2 | 0.25 | 62 | 0.4 | 8 | | | CWG |
| 65 | APG-1103A-SU-19B-15 | 12/10/2009 | 5 | 2369 | 1 | 207 | 0.1 | 59.2 | 0.25 | 52 | 0.4 | -22 | | | CWG |
| 66 | APG-1103A-SU-19B-16 | 12/10/2009 | 5 | 2369 | 1 | 240 | 0.1 | 59.2 | 0.25 | 60 | 0.4 | 2 | | | CWG |
| 67 | APG-1103A-SU-19B-17 | 12/10/2009 | 5 | 2369 | 1 | 229 | 0.1 | 59.2 | 0.25 | 57 | 0.4 | -6 | | | CWG |
| 68 | APG-1103A-SU-19B-18 | 12/10/2009 | 5 | 2369 | 2 | 259 | 0.1 | 59.2 | 0.50 | 65 | 1.3 | 16 | | | CWG |

# Aberdeen Proving Ground - Building 1103A Final Status Survey Results

| Ludlum 2929 SN 196230 Cal Due 11/25/10 | |
|---|---|
| α eff | β eff |
| 0.2905 | 0.3364 |

| Sample Count Time (min) | Daily Bkg Count Time (min) |
|---|---|
| 4.0 | 40.0 |

| | | | | | | | | | | | | dpm/100 cm$^2$ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | α Flag | β Flag | |
| | | | | | | | | | | | | 10 | 100 | |
| seq. # | Sample ID# | Date | Background Total Counts* | | Sample Total Counts | | Background (cpm) | | Sample Counts (cpm) | | Sample (dpm/100 cm$^2$) | | > a flag | > β flag | Tech. Initial |
| | | | α | β | α | β | α | β | α | β | α | β | FLAG | FLAG | |
| 69 | APG-1103A-SU-19B-19 | 12/10/2009 | 5 | 2369 | 1 | 222 | 0.1 | 59.2 | 0.25 | 56 | 0.4 | -11 | | | CWG |
| 70 | APG-1103A-SU-19B-20 | 12/10/2009 | 5 | 2369 | 2 | 228 | 0.1 | 59.2 | 0.50 | 57 | 1.3 | -7 | | | CWG |
| | | | | | | | | | | | | | | | |
| 71 | APG-1103A-SU-20-01 | 12/9/2009 | 4 | 2398 | 0 | 241 | 0.1 | 60.0 | 0.00 | 60 | -0.3 | 1 | | | CWG |
| 72 | APG-1103A-SU-20-02 | 12/9/2009 | 4 | 2398 | 0 | 245 | 0.1 | 60.0 | 0.00 | 61 | -0.3 | 4 | | | CWG |
| 73 | APG-1103A-SU-20-03 | 12/9/2009 | 4 | 2398 | 1 | 249 | 0.1 | 60.0 | 0.25 | 62 | 0.5 | 7 | | | CWG |
| 74 | APG-1103A-SU-20-04 | 12/9/2009 | 4 | 2398 | 0 | 216 | 0.1 | 60.0 | 0.00 | 54 | -0.3 | -18 | | | CWG |
| 75 | APG-1103A-SU-20-05 | 12/9/2009 | 4 | 2398 | 0 | 226 | 0.1 | 60.0 | 0.00 | 57 | -0.3 | -10 | | | CWG |
| 76 | APG-1103A-SU-20-06 | 12/9/2009 | 4 | 2398 | 1 | 237 | 0.1 | 60.0 | 0.25 | 59 | 0.5 | -2 | | | CWG |
| 77 | APG-1103A-SU-20-07 | 12/9/2009 | 4 | 2398 | 1 | 232 | 0.1 | 60.0 | 0.25 | 58 | 0.5 | -6 | | | CWG |
| 78 | APG-1103A-SU-20-08 | 12/9/2009 | 4 | 2398 | 0 | 220 | 0.1 | 60.0 | 0.00 | 55 | -0.3 | -15 | | | CWG |
| 79 | APG-1103A-SU-20-09 | 12/9/2009 | 4 | 2398 | 1 | 243 | 0.1 | 60.0 | 0.25 | 61 | 0.5 | 2 | | | CWG |
| 80 | APG-1103A-SU-20-10 | 12/9/2009 | 4 | 2398 | 0 | 231 | 0.1 | 60.0 | 0.00 | 58 | -0.3 | -7 | | | CWG |
| 81 | APG-1103A-SU-20-11 | 12/9/2009 | 4 | 2398 | 1 | 233 | 0.1 | 60.0 | 0.25 | 58 | 0.5 | -5 | | | CWG |
| 82 | APG-1103A-SU-20-12 | 12/9/2009 | 4 | 2398 | 0 | 242 | 0.1 | 60.0 | 0.00 | 61 | -0.3 | 2 | | | CWG |
| 83 | APG-1103A-SU-20-13 | 12/9/2009 | 4 | 2398 | 1 | 229 | 0.1 | 60.0 | 0.25 | 57 | 0.5 | -8 | | | CWG |
| 84 | APG-1103A-SU-20-14 | 12/9/2009 | 4 | 2398 | 1 | 265 | 0.1 | 60.0 | 0.25 | 66 | 0.5 | 19 | | | CWG |
| 85 | APG-1103A-SU-20-15 | 12/9/2009 | 4 | 2398 | 0 | 231 | 0.1 | 60.0 | 0.00 | 58 | -0.3 | -7 | | | CWG |
| 86 | APG-1103A-SU-20-16 | 12/9/2009 | 4 | 2398 | 0 | 232 | 0.1 | 60.0 | 0.00 | 58 | -0.3 | -6 | | | CWG |
| 87 | APG-1103A-SU-20-17 | 12/9/2009 | 4 | 2398 | 1 | 213 | 0.1 | 60.0 | 0.25 | 53 | 0.5 | -20 | | | CWG |
| 88 | APG-1103A-SU-20-18 | 12/9/2009 | 4 | 2398 | 0 | 242 | 0.1 | 60.0 | 0.00 | 61 | -0.3 | 2 | | | CWG |
| 89 | APG-1103A-SU-20-19 | 12/9/2009 | 4 | 2398 | 1 | 255 | 0.1 | 60.0 | 0.25 | 64 | 0.5 | 11 | | | CWG |
| 90 | APG-1103A-SU-20-20 | 12/9/2009 | 4 | 2398 | 0 | 252 | 0.1 | 60.0 | 0.00 | 63 | -0.3 | 9 | | | CWG |
| | | | | | | | | | | | | | | | |
| 121 | APG-1103A-SU-20A-01 | 12/9/2009 | 4 | 2398 | 1 | 242 | 0.1 | 60.0 | 0.25 | 61 | 0.5 | 2 | | | CWG |
| 122 | APG-1103A-SU-20A-02 | 12/9/2009 | 4 | 2398 | 2 | 216 | 0.1 | 60.0 | 0.50 | 54 | 1.4 | -18 | | | CWG |
| 123 | APG-1103A-SU-20A-03 | 12/9/2009 | 4 | 2398 | 1 | 237 | 0.1 | 60.0 | 0.25 | 59 | 0.5 | -2 | | | CWG |
| 124 | APG-1103A-SU-20A-04 | 12/9/2009 | 4 | 2398 | 3 | 249 | 0.1 | 60.0 | 0.75 | 62 | 2.2 | 7 | | | CWG |
| 125 | APG-1103A-SU-20A-05 | 12/9/2009 | 4 | 2398 | 0 | 216 | 0.1 | 60.0 | 0.00 | 54 | -0.3 | -18 | | | CWG |
| 126 | APG-1103A-SU-20A-06 | 12/9/2009 | 4 | 2398 | 0 | 226 | 0.1 | 60.0 | 0.00 | 57 | -0.3 | -10 | | | CWG |
| 127 | APG-1103A-SU-20A-07 | 12/9/2009 | 4 | 2398 | 2 | 242 | 0.1 | 60.0 | 0.50 | 61 | 1.4 | 2 | | | CWG |
| 128 | APG-1103A-SU-20A-08 | 12/9/2009 | 4 | 2398 | 0 | 225 | 0.1 | 60.0 | 0.00 | 56 | -0.3 | -11 | | | CWG |
| 129 | APG-1103A-SU-20A-09 | 12/9/2009 | 4 | 2398 | 0 | 232 | 0.1 | 60.0 | 0.00 | 58 | -0.3 | -6 | | | CWG |
| 130 | APG-1103A-SU-20A-10 | 12/9/2009 | 4 | 2398 | 2 | 223 | 0.1 | 60.0 | 0.50 | 56 | 1.4 | -12 | | | CWG |
| 131 | APG-1103A-SU-20A-11 | 12/9/2009 | 4 | 2398 | 2 | 214 | 0.1 | 60.0 | 0.50 | 54 | 1.4 | -19 | | | CWG |
| 132 | APG-1103A-SU-20A-12 | 12/9/2009 | 4 | 2398 | 4 | 219 | 0.1 | 60.0 | 1.00 | 55 | 3.1 | -15 | | | CWG |
| 133 | APG-1103A-SU-20A-13 | 12/9/2009 | 4 | 2398 | 0 | 240 | 0.1 | 60.0 | 0.00 | 60 | -0.3 | 0 | | | CWG |
| 134 | APG-1103A-SU-20A-14 | 12/9/2009 | 4 | 2398 | 1 | 243 | 0.1 | 60.0 | 0.25 | 61 | 0.5 | 2 | | | CWG |

## Aberdeen Proving Ground - Building 1103A Final Status Survey Results

| Ludlum 2929 SN 196230 Cal Due 11/25/10 | |
|---|---|
| α eff | β eff |
| 0.2905 | 0.3364 |

| Sample Count Time (min) | Daily Bkg Count Time (min) |
|---|---|
| 4.0 | 40.0 |

| | | | | | | | | | | | | dpm/100 cm$^2$ α Flag 10 | dpm/100 cm$^2$ β Flag 100 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| seq. # | Sample ID# | Date | Background Total Counts* | | Sample Total Counts | | Background (cpm) | | Sample Counts (cpm) | | Sample (dpm/100 cm$^2$) | | > a flag | > β flag | Tech. Initial |
| | | | α | β | α | β | α | β | α | β | α | β | FLAG | FLAG | |
| 135 | APG-1103A-SU-20A-15 | 12/9/2009 | 4 | 2398 | 0 | 254 | 0.1 | 60.0 | 0.00 | 64 | -0.3 | 11 | | | CWG |
| 136 | APG-1103A-SU-20A-16 | 12/9/2009 | 4 | 2398 | 0 | 205 | 0.1 | 60.0 | 0.00 | 51 | -0.3 | -26 | | | CWG |
| 137 | APG-1103A-SU-20A-17 | 12/9/2009 | 4 | 2398 | 2 | 240 | 0.1 | 60.0 | 0.50 | 60 | 1.4 | 0 | | | CWG |
| 138 | APG-1103A-SU-20A-18 | 12/9/2009 | 4 | 2398 | 1 | 244 | 0.1 | 60.0 | 0.25 | 61 | 0.5 | 3 | | | CWG |
| 139 | APG-1103A-SU-20A-19 | 12/9/2009 | 4 | 2398 | 0 | 244 | 0.1 | 60.0 | 0.00 | 61 | -0.3 | 3 | | | CWG |
| 140 | APG-1103A-SU-20A-20 | 12/9/2009 | 4 | 2398 | 1 | 245 | 0.1 | 60.0 | 0.25 | 61 | 0.5 | 4 | | | CWG |
| | | | | | | | | | | | | | | | |
| 141 | APG-1103A-SU-23-01 | 12/11/2009 | 13 | 2331 | 2 | 229 | 0.3 | 58.3 | 0.50 | 57 | 0.6 | -3 | | | CWG |
| 142 | APG-1103A-SU-23-02 | 12/11/2009 | 13 | 2331 | 0 | 231 | 0.3 | 58.3 | 0.00 | 58 | -1.1 | -2 | | | CWG |
| 143 | APG-1103A-SU-23-03 | 12/11/2009 | 13 | 2331 | 3 | 231 | 0.3 | 58.3 | 0.75 | 58 | 1.5 | -2 | | | CWG |
| 144 | APG-1103A-SU-23-04 | 12/11/2009 | 13 | 2331 | 1 | 254 | 0.3 | 58.3 | 0.25 | 64 | -0.3 | 16 | | | CWG |
| 145 | APG-1103A-SU-23-05 | 12/11/2009 | 13 | 2331 | 2 | 241 | 0.3 | 58.3 | 0.50 | 60 | 0.6 | 6 | | | CWG |
| 146 | APG-1103A-SU-23-06 | 12/11/2009 | 13 | 2331 | 5 | 208 | 0.3 | 58.3 | 1.25 | 52 | 3.2 | -19 | | | CWG |
| 147 | APG-1103A-SU-23-07 | 12/11/2009 | 13 | 2331 | 7 | 230 | 0.3 | 58.3 | 1.75 | 58 | 4.9 | -2 | | | CWG |
| 148 | APG-1103A-SU-23-08 | 12/11/2009 | 13 | 2331 | 3 | 249 | 0.3 | 58.3 | 0.75 | 62 | 1.5 | 12 | | | CWG |
| 149 | APG-1103A-SU-23-09 | 12/11/2009 | 13 | 2331 | 3 | 243 | 0.3 | 58.3 | 0.75 | 61 | 1.5 | 7 | | | CWG |
| 150 | APG-1103A-SU-23-10 | 12/11/2009 | 13 | 2331 | 1 | 219 | 0.3 | 58.3 | 0.25 | 55 | -0.3 | -10 | | | CWG |
| 151 | APG-1103A-SU-23-11 | 12/15/2009 | 3 | 2352 | 0 | 235 | 0.1 | 58.8 | 0.00 | 59 | -0.3 | 0 | | | CWG |
| 152 | APG-1103A-SU-23-12 | 12/15/2009 | 3 | 2352 | 2 | 242 | 0.1 | 58.8 | 0.50 | 61 | 1.5 | 5 | | | CWG |
| 153 | APG-1103A-SU-23-13 | 12/15/2009 | 3 | 2352 | 2 | 226 | 0.1 | 58.8 | 0.50 | 57 | 1.5 | -7 | | | CWG |
| 154 | APG-1103A-SU-23-14 | 12/15/2009 | 3 | 2352 | 1 | 203 | 0.1 | 58.8 | 0.25 | 51 | 0.6 | -24 | | | CWG |
| 155 | APG-1103A-SU-23-15 | 12/15/2009 | 3 | 2352 | 1 | 228 | 0.1 | 58.8 | 0.25 | 57 | 0.6 | -5 | | | CWG |
| 156 | APG-1103A-SU-23-16 | 12/15/2009 | 3 | 2352 | 2 | 239 | 0.1 | 58.8 | 0.50 | 60 | 1.5 | 3 | | | CWG |
| 157 | APG-1103A-SU-23-17 | 12/15/2009 | 3 | 2352 | 1 | 222 | 0.1 | 58.8 | 0.25 | 56 | 0.6 | -10 | | | CWG |
| 158 | APG-1103A-SU-23-18 | 12/15/2009 | 3 | 2352 | 3 | 222 | 0.1 | 58.8 | 0.75 | 56 | 2.3 | -10 | | | CWG |
| 159 | APG-1103A-SU-23-19 | 12/15/2009 | 3 | 2352 | 2 | 243 | 0.1 | 58.8 | 0.50 | 61 | 1.5 | 6 | | | CWG |
| 160 | APG-1103A-SU-23-20 | 12/15/2009 | 3 | 2352 | 2 | 217 | 0.1 | 58.8 | 0.50 | 54 | 1.5 | -14 | | | CWG |
| 161 | APG-1103A-SU-23-21 | 12/15/2009 | 3 | 2352 | 0 | 258 | 0.1 | 58.8 | 0.00 | 65 | -0.3 | 17 | | | CWG |
| | | | | | | | | | | | | | | | |
| 274 | APG-1103A-SU-24-01 | 12/17/2009 | 6 | 2338 | 0 | 226 | 0.2 | 58.5 | 0.00 | 57 | -0.5 | -6 | | | CWG |
| 275 | APG-1103A-SU-24-02 | 12/17/2009 | 6 | 2338 | 0 | 236 | 0.2 | 58.5 | 0.00 | 59 | -0.5 | 2 | | | CWG |
| 276 | APG-1103A-SU-24-03 | 12/17/2009 | 6 | 2338 | 0 | 230 | 0.2 | 58.5 | 0.00 | 58 | -0.5 | -3 | | | CWG |
| 277 | APG-1103A-SU-24-04 | 12/17/2009 | 6 | 2338 | 1 | 218 | 0.2 | 58.5 | 0.25 | 55 | 0.3 | -12 | | | CWG |
| 278 | APG-1103A-SU-24-05 | 12/17/2009 | 6 | 2338 | 0 | 236 | 0.2 | 58.5 | 0.00 | 59 | -0.5 | 2 | | | CWG |
| 279 | APG-1103A-SU-24-06 | 12/17/2009 | 6 | 2338 | 2 | 225 | 0.2 | 58.5 | 0.50 | 56 | 1.2 | -7 | | | CWG |
| 280 | APG-1103A-SU-24-07 | 12/17/2009 | 6 | 2338 | 0 | 246 | 0.2 | 58.5 | 0.00 | 62 | -0.5 | 9 | | | CWG |
| 281 | APG-1103A-SU-24-08 | 12/17/2009 | 6 | 2338 | 1 | 230 | 0.2 | 58.5 | 0.25 | 58 | 0.3 | -3 | | | CWG |
| 282 | APG-1103A-SU-24-09 | 12/17/2009 | 6 | 2338 | 0 | 227 | 0.2 | 58.5 | 0.00 | 57 | -0.5 | -5 | | | CWG |

## Aberdeen Proving Ground - Building 1103A Final Status Survey Results

| Ludlum 2929 SN 196230 Cal Due 11/25/10 | |
|---|---|
| α eff | β eff |
| 0.2905 | 0.3364 |

| Sample Count Time (min) | Daily Bkg Count Time (min) |
|---|---|
| 4.0 | 40.0 |

| | | | dpm/100 cm$^2$ | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | α Flag | β Flag | | | | | | | | | | | |
| | | | 10 | 100 | | | | | | | | | | | |
| seq. # | Sample ID# | Date | Background Total Counts* | | Sample Total Counts | | Background (cpm) | | Sample Counts (cpm) | | Sample (dpm/100 cm$^2$) | | > a flag | > β flag | Tech. Initial |
| | | | α | β | α | β | α | β | α | β | α | β | FLAG | FLAG | |
| 283 | APG-1103A-SU-24-10 | 12/17/2009 | 6 | 2338 | 1 | 206 | 0.2 | 58.5 | 0.25 | 52 | 0.3 | -21 | | | CWG |
| 284 | APG-1103A-SU-24-11 | 12/17/2009 | 6 | 2338 | 2 | 228 | 0.2 | 58.5 | 0.50 | 57 | 1.2 | -4 | | | CWG |
| 285 | APG-1103A-SU-24-12 | 12/17/2009 | 6 | 2338 | 0 | 224 | 0.2 | 58.5 | 0.00 | 56 | -0.5 | -7 | | | CWG |
| 286 | APG-1103A-SU-24-13 | 12/17/2009 | 6 | 2338 | 0 | 223 | 0.2 | 58.5 | 0.00 | 56 | -0.5 | -8 | | | CWG |
| 287 | APG-1103A-SU-24-14 | 12/17/2009 | 6 | 2338 | 1 | 225 | 0.2 | 58.5 | 0.25 | 56 | 0.3 | -7 | | | CWG |
| 288 | APG-1103A-SU-24-15 | 12/17/2009 | 6 | 2338 | 0 | 222 | 0.2 | 58.5 | 0.00 | 56 | -0.5 | -9 | | | CWG |
| 289 | APG-1103A-SU-24-16 | 12/17/2009 | 6 | 2338 | 0 | 252 | 0.2 | 58.5 | 0.00 | 63 | -0.5 | 14 | | | CWG |
| 290 | APG-1103A-SU-24-17 | 12/17/2009 | 6 | 2338 | 1 | 255 | 0.2 | 58.5 | 0.25 | 64 | 0.3 | 16 | | | CWG |
| 291 | APG-1103A-SU-24-18 | 12/17/2009 | 6 | 2338 | 2 | 269 | 0.2 | 58.5 | 0.50 | 67 | 1.2 | 26 | | | CWG |
| 292 | APG-1103A-SU-24-19 | 12/17/2009 | 6 | 2338 | 0 | 217 | 0.2 | 58.5 | 0.00 | 54 | -0.5 | -12 | | | CWG |
| 293 | APG-1103A-SU-24-20 | 12/17/2009 | 6 | 2338 | 0 | 241 | 0.2 | 58.5 | 0.00 | 60 | -0.5 | 5 | | | CWG |
| | | | | | | | | | | | | | | | |
| 294 | APG-1103A-SU-25-01 | 12/17/2009 | 6 | 2338 | 0 | 256 | 0.2 | 58.5 | 0.00 | 64 | -0.5 | 16 | | | CWG |
| 295 | APG-1103A-SU-25-02 | 12/17/2009 | 6 | 2338 | 1 | 200 | 0.2 | 58.5 | 0.25 | 50 | 0.3 | -25 | | | CWG |
| 296 | APG-1103A-SU-25-03 | 12/17/2009 | 6 | 2338 | 3 | 216 | 0.2 | 58.5 | 0.75 | 54 | 2.1 | -13 | | | CWG |
| 297 | APG-1103A-SU-25-04 | 12/17/2009 | 6 | 2338 | 1 | 245 | 0.2 | 58.5 | 0.25 | 61 | 0.3 | 8 | | | CWG |
| 298 | APG-1103A-SU-25-05 | 12/17/2009 | 6 | 2338 | 1 | 224 | 0.2 | 58.5 | 0.25 | 56 | 0.3 | -7 | | | CWG |
| 299 | APG-1103A-SU-25-06 | 12/17/2009 | 6 | 2338 | 1 | 245 | 0.2 | 58.5 | 0.25 | 61 | 0.3 | 8 | | | CWG |
| 300 | APG-1103A-SU-25-07 | 12/17/2009 | 6 | 2338 | 0 | 235 | 0.2 | 58.5 | 0.00 | 59 | -0.5 | 1 | | | CWG |
| 301 | APG-1103A-SU-25-08 | 12/17/2009 | 6 | 2338 | 1 | 219 | 0.2 | 58.5 | 0.25 | 55 | 0.3 | -11 | | | CWG |
| 302 | APG-1103A-SU-25-09 | 12/17/2009 | 6 | 2338 | 1 | 223 | 0.2 | 58.5 | 0.25 | 56 | 0.3 | -8 | | | CWG |
| 303 | APG-1103A-SU-25-10 | 12/17/2009 | 6 | 2338 | 0 | 220 | 0.2 | 58.5 | 0.00 | 55 | -0.5 | -10 | | | CWG |
| 304 | APG-1103A-SU-25-11 | 12/17/2009 | 6 | 2338 | 0 | 247 | 0.2 | 58.5 | 0.00 | 62 | -0.5 | 10 | | | CWG |
| 305 | APG-1103A-SU-25-12 | 12/17/2009 | 6 | 2338 | 1 | 231 | 0.2 | 58.5 | 0.25 | 58 | 0.3 | -2 | | | CWG |
| 306 | APG-1103A-SU-25-13 | 12/17/2009 | 6 | 2338 | 2 | 222 | 0.2 | 58.5 | 0.50 | 56 | 1.2 | -9 | | | CWG |
| 307 | APG-1103A-SU-25-14 | 12/17/2009 | 6 | 2338 | 1 | 245 | 0.2 | 58.5 | 0.25 | 61 | 0.3 | 8 | | | CWG |
| 308 | APG-1103A-SU-25-15 | 12/17/2009 | 6 | 2338 | 1 | 223 | 0.2 | 58.5 | 0.25 | 56 | 0.3 | -8 | | | CWG |
| 309 | APG-1103A-SU-25-16 | 12/17/2009 | 6 | 2338 | 1 | 206 | 0.2 | 58.5 | 0.25 | 52 | 0.3 | -21 | | | CWG |
| 310 | APG-1103A-SU-25-17 | 12/17/2009 | 6 | 2338 | 1 | 257 | 0.2 | 58.5 | 0.25 | 64 | 0.3 | 17 | | | CWG |
| 311 | APG-1103A-SU-25-18 | 12/17/2009 | 6 | 2338 | 0 | 237 | 0.2 | 58.5 | 0.00 | 59 | -0.5 | 2 | | | CWG |
| 312 | APG-1103A-SU-25-19 | 12/17/2009 | 6 | 2338 | 2 | 242 | 0.2 | 58.5 | 0.50 | 61 | 1.2 | 6 | | | CWG |
| 313 | APG-1103A-SU-25-20 | 12/17/2009 | 6 | 2338 | 1 | 250 | 0.2 | 58.5 | 0.25 | 63 | 0.3 | 12 | | | CWG |
| 314 | APG-1103A-SU-25-21 | 12/17/2009 | 6 | 2338 | 2 | 212 | 0.2 | 58.5 | 0.50 | 53 | 1.2 | -16 | | | CWG |
| | | | | | | | | | | | | | | | |
| 315 | APG-1103A-SU-27-15 | 12/7/2009 | 9 | 2547 | 0 | 219 | 0.2 | 63.7 | 0.00 | 55 | -0.8 | -27 | | | CWG |
| 316 | APG-1103A-SU-27-16 | 12/7/2009 | 9 | 2547 | 1 | 244 | 0.2 | 63.7 | 0.25 | 61 | 0.1 | -8 | | | CWG |
| 317 | APG-1103A-SU-27-17 | 12/7/2009 | 9 | 2547 | 3 | 236 | 0.2 | 63.7 | 0.75 | 59 | 1.8 | -14 | | | CWG |
| 318 | APG-1103A-SU-27-18 | 12/7/2009 | 9 | 2547 | 1 | 230 | 0.2 | 63.7 | 0.25 | 58 | 0.1 | -18 | | | CWG |

## Aberdeen Proving Ground - Building 1103A Final Status Survey Results

| Ludlum 2929 SN 196230 Cal Due 11/25/10 | |
|---|---|
| α eff | β eff |
| 0.2905 | 0.3364 |

| Sample Count Time (min) | Daily Bkg Count Time (min) |
|---|---|
| 4.0 | 40.0 |

| | | | | | | | | | | | | dpm/100 cm$^2$ α Flag 10 | dpm/100 cm$^2$ β Flag 100 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| seq. # | Sample ID# | Date | Background Total Counts* | | Sample Total Counts | | Background (cpm) | | Sample Counts (cpm) | | Sample (dpm/100 cm$^2$) | | > a flag | > β flag | Tech. Initial |
| | | | α | β | α | β | α | β | α | β | α | β | FLAG | FLAG | |
| 319 | APG-1103A-SU-27-19 | 12/7/2009 | 9 | 2547 | 3 | 254 | 0.2 | 63.7 | 0.75 | 64 | 1.8 | -1 | | | CWG |
| 320 | APG-1103A-SU-27-20 | 12/7/2009 | 9 | 2547 | 0 | 214 | 0.2 | 63.7 | 0.00 | 54 | -0.8 | -30 | | | CWG |
| 321 | APG-1103A-SU-27-21 | 12/7/2009 | 9 | 2547 | 1 | 264 | 0.2 | 63.7 | 0.25 | 66 | 0.1 | 7 | | | CWG |
| 322 | APG-1103A-SU-27-22 | 12/7/2009 | 9 | 2547 | 2 | 265 | 0.2 | 63.7 | 0.50 | 66 | 0.9 | 8 | | | CWG |
| | APG-1103A-SU-27-23 | 12/7/2009 | 9 | 2547 | 3 | 226 | 0.2 | 63.7 | 0.75 | 57 | 1.8 | -21 | | | CWG |
| 323 | APG-1103A-SU-27-24 | 12/7/2009 | 9 | 2547 | 1 | 246 | 0.2 | 63.7 | 0.25 | 62 | 0.1 | -6 | | | CWG |
| | APG-1103A-SU-27-25 | 12/7/2009 | 9 | 2547 | 4 | 238 | 0.2 | 63.7 | 1.00 | 60 | 2.7 | -12 | | | CWG |
| 324 | APG-1103A-SU-27-26 | 12/7/2009 | 9 | 2547 | 2 | 223 | 0.2 | 63.7 | 0.50 | 56 | 0.9 | -24 | | | CWG |
| 325 | APG-1103A-SU-27-27 | 12/7/2009 | 9 | 2547 | 1 | 239 | 0.2 | 63.7 | 0.25 | 60 | 0.1 | -12 | | | CWG |
| 326 | APG-1103A-SU-27-28 | 12/7/2009 | 9 | 2547 | 4 | 215 | 0.2 | 63.7 | 1.00 | 54 | 2.7 | -30 | | | CWG |
| | | | | | | | | | | | | | | | |
| 1 | APG-1100E-SU-28-01 | 12/7/2009 | 9 | 2547 | 1 | 241 | 0.2 | 63.7 | 0.25 | 60 | 0.1 | -10 | | | CWG |
| 2 | APG-1100E-SU-28-02 | 12/7/2009 | 9 | 2547 | 1 | 248 | 0.2 | 63.7 | 0.25 | 62 | 0.1 | -5 | | | CWG |
| 3 | APG-1100E-SU-28-03 | 12/7/2009 | 9 | 2547 | 2 | 241 | 0.2 | 63.7 | 0.50 | 60 | 0.9 | -10 | | | CWG |
| 4 | APG-1100E-SU-28-04 | 12/7/2009 | 9 | 2547 | 1 | 242 | 0.2 | 63.7 | 0.25 | 61 | 0.1 | -9 | | | CWG |
| 5 | APG-1100E-SU-28-05 | 12/7/2009 | 9 | 2547 | 0 | 270 | 0.2 | 63.7 | 0.00 | 68 | -0.8 | 11 | | | CWG |
| 6 | APG-1100E-SU-28-06 | 12/7/2009 | 9 | 2547 | 3 | 252 | 0.2 | 63.7 | 0.75 | 63 | 1.8 | -2 | | | CWG |
| 7 | APG-1100E-SU-28-07 | 12/7/2009 | 9 | 2547 | 1 | 241 | 0.2 | 63.7 | 0.25 | 60 | 0.1 | -10 | | | CWG |
| 8 | APG-1100E-SU-28-08 | 12/7/2009 | 9 | 2547 | 1 | 225 | 0.2 | 63.7 | 0.25 | 56 | 0.1 | -22 | | | CWG |
| 9 | APG-1100E-SU-28-09 | 12/7/2009 | 9 | 2547 | 2 | 252 | 0.2 | 63.7 | 0.50 | 63 | 0.9 | -2 | | | CWG |
| 10 | APG-1100E-SU-28-10 | 12/7/2009 | 9 | 2547 | 2 | 232 | 0.2 | 63.7 | 0.50 | 58 | 0.9 | -17 | | | CWG |
| 11 | APG-1100E-SU-28-11 | 12/7/2009 | 9 | 2547 | 2 | 254 | 0.2 | 63.7 | 0.50 | 64 | 0.9 | -1 | | | CWG |
| 12 | APG-1100E-SU-28-12 | 12/7/2009 | 9 | 2547 | 1 | 251 | 0.2 | 63.7 | 0.25 | 63 | 0.1 | -3 | | | CWG |
| 13 | APG-1100E-SU-28-13 | 12/7/2009 | 9 | 2547 | 1 | 236 | 0.2 | 63.7 | 0.25 | 59 | 0.1 | -14 | | | CWG |
| 14 | APG-1100E-SU-28-14 | 12/7/2009 | 9 | 2547 | 2 | 223 | 0.2 | 63.7 | 0.50 | 56 | 0.9 | -24 | | | CWG |
| 15 | APG-1100E-SU-28-15 | 12/7/2009 | 9 | 2547 | 3 | 222 | 0.2 | 63.7 | 0.75 | 56 | 1.8 | -24 | | | CWG |
| 16 | APG-1100E-SU-28-16 | 12/7/2009 | 9 | 2547 | 1 | 231 | 0.2 | 63.7 | 0.25 | 58 | 0.1 | -18 | | | CWG |
| 17 | APG-1100E-SU-28-18 | 12/7/2009 | 9 | 2547 | 0 | 247 | 0.2 | 63.7 | 0.00 | 62 | -0.8 | -6 | | | CWG |
| 18 | APG-1100E-SU-28-19 | 12/7/2009 | 9 | 2547 | 4 | 226 | 0.2 | 63.7 | 1.00 | 57 | 2.7 | -21 | | | CWG |

# Aberdeen Proving Ground - Building 1103A Final Status Survey Results

| Ludlum 2929 SN 174039 Cal Due 08/10/10 | |
|---|---|
| α eff | β eff |
| 0.3559 | 0.1814 |

| Sample Count Time (min) | Daily Bkg Count Time (min) |
|---|---|
| 4.0 | 10.0 |

| dpm/100 cm$^2$ | |
|---|---|
| α Flag | β Flag |
| 10 | 100 |

| seq. # | Sample ID# | Date | Background Total Counts* | | Sample Total Counts | | Background (cpm) | | Sample Counts (cpm) | | Sample (dpm/100 cm$^2$) | | > a flag | > β flag | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | α | β | α | β | FLAG | FLAG | |
| 260 | BLDG 1103A,SURVEY UNIT 6,SOUTH FLOOR 6-1 | 11/5/2009 | 2 | 460 | 0 | 180 | 0 | 46 | 0 | 45 | -1 | -6 | | | JF |
| 261 | SOUTH FLOOR 6-2 | 11/5/2009 | 2 | 460 | 1 | 129 | 0 | 46 | 0 | 32 | 0 | -76 | | | JF |
| 262 | SOUTH FLOOR 6-3 | 11/5/2009 | 2 | 460 | 1 | 160 | 0 | 46 | 0 | 40 | 0 | -33 | | | JF |
| 263 | SOUTH FLOOR 6-4 | 11/5/2009 | 2 | 460 | 0 | 152 | 0 | 46 | 0 | 38 | -1 | -44 | | | JF |
| 264 | SOUTH FLOOR 6-5 | 11/5/2009 | 2 | 460 | 0 | 147 | 0 | 46 | 0 | 37 | -1 | -51 | | | JF |
| 265 | SOUTH FLOOR 6-6 | 11/5/2009 | 2 | 460 | 0 | 159 | 0 | 46 | 0 | 40 | -1 | -34 | | | JF |
| 266 | SOUTH FLOOR 6-7 | 11/5/2009 | 2 | 460 | 0 | 163 | 0 | 46 | 0 | 41 | -1 | -29 | | | JF |
| 267 | SOUTH FLOOR 6-8 | 11/5/2009 | 2 | 460 | 1 | 210 | 0 | 46 | 0 | 53 | 0 | 36 | | | JF |
| 268 | SOUTH FLOOR 6-9 | 11/5/2009 | 2 | 460 | 1 | 179 | 0 | 46 | 0 | 45 | 0 | -7 | | | JF |
| 269 | SOUTH FLOOR 6-10 | 11/5/2009 | 2 | 460 | 0 | 180 | 0 | 46 | 0 | 45 | -1 | -6 | | | JF |
| 270 | SOUTH FLOOR 6-11 | 11/5/2009 | 2 | 460 | 0 | 151 | 0 | 46 | 0 | 38 | -1 | -45 | | | JF |
| 271 | SOUTH FLOOR 6-12 | 11/5/2009 | 2 | 460 | 0 | 139 | 0 | 46 | 0 | 35 | -1 | -62 | | | JF |
| 272 | SOUTH FLOOR 6-13 | 11/5/2009 | 2 | 460 | 1 | 170 | 0 | 46 | 0 | 43 | 0 | -19 | | | JF |
| 273 | SOUTH FLOOR 6-14 | 11/5/2009 | 2 | 460 | 1 | 162 | 0 | 46 | 0 | 41 | 0 | -30 | | | JF |
| 274 | SOUTH FLOOR 6-15 | 11/5/2009 | 2 | 460 | 0 | 178 | 0 | 46 | 0 | 45 | -1 | -8 | | | JF |
| 275 | SOUTH FLOOR 6-16 | 11/5/2009 | 2 | 460 | 0 | 180 | 0 | 46 | 0 | 45 | -1 | -6 | | | JF |
| 276 | SOUTH FLOOR 6-17 | 11/5/2009 | 2 | 460 | 0 | 170 | 0 | 46 | 0 | 43 | -1 | -19 | | | JF |
| 277 | SOUTH FLOOR 6-18 | 11/5/2009 | 2 | 460 | 2 | 188 | 0 | 46 | 1 | 47 | 1 | 6 | | | JF |
| 278 | SOUTH FLOOR 6-19 | 11/5/2009 | 2 | 460 | 0 | 159 | 0 | 46 | 0 | 40 | -1 | -34 | | | JF |
| 279 | SOUTH FLOOR 6-20 | 11/5/2009 | 2 | 460 | 0 | 132 | 0 | 46 | 0 | 33 | -1 | -72 | | | JF |

## Aberdeen Proving Ground - Building 1103A Final Status Survey Results

| Ludlum 2929 SN 196230 Cal Due 12/08/09 | |
|---|---|
| α eff | β eff |
| 0.2845 | 0.3363 |

| Sample Count Time (min) | Daily Bkg Count Time (min) |
|---|---|
| 4.0 | 10.0 |

| | | | Background Total Counts* | | Sample Total Counts | | Background (cpm) | | Sample Counts (cpm) | | Sample (dpm/100 cm$^2$) | | dpm/100 cm$^2$ α Flag 10 | dpm/100 cm$^2$ β Flag 100 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| seq. # | Sample ID# | Date | α | β | α | β | α | β | α | β | α | β | > a flag FLAG | > β flag FLAG | Tech. Initial |
| 1 | APG-1103A-SU-10-01 | 11/19/2009 | 7 | 2181 | 2 | 217 | 0.2 | 54.5 | 0.50 | 54 | 1.1 | -1 | | | CWG |
| 2 | APG-1103A-SU-10-02 | 11/19/2009 | 7 | 2181 | 1 | 209 | 0.2 | 54.5 | 0.25 | 52 | 0.3 | -7 | | | CWG |
| 3 | APG-1103A-SU-10-03 | 11/19/2009 | 7 | 2181 | 1 | 218 | 0.2 | 54.5 | 0.25 | 55 | 0.3 | 0 | | | CWG |
| 4 | APG-1103A-SU-10-04 | 11/19/2009 | 7 | 2181 | 1 | 194 | 0.2 | 54.5 | 0.25 | 49 | 0.3 | -18 | | | CWG |
| 5 | APG-1103A-SU-10-05 | 11/19/2009 | 7 | 2181 | 1 | 200 | 0.2 | 54.5 | 0.25 | 50 | 0.3 | -13 | | | CWG |
| 6 | APG-1103A-SU-10-06 | 11/19/2009 | 7 | 2181 | 1 | 194 | 0.2 | 54.5 | 0.25 | 49 | 0.3 | -18 | | | CWG |
| 7 | APG-1103A-SU-10-07 | 11/19/2009 | 7 | 2181 | 0 | 212 | 0.2 | 54.5 | 0.00 | 53 | -0.6 | -5 | | | CWG |
| 8 | APG-1103A-SU-10-08 | 11/19/2009 | 7 | 2181 | 0 | 221 | 0.2 | 54.5 | 0.00 | 55 | -0.6 | 2 | | | CWG |
| 9 | APG-1103A-SU-10-09 | 11/19/2009 | 7 | 2181 | 0 | 206 | 0.2 | 54.5 | 0.00 | 52 | -0.6 | -9 | | | CWG |
| 10 | APG-1103A-SU-10-10 | 11/19/2009 | 7 | 2181 | 0 | 199 | 0.2 | 54.5 | 0.00 | 50 | -0.6 | -14 | | | CWG |
| 11 | APG-1103A-SU-10-11 | 11/19/2009 | 7 | 2181 | 1 | 242 | 0.2 | 54.5 | 0.25 | 61 | 0.3 | 18 | | | CWG |
| 12 | APG-1103A-SU-10-12 | 11/19/2009 | 7 | 2181 | 1 | 223 | 0.2 | 54.5 | 0.25 | 56 | 0.3 | 4 | | | CWG |
| 13 | APG-1103A-SU-10-13 | 11/19/2009 | 7 | 2181 | 1 | 218 | 0.2 | 54.5 | 0.25 | 55 | 0.3 | 0 | | | CWG |
| 14 | APG-1103A-SU-10-14 | 11/19/2009 | 7 | 2181 | 1 | 220 | 0.2 | 54.5 | 0.25 | 55 | 0.3 | 1 | | | CWG |
| 15 | APG-1103A-SU-10-15 | 11/19/2009 | 7 | 2181 | 0 | 216 | 0.2 | 54.5 | 0.00 | 54 | -0.6 | -2 | | | CWG |
| 16 | APG-1103A-SU-10-16 | 11/19/2009 | 7 | 2181 | 1 | 200 | 0.2 | 54.5 | 0.25 | 50 | 0.3 | -13 | | | CWG |
| 17 | APG-1103A-SU-10-17 | 11/19/2009 | 7 | 2181 | 1 | 196 | 0.2 | 54.5 | 0.25 | 49 | 0.3 | -16 | | | CWG |
| 18 | APG-1103A-SU-10-18 | 11/19/2009 | 7 | 2181 | 0 | 206 | 0.2 | 54.5 | 0.00 | 52 | -0.6 | -9 | | | CWG |
| 19 | APG-1103A-SU-10-19 | 11/19/2009 | 7 | 2181 | 2 | 222 | 0.2 | 54.5 | 0.50 | 56 | 1.1 | 3 | | | CWG |
| 20 | APG-1103A-SU-10-20 | 11/19/2009 | 7 | 2181 | 3 | 201 | 0.2 | 54.5 | 0.75 | 50 | 2.0 | -13 | | | CWG |
| 21 | APG-1103A-SU-11-01 | 11/19/2009 | 7 | 2181 | 0 | 198 | 0.2 | 54.5 | 0.00 | 50 | -0.6 | -15 | | | CWG |
| 22 | APG-1103A-SU-11-02 | 11/19/2009 | 7 | 2181 | 1 | 210 | 0.2 | 54.5 | 0.25 | 53 | 0.3 | -6 | | | CWG |
| 23 | APG-1103A-SU-11-03 | 11/19/2009 | 7 | 2181 | 11 | 241 | 0.2 | 54.5 | 2.75 | 60 | 9.0 | 17 | | | CWG |
| 24 | APG-1103A-SU-11-04 | 11/19/2009 | 7 | 2181 | 1 | 232 | 0.2 | 54.5 | 0.25 | 58 | 0.3 | 10 | | | CWG |
| 25 | APG-1103A-SU-11-05 | 11/19/2009 | 7 | 2181 | 1 | 188 | 0.2 | 54.5 | 0.25 | 47 | 0.3 | -22 | | | CWG |
| 26 | APG-1103A-SU-11-06 | 11/19/2009 | 7 | 2181 | 0 | 212 | 0.2 | 54.5 | 0.00 | 53 | -0.6 | -5 | | | CWG |
| 27 | APG-1103A-SU-11-07 | 11/19/2009 | 7 | 2181 | 1 | 216 | 0.2 | 54.5 | 0.25 | 54 | 0.3 | -2 | | | CWG |
| 28 | APG-1103A-SU-11-08 | 11/19/2009 | 7 | 2181 | 1 | 197 | 0.2 | 54.5 | 0.25 | 49 | 0.3 | -16 | | | CWG |
| 29 | APG-1103A-SU-11-09 | 11/19/2009 | 7 | 2181 | 0 | 227 | 0.2 | 54.5 | 0.00 | 57 | -0.6 | 7 | | | CWG |
| 30 | APG-1103A-SU-11-10 | 11/19/2009 | 7 | 2181 | 0 | 176 | 0.2 | 54.5 | 0.00 | 44 | -0.6 | -31 | | | CWG |
| 31 | APG-1103A-SU-11-11 | 11/19/2009 | 7 | 2181 | 3 | 218 | 0.2 | 54.5 | 0.75 | 55 | 2.0 | 0 | | | CWG |
| 32 | APG-1103A-SU-11-12 | 11/19/2009 | 7 | 2181 | 1 | 189 | 0.2 | 54.5 | 0.25 | 47 | 0.3 | -22 | | | CWG |
| 33 | APG-1103A-SU-11-13 | 11/19/2009 | 7 | 2181 | 0 | 219 | 0.2 | 54.5 | 0.00 | 55 | -0.6 | 1 | | | CWG |
| 34 | APG-1103A-SU-11-14 | 11/19/2009 | 7 | 2181 | 0 | 230 | 0.2 | 54.5 | 0.00 | 58 | -0.6 | 9 | | | CWG |
| 35 | APG-1103A-SU-11-15 | 11/19/2009 | 7 | 2181 | 1 | 220 | 0.2 | 54.5 | 0.25 | 55 | 0.3 | 1 | | | CWG |
| 36 | APG-1103A-SU-11-16 | 11/19/2009 | 7 | 2181 | 3 | 209 | 0.2 | 54.5 | 0.75 | 52 | 2.0 | -7 | | | CWG |
| 37 | APG-1103A-SU-11-17 | 11/19/2009 | 7 | 2181 | 0 | 212 | 0.2 | 54.5 | 0.00 | 53 | -0.6 | -5 | | | CWG |
| 38 | APG-1103A-SU-11-18 | 11/19/2009 | 7 | 2181 | 0 | 210 | 0.2 | 54.5 | 0.00 | 53 | -0.6 | -6 | | | CWG |

## Aberdeen Proving Ground - Building 1103A Final Status Survey Results

| Ludlum 2929 SN 196230 Cal Due 12/08/09 | |
|---|---|
| α eff | β eff |
| 0.2845 | 0.3363 |

| Sample Count Time (min) | Daily Bkg Count Time (min) |
|---|---|
| 4.0 | 10.0 |

| | | | | | | | | | | | | | dpm/100 cm$^2$ α Flag 10 | dpm/100 cm$^2$ β Flag 100 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| seq. # | Sample ID# | Date | Background Total Counts* | | Sample Total Counts | | Background (cpm) | | Sample Counts (cpm) | | Sample (dpm/100 cm$^2$) | | > a flag | > β flag | Tech. Initial |
| | | | α | β | α | β | α | β | α | β | α | β | FLAG | FLAG | |
| 39 | APG-1103A-SU-12-01 | 11/19/2009 | 7 | 2181 | 2 | 188 | 0.2 | 54.5 | 0.50 | 47 | 1.1 | -22 | | | CWG |
| 40 | APG-1103A-SU-12-02 N/A | 11/19/2009 | 7 | 2181 | 0 | 215 | 0.2 | 54.5 | 0.00 | 54 | -0.6 | -2 | | | CWG |
| 41 | APG-1103A-SU-12-03 | 11/19/2009 | 7 | 2181 | 0 | 222 | 0.2 | 54.5 | 0.00 | 56 | -0.6 | 3 | | | CWG |
| 42 | APG-1103A-SU-12-04 | 11/19/2009 | 7 | 2181 | 0 | 210 | 0.2 | 54.5 | 0.00 | 53 | -0.6 | -6 | | | CWG |
| 43 | APG-1103A-SU-12-05 | 11/19/2009 | 7 | 2181 | 1 | 233 | 0.2 | 54.5 | 0.25 | 58 | 0.3 | 11 | | | CWG |
| 44 | APG-1103A-SU-12-06 | 11/19/2009 | 7 | 2181 | 0 | 222 | 0.2 | 54.5 | 0.00 | 56 | -0.6 | 3 | | | CWG |
| 45 | APG-1103A-SU-12-07 | 11/19/2009 | 7 | 2181 | 0 | 208 | 0.2 | 54.5 | 0.00 | 52 | -0.6 | -8 | | | CWG |
| 46 | APG-1103A-SU-12-08 | 11/19/2009 | 7 | 2181 | 1 | 227 | 0.2 | 54.5 | 0.25 | 57 | 0.3 | 7 | | | CWG |
| 47 | APG-1103A-SU-12-09 | 11/19/2009 | 7 | 2181 | 0 | 194 | 0.2 | 54.5 | 0.00 | 49 | -0.6 | -18 | | | CWG |
| 48 | APG-1103A-SU-12-10 | 11/19/2009 | 7 | 2181 | 0 | 185 | 0.2 | 54.5 | 0.00 | 46 | -0.6 | -25 | | | CWG |
| 49 | APG-1103A-SU-12-11 | 11/19/2009 | 7 | 2181 | 2 | 215 | 0.2 | 54.5 | 0.50 | 54 | 1.1 | -2 | | | CWG |
| 50 | APG-1103A-SU-12-12 | 11/19/2009 | 7 | 2181 | 2 | 206 | 0.2 | 54.5 | 0.50 | 52 | 1.1 | -9 | | | CWG |
| 51 | APG-1103A-SU-12-13 | 11/19/2009 | 7 | 2181 | 1 | 231 | 0.2 | 54.5 | 0.25 | 58 | 0.3 | 10 | | | CWG |
| 52 | APG-1103A-SU-12-14 N/A | 11/19/2009 | 7 | 2181 | 0 | 204 | 0.2 | 54.5 | 0.00 | 51 | -0.6 | -10 | | | CWG |
| 53 | APG-1103A-SU-12-15 | 11/19/2009 | 7 | 2181 | 0 | 249 | 0.2 | 54.5 | 0.00 | 62 | -0.6 | 23 | | | CWG |
| 54 | APG-1103A-SU-12-16 | 11/19/2009 | 7 | 2181 | 0 | 211 | 0.2 | 54.5 | 0.00 | 53 | -0.6 | -5 | | | CWG |
| 55 | APG-1103A-SU-12-17 | 11/19/2009 | 7 | 2181 | 0 | 205 | 0.2 | 54.5 | 0.00 | 51 | -0.6 | -10 | | | CWG |
| 501 | APG-1103A-SU-12-18 | 11/19/2009 | 7 | 2181 | 0 | 206 | 0.2 | 54.5 | 0.00 | 52 | -0.6 | -9 | | | CWG |
| 502 | APG-1103A-SU-12-19 | 11/19/2009 | 7 | 2181 | 1 | 189 | 0.2 | 54.5 | 0.25 | 47 | 0.3 | -22 | | | CWG |
| 503 | APG-1103A-SU-12-20 | 11/19/2009 | 7 | 2181 | 0 | 221 | 0.2 | 54.5 | 0.00 | 55 | -0.6 | 2 | | | CWG |
| 504 | APG-1103A-SU-12A-01 | 11/19/2009 | 7 | 2181 | 0 | 217 | 0.2 | 54.5 | 0.00 | 54 | -0.6 | -1 | | | CWG |
| 505 | APG-1103A-SU-12A-02 | 11/19/2009 | 7 | 2181 | 0 | 211 | 0.2 | 54.5 | 0.00 | 53 | -0.6 | -5 | | | CWG |
| 506 | APG-1103A-SU-12A-03 | 11/19/2009 | 7 | 2181 | 2 | 192 | 0.2 | 54.5 | 0.50 | 48 | 1.1 | -19 | | | CWG |
| 507 | APG-1103A-SU-12A-04 | 11/19/2009 | 7 | 2181 | 0 | 208 | 0.2 | 54.5 | 0.00 | 52 | -0.6 | -8 | | | CWG |
| 508 | APG-1103A-SU-12A-05 | 11/19/2009 | 7 | 2181 | 0 | 231 | 0.2 | 54.5 | 0.00 | 58 | -0.6 | 10 | | | CWG |
| 509 | APG-1103A-SU-12A-06 | 11/19/2009 | 7 | 2181 | 0 | 195 | 0.2 | 54.5 | 0.00 | 49 | -0.6 | -17 | | | CWG |
| 510 | APG-1103A-SU-12A-07 | 11/19/2009 | 7 | 2181 | 1 | 213 | 0.2 | 54.5 | 0.25 | 53 | 0.3 | -4 | | | CWG |
| 511 | APG-1103A-SU-12A-08 | 11/19/2009 | 7 | 2181 | 0 | 231 | 0.2 | 54.5 | 0.00 | 58 | -0.6 | 10 | | | CWG |
| 512 | APG-1103A-SU-12A-09 | 11/19/2009 | 7 | 2181 | 0 | 225 | 0.2 | 54.5 | 0.00 | 56 | -0.6 | 5 | | | CWG |
| 513 | APG-1103A-SU-12A-10 | 11/19/2009 | 7 | 2181 | 1 | 212 | 0.2 | 54.5 | 0.25 | 53 | 0.3 | -5 | | | CWG |
| 514 | APG-1103A-SU-12A-11 | 11/20/2009 | 10 | 2181 | 2 | 199 | 0.3 | 54.5 | 0.50 | 50 | 0.9 | -14 | | | CWG |
| 515 | APG-1103A-SU-12A-12 | 11/20/2009 | 10 | 2181 | 2 | 227 | 0.3 | 54.5 | 0.50 | 57 | 0.9 | 7 | | | CWG |
| 516 | APG-1103A-SU-12A-13 | 11/20/2009 | 10 | 2181 | 0 | 237 | 0.3 | 54.5 | 0.00 | 59 | -0.9 | 14 | | | CWG |
| 517 | APG-1103A-SU-12A-14 | 11/20/2009 | 10 | 2181 | 1 | 218 | 0.3 | 54.5 | 0.25 | 55 | 0.0 | 0 | | | CWG |
| 518 | APG-1103A-SU-12A-15 | 11/20/2009 | 10 | 2181 | 4 | 223 | 0.3 | 54.5 | 1.00 | 56 | 2.6 | 4 | | | CWG |
| 519 | APG-1103A-SU-12A-16 | 11/20/2009 | 10 | 2181 | 0 | 213 | 0.3 | 54.5 | 0.00 | 53 | -0.9 | -4 | | | CWG |
| 520 | APG-1103A-SU-12A-17 | 11/20/2009 | 10 | 2181 | 3 | 222 | 0.3 | 54.5 | 0.75 | 56 | 1.8 | 3 | | | CWG |
| 521 | APG-1103A-SU-12A-18 | 11/20/2009 | 10 | 2181 | 1 | 246 | 0.3 | 54.5 | 0.25 | 62 | 0.0 | 21 | | | CWG |

## Aberdeen Proving Ground - Building 1103A Final Status Survey Results

| Ludlum 2929 SN 196230 Cal Due 12/08/09 | |
|---|---|
| α eff | β eff |
| 0.2845 | 0.3363 |

| Sample Count Time (min) | Daily Bkg Count Time (min) |
|---|---|
| 4.0 | 10.0 |

| | | | | | | | | | | | | dpm/100 cm² | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | α Flag | β Flag | | |
| | | | | | | | | | | | | 10 | 100 | | |
| seq. # | Sample ID# | Date | Background Total Counts* | | Sample Total Counts | | Background (cpm) | | Sample Counts (cpm) | | Sample (dpm/100 cm²) | | > a flag | > β flag | Tech. Initial |
| | | | α | β | α | β | α | β | α | β | α | β | FLAG | FLAG | |
| 522 | APG-1103A-SU-12A-19 | 11/20/2009 | 10 | 2181 | 0 | 204 | 0.3 | 54.5 | 0.00 | 51 | -0.9 | -10 | | | CWG |
| 523 | APG-1103A-SU-12A-20 | 11/20/2009 | 10 | 2181 | 2 | 259 | 0.3 | 54.5 | 0.50 | 65 | 0.9 | 30 | | | CWG |
| 524 | APG-1103A-SU-12B-01 | 11/20/2009 | 10 | 2181 | 3 | 219 | 0.3 | 54.5 | 0.75 | 55 | 1.8 | 1 | | | CWG |
| 525 | APG-1103A-SU-12B-02 | 11/20/2009 | 10 | 2181 | 4 | 243 | 0.3 | 54.5 | 1.00 | 61 | 2.6 | 19 | | | CWG |
| 526 | APG-1103A-SU-12B-03 | 11/20/2009 | 10 | 2181 | 4 | 227 | 0.3 | 54.5 | 1.00 | 57 | 2.6 | 7 | | | CWG |
| 527 | APG-1103A-SU-12B-04 | 11/20/2009 | 10 | 2181 | 6 | 225 | 0.3 | 54.5 | 1.50 | 56 | 4.4 | 5 | | | CWG |
| 528 | APG-1103A-SU-12B-05 | 11/20/2009 | 10 | 2181 | 1 | 222 | 0.3 | 54.5 | 0.25 | 56 | 0.0 | 3 | | | CWG |
| 529 | APG-1103A-SU-12B-06 | 11/20/2009 | 10 | 2181 | 1 | 230 | 0.3 | 54.5 | 0.25 | 58 | 0.0 | 9 | | | CWG |
| 530 | APG-1103A-SU-12B-07 | 11/20/2009 | 10 | 2181 | 8 | 210 | 0.3 | 54.5 | 2.00 | 53 | 6.2 | -6 | | | CWG |
| 531 | APG-1103A-SU-12B-08 | 11/20/2009 | 10 | 2181 | 5 | 250 | 0.3 | 54.5 | 1.25 | 63 | 3.5 | 24 | | | CWG |
| 532 | APG-1103A-SU-12B-09 | 11/20/2009 | 10 | 2181 | 3 | 216 | 0.3 | 54.5 | 0.75 | 54 | 1.8 | -2 | | | CWG |
| 533 | APG-1103A-SU-12B-10 | 11/20/2009 | 10 | 2181 | 1 | 198 | 0.3 | 54.5 | 0.25 | 50 | 0.0 | -15 | | | CWG |
| 534 | APG-1103A-SU-12B-11 | 11/20/2009 | 10 | 2181 | 2 | 215 | 0.3 | 54.5 | 0.50 | 54 | 0.9 | -2 | | | CWG |
| 535 | APG-1103A-SU-12B-12 | 11/20/2009 | 10 | 2181 | 12 | 249 | 0.3 | 54.5 | 3.00 | 62 | 9.7 | 23 | | | CWG |
| 536 | APG-1103A-SU-12B-13 | 11/20/2009 | 10 | 2181 | 6 | 211 | 0.3 | 54.5 | 1.50 | 53 | 4.4 | -5 | | | CWG |
| 537 | APG-1103A-SU-12B-14 | 11/20/2009 | 10 | 2181 | 6 | 259 | 0.3 | 54.5 | 1.50 | 65 | 4.4 | 30 | | | CWG |
| 538 | APG-1103A-SU-12B-15 | 11/20/2009 | 10 | 2181 | 2 | 221 | 0.3 | 54.5 | 0.50 | 55 | 0.9 | 2 | | | CWG |
| 539 | APG-1103A-SU-12B-16 | 11/20/2009 | 10 | 2181 | 0 | 210 | 0.3 | 54.5 | 0.00 | 53 | -0.9 | -6 | | | CWG |
| 540 | APG-1103A-SU-12B-17 | 11/20/2009 | 10 | 2181 | 1 | 199 | 0.3 | 54.5 | 0.25 | 50 | 0.0 | -14 | | | CWG |
| 541 | APG-1103A-SU-12B-18 | 11/20/2009 | 10 | 2181 | 7 | 242 | 0.3 | 54.5 | 1.75 | 61 | 5.3 | 18 | | | CWG |
| 542 | APG-1103A-SU-12B-19 | 11/20/2009 | 10 | 2181 | 1 | 212 | 0.3 | 54.5 | 0.25 | 53 | 0.0 | -5 | | | CWG |
| 543 | APG-1103A-SU-12B-20 | 11/20/2009 | 10 | 2181 | 0 | 192 | 0.3 | 54.5 | 0.00 | 48 | -0.9 | -19 | | | CWG |
| 544 | APG-1103A-SU-13-01 | 11/20/2009 | 10 | 2181 | 1 | 207 | 0.3 | 54.5 | 0.25 | 52 | 0.0 | -8 | | | CWG |
| 545 | APG-1103A-SU-13-02 | 11/20/2009 | 10 | 2181 | 1 | 224 | 0.3 | 54.5 | 0.25 | 56 | 0.0 | 4 | | | CWG |
| 546 | APG-1103A-SU-13-03 | 11/20/2009 | 10 | 2181 | 2 | 207 | 0.3 | 54.5 | 0.50 | 52 | 0.9 | -8 | | | CWG |
| 547 | APG-1103A-SU-13-04 | 11/20/2009 | 10 | 2181 | 1 | 208 | 0.3 | 54.5 | 0.25 | 52 | 0.0 | -8 | | | CWG |
| 548 | APG-1103A-SU-13-05 | 11/20/2009 | 10 | 2181 | 0 | 200 | 0.3 | 54.5 | 0.00 | 50 | -0.9 | -13 | | | CWG |
| 549 | APG-1103A-SU-13-06 | 11/20/2009 | 10 | 2181 | 4 | 217 | 0.3 | 54.5 | 1.00 | 54 | 2.6 | -1 | | | CWG |
| 550 | APG-1103A-SU-13-07 | 11/20/2009 | 10 | 2181 | 1 | 214 | 0.3 | 54.5 | 0.25 | 54 | 0.0 | -3 | | | CWG |
| 551 | APG-1103A-SU-13-08 | 11/20/2009 | 10 | 2181 | 2 | 207 | 0.3 | 54.5 | 0.50 | 52 | 0.9 | -8 | | | CWG |
| 552 | APG-1103A-SU-13-09 | 11/20/2009 | 10 | 2181 | 1 | 207 | 0.3 | 54.5 | 0.25 | 52 | 0.0 | -8 | | | CWG |
| 553 | APG-1103A-SU-13-10 | 11/20/2009 | 10 | 2181 | 1 | 237 | 0.3 | 54.5 | 0.25 | 59 | 0.0 | 14 | | | CWG |
| 554 | APG-1103A-SU-13-11 | 11/20/2009 | 10 | 2181 | 3 | 226 | 0.3 | 54.5 | 0.75 | 57 | 1.8 | 6 | | | CWG |
| 555 | APG-1103A-SU-13-12 | 11/20/2009 | 10 | 2181 | 1 | 205 | 0.3 | 54.5 | 0.25 | 51 | 0.0 | -10 | | | CWG |
| 556 | APG-1103A-SU-13-13 | 11/20/2009 | 10 | 2181 | 0 | 231 | 0.3 | 54.5 | 0.00 | 58 | -0.9 | 10 | | | CWG |
| 557 | APG-1103A-SU-13-14 | 11/20/2009 | 10 | 2181 | 0 | 223 | 0.3 | 54.5 | 0.00 | 56 | -0.9 | 4 | | | CWG |
| 558 | APG-1103A-SU-13-15 | 11/20/2009 | 10 | 2181 | 0 | 222 | 0.3 | 54.5 | 0.00 | 56 | -0.9 | 3 | | | CWG |
| 559 | APG-1103A-SU-13-16 | 11/20/2009 | 10 | 2181 | 2 | 218 | 0.3 | 54.5 | 0.50 | 55 | 0.9 | 0 | | | CWG |

## Aberdeen Proving Ground - Building 1103A Final Status Survey Results

| Ludlum 2929 SN 196230 Cal Due 12/08/09 | |
|---|---|
| α eff | β eff |
| 0.2845 | 0.3363 |

| Sample Count Time (min) | Daily Bkg Count Time (min) |
|---|---|
| 4.0 | 10.0 |

| | | | | | | | | | | | | | dpm/100 cm$^2$ α Flag: 10 | dpm/100 cm$^2$ β Flag: 100 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| seq. # | Sample ID# | Date | Background Total Counts* | | Sample Total Counts | | Background (cpm) | | Sample Counts (cpm) | | Sample (dpm/100 cm$^2$) | | > a flag | > β flag | Tech. Initial |
| | | | α | β | α | β | α | β | α | β | α | β | FLAG | FLAG | |
| 560 | APG-1103A-SU-13-17 | 11/20/2009 | 10 | 2181 | 1 | 220 | 0.3 | 54.5 | 0.25 | 55 | 0.0 | 1 | | | CWG |
| 561 | APG-1103A-SU-13-18 | 11/20/2009 | 10 | 2181 | 2 | 232 | 0.3 | 54.5 | 0.50 | 58 | 0.9 | 10 | | | CWG |
| 562 | APG-1103A-SU-13-19 | 11/20/2009 | 10 | 2181 | 1 | 213 | 0.3 | 54.5 | 0.25 | 53 | 0.0 | -4 | | | CWG |
| 563 | APG-1103A-SU-13-20 | 11/20/2009 | 10 | 2181 | 1 | 228 | 0.3 | 54.5 | 0.25 | 57 | 0.0 | 7 | | | CWG |
| 564 | APG-1103A-SU-29-01 | 11/16/2009 | 9 | 2171 | 0 | 221 | 0.2 | 54.3 | 0.00 | 55 | -0.8 | 3 | | | CWG |
| 565 | APG-1103A-SU-29-02 | 11/16/2009 | 9 | 2171 | 0 | 224 | 0.2 | 54.3 | 0.00 | 56 | -0.8 | 5 | | | CWG |
| 566 | APG-1103A-SU-29-03 | 11/16/2009 | 9 | 2171 | 1 | 212 | 0.2 | 54.3 | 0.25 | 53 | 0.1 | -4 | | | CWG |
| 567 | APG-1103A-SU-29-04 | 11/16/2009 | 9 | 2171 | 0 | 222 | 0.2 | 54.3 | 0.00 | 56 | -0.8 | 4 | | | CWG |
| 568 | APG-1103A-SU-29-05 | 11/16/2009 | 9 | 2171 | 0 | 203 | 0.2 | 54.3 | 0.00 | 51 | -0.8 | -10 | | | CWG |
| 569 | APG-1103A-SU-29-06 | 11/16/2009 | 9 | 2171 | 0 | 216 | 0.2 | 54.3 | 0.00 | 54 | -0.8 | -1 | | | CWG |
| 570 | APG-1103A-SU-29-07 | 11/16/2009 | 9 | 2171 | 2 | 230 | 0.2 | 54.3 | 0.50 | 58 | 1.0 | 10 | | | CWG |
| 571 | APG-1103A-SU-29-08 | 11/16/2009 | 9 | 2171 | 0 | 208 | 0.2 | 54.3 | 0.00 | 52 | -0.8 | -7 | | | CWG |
| 572 | APG-1103A-SU-29-09 | 11/16/2009 | 9 | 2171 | 2 | 199 | 0.2 | 54.3 | 0.50 | 50 | 1.0 | -13 | | | CWG |
| 573 | APG-1103A-SU-29-10 | 11/16/2009 | 9 | 2171 | 4 | 209 | 0.2 | 54.3 | 1.00 | 52 | 2.7 | -6 | | | CWG |
| 574 | APG-1103A-SU-29-11 | 11/16/2009 | 9 | 2171 | 0 | 209 | 0.2 | 54.3 | 0.00 | 52 | -0.8 | -6 | | | CWG |
| 575 | APG-1103A-SU-29-12 | 11/16/2009 | 9 | 2171 | 0 | 203 | 0.2 | 54.3 | 0.00 | 51 | -0.8 | -10 | | | CWG |
| 576 | APG-1103A-SU-29-13 | 11/16/2009 | 9 | 2171 | 3 | 208 | 0.2 | 54.3 | 0.75 | 52 | 1.8 | -7 | | | CWG |
| 577 | APG-1103A-SU-29-14 | 11/16/2009 | 9 | 2171 | 0 | 213 | 0.2 | 54.3 | 0.00 | 53 | -0.8 | -3 | | | CWG |
| 578 | APG-1103A-SU-29-15 | 11/16/2009 | 9 | 2171 | 3 | 226 | 0.2 | 54.3 | 0.75 | 57 | 1.8 | 7 | | | CWG |
| 579 | APG-1103A-SU-29-16 | 11/16/2009 | 9 | 2171 | 0 | 234 | 0.2 | 54.3 | 0.00 | 59 | -0.8 | 13 | | | CWG |
| 580 | APG-1103A-SU-29-17 | 11/16/2009 | 9 | 2171 | 2 | 217 | 0.2 | 54.3 | 0.50 | 54 | 1.0 | 0 | | | CWG |
| 581 | APG-1103A-SU-29-18 | 11/16/2009 | 9 | 2171 | 1 | 214 | 0.2 | 54.3 | 0.25 | 54 | 0.1 | -2 | | | CWG |
| 582 | APG-1103A-SU-29-19 | 11/16/2009 | 9 | 2171 | 0 | 205 | 0.2 | 54.3 | 0.00 | 51 | -0.8 | -9 | | | CWG |
| 583 | APG-1103A-SU-29-20 | 11/16/2009 | 9 | 2171 | 1 | 230 | 0.2 | 54.3 | 0.25 | 58 | 0.1 | 10 | | | CWG |
| 320 | APG-1103A-SU5-01 | 11/12/2009 | 7 | 2007 | 2 | 195 | 0.2 | 50.2 | 0.50 | 49 | 1.1 | -4 | | | CWG |
| 321 | APG-1103A-SU5-02 | 11/12/2009 | 7 | 2007 | 1 | 223 | 0.2 | 50.2 | 0.25 | 56 | 0.3 | 17 | | | CWG |
| 322 | APG-1103A-SU5-03 | 11/12/2009 | 7 | 2007 | 1 | 232 | 0.2 | 50.2 | 0.25 | 58 | 0.3 | 23 | | | CWG |
| 323 | APG-1103A-SU5-04 | 11/12/2009 | 7 | 2007 | 0 | 222 | 0.2 | 50.2 | 0.00 | 56 | -0.6 | 16 | | | CWG |
| 324 | APG-1103A-SU5-05 | 11/12/2009 | 7 | 2007 | 0 | 212 | 0.2 | 50.2 | 0.00 | 53 | -0.6 | 8 | | | CWG |
| 325 | APG-1103A-SU5-06 | 11/12/2009 | 7 | 2007 | 0 | 214 | 0.2 | 50.2 | 0.00 | 54 | -0.6 | 10 | | | CWG |
| 326 | APG-1103A-SU5-07 | 11/12/2009 | 7 | 2007 | 2 | 208 | 0.2 | 50.2 | 0.50 | 52 | 1.1 | 5 | | | CWG |
| 327 | APG-1103A-SU5-08 | 11/12/2009 | 7 | 2007 | 1 | 225 | 0.2 | 50.2 | 0.25 | 56 | 0.3 | 18 | | | CWG |
| 328 | APG-1103A-SU5-09 | 11/12/2009 | 7 | 2007 | 1 | 216 | 0.2 | 50.2 | 0.25 | 54 | 0.3 | 11 | | | CWG |
| 329 | APG-1103A-SU5-10 | 11/12/2009 | 7 | 2007 | 1 | 216 | 0.2 | 50.2 | 0.25 | 54 | 0.3 | 11 | | | CWG |
| 330 | APG-1103A-SU5-11 | 11/12/2009 | 7 | 2007 | 0 | 242 | 0.2 | 50.2 | 0.00 | 61 | -0.6 | 31 | | | CWG |
| 331 | APG-1103A-SU5-12 | 11/12/2009 | 7 | 2007 | 1 | 195 | 0.2 | 50.2 | 0.25 | 49 | 0.3 | -4 | | | CWG |
| 332 | APG-1103A-SU5-13 | 11/12/2009 | 7 | 2007 | 1 | 198 | 0.2 | 50.2 | 0.25 | 50 | 0.3 | -2 | | | CWG |
| 333 | APG-1103A-SU5-14 | 11/12/2009 | 7 | 2007 | 0 | 189 | 0.2 | 50.2 | 0.00 | 47 | -0.6 | -9 | | | CWG |

## Aberdeen Proving Ground - Building 1103A Final Status Survey Results

| Ludlum 2929 SN 196230 Cal Due 12/08/09 | |
|---|---|
| α eff | β eff |
| 0.2845 | 0.3363 |

| Sample Count Time (min) | Daily Bkg Count Time (min) |
|---|---|
| 4.0 | 10.0 |

| | | | dpm/100 cm$^2$ | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | α Flag | β Flag | |
| | | | | | | | | | | | | | 10 | 100 | |
| seq. # | Sample ID# | Date | Background Total Counts* | | Sample Total Counts | | Background (cpm) | | Sample Counts (cpm) | | Sample (dpm/100 cm$^2$) | | > a flag | > β flag | Tech. Initial |
| | | | α | β | α | β | α | β | α | β | α | β | FLAG | FLAG | |
| 334 | APG-1103A-SU5-15 | 11/12/2009 | 7 | 2007 | 0 | 212 | 0.2 | 50.2 | 0.00 | 53 | -0.6 | 8 | | | CWG |
| 335 | APG-1103A-SU5-16 | 11/12/2009 | 7 | 2007 | 2 | 211 | 0.2 | 50.2 | 0.50 | 53 | 1.1 | 8 | | | CWG |
| 336 | APG-1103A-SU5-17 | 11/12/2009 | 7 | 2007 | 1 | 194 | 0.2 | 50.2 | 0.25 | 49 | 0.3 | -5 | | | CWG |
| 337 | APG-1103A-SU5-18 | 11/12/2009 | 7 | 2007 | 0 | 196 | 0.2 | 50.2 | 0.00 | 49 | -0.6 | -3 | | | CWG |
| 338 | APG-1103A-SU5-19 | 11/12/2009 | 7 | 2007 | 0 | 221 | 0.2 | 50.2 | 0.00 | 55 | -0.6 | 15 | | | CWG |
| 339 | APG-1103A-SU5-20 | 11/12/2009 | 7 | 2007 | 0 | 211 | 0.2 | 50.2 | 0.00 | 53 | -0.6 | 8 | | | CWG |
| 340 | APG-1103A-SU7-01 | 11/13/2009 | 5 | 2145 | 2 | 213 | 0.1 | 53.6 | 0.50 | 53 | 1.3 | -1 | | | CWG |
| 341 | APG-1103A-SU7-02 | 11/13/2009 | 5 | 2145 | 0 | 215 | 0.1 | 53.6 | 0.00 | 54 | -0.4 | 0 | | | CWG |
| 342 | APG-1103A-SU7-03 | 11/13/2009 | 5 | 2145 | 1 | 220 | 0.1 | 53.6 | 0.25 | 55 | 0.4 | 4 | | | CWG |
| 343 | APG-1103A-SU7-04 | 11/13/2009 | 5 | 2145 | 0 | 230 | 0.1 | 53.6 | 0.00 | 58 | -0.4 | 12 | | | CWG |
| 344 | APG-1103A-SU7-05 | 11/13/2009 | 5 | 2145 | 3 | 205 | 0.1 | 53.6 | 0.75 | 51 | 2.2 | -7 | | | CWG |
| 345 | APG-1103A-SU7-06 | 11/13/2009 | 5 | 2145 | 0 | 211 | 0.1 | 53.6 | 0.00 | 53 | -0.4 | -3 | | | CWG |
| 346 | APG-1103A-SU7-07 | 11/13/2009 | 5 | 2145 | 0 | 205 | 0.1 | 53.6 | 0.00 | 51 | -0.4 | -7 | | | CWG |
| 347 | APG-1103A-SU7-08 | 11/13/2009 | 5 | 2145 | 1 | 211 | 0.1 | 53.6 | 0.25 | 53 | 0.4 | -3 | | | CWG |
| 348 | APG-1103A-SU7-09 | 11/13/2009 | 5 | 2145 | 1 | 215 | 0.1 | 53.6 | 0.25 | 54 | 0.4 | 0 | | | CWG |
| 349 | APG-1103A-SU7-10 | 11/13/2009 | 5 | 2145 | 0 | 203 | 0.1 | 53.6 | 0.00 | 51 | -0.4 | -9 | | | CWG |
| 350 | APG-1103A-SU7-11 | 11/13/2009 | 5 | 2145 | 0 | 196 | 0.1 | 53.6 | 0.00 | 49 | -0.4 | -14 | | | CWG |
| 351 | APG-1103A-SU7-12 | 11/13/2009 | 5 | 2145 | 0 | 209 | 0.1 | 53.6 | 0.00 | 52 | -0.4 | -4 | | | CWG |
| 352 | APG-1103A-SU7-13 | 11/13/2009 | 5 | 2145 | 0 | 193 | 0.1 | 53.6 | 0.00 | 48 | -0.4 | -16 | | | CWG |
| 353 | APG-1103A-SU7-14 | 11/13/2009 | 5 | 2145 | 0 | 204 | 0.1 | 53.6 | 0.00 | 51 | -0.4 | -8 | | | CWG |
| 354 | APG-1103A-SU7-15 | 11/13/2009 | 5 | 2145 | 0 | 217 | 0.1 | 53.6 | 0.00 | 54 | -0.4 | 2 | | | CWG |
| 355 | APG-1103A-SU7-16 | 11/13/2009 | 5 | 2145 | 0 | 223 | 0.1 | 53.6 | 0.00 | 56 | -0.4 | 6 | | | CWG |
| 356 | APG-1103A-SU7-17 | 11/13/2009 | 5 | 2145 | 0 | 226 | 0.1 | 53.6 | 0.00 | 57 | -0.4 | 9 | | | CWG |
| 357 | APG-1103A-SU7-18 | 11/13/2009 | 5 | 2145 | 0 | 216 | 0.1 | 53.6 | 0.00 | 54 | -0.4 | 1 | | | CWG |
| 358 | APG-1103A-SU7-18/EW | 11/13/2009 | 5 | 2145 | 0 | 213 | 0.1 | 53.6 | 0.00 | 53 | -0.4 | -1 | | | CWG |
| 359 | APG-1103A-SU7-19 | 11/13/2009 | 5 | 2145 | 0 | 205 | 0.1 | 53.6 | 0.00 | 51 | -0.4 | -7 | | | CWG |
| 360 | APG-1103A-SU7-20 | 11/13/2009 | 5 | 2145 | 3 | 211 | 0.1 | 53.6 | 0.75 | 53 | 2.2 | -3 | | | CWG |
| 361 | APG-1103A-SU8-01 | 11/16/2009 | 9 | 2171 | 0 | 213 | 0.2 | 54.3 | 0.00 | 53 | -0.8 | -3 | | | CWG |
| 362 | APG-1103A-SU8-02 | 11/16/2009 | 9 | 2171 | 1 | 198 | 0.2 | 54.3 | 0.25 | 50 | 0.1 | -14 | | | CWG |
| 363 | APG-1103A-SU8-03 | 11/16/2009 | 9 | 2171 | 0 | 216 | 0.2 | 54.3 | 0.00 | 54 | -0.8 | -1 | | | CWG |
| 364 | APG-1103A-SU8-04 | 11/16/2009 | 9 | 2171 | 2 | 194 | 0.2 | 54.3 | 0.50 | 49 | 1.0 | -17 | | | CWG |
| 365 | APG-1103A-SU8-05 | 11/16/2009 | 9 | 2171 | 2 | 182 | 0.2 | 54.3 | 0.50 | 46 | 1.0 | -26 | | | CWG |
| 366 | APG-1103A-SU8-06 | 11/16/2009 | 9 | 2171 | 0 | 197 | 0.2 | 54.3 | 0.00 | 49 | -0.8 | -15 | | | CWG |
| 367 | APG-1103A-SU8-07 | 11/16/2009 | 9 | 2171 | 26 | 246 | 0.2 | 54.3 | 6.50 | 62 | 22.1 | 21 | FLAG | | CWG |
| 368 | APG-1103A-SU8-08 | 11/16/2009 | 9 | 2171 | 1 | 227 | 0.2 | 54.3 | 0.25 | 57 | 0.1 | 7 | | | CWG |
| 369 | APG-1103A-SU8-09 | 11/16/2009 | 9 | 2171 | 0 | 222 | 0.2 | 54.3 | 0.00 | 56 | -0.8 | 4 | | | CWG |
| 370 | APG-1103A-SU8-10 | 11/16/2009 | 9 | 2171 | 5 | 206 | 0.2 | 54.3 | 1.25 | 52 | 3.6 | -8 | | | CWG |
| 371 | APG-1103A-SU8-11 | 11/16/2009 | 9 | 2171 | 0 | 198 | 0.2 | 54.3 | 0.00 | 50 | -0.8 | -14 | | | CWG |

## Aberdeen Proving Ground - Building 1103A Final Status Survey Results

| Ludlum 2929 SN 196230 Cal Due 12/08/09 | |
|---|---|
| α eff | β eff |
| 0.2845 | 0.3363 |

| Sample Count Time (min) | Daily Bkg Count Time (min) |
|---|---|
| 4.0 | 10.0 |

| | | | | | | | | | | | | | dpm/100 cm$^2$ α Flag 10 | dpm/100 cm$^2$ β Flag 100 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| seq. # | Sample ID# | Date | Background Total Counts* | | Sample Total Counts | | Background (cpm) | | Sample Counts (cpm) | | Sample (dpm/100 cm$^2$) | | > a flag | > β flag | Tech. Initial |
| | | | α | β | α | β | α | β | α | β | α | β | FLAG | FLAG | |
| 372 | APG-1103A-SU8-12 | 11/16/2009 | 9 | 2171 | 1 | 227 | 0.2 | 54.3 | 0.25 | 57 | 0.1 | 7 | | | CWG |
| 373 | APG-1103A-SU8-13 | 11/16/2009 | 9 | 2171 | 0 | 244 | 0.2 | 54.3 | 0.00 | 61 | -0.8 | 20 | | | CWG |
| 374 | APG-1103A-SU8-14 | 11/16/2009 | 9 | 2171 | 0 | 223 | 0.2 | 54.3 | 0.00 | 56 | -0.8 | 4 | | | CWG |
| 375 | APG-1103A-SU8-15 | 11/16/2009 | 9 | 2171 | 1 | 204 | 0.2 | 54.3 | 0.25 | 51 | 0.1 | -10 | | | CWG |
| 376 | APG-1103A-SU8-16 | 11/16/2009 | 9 | 2171 | 1 | 215 | 0.2 | 54.3 | 0.25 | 54 | 0.1 | -2 | | | CWG |
| 377 | APG-1103A-SU8-17 | 11/16/2009 | 9 | 2171 | 0 | 240 | 0.2 | 54.3 | 0.00 | 60 | -0.8 | 17 | | | CWG |
| 378 | APG-1103A-SU8-18 | 11/16/2009 | 9 | 2171 | 1 | 224 | 0.2 | 54.3 | 0.25 | 56 | 0.1 | 5 | | | CWG |
| 379 | APG-1103A-SU8-19 | 11/16/2009 | 9 | 2171 | 1 | 249 | 0.2 | 54.3 | 0.25 | 62 | 0.1 | 24 | | | CWG |
| 380 | APG-1103A-SU8-20 | 11/16/2009 | 9 | 2171 | 0 | 231 | 0.2 | 54.3 | 0.00 | 58 | -0.8 | 10 | | | CWG |
| 381 | APG-1103A-SU-9-01 | 11/19/2009 | 7 | 2181 | 1 | 194 | 0.2 | 54.5 | 0.25 | 49 | 0.3 | -18 | | | CWG |
| 382 | APG-1103A-SU-9-02 | 11/19/2009 | 7 | 2181 | 1 | 218 | 0.2 | 54.5 | 0.25 | 55 | 0.3 | 0 | | | CWG |
| 383 | APG-1103A-SU-9-03 | 11/19/2009 | 7 | 2181 | 0 | 206 | 0.2 | 54.5 | 0.00 | 52 | -0.6 | -9 | | | CWG |
| 384 | APG-1103A-SU-9-04 | 11/19/2009 | 7 | 2181 | 2 | 221 | 0.2 | 54.5 | 0.50 | 55 | 1.1 | 2 | | | CWG |
| 385 | APG-1103A-SU-9-05 | 11/19/2009 | 7 | 2181 | 1 | 239 | 0.2 | 54.5 | 0.25 | 60 | 0.3 | 16 | | | CWG |
| 386 | APG-1103A-SU-9-06 | 11/19/2009 | 7 | 2181 | 2 | 188 | 0.2 | 54.5 | 0.50 | 47 | 1.1 | -22 | | | CWG |
| 387 | APG-1103A-SU-9-07 | 11/19/2009 | 7 | 2181 | 0 | 233 | 0.2 | 54.5 | 0.00 | 58 | -0.6 | 11 | | | CWG |
| 388 | APG-1103A-SU-9-08 | 11/19/2009 | 7 | 2181 | 1 | 230 | 0.2 | 54.5 | 0.25 | 58 | 0.3 | 9 | | | CWG |
| 389 | APG-1103A-SU-9-09 | 11/19/2009 | 7 | 2181 | 2 | 231 | 0.2 | 54.5 | 0.50 | 58 | 1.1 | 10 | | | CWG |
| 390 | APG-1103A-SU-9-10 | 11/19/2009 | 7 | 2181 | 2 | 229 | 0.2 | 54.5 | 0.50 | 57 | 1.1 | 8 | | | CWG |
| 391 | APG-1103A-SU-9-11 | 11/19/2009 | 7 | 2181 | 1 | 226 | 0.2 | 54.5 | 0.25 | 57 | 0.3 | 6 | | | CWG |
| 392 | APG-1103A-SU-9-12 | 11/19/2009 | 7 | 2181 | 0 | 228 | 0.2 | 54.5 | 0.00 | 57 | -0.6 | 7 | | | CWG |
| 393 | APG-1103A-SU-9-13 | 11/19/2009 | 7 | 2181 | 1 | 200 | 0.2 | 54.5 | 0.25 | 50 | 0.3 | -13 | | | CWG |
| 394 | APG-1103A-SU-9-14 | 11/19/2009 | 7 | 2181 | 1 | 192 | 0.2 | 54.5 | 0.25 | 48 | 0.3 | -19 | | | CWG |
| 395 | APG-1103A-SU-9-15 | 11/19/2009 | 7 | 2181 | 0 | 225 | 0.2 | 54.5 | 0.00 | 56 | -0.6 | 5 | | | CWG |
| 396 | APG-1103A-SU-9-16 | 11/19/2009 | 7 | 2181 | 1 | 204 | 0.2 | 54.5 | 0.25 | 51 | 0.3 | -10 | | | CWG |
| 397 | APG-1103A-SU-9-17 | 11/19/2009 | 7 | 2181 | 1 | 210 | 0.2 | 54.5 | 0.25 | 53 | 0.3 | -6 | | | CWG |
| 398 | APG-1103A-SU-9-18 | 11/19/2009 | 7 | 2181 | 1 | 195 | 0.2 | 54.5 | 0.25 | 49 | 0.3 | -17 | | | CWG |
| 399 | APG-1103A-SU-9-19 | 11/19/2009 | 7 | 2181 | 0 | 221 | 0.2 | 54.5 | 0.00 | 55 | -0.6 | 2 | | | CWG |
| 400 | APG-1103A-SU-9-20 | 11/19/2009 | 7 | 2181 | 0 | 211 | 0.2 | 54.5 | 0.00 | 53 | -0.6 | -5 | | | CWG |
| 401 | APG-1103B-SU-26-001 | 11/16/2009 | 9 | 2171 | 1 | 223 | 0.2 | 54.3 | 0.25 | 56 | 0.1 | 4 | | | CWG |
| 402 | APG-1103B-SU-26-002 | 11/16/2009 | 9 | 2171 | 0 | 202 | 0.2 | 54.3 | 0.00 | 51 | -0.8 | -11 | | | CWG |
| 403 | APG-1103B-SU-26-003 | 11/16/2009 | 9 | 2171 | 1 | 202 | 0.2 | 54.3 | 0.25 | 51 | 0.1 | -11 | | | CWG |
| 404 | APG-1103B-SU-26-004 | 11/16/2009 | 9 | 2171 | 2 | 205 | 0.2 | 54.3 | 0.50 | 51 | 1.0 | -9 | | | CWG |
| 405 | APG-1103B-SU-26-005 | 11/16/2009 | 9 | 2171 | 1 | 198 | 0.2 | 54.3 | 0.25 | 50 | 0.1 | -14 | | | CWG |
| 406 | APG-1103B-SU-26-006 | 11/16/2009 | 9 | 2171 | 1 | 191 | 0.2 | 54.3 | 0.25 | 48 | 0.1 | -19 | | | CWG |
| 407 | APG-1103B-SU-26-007 | 11/16/2009 | 9 | 2171 | 1 | 202 | 0.2 | 54.3 | 0.25 | 51 | 0.1 | -11 | | | CWG |
| 408 | APG-1103B-SU-26-008 | 11/16/2009 | 9 | 2171 | 0 | 215 | 0.2 | 54.3 | 0.00 | 54 | -0.8 | -2 | | | CWG |
| 409 | APG-1103B-SU-26-009 | 11/16/2009 | 9 | 2171 | 1 | 197 | 0.2 | 54.3 | 0.25 | 49 | 0.1 | -15 | | | CWG |

## Aberdeen Proving Ground - Building 1103A Final Status Survey Results

| Ludlum 2929 SN 196230 Cal Due 12/08/09 | |
|---|---|
| α eff | β eff |
| 0.2845 | 0.3363 |

| Sample Count Time (min) | Daily Bkg Count Time (min) |
|---|---|
| 4.0 | 10.0 |

| | | | | | | | | | | | | dpm/100 cm$^2$ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | α Flag | β Flag | |
| | | | | | | | | | | | | 10 | 100 | |
| **seq. #** | **Sample ID#** | **Date** | **Background Total Counts*** | | **Sample Total Counts** | | **Background (cpm)** | | **Sample Counts (cpm)** | | **Sample (dpm/100 cm$^2$)** | | **> a flag** | **> β flag** | **Tech. Initial** |
| | | | **α** | **β** | **α** | **β** | **α** | **β** | **α** | **β** | **α** | **β** | **FLAG** | **FLAG** | |
| 409 | APG-1103B-SU-26-010 | 11/16/2009 | 9 | 2171 | 0 | 217 | 0.2 | 54.3 | 0.00 | 54 | -0.8 | 0 | | | CWG |
| 410 | APG-1103B-SU-26-011 | 11/16/2009 | 9 | 2171 | 4 | 195 | 0.2 | 54.3 | 1.00 | 49 | 2.7 | -16 | | | CWG |
| 411 | APG-1103B-SU-26-012 | 11/16/2009 | 9 | 2171 | 0 | 207 | 0.2 | 54.3 | 0.00 | 52 | -0.8 | -8 | | | CWG |
| 412 | APG-1103B-SU-26-013 | 11/16/2009 | 9 | 2171 | 4 | 202 | 0.2 | 54.3 | 1.00 | 51 | 2.7 | -11 | | | CWG |
| 413 | APG-1103B-SU-26-014 | 11/16/2009 | 9 | 2171 | 1 | 188 | 0.2 | 54.3 | 0.25 | 47 | 0.1 | -22 | | | CWG |
| 414 | APG-1103B-SU-26-015 | 11/16/2009 | 9 | 2171 | 0 | 180 | 0.2 | 54.3 | 0.00 | 45 | -0.8 | -28 | | | CWG |
| 415 | APG-1103B-SU-26-016 | 11/16/2009 | 9 | 2171 | 1 | 198 | 0.2 | 54.3 | 0.25 | 50 | 0.1 | -14 | | | CWG |
| 416 | APG-1103B-SU-26-017 | 11/16/2009 | 9 | 2171 | 1 | 190 | 0.2 | 54.3 | 0.25 | 48 | 0.1 | -20 | | | CWG |
| 417 | APG-1103B-SU-26-018 | 11/16/2009 | 9 | 2171 | 1 | 217 | 0.2 | 54.3 | 0.25 | 54 | 0.1 | 0 | | | CWG |
| 418 | APG-1103B-SU-26-019 | 11/16/2009 | 9 | 2171 | 0 | 210 | 0.2 | 54.3 | 0.00 | 53 | -0.8 | -5 | | | CWG |
| 419 | APG-1103B-SU-26-020 | 11/16/2009 | 9 | 2171 | 0 | 209 | 0.2 | 54.3 | 0.00 | 52 | -0.8 | -6 | | | CWG |
| | | | | | | | | | | | | | | | |
| n/a | APG/1103A/SU8-07--RECOUNT | 1/5/2010 | 4 | 2374 | 14 | 348 | 0.1 | 59.4 | 3.50 | 87 | 11.9 | 82 | **FLAG** | | CWG |

## Aberdeen Proving Ground - Building 1103A Final Status Survey Results

| Ludlum 2929 SN 196226 Cal Due 09/15/10 | |
|---|---|
| α eff | β eff |
| 0.3657 | 0.1775 |

| Sample Count Time (min) | Daily Bkg Count Time (min) |
|---|---|
| 4.0 | 10.0 |

| dpm/100 cm² | |
|---|---|
| α Flag | β Flag |
| 10 | 100 |

| seq. # | Sample ID# | Date | Background Total Counts* | | Sample Total Counts | | Background (cpm) | | Sample Counts (cpm) | | Sample (dpm/100 cm²) | | > a flag | > β flag | Tech. Initial |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | α | β | α | β | α | β | α | β | α | β | FLAG | FLAG | |
| 1 | 19A-7 NORTH VAULT INTERIOR | 10/5/2009 | 1 | 436 | 1 | 167 | 0.1 | 43.6 | 0.25 | 42 | 0.4 | -10 | | | JF |
| 2 | 19A-8 | 10/5/2009 | 1 | 436 | 2 | 60 | 0.1 | 43.6 | 0.50 | 15 | 1.1 | -161 | | | JF |
| 3 | 19A-9 | 10/5/2009 | 1 | 436 | 3 | 160 | 0.1 | 43.6 | 0.75 | 40 | 1.8 | -20 | | | JF |
| 4 | 19A-10 | 10/5/2009 | 1 | 436 | 2 | 197 | 0.1 | 43.6 | 0.50 | 49 | 1.1 | 32 | | | JF |
| 5 | 19A-11 | 10/5/2009 | 1 | 436 | 0 | 192 | 0.1 | 43.6 | 0.00 | 48 | -0.3 | 25 | | | JF |
| 6 | 19A-12 | 10/5/2009 | 1 | 436 | 1 | 138 | 0.1 | 43.6 | 0.25 | 35 | 0.4 | -51 | | | JF |
| 7 | 19A-13 | 10/5/2009 | 1 | 436 | 1 | 155 | 0.1 | 43.6 | 0.25 | 39 | 0.4 | -27 | | | JF |
| 8 | 19A-18 | 10/5/2009 | 1 | 436 | 2 | 207 | 0.1 | 43.6 | 0.50 | 52 | 1.1 | 46 | | | JF |
| 9 | 19A-14 | 10/5/2009 | 1 | 436 | 1 | 164 | 0.1 | 43.6 | 0.25 | 41 | 0.4 | -15 | | | JF |
| 10 | 19A-15 | 10/5/2009 | 1 | 436 | 1 | 185 | 0.1 | 43.6 | 0.25 | 46 | 0.4 | 15 | | | JF |
| 11 | 19A-16 | 10/5/2009 | 1 | 436 | 0 | 201 | 0.1 | 43.6 | 0.00 | 50 | -0.3 | 37 | | | JF |
| 12 | 19A-17 | 10/5/2009 | 1 | 436 | 0 | 169 | 0.1 | 43.6 | 0.00 | 42 | -0.3 | -8 | | | JF |
| 13 | 19A-18 | 10/5/2009 | 1 | 436 | 2 | 187 | 0.1 | 43.6 | 0.50 | 47 | 1.1 | 18 | | | JF |
| 14 | 19A-19 | 10/5/2009 | 1 | 436 | 1 | 168 | 0.1 | 43.6 | 0.25 | 42 | 0.4 | -9 | | | JF |
| 15 | 19A-20 | 10/5/2009 | 1 | 436 | 1 | 178 | 0.1 | 43.6 | 0.25 | 45 | 0.4 | 5 | | | JF |
| 16 | 19A-1 | 10/5/2009 | 1 | 436 | 0 | 174 | 0.1 | 43.6 | 0.00 | 44 | -0.3 | -1 | | | JF |
| 17 | 19A-2 | 10/5/2009 | 1 | 436 | 1 | 169 | 0.1 | 43.6 | 0.25 | 42 | 0.4 | -8 | | | JF |
| 18 | 19A-3 | 10/5/2009 | 1 | 436 | 0 | 156 | 0.1 | 43.6 | 0.00 | 39 | -0.3 | -26 | | | JF |
| 19 | 19A-4 | 10/5/2009 | 1 | 436 | 1 | 187 | 0.1 | 43.6 | 0.25 | 47 | 0.4 | 18 | | | JF |
| 20 | 19A-5 | 10/5/2009 | 1 | 436 | 2 | 175 | 0.1 | 43.6 | 0.50 | 44 | 1.1 | 1 | | | JF |
| 21 | 19A-6 | 10/5/2009 | 1 | 436 | 2 | 165 | 0.1 | 43.6 | 0.50 | 41 | 1.1 | -13 | | | JF |

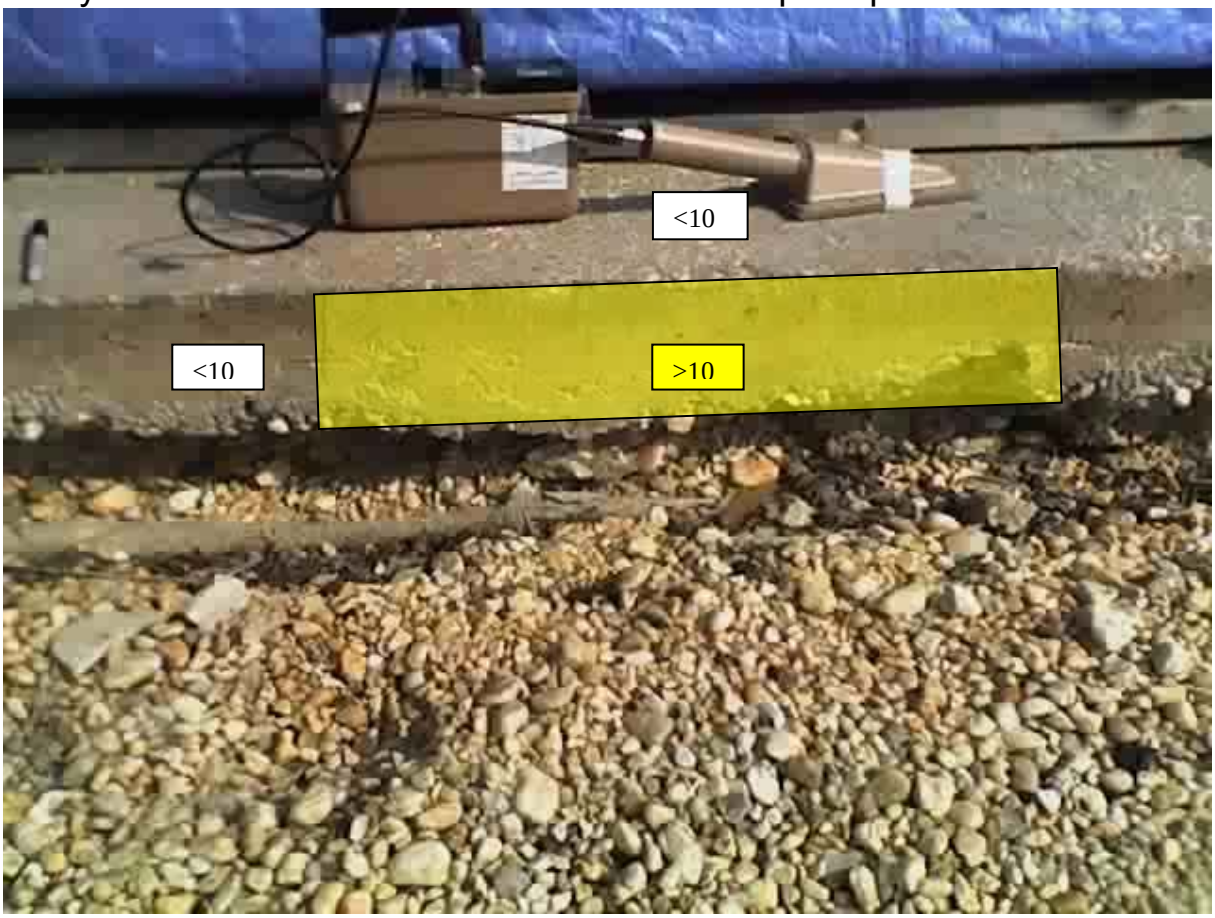
# APPENDIX B4

Investigation Results

| DATE: 8/26/2010 | TIME: 09:00 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|---|
| SURVEY NUMBER: APG-2-1 | | MODEL | S/N | % EFF. | CAL DUE | BKGD |
| LOCATION: Aberdeen Proving Ground | | LMI 2360 | 225237 | 0.46 | 11/23/10 | 0 |
| SURVEYOR: J. Cehn | | LMI 43-93 | PR236961 | - | 11/23/10 | - |
| REVIEWED BY: Jeanne Hoelzle | | | | | | |
| RSO/HP: Joel I Cehn | | | | | | |

Description of drawing: APG Bldg 1103A Exterior South Wall

Survey unit: 11 VSP Location: 3 Units: alpha cpm




Area >10 cpm = 31” x 5” ≈ 1.5 ft$^2$

Routine ☐ (Daily / Weekly / Monthly) Non-routine X

Comments:

**Post-MARSSIM survey to delineate elevated areas.**

DCGLw ≈ 10cpm (100 dpm/100cm$^2$)

All radiation readings in µr/hr unless otherwise noted.
(#)….denotes smear location or fixed α/β readings.
#…….denotes contact radiation readings.
#/#…denotes contact / 1 meter radiation readings.
*……denotes highest radiation reading on contact.
Δ……..denotes A/S location.

| **DATE: 8/26/2010** | **TIME:** 09:15 | **INSTRUMENTATION USED** | | | | |
|---|---|---|---|---|---|---|
| **SURVEY NUMBER: APG-2-2** | | **MODEL** | **S/N** | **% EFF.** | **CAL DUE** | **BKGD** |
| LOCATION: Aberdeen Proving Ground | | LMI 2360 | 225237 | 0.46 | 11/23/10 | 0 |
| SURVEYOR: J. Cehn | | LMI 43-93 | PR236961 | - | 11/23/10 | - |
| REVIEWED BY: Jeanne Haslett | | | | | | |
| RSO/HP: Joel I Cehn | | | | | | |

Description of drawing: APG Bldg 1103A Exterior South Wall

Survey unit: 11 VSP Location: 8 Units: alpha cpm


Note: Original reading of 13 (116 dpm/100cm$^2$) was not found.

Routine ☐ (Daily / Weekly / Monthly) Non-routine **X**

Comments:

**Post-MARSSIM survey to delineate elevated areas.**

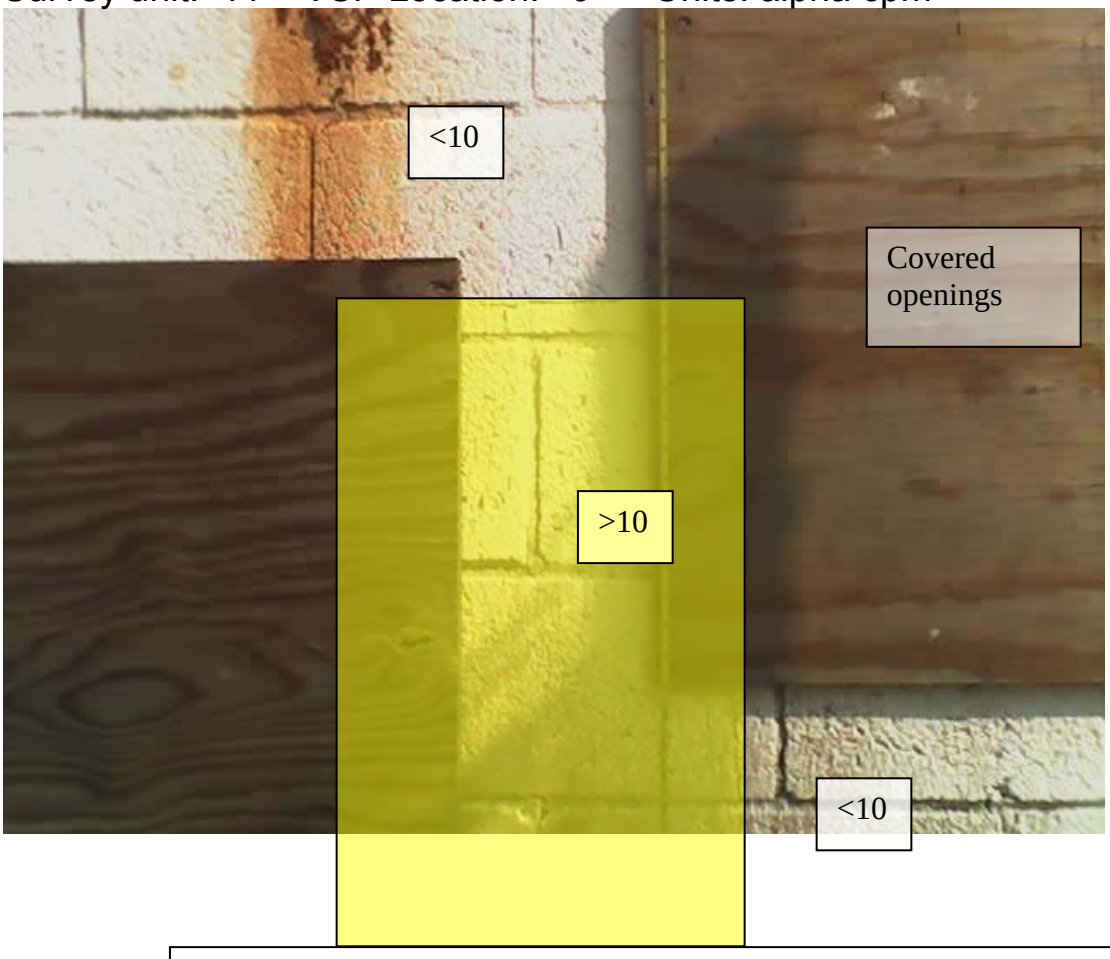
DCGLw ≈ 10cpm (100 dpm/100cm$^2$)

All radiation readings in µr/hr unless otherwise noted.
(#)….denotes smear location or fixed α/β readings.
#…….denotes contact radiation readings.
#/#…denotes contact / 1 meter radiation readings.
*…….denotes highest radiation reading on contact.
Δ……..denotes A/S location.

| DATE: 8/26/2010 | TIME: 09:30 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|---|
| SURVEY NUMBER: APG-2-3 | | MODEL | S/N | % EFF. | CAL DUE | BKGD |
| LOCATION: Aberdeen Proving Ground | | LMI 2360 | 225237 | 0.46 | 11/23/10 | 0 |
| SURVEYOR: J. Cehn | | LMI 43-93 | PR236961 | - | 11/23/10 | - |
| REVIEWED BY: Jeanne Haslett | | | | | | |
| RSO/HP: Joel I Cehn | | | | | | |

Description of drawing: APG Bldg 1103A Exterior South Wall

Survey unit: 11 VSP Location: 9 Units: alpha cpm




Area >10 cpm = 24” x 12” = 2 $ft^2$

Routine ☐ (Daily / Weekly / Monthly) Non-routine X

Comments:

**Post-MARSSIM survey to delineate elevated areas.**

DCGLw ≈ 10cpm (100 dpm/100$cm^2$)

All radiation readings in µr/hr unless otherwise noted.
(#)….denotes smear location or fixed α/β readings.
#…….denotes contact radiation readings.
#/#…denotes contact / 1 meter radiation readings.
*……denotes highest radiation reading on contact.
Δ……..denotes A/S location.

| DATE: 8/26/2010 | TIME: 09:55 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|---|
| SURVEY NUMBER: APG-2-4 | | MODEL | S/N | % EFF. | CAL DUE | BKGD |
| LOCATION: Aberdeen Proving Ground | | LMI 2360 | 225237 | 0.46 | 11/23/10 | 0 |
| SURVEYOR: J. Cehn | | LMI 43-93 | PR236961 | - | 11/23/10 | - |
| REVIEWED BY: Jeanne Haslett | | | | | | |
| RSO/HP: Joel T Cehn | | | | | | |

Description of drawing: APG Bldg 1103A Exterior South Wall

Survey unit: 11 VSP Location: 11 Units: alpha cpm


Note: Original reading of 14 (126 dpm/100cm$^2$) was not found.

Routine ☐ (Daily / Weekly / Monthly) Non-routine **X**

Comments:

**Post-MARSSIM survey to delineate elevated areas.**

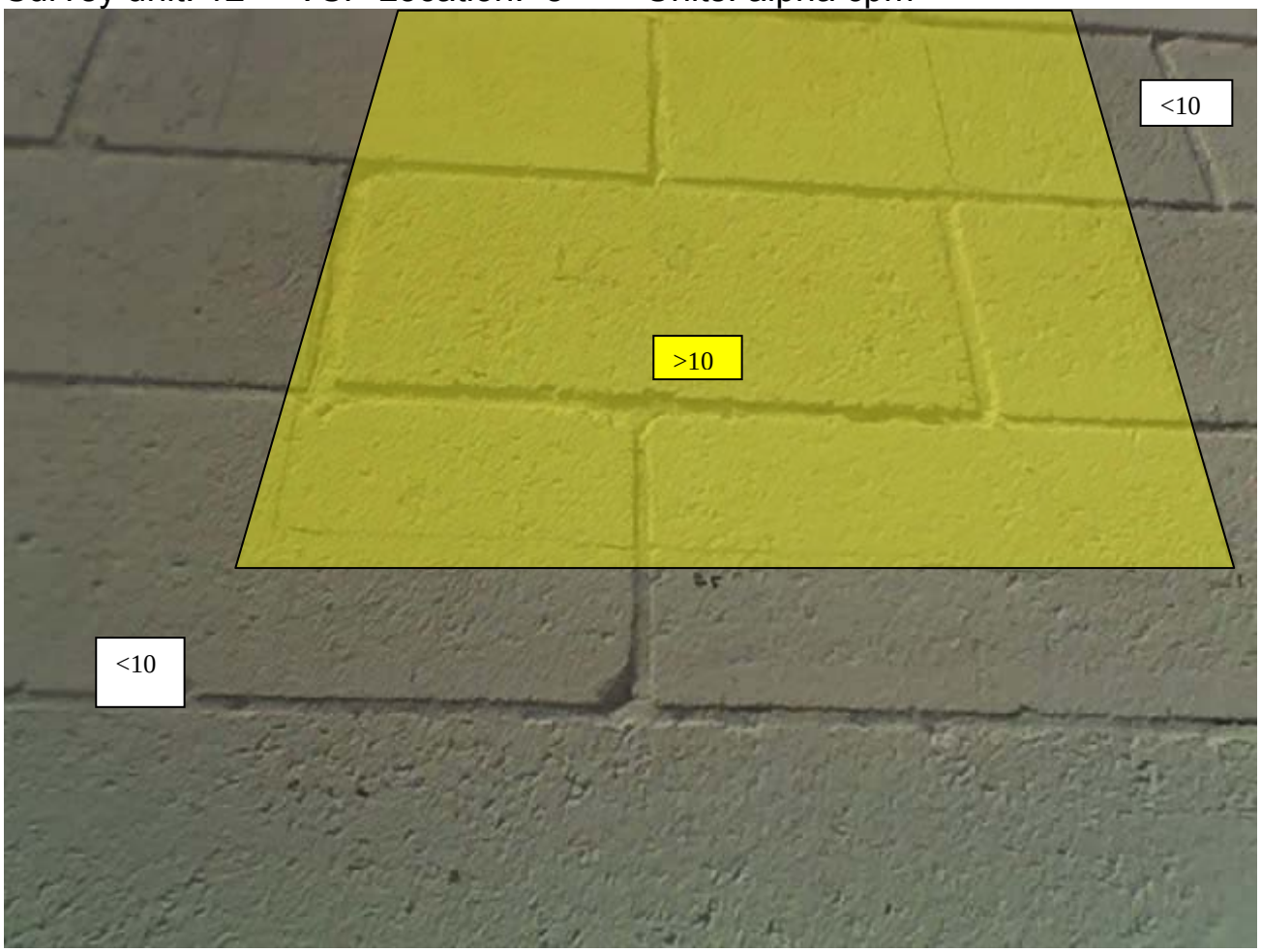
DCGLw ≈ 10cpm (100 dpm/100cm$^2$)

All radiation readings in µr/hr unless otherwise noted.
(#)….denotes smear location or fixed α/β readings.
#…….denotes contact radiation readings.
#/#…denotes contact / 1 meter radiation readings.
*……denotes highest radiation reading on contact.
Δ……..denotes A/S location.

| DATE: 8/26/2010 | TIME: 10:40 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|---|
| SURVEY NUMBER: APG-2-5 | | MODEL | S/N | % EFF. | CAL DUE | BKGD |
| LOCATION: Aberdeen Proving Ground | | LMI 2360 | 225237 | 0.46 | 11/23/10 | 0 |
| SURVEYOR: J. Cehn | | LMI 43-93 | PR236961 | - | 11/23/10 | - |
| REVIEWED BY: Jeanne Hoslett | | | | | | |
| RSO/HP: Joel I Cehn | | | | | | |

Description of drawing: APG Bldg 1103A Exterior East Wall

Survey unit: 12 VSP Location: 8 Units: alpha cpm




Area >10 cpm ≈ 24" x 25" ≈ 4 ft$^2$

Routine ☐ (Daily / Weekly / Monthly) Non-routine X

Comments:

**Post-MARSSIM survey to delineate elevated areas.**

DCGLw ≈ 10cpm (100 dpm/100cm$^2$)

All radiation readings in µr/hr unless otherwise noted.
(#)….denotes smear location or fixed α/β readings.
#…….denotes contact radiation readings.
#/#…denotes contact / 1 meter radiation readings.
*……denotes highest radiation reading on contact.
Δ……..denotes A/S location.

| DATE: 8/26/2010 | TIME: 10:20 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|---|
| SURVEY NUMBER: APG-2-6 | | MODEL | S/N | % EFF. | CAL DUE | BKGD |
| LOCATION: Aberdeen Proving Ground | | LMI 2360 | 225237 | 0.46 | 11/23/10 | 0 |
| SURVEYOR: J. Cehn | | LMI 43-93 | PR236961 | - | 11/23/10 | - |
| REVIEWED BY: Jeanne Hazlett | | | | | | |
| RSO/HP: Joel T Cehn | | | | | | |

Description of drawing: APG Bldg 1103A Exterior West Wall

Survey unit: 12 VSP Location: 20 Units: alpha cpm


Area >10 cpm ≈ 12" x 15" = 1.25 $ft^2$

Routine ☐ (Daily / Weekly / Monthly) Non-routine X

Comments:

**Post-MARSSIM survey to delineate elevated areas.**

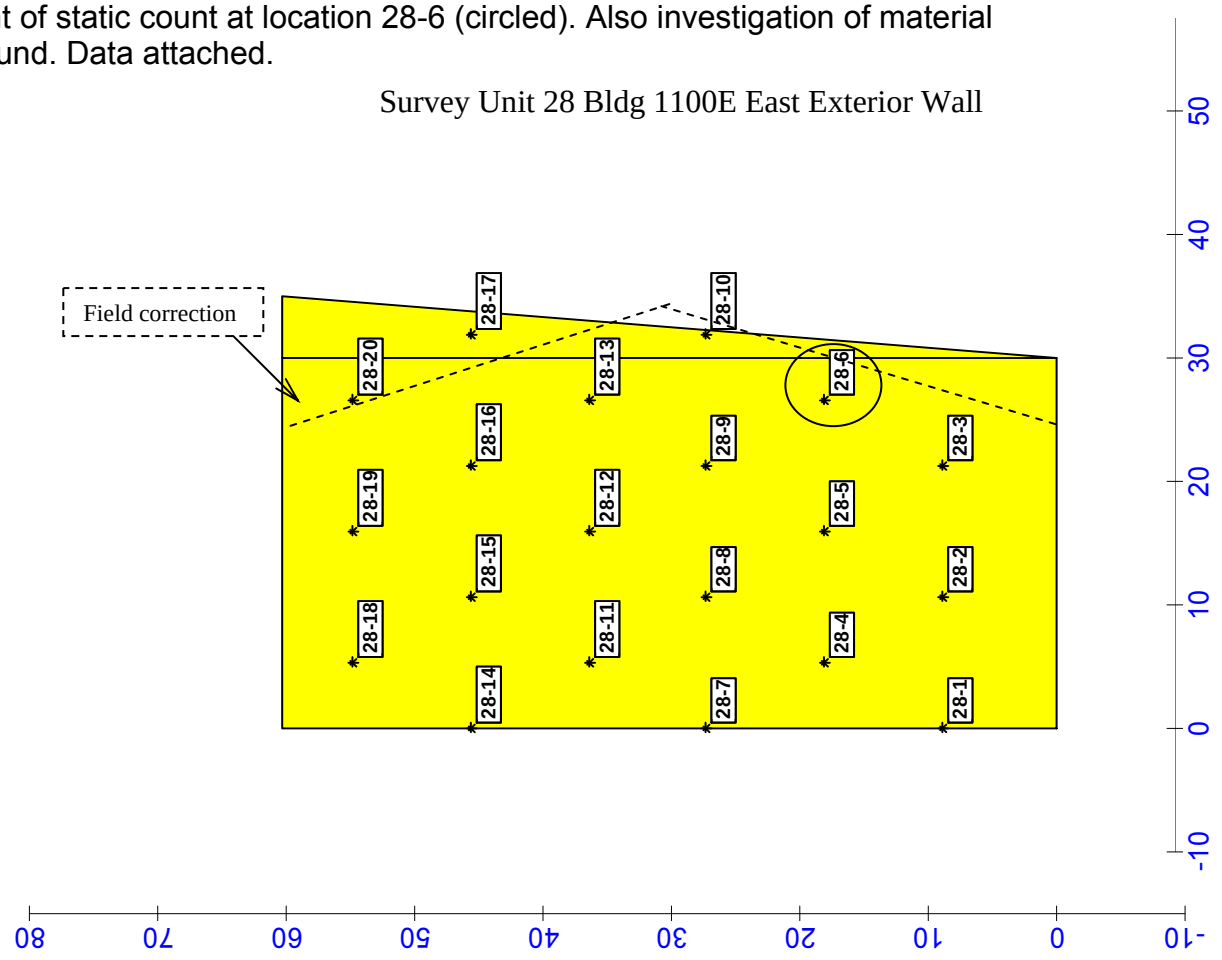
DCGLw ≈ 10cpm (100 dpm/100$cm^2$)

All radiation readings in µr/hr unless otherwise noted.
(#)….denotes smear location or fixed α/β readings.
#…….denotes contact radiation readings.
#/#…denotes contact / 1 meter radiation readings.
*……denotes highest radiation reading on contact.
Δ……..denotes A/S location.

| **DATE:** Dec. 20, 2010* | **TIME:** 12:00 | **INSTRUMENTATION USED** | | | | |
|---|---|---|---|---|---|---|
| **SURVEY NUMBER:** | | **MODEL** | **S/N** | **% EFF.** | **CAL DUE** | **BKGD** |
| LOCATION: APG, Bldg. 1103A Area | | LMI 2360 | 225218 | | 6/9/11 | 7.1 |
| SURVEYOR: Pat Marine | | LMI 43-93 | PR236955 | | | cpm α |
| REVIEWED BY: R. Markland | | | | | | |
| RSO/HP: | | | | | | |

Description of drawing: Survey Unit 28, location #6 on east wall of Bldg. 1100E

Re-count of static count at location 28-6 (circled). Also investigation of material background. Data attached.




Routine ☐ (Daily / Weekly / Monthly) Non-routine **X**

Comments:

* Material backgrounds taken on subsequent dates; material is metal siding.

All radiation readings in μr/hr unless otherwise noted.
(#)….denotes smear location or fixed α/β readings.
#…….denotes contact radiation readings.
#/#…denotes contact / 1 meter radiation readings.
*…….denotes highest radiation reading on contact.
Δ……..denotes A/S location.

## Data for 1-min alpha counts (all cpm)

| | Survey Data[2] | |
|---|---|---|
| | gross | net[3] |
| **Bkgd.[1]** | **7.1** | **n/a** |
| | 22 | 14.9 |
| | 22 | 14.9 |
| | 12 | 4.9 |
| | 14 | 6.9 |
| | 12 | 4.9 |
| | 8 | 0.9 |
| | 12 | 4.9 |
| | 14 | 6.9 |
| **Ave.** | 14.5 | 7.4 |

Notes:
1. Background from table below.
2. at/near location 28-6
3, Net of background

| **Backgrnd.** | **Data** | | |
|---|---|---|---|
| | west | south | north |
| from | 5 | 7 | 10 |
| unimpacted | 6 | 6 | 4 |
| sides of | 13 | 7 | 8 |
| Bldg.1100E | 5 | | |
| | 5 | | |
| Grand | 10 | | |
| Average | 5 | | |
| =7.1 | 7 | | |
| | 9 | | |
| | 7 | | |
| | 7.2 | 6.7 | 7.3 |

# APPENDIX C1

Beta Scan Data

SU 5 scans
SU 6 scans
SU 7 scans
SU 8 scans
SU 9 scans
SU 10 scans
SU 11 scans
SU 12 scans
SU 12A scans
SU 12B scans
SU 13 scans
SU 15 scans
SU 19 scans
SU 19A scans
SU 20 scans
SU 20A scans
SU 23 scans
SU 24 scans
SU 25 scans
SU 26 scans
SU 28 scans
SU 29 scans

**Provided on CD**

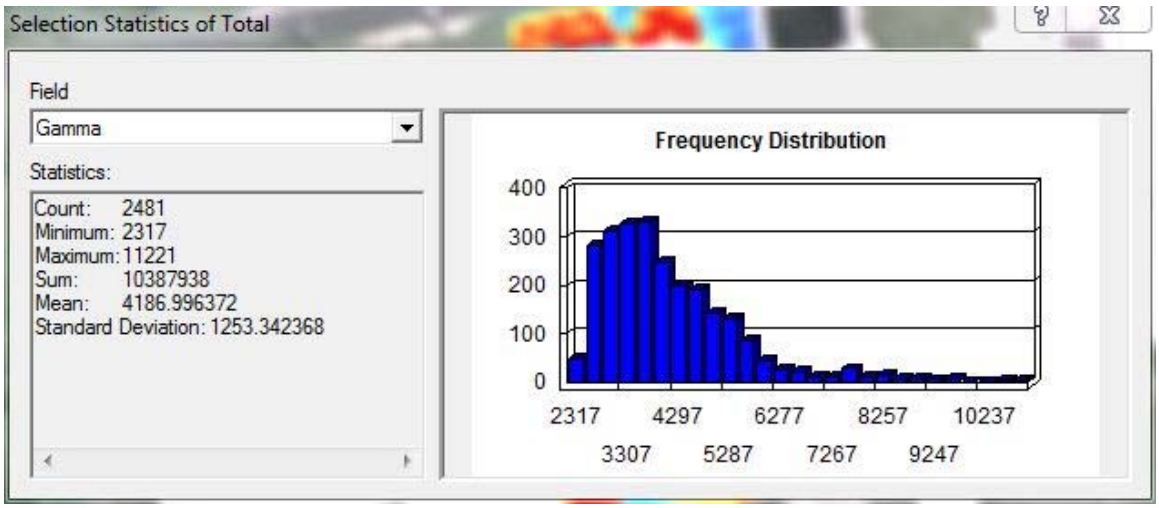
# APPENDIX C2

Gamma Scan Data Histograms

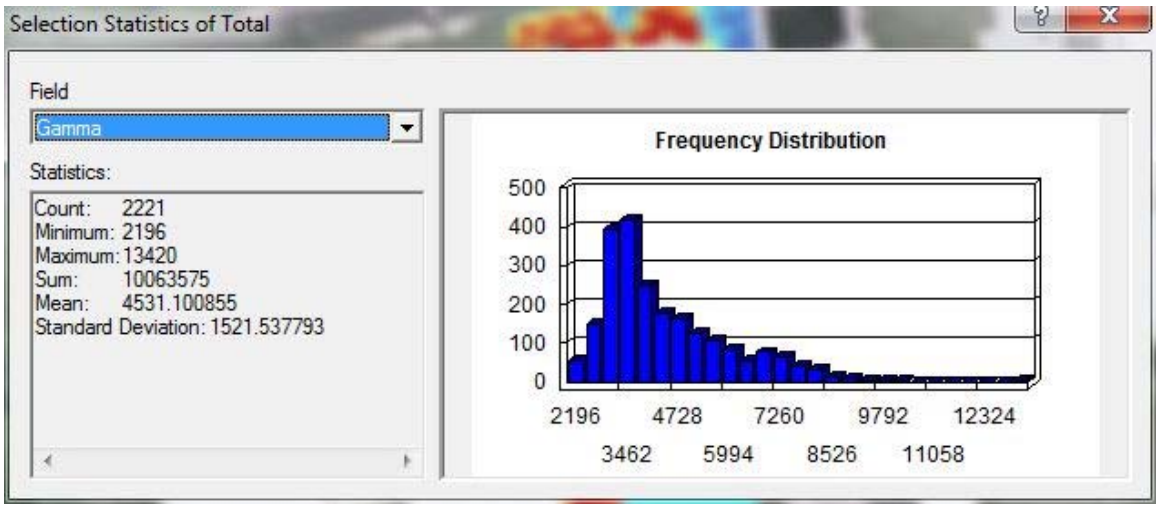
# APPENDIX C2

Gamma Scan Data Histograms

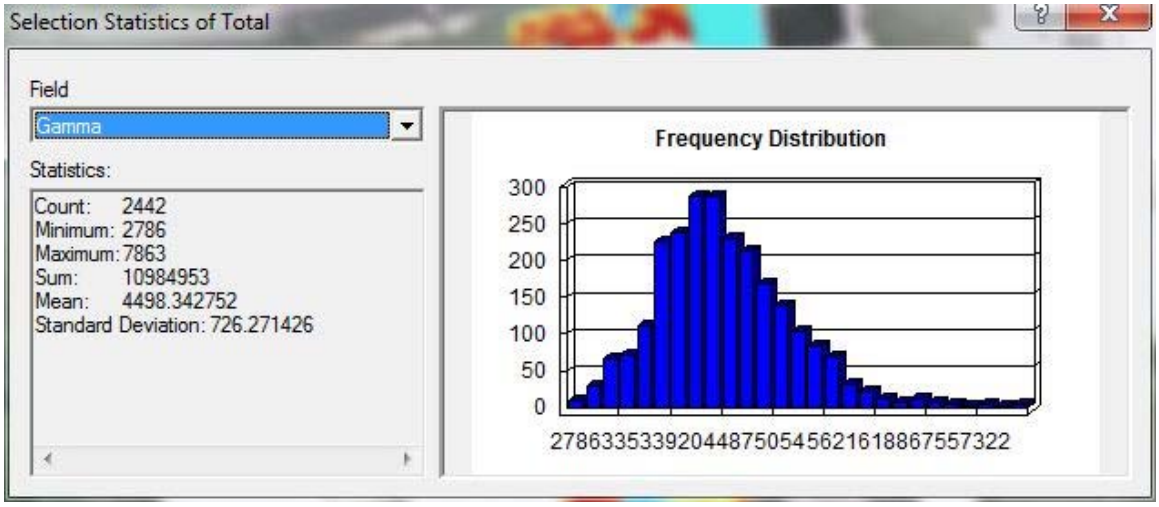
Survey Unit 1



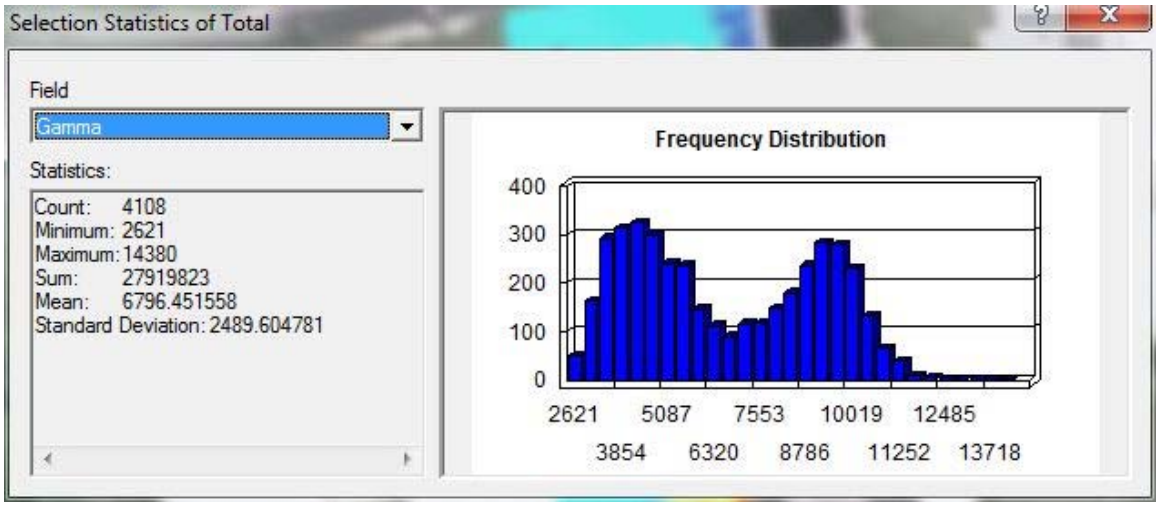

Survey Unit 2



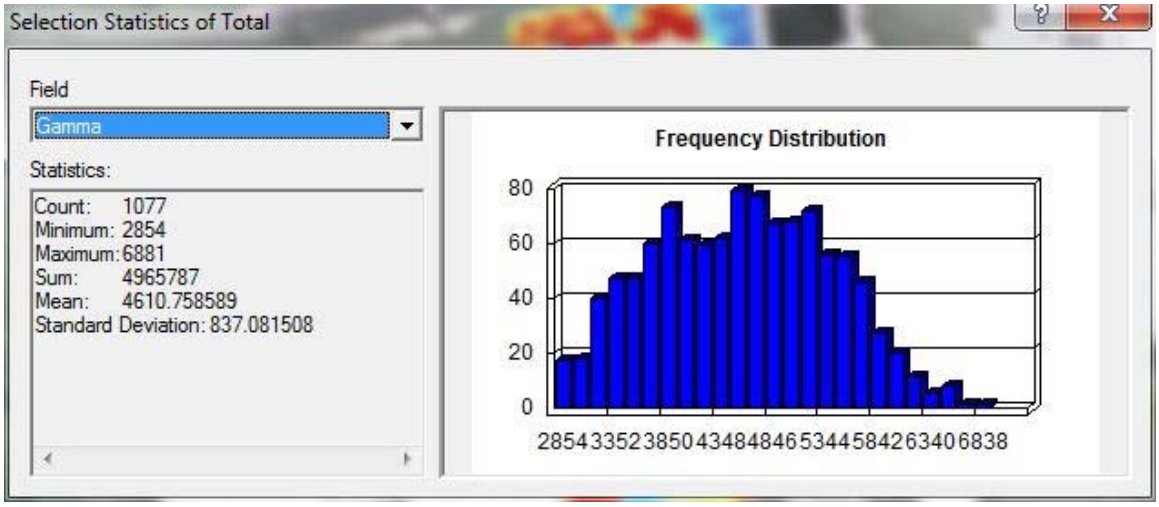
Survey Unit 3




Survey Unit 4



Survey Unit 14



# APPENDIX D

Soils Data

Uranium in Soils

QC Soils

**Provided on CD**

# Results of Gamma Spec Analysis for Depleted Uranium in APG Soils

| Sample ID: | pCi/g U-238 (Th-234) | Total Curies U-238 | grams U-238 per Sample | pCi/g U-235 | Total Curies U-235 | grams U-235 per sample | U-235/U-238 Ratio | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | 6.4227E-02 | This Sample |
| | 0.60 | 5.9600E-13 | 1.7898E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-1-1 | | | | | | | 785.53 | % Diff from Natual |
| | | | | | | | 1.0346E-01 | This Sample |
| | 0.37 | 3.7000E-13 | 1.1111E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-1-2 | | | | | | | 1326.43 | % Diff from Natual |
| | | | | | | | 5.4596E-03 | This Sample |
| | 0.93 | 9.3200E-13 | 2.7988E-06 | 0.033 | 3.2700E-14 | 1.5280E-08 | 7.2529E-03 | Natural |
| SU-1-3 | | | | | | | -24.73 | % Diff from Natual |
| | | | | | | | 5.3729E-03 | This Sample |
| | 2.65 | 2.6500E-12 | 7.9580E-06 | 0.092 | 9.1500E-14 | 4.2757E-08 | 7.2529E-03 | Natural |
| SU-1-4 | | | | | | | -25.92 | % Diff from Natual |
| | | | | | | | 6.5900E-03 | This Sample |
| | 0.90 | 9.0200E-13 | 2.7087E-06 | 0.038 | 3.8200E-14 | 1.7850E-08 | 7.2529E-03 | Natural |
| SU-1-5 | | | | | | | -9.14 | % Diff from Natual |
| | | | | | | | 1.0346E-01 | This Sample |
| | 0.37 | 3.7000E-13 | 1.1111E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-1-6 | | | | | | | 1326.43 | % Diff from Natual |
| | | | | | | | 4.7790E-02 | This Sample |
| | 0.80 | 8.0100E-13 | 2.4054E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-1-7 | | | | | | | 558.90 | % Diff from Natual |
| | | | | | | | 6.9749E-03 | This Sample |
| | 1.70 | 1.7000E-12 | 5.1051E-06 | 0.076 | 7.6200E-14 | 3.5607E-08 | 7.2529E-03 | Natural |
| SU-1-8 | | | | | | | -3.83 | % Diff from Natual |
| | | | | | | | 2.6988E-03 | This Sample |
| | 12.80 | 1.2800E-11 | 3.8438E-05 | 0.222 | 2.2200E-13 | 1.0374E-07 | 7.2529E-03 | Natural |
| SU-1-9 | | | | | | | -62.79 | % Diff from Natual |
| | | | | | | | 3.2168E-03 | This Sample |
| | 5.95 | 5.9500E-12 | 1.7868E-05 | 0.123 | 1.2300E-13 | 5.7477E-08 | 7.2529E-03 | Natural |
| SU-1-10 | | | | | | | -55.65 | % Diff from Natual |
| | | | | | | | 2.2662E-03 | This Sample |
| | 2.52 | 2.5200E-12 | 7.5676E-06 | 0.037 | 3.6700E-14 | 1.7150E-08 | 7.2529E-03 | Natural |
| SU-1-11 | | | | | | | -68.75 | % Diff from Natual |
| | | | | | | | 3.1928E-03 | This Sample |
| | 1.93 | 1.9300E-12 | 5.7958E-06 | 0.040 | 3.9600E-14 | 1.8505E-08 | 7.2529E-03 | Natural |
| SU-1-12 | | | | | | | -55.98 | % Diff from Natual |
| | | | | | | | 3.8379E-03 | This Sample |
| | 0.89 | 8.9200E-13 | 2.6787E-06 | 0.022 | 2.2000E-14 | 1.0280E-08 | 7.2529E-03 | Natural |
| SU-1-13 | | | | | | | -47.09 | % Diff from Natual |
| | | | | | | | 2.3256E-03 | This Sample |
| | 2.75 | 2.7500E-12 | 8.2583E-06 | 0.041 | 4.1100E-14 | 1.9206E-08 | 7.2529E-03 | Natural |
| SU-1-14 | | | | | | | -67.94 | % Diff from Natual |
| | | | | | | | 1.0346E-01 | This Sample |
| | 0.37 | 3.7000E-13 | 1.1111E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-2-1 | | | | | | | 1326.43 | % Diff from Natual |
| | | | | | | | 2.8087E-01 | This Sample |
| | 0.02 | 2.0000E-14 | 6.0060E-08 | 0.036 | 3.6100E-14 | 1.6869E-08 | 7.2529E-03 | Natural |
| SU-2-2 | | | | | | | 3772.52 | % Diff from Natual |
| | | | | | | | 6.6689E-02 | This Sample |
| | 0.57 | 5.7400E-13 | 1.7237E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-2-3 | | | | | | | 819.47 | % Diff from Natual |
| | | | | | | | 1.0346E-01 | This Sample |
| | 0.37 | 3.7000E-13 | 1.1111E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-2-4 | | | | | | | 1326.43 | % Diff from Natual |
| | | | | | | | 1.0346E-01 | This Sample |
| | 0.37 | 3.7000E-13 | 1.1111E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-2-5 | | | | | | | 1326.43 | % Diff from Natual |

# Results of Gamma Spec Analysis for Depleted Uranium in APG Soils

| Sample ID: | pCi/g U-238 (Th-234) | Total Curies U-238 | grams U-238 per Sample | pCi/g U-235 | Total Curies U-235 | grams U-235 per sample | U-235/U-238 Ratio | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | 8.6801E-02 | This Sample |
| | 0.44 | 4.4100E-13 | 1.3243E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-2-6 | | | | | | | 1096.77 | % Diff from Natual |
| | | | | | | | 6.7751E-02 | This Sample |
| | 0.57 | 5.6500E-13 | 1.6967E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-2-7 | | | | | | | 834.12 | % Diff from Natual |
| | | | | | | | 2.6308E-03 | This Sample |
| | 13.90 | 1.3900E-11 | 4.1742E-05 | 0.235 | 2.3500E-13 | 1.0981E-07 | 7.2529E-03 | Natural |
| SU-2-8 | | | | | | | -63.73 | % Diff from Natual |
| | | | | | | | 2.8065E-03 | This Sample |
| | 3.92 | 3.9200E-12 | 1.1772E-05 | 0.071 | 7.0700E-14 | 3.3037E-08 | 7.2529E-03 | Natural |
| SU-2-9 | | | | | | | -61.31 | % Diff from Natual |
| | | | | | | | 4.8578E-02 | This Sample |
| | 0.79 | 7.8800E-13 | 2.3664E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-2-10 | | | | | | | 569.77 | % Diff from Natual |
| | | | | | | | 4.2080E-03 | This Sample |
| | 0.87 | 8.6900E-13 | 2.6096E-06 | 0.024 | 2.3500E-14 | 1.0981E-08 | 7.2529E-03 | Natural |
| SU-2-11 | | | | | | | -41.98 | % Diff from Natual |
| | | | | | | | 3.2717E+00 | This Sample |
| | 0.01 | 1.1700E-14 | 3.5135E-08 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-2-12 | | | | | | | 45009.21 | % Diff from Natual |
| | | | | | | | 1.0346E-01 | This Sample |
| | 0.37 | 3.7000E-13 | 1.1111E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-2-13 | | | | | | | 1326.43 | % Diff from Natual |
| | | | | | | | 4.2914E-02 | This Sample |
| | 0.89 | 8.9200E-13 | 2.6787E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-2-14 | | | | | | | 491.68 | % Diff from Natual |
| | | | | | | | 1.0346E-01 | This Sample |
| | 0.37 | 3.7000E-13 | 1.1111E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-4-1 | | | | | | | 1326.43 | % Diff from Natual |
| | | | | | | | 3.1121E-01 | This Sample |
| | 0.05 | 5.3000E-14 | 1.5916E-07 | 0.106 | 1.0600E-13 | 4.9533E-08 | 7.2529E-03 | Natural |
| SU-4-2 | | | | | | | 4190.88 | % Diff from Natual |
| | | | | | | | 4.6260E-03 | This Sample |
| | 2.21 | 2.2100E-12 | 6.6366E-06 | 0.066 | 6.5700E-14 | 3.0701E-08 | 7.2529E-03 | Natural |
| SU-4-3 | | | | | | | -36.22 | % Diff from Natual |
| | | | | | | | 3.0677E-01 | This Sample |
| | 0.02 | 2.1000E-14 | 6.3063E-08 | 0.041 | 4.1400E-14 | 1.9346E-08 | 7.2529E-03 | Natural |
| SU-4-4 | | | | | | | 4129.58 | % Diff from Natual |
| | | | | | | | 2.5656E-03 | This Sample |
| | 20.50 | 2.0500E-11 | 6.1562E-05 | 0.338 | 3.3800E-13 | 1.5794E-07 | 7.2529E-03 | Natural |
| SU-4-5 | | | | | | | -64.63 | % Diff from Natual |
| | | | | | | | 2.0774E-01 | This Sample |
| | 0.04 | 4.0000E-14 | 1.2012E-07 | 0.053 | 5.3400E-14 | 2.4953E-08 | 7.2529E-03 | Natural |
| SU-4-6 | | | | | | | 2764.16 | % Diff from Natual |
| | | | | | | | 1.0346E-01 | This Sample |
| | 0.37 | 3.7000E-13 | 1.1111E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-4-7 | | | | | | | 1326.43 | % Diff from Natual |
| | | | | | | | 3.6872E-01 | This Sample |
| | 0.05 | 4.6000E-14 | 1.3814E-07 | 0.109 | 1.0900E-13 | 5.0935E-08 | 7.2529E-03 | Natural |
| SU-4-8 | | | | | | | 4983.76 | % Diff from Natual |
| | | | | | | | 1.7466E-02 | This Sample |
| | 0.98 | 9.8000E-13 | 2.9429E-06 | 0.110 | 1.1000E-13 | 5.1402E-08 | 7.2529E-03 | Natural |
| SU-4-9 | | | | | | | 140.81 | % Diff from Natual |
| | | | | | | | 1.6235E-01 | This Sample |
| | 0.06 | 6.0000E-14 | 1.8018E-07 | 0.063 | 6.2600E-14 | 2.9252E-08 | 7.2529E-03 | Natural |
| SU-4-10 | | | | | | | 2138.41 | % Diff from Natual |

# Results of Gamma Spec Analysis for Depleted Uranium in APG Soils

| Sample ID: | pCi/g U-238 (Th-234) | Total Curies U-238 | grams U-238 per Sample | pCi/g U-235 | Total Curies U-235 | grams U-235 per sample | U-235/U-238 Ratio | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | 7.8119E-03 | This Sample |
| | 2.47 | 2.4700E-12 | 7.4174E-06 | 0.124 | 1.2400E-13 | 5.7944E-08 | 7.2529E-03 | Natural |
| SU-4-11 | | | | | | | 7.71 | % Diff from Natual |
| | | | | | | | 3.0468E-01 | This Sample |
| | 0.05 | 5.0000E-14 | 1.5015E-07 | 0.098 | 9.7900E-14 | 4.5748E-08 | 7.2529E-03 | Natural |
| SU-4-12 | | | | | | | 4100.77 | % Diff from Natual |
| | | | | | | | 2.6648E-01 | This Sample |
| | 0.08 | 8.0000E-14 | 2.4024E-07 | 0.137 | 1.3700E-13 | 6.4019E-08 | 7.2529E-03 | Natural |
| SU-4-13 | | | | | | | 3574.06 | % Diff from Natual |
| | | | | | | | 5.2301E-01 | This Sample |
| | 0.04 | 3.6000E-14 | 1.0811E-07 | 0.121 | 1.2100E-13 | 5.6542E-08 | 7.2529E-03 | Natural |
| SU-4-14 | | | | | | | 7111.06 | % Diff from Natual |
| | | | | | | | 3.2949E-03 | This Sample |
| | 2.98 | 2.9800E-12 | 8.9489E-06 | 0.063 | 6.3100E-14 | 2.9486E-08 | 7.2529E-03 | Natural |
| SU-14-1 | | | | | | | -54.57 | % Diff from Natual |
| | | | | | | | 4.2056E-03 | This Sample |
| | 2.22 | 2.2200E-12 | 6.6667E-06 | 0.060 | 6.0000E-14 | 2.8037E-08 | 7.2529E-03 | Natural |
| SU-14-2 | | | | | | | -42.02 | % Diff from Natual |
| | | | | | | | 2.3806E-03 | This Sample |
| | 0.72 | 7.1900E-13 | 2.1592E-06 | 0.011 | 1.1000E-14 | 5.1402E-09 | 7.2529E-03 | Natural |
| SU-14-3 | | | | | | | -67.18 | % Diff from Natual |
| | | | | | | | 4.8736E-03 | This Sample |
| | 3.03 | 3.0300E-12 | 9.0991E-06 | 0.095 | 9.4900E-14 | 4.4346E-08 | 7.2529E-03 | Natural |
| SU-14-4 | | | | | | | -32.80 | % Diff from Natual |
| | | | | | | | 5.3915E-02 | This Sample |
| | 0.71 | 7.1000E-13 | 2.1321E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-14-5 | | | | | | | 643.35 | % Diff from Natual |
| | | | | | | | 1.0346E-01 | This Sample |
| | 0.37 | 3.7000E-13 | 1.1111E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-14-6 | | | | | | | 1326.43 | % Diff from Natual |
| | | | | | | | 1.0346E-01 | This Sample |
| | 0.37 | 3.7000E-13 | 1.1111E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-14-7 | | | | | | | 1326.43 | % Diff from Natual |
| | | | | | | | 1.0346E-01 | This Sample |
| | 0.37 | 3.7000E-13 | 1.1111E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-14-8 | | | | | | | 1326.43 | % Diff from Natual |
| | | | | | | | 3.2430E-03 | This Sample |
| | 3.33 | 3.3300E-12 | 1.0000E-05 | 0.069 | 6.9400E-14 | 3.2430E-08 | 7.2529E-03 | Natural |
| SU-14-9 | | | | | | | -55.29 | % Diff from Natual |
| | | | | | | | 1.5065E-03 | This Sample |
| | 3.45 | 3.4500E-12 | 1.0360E-05 | 0.033 | 3.3400E-14 | 1.5607E-08 | 7.2529E-03 | Natural |
| SU-14-10 | | | | | | | -79.23 | % Diff from Natual |
| | | | | | | | 8.1101E-02 | This Sample |
| | 0.47 | 4.7200E-13 | 1.4174E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-14-11 | | | | | | | 1018.17 | % Diff from Natual |
| | | | | | | | 1.0346E-01 | This Sample |
| | 0.37 | 3.7000E-13 | 1.1111E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-14-12 | | | | | | | 1326.43 | % Diff from Natual |
| | | | | | | | 1.0346E-01 | This Sample |
| | 0.37 | 3.7000E-13 | 1.1111E-06 | 0.246 | 2.4600E-13 | 1.1495E-07 | 7.2529E-03 | Natural |
| SU-14-13 | | | | | | | 1326.43 | % Diff from Natual |
| | | | | | | | 2.1653E-03 | This Sample |
| | 0.96 | 9.6300E-13 | 2.8919E-06 | 0.013 | 1.3400E-14 | 6.2617E-09 | 7.2529E-03 | Natural |
| SU-14-14 | | | | | | | -70.15 | % Diff from Natual |

**Sample ID:** Example

| pCi/g U-238 | Grams of Sample | Total Curies | grams U-238 per Sample |
|---|---|---|---|
| 14.40 | 1600 | 2.3040E-08 | 6.9189E-02 |

| pCi/g U-235 | | Total Curies | grams U-235 |
|---|---|---|---|
| 0.24 | | 3.8880E-10 | 1.8168E-04 |

| | U-235/U-238 Ratio | |
|---|---|---|
| Depleted | 2.6259E-03 | This Sample |
| 0 | 7.2529E-03 | Natural |
| 0 | -63.80 | % Diff from Natual |

Enter pCi/g and grams of sample from analysis report.

| Natural Abundance |
|---|
| 0.7200% U-235 |
| 99.2745% U-238 |

| Specific Activity | | |
|---|---|---|
| Ci/g = **U-238** | 3.33E-07 | t 1/2 = 4.47E+09 yr |
| Ci/g = **U-235** | 2.14E-06 | t 1/2 = 7.1E+08 yr |
| Ci/g = **Th-234** | 2.30E+04 | t1/2 = 24.2 days |

| Specific Activity Calculation | Conversions |
|---|---|
| Ci/g = 1.30E+08 / (t1/2 (days) x atomic wt) | 1dps = 1bq<br>1bq = 27 pCi<br>1Ci = 3.7E9dps |

**Bob's Ratio by Activity**

| **Isotope** | **U238** | | | |
|---|---|---|---|---|
| Half-life | 1.41E+17 | sec | | |
| A.W. | 238.050788 | g | N. Abd. | Activity |
| SpA | 3.36E-07 | Ci/g | 99.2745 | 3.33E-05 |

| **Isotope** | **U235** | | | |
|---|---|---|---|---|
| Half-life | 2.22E+16 | sec | | |
| A.W. | 235.043928 | g | 0.72 | 1.55E-06 |
| SpA | 2.16E-06 | Ci/g | | |

| Sample | pCi/g |
|---|---|
| **U235** | 0.239 |
| **U238** | 7.78 |

| **Ratio Natural** | |
|---|---|
| U235/238 | 0.0466 |
| **Ratio Sample** | |
| U235/238 | 0.0307 |
| **Ratio** | |
| Samp/Nat | 0.6588 |
| -34.12 | % Diff from Natual |

Less than 1 indicates depletion
Greater than 1 indicates enrichment
Look at counting statistics
to see if uncertainties overlap natural.

| Sample ID | |
|---|---|

| U-235/U-238 Ratio | |
|---|---|
| 4.6600E-02 | Natural |
| 4.7120E-02 | This Sample |

| pCi/g U-238 | Grams of Sample | Total Curies |
|---|---|---|
| 19.10 | 1600 | 3.0560E-08 |

| | |
|---|---|
| 0 | |
| 0 | |
| Natural | |

| pCi/g U-235 | Grams of Sample | Total Curies |
|---|---|---|
| 0.90 | 1600 | 1.4400E-09 |

**Enter pCi/g from analysis report in Column A

| Ratio | |
|---|---|
| U235/238 | 0.0466 |

| Isotope | U238 | | | |
|---|---|---|---|---|
| Half-life | 1.41E+17 | sec | | |
| A.W. | 238.050788 | g | N. Abd. | Activity Ci |
| SpA | 3.36E-07 | Ci/g | 99.2745 | 3.33E-05 |

| Isotope | U235 | | | |
|---|---|---|---|---|
| Half-life | 2.22E+16 | sec | | |
| A.W. | 235.043928 | g | N. Abd. | Activity Ci |
| SpA | 2.16E-06 | Ci/g | 0.7200 | 1.55E-06 |

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

# ANALYTICAL REPORT

APG

Lot #: F9L100438

PIKA International, Inc.

PIKA International, Inc.
12723 Capricorn Drive
Suite 500
Stafford, TX 77477

TESTAMERICA LABORATORIES, INC.

Kay Clay
Project Manager

December 23, 2009

Case Narrative
LOT NUMBER: F9L100438

This report contains the analytical results for the 10 samples received under chain of custody by TestAmerica St. Louis on December 9, 2009. These samples are associated with your APG project.

The analytical results included in this report meet all applicable quality control procedure requirements.

The test results in this report meet all NELAP requirements for parameters in which accreditations are held by TestAmerica St. Louis. Any exceptions to NELAP requirements are noted in the case narrative. **TestAmerica St. Louis' Florida certification number is E87689.** The case narrative is an integral part of this report.

This report shall not be reproduced, except in full, without the written approval of the laboratory.

All chemical analysis results are based upon sample as received, wet weight, unless noted otherwise. All radiochemistry results are based upon sample as dried and ground with the exception of tritium, unless requested wet weight by the client.

**Observations/Nonconformances**
Reference the chain of custody and condition upon receipt report for any variations on receipt conditions and temperature of samples on receipt.

There are no observations or nonconformances associated with the analysis in this lot.

# METHODS SUMMARY

**F9L100438**

| PARAMETER | ANALYTICAL METHOD | PREPARATION METHOD |
|---|---|---|
| Gamma Spectroscopy - Cesium-137 & Hits | EML GA-01-R MOD | |

**References:**

EML "ENVIRONMENTAL MEASUREMENTS LABORATORY PROCEDURES MANUAL" HASL-300 28TH EDITION, VOLUME I and II DEPARTMENT OF ENERGY

# SAMPLE SUMMARY

**F9L100438**

| WO # | SAMPLE# | CLIENT SAMPLE ID | | SAMPLED DATE | SAMP TIME |
|---|---|---|---|---|---|
| LQVD2 | 001 | SU1 1-11 | | 11/23/09 | 11:00 |
| LQVD3 | 002 | SU1 1-4 | | 11/23/09 | 13:05 |
| LQVD6 | 003 | SU2 2-5 | | 11/23/09 | 08:50 |
| LQVD7 | 004 | SU2 2-12 | | 11/23/09 | 08:30 |
| LQVEA | 005 | SU4 4-7 | | 11/23/09 | 13:49 |
| LQVEC | 006 | SU4 4-11 | | 11/23/09 | 13:40 |
| LQVEE | 007 | SU14A 14A-10 | (SU 14-10) | 11/23/09 | 09:15 |
| LQVEF | 008 | SU14A 14A-03 | (SU 14-03) | 11/23/09 | 09:57 |
| LQVEJ | 009 | APG11-APG20 | (waste samples - 2) | 10/13/09 | 14:30 |
| LQVEL | 010 | APG81-APG90 | | 10/20/09 | 13:40 |

**NOTE(S):**

- The analytical results of the samples listed above are presented on the following pages.
- All calculations are performed before rounding to avoid round-off errors in calculated results.
- Results noted as "ND" were not detected at or above the stated limit.
- This report must not be reproduced, except in full, without the written approval of the laboratory.
- Results for the following parameters are never reported on a dry weight basis: color, corrosivity, density, flashpoint, ignitability, layers, odor, paint filter test, pH, porosity pressure, reactivity, redox potential, specific gravity, spot tests, solids, solubility, temperature, viscosity, and weight.

# PIKA International, Inc.

## Client Sample ID: SU1 1-11

### Radiochemistry

Lab Sample ID: F9L100438-001
Work Order: LQVD2
Matrix: SOLID

Date Collected: 11/23/09 1100
Date Received: 12/09/09 0910

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | mdc | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD** | | | | **pCi/g** | | **Batch # 9351249** | **Yld %** |
| Cesium 137 | 0.020 | U | 0.022 | 0.200 | 0.035 | 12/17/09 | 12/18/09 |
| Uranium 235 | -0.03 | U | 1.4 | | 0.3 | 12/17/09 | 12/18/09 |
| **Uranium 238** | **2.02** | | **0.48** | | **1.1** | **12/17/09** | **12/18/09** |
| --- Other Detected Radionuclides --- | | | | | | | |
| **Thorium 234** | **2.02** | | **0.48** | | **1.1** | **12/17/09** | **12/18/09** |

**NOTE(S)**

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC.

U Result is less than the sample detection limit.

# PIKA International, Inc.

## Client Sample ID: SU1 1-4

### Radiochemistry

Lab Sample ID: F9L100438-002
Work Order: LQVD3
Matrix: SOLID

Date Collected: 11/23/09 1305
Date Received: 12/09/09 0910

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | mdc | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD** | | | pCi/g | | Batch # 9351249 | | Yld % |
| **Cesium 137** | **0.177** | **J** | **0.074** | 0.200 | **0.059** | **12/17/09** | **12/18/09** |
| Uranium 235 | 0.04 | U | 0.23 | | 0.40 | 12/17/09 | 12/18/09 |
| **Uranium 238** | **3.4** | | **1.5** | | **1.9** | **12/17/09** | **12/18/09** |
| --- Other Detected Radionuclides --- | | | | | | | |
| **Actinium 228** | **0.77** | | **0.30** | | **0.30** | **12/17/09** | **12/18/09** |
| **Bismuth 214** | **0.61** | | **0.18** | | **0.20** | **12/17/09** | **12/18/09** |
| **Lead 212** | **0.76** | | **0.14** | | **0.13** | **12/17/09** | **12/18/09** |
| **Lead 214** | **0.69** | | **0.14** | | **0.12** | **12/17/09** | **12/18/09** |
| **Potassium 40** | **5.5** | | **1.4** | | **1** | **12/17/09** | **12/18/09** |
| **Thallium 208** | **0.249** | | **0.074** | | **0.066** | **12/17/09** | **12/18/09** |
| **Thorium 234** | **3.4** | | **1.5** | | **1.9** | **12/17/09** | **12/18/09** |

**NOTE(S)**

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC.

J Result is greater than sample detection limit but less than stated reporting limit.
U Result is less than the sample detection limit.

# PIKA International, Inc.

## Client Sample ID: SU2 2-5

### Radiochemistry

Lab Sample ID: F9L100438-003
Work Order: LQVD6
Matrix: SOLID

Date Collected: 11/23/09 0850
Date Received: 12/09/09 0910

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | mdc | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD** | | | **pCi/g** | | **Batch # 9351249** | | **Yld %** |
| Cesium 137 | 0.007 | U | 0.025 | 0.200 | 0.045 | 12/17/09 | 12/18/09 |
| Uranium 235 | -0.06 | U | 0.43 | | 0.20 | 12/17/09 | 12/18/09 |
| Uranium 238 | 0.02 | U | 0.50 | | 0.95 | 12/17/09 | 12/18/09 |
| --- Other Detected Radionuclides --- | | | | | | | |
| **Actinium 228** | **0.18** | | **0.11** | | **0.14** | **12/17/09** | **12/18/09** |
| **Bismuth 214** | **0.141** | | **0.060** | | **0.090** | **12/17/09** | **12/18/09** |
| **Lead 212** | **0.160** | | **0.059** | | **0.071** | **12/17/09** | **12/18/09** |
| **Potassium 40** | **1.44** | | **0.61** | | **0.82** | **12/17/09** | **12/18/09** |

**NOTE(S)**

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC.

U Result is less than the sample detection limit.

# PIKA International, Inc.

## Client Sample ID: SU2 2-12

### Radiochemistry

Lab Sample ID: F9L100438-004
Work Order: LQVD7
Matrix: SOLID

Date Collected: 11/23/09 0830
Date Received: 12/09/09 0910

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | mdc | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD** | | | | **pCi/g** | | **Batch # 9351249** | **Yld %** |
| Cesium 137 | -0.002 | U | 0.026 | 0.200 | 0.053 | 12/17/09 | 12/18/09 |
| Uranium 235 | -0.04 | U | 0.49 | | 0.21 | 12/17/09 | 12/18/09 |
| Uranium 238 | 0.56 | U | 0.29 | | 0.78 | 12/17/09 | 12/18/09 |
| --- Other Detected Radionuclides --- | | | | | | | |
| **Lead 212** | **0.102** | | **0.044** | | **0.055** | **12/17/09** | **12/18/09** |
| **Potassium 40** | **0.84** | | **0.56** | | **0.81** | **12/17/09** | **12/18/09** |

**NOTE(S)**

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC.

U Result is less than the sample detection limit.

# PIKA International, Inc.

## Client Sample ID: SU4 4-7

### Radiochemistry

Lab Sample ID: F9L100438-005
Work Order: LOVEA
Matrix: SOLID

Date Collected: 11/23/09 1349
Date Received: 12/09/09 0910

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | mdc | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD** | | | **pCi/g** | | **Batch # 9351249** | | **Yld %** |
| Cesium 137 | 0.0 | U | 0.031 | 0.200 | 0.058 | 12/17/09 | 12/18/09 |
| Uranium 235 | 0.04 | U | 0.12 | | 0.21 | 12/17/09 | 12/18/09 |
| Uranium 238 | -0.4 | U | 1.6 | | 1.3 | 12/17/09 | 12/18/09 |
| --- Other Detected Radionuclides --- | | | | | | | |
| **Potassium 40** | **0.69** | | **0.42** | | **0.66** | **12/17/09** | **12/18/09** |

**NOTE(S)**

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC.

U Result is less than the sample detection limit.

# PIKA International, Inc.

## Client Sample ID: SU4 4-11

### Radiochemistry

Lab Sample ID: F9L100438-006
Work Order: LOVEC
Matrix: SOLID

Date Collected: 11/23/09 1340
Date Received: 12/09/09 0910

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | mdc | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD** | | | | pCi/g | | Batch # 9351249 | Yld % |
| **Cesium 137** | **0.42** | | **0.11** | 0.20 | **0.08** | **12/17/09** | **12/18/09** |
| Uranium 235 | 0.20 | U | 0.35 | | 0.59 | 12/17/09 | 12/18/09 |
| **Uranium 238** | **4.6** | | **2.3** | | **2.8** | **12/17/09** | **12/18/09** |
| --- Other Detected Radionuclides --- | | | | | | | |
| **Actinium 228** | **1.17** | | **0.34** | | **0.32** | **12/17/09** | **12/18/09** |
| **Bismuth 214** | **1.08** | | **0.23** | | **0.20** | **12/17/09** | **12/18/09** |
| **Lead 212** | **1.10** | | **0.18** | | **0.17** | **12/17/09** | **12/18/09** |
| **Lead 214** | **1.08** | | **0.25** | | **0.24** | **12/17/09** | **12/18/09** |
| **Potassium 40** | **9.1** | | **1.7** | | **1.3** | **12/17/09** | **12/18/09** |
| **Thallium 208** | **0.371** | | **0.099** | | **0.096** | **12/17/09** | **12/18/09** |
| **Thorium 234** | **4.6** | | **2.3** | | **2.8** | **12/17/09** | **12/18/09** |

**NOTE(S)**

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC.

U Result is less than the sample detection limit.

# PIKA International, Inc.

## Client Sample ID: SU14A 14A-10

### Radiochemistry

Lab Sample ID: F9L100438-007
Work Order: LOVEE
Matrix: SOLID

Date Collected: 11/23/09 0915
Date Received: 12/09/09 0910

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | mdc | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD** | | | | **pCi/g** | | **Batch # 9351249** | **Yld %** |
| Cesium 137 | 0.011 | U | 0.031 | 0.200 | 0.055 | 12/17/09 | 12/21/09 |
| Uranium 235 | -0.03 | U | 0.56 | | 0.28 | 12/17/09 | 12/21/09 |
| Uranium 238 | 0.86 | U | 0.81 | | 1.2 | 12/17/09 | 12/21/09 |

**NOTE(S)**

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC.

U Result is less than the sample detection limit.

# PIKA International, Inc.

## Client Sample ID: SU14A 14A-03

### Radiochemistry

Lab Sample ID: F9L100438-008
Work Order: LOVEF
Matrix: SOLID

Date Collected: 11/23/09 0957
Date Received: 12/09/09 0910

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | mdc | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD** | | | | **pCi/g** | **Batch # 9351249** | | **Yld %** |
| Cesium 137 | -0.0001 | U | 0.028 | 0.200 | 0.054 | 12/17/09 | 12/18/09 |
| Uranium 235 | 0.03 | U | 0.14 | | 0.27 | 12/17/09 | 12/18/09 |
| Uranium 238 | 0.34 | U | 0.81 | | 1.3 | 12/17/09 | 12/18/09 |
| --- Other Detected Radionuclides --- | | | | | | | |
| **Bismuth 214** | **0.144** | | **0.074** | | **0.12** | **12/17/09** | **12/18/09** |

**NOTE(S)**

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC.

U Result is less than the sample detection limit.

# PIKA International, Inc.

## Client Sample ID: APG11-APG20

### Radiochemistry

Lab Sample ID: F9L100438-009
Work Order: LOVEJ
Matrix: SOLID

Date Collected: 10/13/09 1430
Date Received: 12/09/09 0910

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | mdc | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD** | | | | **pCi/g** | | **Batch # 9351249** | **Yld %** |
| Cesium 137 | -0.0003 | U | 0.024 | 0.200 | 0.048 | 12/17/09 | 12/18/09 |
| Uranium 235 | 0.06 | U | 0.12 | | 0.21 | 12/17/09 | 12/18/09 |
| **Uranium 238** | **1.74** | | **0.46** | | **1.0** | **12/17/09** | **12/18/09** |
| --- Other Detected Radionuclides --- | | | | | | | |
| **Bismuth 214** | **0.190** | | **0.083** | | **0.085** | **12/17/09** | **12/18/09** |
| **Lead 212** | **0.129** | | **0.052** | | **0.067** | **12/17/09** | **12/18/09** |
| **Potassium 40** | **1.60** | | **0.65** | | **0.69** | **12/17/09** | **12/18/09** |
| **Thallium 208** | **0.051** | | **0.029** | | **0.042** | **12/17/09** | **12/18/09** |
| **Thorium 234** | **1.74** | | **0.46** | | **1.0** | **12/17/09** | **12/18/09** |

**NOTE(S)**

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC.

U Result is less than the sample detection limit.

# PIKA International, Inc.

## Client Sample ID: APG81-APG90

### Radiochemistry

Lab Sample ID: F9L100438-010
Work Order: LOVEL
Matrix: SOLID

Date Collected: 10/20/09 1340
Date Received: 12/09/09 0910

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | mdc | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD** | | | | **pCi/g** | | **Batch # 9351249** | **Yld %** |
| Cesium 137 | 0.019 | U | 0.031 | 0.200 | 0.052 | 12/17/09 | 12/18/09 |
| **Uranium 235** | **0.38** | | **0.23** | | **0.28** | **12/17/09** | **12/18/09** |
| **Uranium 238** | **16.3** | | **1.7** | | **1.9** | **12/17/09** | **12/18/09** |
| --- Other Detected Radionuclides --- | | | | | | | |
| **Actinium 228** | **0.247** | | **0.095** | | **0.065** | **12/17/09** | **12/18/09** |
| **Lead 212** | **0.143** | | **0.061** | | **0.077** | **12/17/09** | **12/18/09** |
| **Lead 214** | **0.091** | | **0.051** | | **0.076** | **12/17/09** | **12/18/09** |
| **Thorium 234** | **16.3** | | **1.7** | | **1.9** | **12/17/09** | **12/18/09** |

**NOTE(S)**

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC.

U Result is less than the sample detection limit.

# METHOD BLANK REPORT

## Radiochemistry

Client Lot ID: F9L100438
Matrix: SOLID

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | | Prep Date | Lab Sample ID / Analysis Date |
|---|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD** | | | **pCi/g** | **Batch # 9351249** | | **Yld %** | | **F9L170000-249B** |
| Cesium 137 | -0.002 | U | 0.030 | 0.200 | 0.058 | | 12/17/09 | 12/18/09 |
| Uranium 235 | 0.11 | U | 0.14 | | 0.24 | | 12/17/09 | 12/18/09 |
| Uranium 238 | -0.06 | U | 0.75 | | 1.2 | | 12/17/09 | 12/18/09 |

**NOTE(S)**

Data are incomplete without the case narrative.

MDC is determined using instrument performance only
Bold results are greater than the MDC.

U Result is less than the sample detection limit.

# Laboratory Control Sample Report

## Radiochemistry

Client Lot ID: F9L100438
Matrix: SOLID

| Parameter | Spike Amount | Result | Total Uncert. (2 σ+/-) | MDC | % Yld | % Rec | Lab Sample ID QC Control Limits |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD** | | **pCi/g** | | **GA-01-R MOD** | | | **F9L170000-249C** |
| Americium 241 | 98.8 | 97.1 | 8.3 | 2.9 | | 98 | (90 - 110) |
| Cesium 137 | 37.1 | 38.9 | 2.4 | 0.3 | | 105 | (90 - 110) |
| Cobalt 60 | 61.4 | 60.0 | 3.5 | 0.2 | | 98 | (90 - 110) |
| | **Batch #:** | 9351249 | | **Analysis Date:** | 12/18/09 | | |

**NOTE(S)**

MDC is determined by instrument performance only
Calculations are performed before rounding to avoid round-off error in calculated results

# DUPLICATE EVALUATION REPORT

## Radiochemistry

Client Lot ID: F9L100438
Matrix: SOLID

Date Sampled: 11/23/09
Date Received: 12/09/09

| Parameter | SAMPLE Result | | Total Uncert. (2σ+/-) | % Yld | DUPLICATE Result | | Total Uncert. (2 σ+/-) | % Yld | QC Sample ID Precision | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD** | | **pCi/g** | | | **GA-01-R MOD** | | | | **F9L100438-001** | |
| Cesium 137 | 0.020 | U | 0.022 | | 0.012 | U | 0.024 | | 45 | %RPD |
| Uranium 235 | -0.03 | U | 1.4 | | 0.037 | U | 0.097 | | 6140 | %RPD |
| Uranium 238 | **2.02** | | **0.48** | | **2.30** | | **0.48** | | 13 | %RPD |
| ---Other Dedected Radionuclides--- | | | | | | | | | | |
| Thorium 234 | **2.02** | | **0.48** | | **2.30** | | **0.48** | | 13 | %RPD |
| | **Batch #:** | | 9351249 (Sample) | | 9351249 (Duplicate) | | | | | |

**NOTE(S)**

Data are incomplete without the case narrative.
Calculations are performed before rounding to avoid round-off error in calculated results

U Result is less than the sample detection limit.

Lot F9L100438

# PIKA

PIKA International, Inc.

Clerk 329 AB 12-9-09

## Chain of Custody Record

Fedex Airbill #

F9L100438

Document No. 12-1
Page 1 of 2

| | | | |
|---|---|---|---|
| Project Number | 08-07-172 | Project Fax | 916-920-9163 |
| Project Name | APG | Req'd Report Date | |
| Project Contact | Jeanne Haslett | Lab Contact | |
| Project Phone | 916-920-9840 | Lab Phone | |

| BILLING ADDRESS: | SEND REPORT TO: | LAB ADDRESS: |
|---|---|---|
| PIKA International, Inc.<br>12723Capricorn Dr., Ste 500<br>Stafford, TX 77477<br>Phone: 281-340-5525<br>Fax: 281-340-5533 | PIKA International<br>5025 Arnold Ave., Ste 100<br>McClellan, CA 95652<br>Attention: Jeanne<br><br>jhaslett@pikainc.com | |

| # | Sample ID# and Description | Matrix TYPE: AIR | AQUEOUS | SOIL | FILTER | CONTAINER TYPE (G, P) | VOLUME | NUMBER OF CONTAINERS | PRESER -VATIVE | ANALYSIS REQUESTED: SW 6020 Metals | HASL 300 Gamma Spec | DATE & TIME COLLECTED | SPECIAL INSTRUCTIONS / NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | soar |
| X | 1 APG11-APG20 | | | X | | | 1.5L | 1 | none | X | X | 10/13/09 1430 | 650 marin |
| X | 2 APG81-APG90 | | | X | | | 1.5L | 1 | none | X | X | 10/20/09 1340 | |
| | 3 | | | | | | | | none | | | | |
| | 4 | | | | | | | | none | | | | |
| | 5 | | | | | | | | none | | | | |
| | 6 | | | | | | | | none | | | | |
| | 7 | | | | | | | | none | | | | |
| | 8 | | | | | | | | none | | | | |

| | | | | |
|---|---|---|---|---|
| Sample TAT Req'd: Standard | Sample Disposal: | ☐ Archive for _____ Months. | ☒ Disposal by Lab | ☐ Return to origin |
| Notes/Comments: | | | | QC Requirements: |
| REPORT U238 | | | | |

### CUSTODY TRACKING

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1) | Relinquished By: | Date: 12-07-09 | Time: 11:37 | Received By: | Date: 12/08/09 | Time: 1137 |
| 2) | Relinquished By: Chengshe | Date: 12/8/09 | Time: 16:00 | Received By: | Date: 12-9-09 | Time: 9:10 |
| 3) | Relinquished By: | Date: | Time: | Received By: | Date: | Time: |
| 4) | Relinquished By: | Date: | Time: | Received By: | Date: | Time: |

x Metals performed @ TAL - W. Sacramento

# PIKA

PIKA International, Inc.

Cur 330

## Chain of Custody Record

F9L100438

**Fedex Airbill #**

Document No. 12-1
Page 2 of 2

| | | | |
|---|---|---|---|
| Project Number | 08-07-172 | Project Fax | 916-920-9163 |
| Project Name | APG | Req'd Report Date | |
| Project Contact | Jeanne Haslett | Lab Contact | |
| Project Phone | 916-920-9840 | Lab Phone | |

| BILLING ADDRESS: | SEND REPORT TO: | LAB ADDRESS: |
|---|---|---|
| PIKA International, Inc.<br>12723Capricorn Dr., Ste 500<br>Stafford, TX 77477<br>Phone: 281-340-5525<br>Fax: 281-340-5533 | PIKA International<br>5025 Arnold Ave., Ste 100<br>McClellan, CA 95652<br>Attention: Jeanne<br><br>jhaslett@pikainc.com | |

| # | Sample ID# and Description | Matrix TYPE: AIR | AQUEOUS | SOIL | FILTER | CONTAINER TYPE (G, P) | VOLUME | NUMBER OF CONTAINERS | PRESER -VATIVE | ANALYSIS REQUESTED: SW6020 Metals | HASL 300 Gamma Spec | DATE & TIME COLLECTED | SPECIAL INSTRUCTIONS / NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | each |
| 1 | SU1- 1-11 | | | X | | | 1.5L | 1 | none | | X | 11/23/09 1100 | 650 marin |
| 2 | SU1 1-4 | | | X | | | 1.5L | 1 | none | | X | 1305 | |
| 3 | SU2 2-5 | | | X | | | 1.5L | 1 | none | | X | 0850 | |
| 4 | SU2 2-12 | | | X | | | 1.5L | 1 | none | | X | 0830 | |
| 5 | SU4 4-7 | | | X | | | 1.5L | 1 | none | | X | 1349 | |
| 6 | SU4 4-11 | | | X | | | 1.5L | 1 | none | | X | 1340 | |
| 7 | SU14A 14A-10 | | | X | | | 1.5L | 1 | none | | X | 0915 | |
| 8 | SU14A 14A-03 | | | X | | | 1.5L | 1 | none | | X | 0957 | |

| | | | | |
|---|---|---|---|---|
| Sample TAT Req'd: Standard | Sample Disposal: | ☐ Archive for _____ Months. | ☒ Disposal by Lab | ☐ Return to origin |
| Notes/Comments: | | | | QC Requirements: |
| REPORT U238 | | | | |

### CUSTODY TRACKING

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1) | Relinquished By: | Date: 12-07-09 | Time: 1137 | Received By: | Date: 07DEC09 | Time: 1137 |
| 2) | Relinquished By: Chang Ke | Date: 12/8/09 | Time: 1600 | Received By: | Date: 12-9-09 | Time: 9:10 |
| 3) | Relinquished By: | Date: | Time: | Received By: | Date: | Time: |
| 4) | Relinquished By: | Date: | Time: | Received By: | Date: | Time: |

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Lot #(s): F9L100438

**CONDITION UPON RECEIPT FORM** 4-09

Client: TA West Sac

Quote No: 84792

COC/RFA No: N/A

330

Initiated By: AB Date: 12-9-09 Time: 910

**Shipping Information**

Shipper: (FedEx) UPS DHL Courier Client Other: _____ Multiple Packages: (Y) N

| Shipping # (s):* | | Sample Temperature (s):** | |
|---|---|---|---|
| 1. 7982 0438 5176 - master | 6. | 1. ambient W for #6 | 6. |
| 2. | 7. | 2. 4 12/10/09 | 7. |
| 3. | 8. | 3. | 8. |
| 4. | 9. | 4. | 9. |
| 5. | 10. | 5. | 10. |

*Numbered shipping lines correspond to Numbered Sample Temp lines

**Sample must be received at 4°C ± 2°C- If not, note contents below. Temperature variance does NOT affect the following: Metals-Liquid or Rad tests- Liquid or Solids

**Condition** (Circle "Y" for yes, "N" for no and "N/A" for not applicable):

| | | | | | |
|---|---|---|---|---|---|
| 1. | (Y) N | Are there custody seals present on the cooler? | 8. | Y (N) | Are there custody seals present on bottles? |
| 2. | Y (N) N/A | Do custody seals on cooler appear to be tampered with? | 9. | Y N (N/A) | Do custody seals on bottles appear to be tampered with? |
| 3. | (Y) N | Were contents of cooler frisked after opening, but before unpacking? | 10. | Y N (N/A) | Was sample received with proper pH[1]? (If not, make note below) |
| 4. | (Y) N | Sample received with Chain of Custody? | 11. | (Y) N | Sample received in proper containers? |
| 5. | (Y) N N/A | Does the Chain of Custody match sample ID's on the container(s)? | 12. | Y N (N/A) | Headspace in VOA or TOX liquid samples? (If Yes, note sample ID's below) |
| 6. | Y (N) | Was sample received broken? | 13. | Y N (N/A) | Was Internal COC/Workshare received? |
| 7. | (Y) N | Is sample volume sufficient for analysis? | 14. | Y N (N/A) | Was pH taken by original TestAmerica lab? |

[1] For DOE-AL (Pantex, LANL, Sandia) sites, pH of ALL containers received must be verified, EXCEPT VOA, TOX and soils.

Notes:

* Following sample with lid partially off - Sample still in container - put lid backon
Sh2 - 2 - 12
Sh1 12-9-09 1-4
Sh4 4-7
Sh1 1-11

* Sample Sh 14A 14A-03 received with lid completely off - cannot get lid back on too full - sample mostly still in container per attached e-mail proceed with all samples 12-10-09

Corrective Action:

☑ Client Contact Name: Jeanne Hazlett Informed by: K. Clay 12-09-09

☐ Sample(s) processed "as is"

☐ Sample(s) on hold until: If released, notify: _____

Project Management Review: Jaymak Patel Date: 12-13-09

THIS FORM MUST BE COMPLETED AT THE TIME THE ITEMS ARE BEING CHECKED IN. IF ANY ITEM IS COMPLETED BY SOMEONE OTHER THAN THE INITIATOR, THEN THAT PERSON IS REQUIRED TO APPLY THEIR INITIAL AND THE DATE NEXT TO THAT ITEM.

ADMIN-0004, REVISED 10/21/08 \\Slsvr01\QA\FORMS\ST-LOUIS\ADMIN\Admin004 rev11.doc

# APPENDIX E

Instrument Calibration Reports

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 PIKA INTERNATIONAL ORDER NO. 20134551/338474

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 221027

Cal. Date 29-May-09 Cal Due Date 29-May-10 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 76 °F RH 41 % Alt 703.8 mm Hg

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

☑ Mechanical check
☑ F/S Resp. check ☑ Reset check ☑ Window Operation ☑ Input Sens. Linearity
☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC
☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check
☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 4 mV
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 498 V Ref./Inst. 2000 / 1999 V

**COMMENTS:** *Firmware: 37122N28*

I/O Firmware: 37123N05

Calibrated using 5' cable.

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

| | Probe Model | Serial # | High Voltage | Threshold | Units/ Time Base | Dead Time Correction Factor | Calibration Constant | Linearity ±10%* |
|---|---|---|---|---|---|---|---|---|
| Detector # | 43-37 A | PR216878 | 1250 | 100 | 7 / 1 | 1.823569E-05 | 1.000000E+00 | |
| Detector # | 43-37 B | PR216878 | 1700 | 100 | 7 / 1 | 2.314757E-05 | 1.000000E+00 | |
| Detector # | 43-68 A | PR216846 | 1200 | 100 | 7 / 1 | 1.669870E-05 | 1.000000E+00 | |
| Detector # | 43-68 B | PR216846 | 1650 | 100 | 7 / 1 | 2.089564E-05 | 1.000000E+00 | |
| Detector # | | | | | | | | |
| Detector # | | | | | | | | |
| Detector # | | | | | | | | |
| Detector # | | | | | | | | |
| Detector # | | | | | | | | |
| Detector # | | | | | | | | |

**Units:** 0 -- rad, 1 -- Gray, 2 -- rem, 3 -- Sv, 4 -- R, 5 -- C/Kg, 6 -- Disintegrations, 7 -- Counts, 8 -- Ci/cm sq, 9 -- Bq/cm sq.
**Time Base:** 0 -- Seconds, 1 -- Minutes, 2 -- Hours

* See attached detector documentation, if app

| Digital Readout | REFERENCE CAL. POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING* | REFERENCE CAL. POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING* |
|---|---|---|---|---|---|---|
| | 400kcpm | 40056(0) | 40056(0) | 400cpm | 40(0) | 40(0) |
| | 40kcpm | 4005 ↓ | 4005 ↓ | 40cpm | 4 ↓ | 4 ↓ |
| | 4kcpm | 400 ↓ | 400 ↓ | | | |

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:** Cs-137 Gamma S/N ☐ S-394/1122 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646
☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☑ Alpha S/N Pu239 s/n 5283 ☑ Beta S/N Tc99 s/n 5296 ☐ Other

☑ m 500 S/N 114520 ☑ Multimeter S/N 78401030

Calibrated By: Sebastian Ceballos Date 29-May-09

Reviewed By: Rhonda Haines Date 3 Jun 09

Designer and Manufacturer
of
Scientific and Industrial
Instruments

**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.

# *Bench Test Data*

Detector 43-37 A Serial No. PR216878 Order #. 20134551/338474

Customer PIKA INTERNATIONAL

Counter 2350-1 Serial No. 221027 Counter Input Sensitivity 4.00 mV

Count Time 1 min. Distance Source to Detector Surface

Other Cal Constant = 1.000000E+00 Dead Time = 1.823569E-05

| High Voltage | Background | Isotope Pu239 Size 24,600 dpm | Isotope Size | Isotope Size | Isotope Size |
|---|---|---|---|---|---|
| 1150V | 5 | 5,665 | | | |
| 1200 | 1 | 5,805 | | | |
| *1250 | 3 | 5,913 | | | |
| 1300 | 3 | 5,929 | | | |
| 1350 | 4 | 5,974 | | | |

☑ Gas proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

Signature Sebastian Ceballos Date 29-May-09

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

Designer and Manufacturer
of
Scientific and Industrial
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501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

## *Bench Test Data*

Detector 43-37 B Serial No. PR216878 Order #. 20134551/338474

Customer PIKA INTERNATIONAL

Counter 2350-1 Serial No. 221027 Counter Input Sensitivity 4.00 mV

Count Time 1 min. Distance Source to Detector surface

Other Cal Constant = 1.000000E+00 Dead Time = 2.314757E-05

| High Voltage | Background | Isotope Tc99 Size 33,200 dpm | Isotope Size | Isotope Size | Isotope Size |
|---|---|---|---|---|---|
| 1650V | 539 | 10,177 | | | |
| 1675 | 703 | 11,174 | | | |
| *1700 | 995 | 12,164 | | | |
| 1725 | 1,197 | 12,856 | | | |

☑ Gas proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

Signature Sebast Ceballos Date 29-May-09

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

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501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

## *Bench Test Data*

Detector 43-68 A Serial No. PR216846 Order #. 20134551/338474

Customer PIKA INTERNATIONAL

Counter 2350-1 Serial No. 221027 Counter Input Sensitivity 4.00 mV

Count Time 1 min. Distance Source to Detector surface

Other Cal Constant = 1.000000E+00 Dead Time = 1.669870E-05

| High Voltage | Background | Isotope Pu239 Size 24,600 dpm | Isotope Size | Isotope Size | Isotope Size |
|---|---|---|---|---|---|
| 1100V | 0 | 5,864 | | | |
| 1150 | 0 | 6,027 | | | |
| *1200 | 3 | 6,159 | | | |
| 1250 | 1 | 6,114 | | | |
| 1300 | 1 | 6,065 | | | |

☑ Gas proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

Signature Sebastian Caballero Date 29-May-09

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.
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501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

## *Bench Test Data*

Detector 43-68 B Serial No. PR216846 Order #. 20134551/338474

Customer PIKA INTERNATIONAL

Counter 2350-1 Serial No. 221027 Counter Input Sensitivity 4.00 mV

Count Time 1 min. Distance Source to Detector Surface

Other Cal Constant = 1.000000E+00 Dead Time = 2.089564E-05

| High Voltage | Background | Isotope Tc99 Size 33,200 dpm | Isotope Size | Isotope Size | Isotope Size |
|---|---|---|---|---|---|
| 1600V | 217 | 11,266 | | | |
| 1625 | 261 | 12,155 | | | |
| * 1650 | 311 | 12,083 | | | |
| 1675 | 357 | 12,098 | | | |

☑ Gas proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

Signature Sebastian Ceballos Date 29-May-09

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

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 PIKA INTERNATIONAL ORDER NO. 20119667/331787

Mfg. Ludlum Measurements, Inc. Model 2360 Serial No. 193654

Mfg. Ludlum Measurements, Inc. Model 43-93 Serial No. PR198509

Cal. Date 11-Nov-08 Cal Due Date 11-Nov-09 Cal. Interval 1 Year Meterface 202-855

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 42 % Alt 701.8 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 ☑ RS-232 Port OK
☑ 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 725 V

☑ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 1500 / 1500 V

Firmware Version: 39010-20
Alpha Threshold: 120 mv
Beta Threshold: 3.5 mv
Beta Window: 30 mv
Overload Set To Simulate light leak.
Instrument calibrated with a 39" cable.
High voltage set with detector Disconnected

(EEPROM Settings)
User Time: 1.0
Alpha Alarm: 50000
Beta Alarm: 50000
A/B Alarm: 50000
Model 2360 Date: 11/11/2008
Calibration Date Due: 11/11/2009

**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* |
|---|---|---|---|
| x1000 | 400k cpm | 400 | 400 |
| x1000 | 100k cpm | 100 | 100 |
| x100 | 40k cpm | 400 | 400 |
| x100 | 10k cpm | 100 | 100 |
| x10 | 4k cpm | 400 | 400 |
| x10 | 1k cpm | 100 | 100 |
| x1 | 400 cpm | 400 | 400 |
| x1 | 100 cpm | 100 | 100 |

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

| | REFERENCE CAL. POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING* |
|---|---|---|---|
| Digital Readout | 400kcpm | 39861 (0) | 39861 (0) |
| | 40kcpm | 3996 | 3996 |
| | 4kcpm | 400 | 400 |
| | 400cpm | 40 | 40 |
| | 40cpm | 4 | 4 |

| | 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 ☐ 059 ☐ 280 ☐ 60646
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 Pu239 SN: 5282 ☑ Beta S/N Tc99 SN: 5296 ☑ Other Sr/90 SN: 5281

☑ m 500 S/N 190566 ☐ Oscilloscope S/N ☑ Multimeter S/N 86250390

Calibrated By: Jason Flan Date 11-Nov-08

Reviewed By: Rhett Hein Date 11 Nov 08


FORM C22S 10/15/2008

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer
of
Scientific and Industrial
Instruments

**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.

## *Bench Test Data For Detector*

Detector 43-93 Serial No. PR198509

Customer PIKA INTERNATIONAL

Counter 2360 Serial No. 193654

Count Time 1Minute

Other

Order #. 20119667/331787

Alpha Input Sensitivity 120 mV

Beta Input Sensitivity 3.5 mV

Beta Window 30 mV

Distance Source to Detector Surface

| High Voltage | Background | | Isotope Pu 239 Size 35515dpm | | Isotope Tc 99 Size 33077dpm | | Isotope Sr Y 90 Size 107687dpm | |
|---|---|---|---|---|---|---|---|---|
| | Alpha | Beta | Alpha | Beta | Alpha | Beta | Alpha | Beta |
| 700 | 0 | 164 | 8790 | 578 | 8 | 3845 | 3 | 26104 |
| 725 | 0 | 226 | 9260 | 777 | 13 | 5506 | 1 | 33004 |
| 750 | 4 | 407 | 9449 | 1218 | 15 | 6862 | 0 | 37089 |

☐ Gas Proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

☐ Gas proportional detector count rate decreased ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature Jason Flan Date 11-nov-08

FORM C4B 04/09/2003

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 PIKA INTERNATIONAL ORDER NO. 20134288/338292

Mfg. Ludlum Measurements, Inc. Model 2360 Serial No. 275173

Mfg. Ludlum Measurements, Inc. Model 43-93 Serial No. PR237000

Cal. Date 29-May-09 Cal Due Date 29-May-10 Cal. Interval 1 Year Meterface 202-855

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 43 % Alt 700.8 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 ☐ RS-232 Port OK
☑ 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 850 V

☑ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 2000 / 2000 V

Firmware Version: 39010n24
Alpha Threshold: 140 mV
Beta Threshold: 38mV
Beta Window: 32mV
Overload set to simulate light leak
Instrument calibrated with a 15' cable.
High voltage set with detector disconnected

(EEPROM Settings)
User Time: 10
Alpha Alarm: 999999
Beta Alarm: 999999
A/B Alarm: 999999
Model 2360 Date: 29.May.09
Calibration Date Due: 29.May.10

**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* |
|---|---|---|---|
| x1000 | 400k cpm | 400 | 400 |
| x1000 | 100k cpm | 100 | 100 |
| x100 | 40k cpm | 400 | 400 |
| x100 | 10k cpm | 100 | 100 |
| x10 | 4k cpm | 400 | 400 |
| x10 | 1k cpm | 100 | 100 |
| x1 | 400 cpm | 400 | 400 |
| x1 | 100 cpm | 100 | 100 |

*Uncertainty within ± 10% C.F. within ± 20%

ALL **Range(s) Calibrated Electronically**

| | REFERENCE CAL. POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING* |
|---|---|---|---|
| Digital Readout | 400kcpm | 39999 (0) | 39999 (0) |
| | 40kcpm | 3999 | 3999 |
| | 4kcpm | 400 | 400 |
| | 400cpm | 40 | 40 |
| | 40cpm | 4 | 4 |
| Log Scale | | | |

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State of Texas Calibration License No. LO-1963

**Reference Instruments and/or Sources:** ☐ S-394/1122 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646
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 Pu239 2928-01 ☑ Beta S/N Tc99 NI-EV SrY90 4016 ☐ Other

☑ m 500 S/N 63893 ☐ Oscilloscope S/N ☑ Multimeter S/N 93870637

Calibrated By: Jeramy Thompson Date 29.May.09

Reviewed By: Rhonda Hain Date 31 May 09


FORM C22S 10/15/2008

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer
of
Scientific and Industrial
Instruments

**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.

# *Bench Test Data For Detector*

Detector 43-93 Serial No. PR237000

Customer PIKA INTERNATIONAL

Counter 2360 Serial No. 225173

Count Time 1Minute

Other Plateau done with 15' cable

Order #. 20134288/338292

Alpha Input Sensitivity 140 mV

Beta Input Sensitivity 3.7 mV

Beta Window 37 mV

Distance Source to Detector Surface

| High Voltage | Background | | Isotope Pu 239 Size ≈ 25,200 dpm | | Isotope Tc 99 Size ≈ 22,600 dpm | | Isotope Sr 90 Size ≈ 55,100 dpm | |
|---|---|---|---|---|---|---|---|---|
| | Alpha | Beta | Alpha | Beta | Alpha | Beta | Alpha | Beta |
| 825 | 1 | 165 | 5208 | 571 | 5 | 2973 | 2 | 9809 |
| * 850 | 1 | 209 | 5359 | 709 | 3 | 3847 | 5 | 17410 |
| 875 | 0 | 339 | 5647 | 1006 | 2 | 4871 | 5 | 14093 |

☐ Gas Proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

☐ Gas proportional detector count rate decreased ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature Jeramy Thompson Date 29-May-09

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 PIKA INTERNATIONAL ORDER NO. 20137527/340279

Mfg. Ludlum Measurements, Inc. Model 2360 Serial No. 193682

Mfg. Ludlum Measurements, Inc. Model 43-93 Serial No. PR236970

Cal. Date 23-Jul-09 Cal Due Date 23-Jul-10 Cal. Interval 1 Year Meterface 202-855

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 45 % Alt 703.8 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 ☐ RS-232 Port OK
☑ 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 800 V

☑ HV Readout (2 points) Ref./Inst. 500 / 504 V Ref./Inst. 1500 / 1486 V

Firmware Version: 39010n24
Alpha Threshold: 120mV
Beta Threshold: 3.5mV
Beta Window: 30mV
Overload set to simulate a light leak
Instrument calibrated with a 39" C- cable.
High voltage set with detector disconnected

(EEPROM Settings)
User Time: 1.0 minutes
Alpha Alarm: 50000
Beta Alarm: 50000
A/B Alarm: 50000
Model 2360 Date: 07/23/2009
Calibration Date Due: 07/23/2010

**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* |
|---|---|---|---|
| x1000 | 400k cpm | 400 | 400 |
| x1000 | 100k cpm | 100 | 100 |
| x100 | 40k cpm | 400 | 400 |
| x100 | 10k cpm | 100 | 100 |
| x10 | 4k cpm | 400 | 400 |
| x10 | 1k cpm | 100 | 100 |
| x1 | 400 cpm | 400 | 400 |
| x1 | 100 cpm | 100 | 100 |

*Uncertainty within ± 10% C.F. within ± 20%

ALL **Range(s) Calibrated Electronically**

| | REFERENCE CAL. POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING* |
|---|---|---|---|
| Digital Readout | 400kcpm | 40098(0) | 40098(0) |
| | 40kcpm | 4010 | 4010 |
| | 4kcpm | 401 | 401 |
| | 400cpm | 40 | 40 |
| | 40cpm | 4 | 4 |

| | 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 ☐ 059 ☐ 280 ☐ 60646
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 Pu239#5283 ☑ Beta S/N Tc99#5280;Sr90Y90#5281 ☐ Other

☑ m 500 S/N 238275 ☐ Oscilloscope S/N ☑ Multimeter S/N 83750210

Calibrated By: James K. Mike Date 23-JUL-09

Reviewed By: Richard Hann Date 24 Jul 09


FORM C22S 10/15/2008

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer
of
Scientific and Industrial
Instruments

**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.

## *Bench Test Data For Detector*

Detector 43-93 Serial No. PR236970 Order #. 20137527/340279

Customer PIKA INTERNATIONAL Alpha Input Sensitivity 120 mV

Counter 2360 Serial No. 193682 Beta Input Sensitivity 3.5 mV

Count Time 1Minute Beta Window 30 mV

Other _____ Distance Source to Detector Surface

| High Voltage | Background | | Isotope Pu239 Size 24640.45 dpm | | Isotope Tc99 Size 93239.85 dpm | | Isotope Sr90Y90 Size 105874.21 dpm | |
|---|---|---|---|---|---|---|---|---|
| | Alpha | Beta | Alpha | Beta | Alpha | Beta | Alpha | Beta |
| 775 | 0 | 125 | 5415 | 312 | 36 | 10587 | 0 | 27246 |
| 800 | 0 | 159 | 5629 | 414 | 26 | 14535 | 1 | 33430 |
| 825 | 0 | 250 | 5679 | 565 | 31 | 18384 | 0 | 37571 |
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☐ Gas Proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

☐ Gas proportional detector count rate decreased ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature James K. McBee Date 23-JUL-09

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 PIKA INTERNATIONAL ORDER NO. 20143814/344064

Mfg. Ludlum Measurements, Inc. Model 2360 Serial No. 225237

Mfg. Ludlum Measurements, Inc. Model 43-93 Serial No. PR237000

Cal. Date 23-Nov-09 Cal Due Date 23-Nov-10 Cal. Interval 1 Year Meterface 202-855

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 70 °F RH 25 % Alt 698.8 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 ☐ RS-232 Port OK
☑ 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 800 V

Replaced fuse

☑ HV Readout (2 points) Ref./Inst. 500 / 505 V Ref./Inst. 1500 / 1511 V

Firmware Version: 39010N24
Alpha Threshold: 120 mV
Beta Threshold: 3.5 mV
Beta Window: 30 mV
Overload Set to simulate a light leak
Instrument calibrated with a 39" cable.
High voltage set with detector not connected

(EEPROM Settings)
User Time: 1.0
Alpha Alarm: 999999
Beta Alarm: 999999
A/B Alarm: 999999
Model 2360 Date: 11/23/2009
Calibration Date Due: 11/23/2010

**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* |
|---|---|---|---|
| X1000 | 400 Kcpm | 400 | 400 |
| X1000 | 100 Kcpm | 100 | 100 |
| X100 | 40 Kcpm | 400 | 400 |
| X100 | 10 Kcpm | 100 | 100 |
| X10 | 4 Kcpm | 400 | 400 |
| X10 | 1 Kcpm | 100 | 100 |
| X1 | 400 cpm | 400 | 400 |
| X1 | 100 cpm | 100 | 100 |

*Uncertainty within ± 10% C.F. within ± 20%

Range(s) Calibrated Electronically

| | REFERENCE CAL. POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING* |
|---|---|---|---|
| Digital Readout | 400 K cpm | 40049 cpm | 40049 cpm |
| | 40 K cpm | 4005 | 4005 |
| | 4 K cpm | 400 | 400 |
| | 400 cpm | 40 | 40 |
| | 40 cpm | 4 | 4 |

| | 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 ☐ 059 ☐ 280 ☐ 60646
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 PU-239#2928 ☑ Beta S/N TC-99#5279 Sr90y90#5281 ☐ Other

☑ m 500 S/N 189506 ☐ Oscilloscope S/N ☑ Multimeter S/N 93870637

Calibrated By: Duane Jackson Date 23-Nov-09

Reviewed By: Rhonda Hein Date 23 Nov 09


FORM C22S 10/15/2008

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer
of
Scientific and Industrial
Instruments

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501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

## *Bench Test Data For Detector*

Detector 43-93 Serial No. PR236961 Order #. 20143814/344064

Customer PIKA INTERNATIONAL Alpha Input Sensitivity 120 mV

Counter 2360 Serial No. 193651 Beta Input Sensitivity 3.5 mV

Count Time 1Minute Beta Window 30 mV

Other _____ Distance Source to Detector Surface

| High Voltage | Background | | Isotope Pu-239 Size 25.2Kdpm | | Isotope Tc99 Size 28,800dpm | | Isotope Sr90/Y90 Size 105,000dpm | |
|---|---|---|---|---|---|---|---|---|
| | Alpha | Beta | Alpha | Beta | Alpha | Beta | Alpha | Beta |
| 775 | 0 | 140 | 5231 | 388 | 8 | 4635 | 2 | 28665 |
| * 800 | 1 | 218 | 5800 | 461 | 10 | 5785 | 3 | 34906 |
| 825 | 0 | 267 | 5907 | 548 | 8 | 6768 | 0 | 39371 |
| 850 | 1 | 352 | 5932 | 700 | 8 | 7855 | 0 | 41264 |

☐ Gas Proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

☐ Gas proportional detector count rate decreased ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature Thomas Jackson Date 23-Nov-09

FORM C4B 04/09/2003

# Certificate of Calibration

## Calibration and Voltage Plateau

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

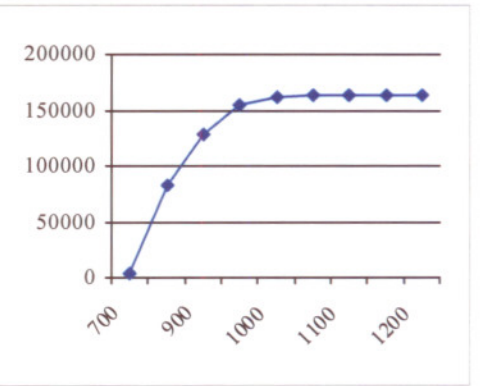
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Meter: | Manufacturer: | Ludlum | Model Number: | 2221 | Serial Number: | 108878 |
| Detector: | Manufacturer: | Ludlum | Model Number: | FIDLER | Serial Number: | 010807G |

☑ Mechanical Check ☑ Geotropism ☑ THR/WIN Operation ☑ Audio Check ☑ Battery Check (Min 4.4 VDC)
☑ F/S Response Check ☑ Meter Zeroed ☑ Reset Check HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V
Source Distance: ☐ Contact ☐ 6 inches ☑ Other: 3/4" Cable Length: ☐ 39-inch ☑ 72-inch ☐ Other:
Source Geometry: ☐ Side ☑ Below ☐ Other: Temperature: 73 F Relative Humidity 20 %
Threshold: 10 mV Window: Barometric Pressure: 24.6 inches Hg
Instrument found within tolerance: ☑ Yes ☐ No

| Range/Multiplier | Reference Setting | "As Found Reading" | Meter Reading | Integrated 1-min count | Log Scale Count |
|---|---|---|---|---|---|
| x 1000 | 400 | 400 | 400 | 399028 | 400 |
| x 1000 | 100 | 100 | 100 | | 100 |
| x 100 | 40 | 400 | 400 | 39899 | 400 |
| x 100 | 10 | 100 | 100 | | 100 |
| x 10 | 4 | 400 | 400 | 3989 | 400 |
| x 10 | 1 | 100 | 100 | | 100 |
| x 1 | 400 | 400 | 400 | 398 | 400 |
| x 1 | 100 | 100 | 100 | | 100 |

| High Voltage | Source Counts | Background |
|---|---|---|
| 700 | 4264 | |
| 800 | 83088 | |
| 900 | 127837 | |
| 950 | 153639 | |
| 1000 | 161439 | |
| 1050 | 163814 | |
| 1100 | 163157 | 5507 |
| 1150 | 163243 | |
| 1200 | 163279 | |

Voltage Plateau




Comments: Recommended HV 1100 * COUNT TIME = 30 SECONDS

**Reference Instruments and/or Sources:**

Ludlum pulser serial number: ☐ 97743 ☑ 201932 Fluke multimeter serial number: ☐ 87490128
☐ Alpha Source: Th-230 @ 12,900 dpm (2/18/09) sn: 4098-03 ☐ Gamma Source Cs-137 @ 5.32 uCi (2/18/09) sn: 4097-03
☐ Beta Source: Tc-99 @ 17,300 dpm (2/18/09) sn: 4099-03 ☑ Other Source: Am-241

Calibrated By: Calibration Date: 10-6-09 Calibration Due: 10-6-10

Reviewed By: Review Date: 10/6/09

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

EBERLINE SERVICES

# CERTIFICATE OF CALIBRATION

**Electroplated Alpha Standard**

S.O.# 6065
P.O.# 789945

**Description of Standard:**

Model No. DNS-16S Serial No. 5282-04 Isotope Pu-239

Electroplated on polished Ni 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 4001-02.

**Measurement Result:**

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

18,100 ± 541

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

35,600 ± 1,070 ( 0.0160 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: Edward F. Hansen

Calibration Technician: Art Reust Q.A. Representative: Anthony W. Toth

Calibration Date: 6-22-2004 Reviewed Date: 6-23-04

7021 Pan American Freeway NI
Albuquerque, New Mexico 87109-4291
(505) 262-2694 Fax (505) 262-269

EBERLINE SERVICES

# CERTIFICATE OF CALIBRATION

**Electroplated Alpha Standard**

S.O.# 6628
P.O.# 705764

**Description of Standard:**

Model No. DNS-16S Serial No. 5283-04 Isotope Pu-239

Electroplated on polished _____ 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 4001-02.

**Measurement Result:**

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

12,500 ± 374

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

24,600 ± 738 ( 0.0111 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: [signature]

Calibration Technician: [signature] Q.A. Manager: Anthony W. Toth

Calibration Date: 5-17-2007 Reviewed Date: 5-17-07

Source Manufacturing Lat
7021 Pan American Freeway NI
Albuquerque, New Mexico 87109-4231
(505) 761-0413 Fax (505) 761-541

EBERLINE SERVICES

# CERTIFICATE OF CALIBRATION

**Electroplated Alpha Standard**

S.O.# 3812
P.O.# 774925

**Description of Standard:**

Model No. S94-1 Serial No. 2928-01 Isotope Pu-239

Electroplated on polished Ni disc, 0.79 mm thick.

Total diameter of 3.18 cm and an active diameter of 2.54 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:

12,600 ± 377

The total disintegration rate (dpm) assuming 0% backscatter of alpha particles from the surface of the disc, was:

25,200 ± 754 ( 0.0113 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: Kathy Burnham

Calibration Date: 10-24-2001 Reviewed Date: 10-24-01

Analytical Services
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4233
(505) 345-3461 Fax (505) 761-5411

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404·352·8677
Fax 404·352·2837
www.analyticsinc.com

# CERTIFICATE OF CALIBRATION
## Standard Radionuclide Source

**76595-763**

Cs-137 47 mm Diameter Glass Fiber Filter in Auminum Planchet

**Customer:** PIKA International, Inc.
**P.O. No.:** 0701151-001, Item 3

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated with an ionization chamber that was calibrated by the National Physical Laboratory, Teddington, U.K., and is directly traceable to national standards.

Radionuclide purity and calibration were checked by germanium gamma-ray spectrometry. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1

| | |
|---|---|
| ISOTOPE: | Cs-137 |
| ACTIVITY (Bq): | 4.949 E1 |
| HALF-LIFE: | 3.007 E1 years |
| CALIBRATION DATE: | January 30, 2008 12:00 EST |
| RELATIVE EXPANDED UNCERTAINTY (k=2): | 3.3% |

**Comments:**
Impurities: γ-impurities <0.1%

Diameter of active area: 47 mm. Low smooth bottom planchet. Source covering 0.85 mg/cm$^2$ mylar.

No expiration date has been given for this source due to the fragile nature of the mylar covering. This source should be carefully tested for leakage at least every six months. If leakage is detected this source should be disposed of by approved radioactive waste disposal procedures.

Source Prepared By: N Kiesman for
M. I. Taskaeva, Radiochemist

QA Approved: QA MG
D. M. Montgomery, QA Manager

Date: 1/31/08

ANA Form005 Rev. ---

End of Certificate

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404·352·8677
Fax 404·352·2837
www.analyticsinc.com

# CERTIFICATE OF CALIBRATION
## Standard Radionuclide Source

## 76593-763

47 mm Diameter Glass Fiber Filter in Aluminum Planchet

**Customer:** PIKA International, Inc.
**P.O. No.:** 0701151-001, Item 1

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The Am-241 was calibrated by liquid scintillation counting. All other radionuclides were calibrated with an ionization chamber that was calibrated by the National Physical Laboratory, Teddington, U.K., and is directly traceable to national standards.

Radionuclide purity and calibration were checked with a germanium gamma spectrometer system. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

CALIBRATION DATE: January 29, 2008 12:00 EST

| ISOTOPE: | Am-241 | Cs-137 |
|---|---|---|
| ACTIVITY (Bq): | 1.688 E2 | 1.684 E2 |
| HALF LIFE: | 4.322 E2 Y | 3.007 E1 Y |
| RELATIVE EXPANDED UNCERTAINTY(k=2): | 3.3% | 3.3% |

**Comments**
Impurities: $\gamma$-impurities <0.1%, $\alpha$-impurities <0.1%

Diameter active area: 47 mm. Low smooth bottom planchet. Source covering 0.85 mg/cm$^2$ mylar.

No expiration date has been given for this source due to the fragile nature of the mylar covering. This source should be carefully tested for leakage at least every six months. If leakage is detected this source should be disposed of by approved radioactive waste disposal procedures.

Source Prepared By: T Kiesman for
M. I. Taskaeva, Radiochemist

QA Approved: QA MT
D. M. Montgomery, QA Manager

Date: 1/31/08

End of Certificate



**Corporate Office**
24937 Avenue Tibbitts Valencia, California 91355

**Laboratory**
1380 Seaboard Industrial Blvd. Atlanta, Georgia, 30318

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404·352·8677
Fax 404·352·2837
www.analyticsinc.com

# CERTIFICATE OF CALIBRATION
## Standard Radionuclide Source

## 76594-763

### Am-241 47 mm Diameter Glass Fiber Filter in Aluminum Planchet

**Customer:** PIKA International Inc.
**P. O. No.:** 0701151-001, Item 2

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated by liquid scintillation counting. The calibration was checked by alpha counting after source preparation.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

| | |
|---|---|
| Isotope: | Am-241 |
| Activity (Bq): | 1.652 E1 |
| Half-Life: | 4.322 E2 years |
| Calibration Date: | January 30, 2008 12:00 EST |
| Relative Expanded Uncertainty (k=2): | 3.3% |

**Comments:**
Impurities: $\gamma$-impurities <0.1%, $\alpha$-impurities <0.1%
Diameter of active area: 47 mm. Low smooth bottom planchet. Source covering 0.85 mg/cm$^2$ mylar.

No expiration date has been given for this source due to the fragile nature of the mylar covering. This source should be carefully tested for leakage at least every six months. If leakage is detected this source should be disposed of by approved radioactive waste disposal procedures.

Source Prepared By: T Kiesman for
M. I. Taskaeva, Radiochemist

QA Approved: QA MM
D. M. Montgmery, QA Manager

Date: 1/31/08

End of Certificate

ANA Form005 Rev. ---

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 PIKA INTERNATIONAL ORDER NO. ~~20155284~~/351080-4

Mfg. Ludlum Measurements, Inc. Model 2360 Serial No. 225218

Mfg. Ludlum Measurements, Inc. Model 43-93 Serial No. PM236955

Cal. Date 9-Jun-10 Cal Due Date 9-Jun-11 Cal. Interval 1 Year Meterface 202-855

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 53 % Alt 700.8 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 ☐ RS-232 Port OK
☑ 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 825 V

☐ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 1500 / 1504 V

Firmware Version: 390100724
Alpha Threshold: 120 mV
Beta Threshold: 3.4 mV
Beta Window: 30 mV
Overload set to simulate light leak
Instrument calibrated with a 5' cable.
High voltage set with detector disconnected

(EEPROM Settings)
User Time: 1.0
Alpha Alarm: 999999
Beta Alarm: 999999
A/B Alarm: 999999
Model 2360 Date: 9-June-10
Calibration Date Due: 9-June-11

**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* |
|---|---|---|---|
| x1000 | 400k cpm | 400 | 400 |
| x1000 | 100k cpm | 100 | 100 |
| x100 | 40k cpm | 400 | 400 |
| x100 | 10k cpm | 100 | 100 |
| x10 | 4k cpm | 400 | 400 |
| x10 | 1k cpm | 100 | 100 |
| x1 | 400 cpm | 400 | 400 |
| x1 | 100 cpm | 100 | 100 |

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

| | REFERENCE CAL. POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING* |
|---|---|---|---|
| Digital Readout | 400kcpm | 399901 | 399901 |
| | 40kcpm | 3995 | 3995 |
| | 4kcpm | 399 | 399 |
| | 400cpm | 40 | 40 |
| | 40cpm | 4 | 4 |

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

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:** ☐ 73410 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646 ☐ 70897
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 Pu239:7053 ☑ Beta S/N Tc99:NI-EV,SrY90:4016 ☐ Other

☑ m 500 S/N 63893 ☐ Oscilloscope S/N ☑ Multimeter S/N 93870637

Calibrated By: Jeremy Thompson Date 9-June-10

Reviewed By: Date 9 Jun 10




AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer
of
Scientific and Industrial
Instruments

**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.

# Bench Test Data For Detector

Detector 43-93 Serial No. PR236955

Customer PIKA INTERNATIONAL

Counter 2360 Serial No. 225218

Count Time 1Minute

Other

Order #. 20155652 ~~20155284~~/351080-A ST

Alpha Input Sensitivity 120 mV

Beta Input Sensitivity 3.4 mV

Beta Window 30 mV

Distance Source to Detector Surface

| High Voltage | Background Alpha | Background Beta | Isotope Pu239 Size = 24,863dpm Alpha | Isotope Pu239 Size = 24,863dpm Beta | Isotope Tc99 Size = 22,600dpm Alpha | Isotope Tc99 Size = 22,600dpm Beta | Isotope Sr90 Size = 53,636dpm Alpha | Isotope Sr90 Size = 53,636dpm Beta |
|---|---|---|---|---|---|---|---|---|
| 800 | 1 | 118 | 5884 | 464 | 3 | 3648 | 2 | 11041 |
| *825 | 1 | 198 | 5918 | 666 | 0 | 4699 | 0 | 13010 |
| 850 | 2 | 270 | 6013 | 876 | 0 | 5794 | 0 | 15135 |

☐ Gas Proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

☐ Gas proportional detector count rate decreased ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature Jeramy Thompson Date 9-June-10

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Header 1: John Q Public
Header 2: Serial#225218
Header 3: Ser#PR236955
Header 4: Site:Building 1
Header 5: Room 7 EastWall
Header 6: More Comments?
Location: Table 007

Calibration Due Date: 06/09/2011
Model 2360 Date: 06/09/2010
Model 2360 Time: 09:13:01 AM

Logged Samples: 0

User PC Scaler Count Time: 1.0 minutes

| | |
|---|---|
| Alpha Ratemeter Alarm Setpoint: | 999999 |
| Beta Ratemeter Alarm Setpoint: | 999999 |
| Alpha + Beta Ratemeter Alarm Setpoint: | 999999 |
| Alpha Scaler Alarm Setpoint: | 999999 |
| Beta Scaler Alarm Setpoint: | 999999 |
| Alpha + Beta Scaler Alarm Setpoint: | 999999 |

# APPENDIX F

Regulatory Comments and Replies

# APPENDIX F

## PIKA'S RESPONSES TO NRC COMMENTS ON THE FSSR FOR 1103A AREA

1. Survey Unit 25 does not appear to meet the criteria based on the information submitted. Please refer to Appendix B2 Static Results page 21 of 26. In the Tech initial is the measured portion for each spot above the criteria and the average. When added together it is 1.06 which is greater than the 1.0 criteria. Please explain in detail why this area is releasable or perform more decontamination and perform a follow up survey.

*Reply: It appears that the data submitted for this Survey unit does not support release. PIKA reviewed the calculations and found that the instrument efficiency was higher than what was used in the spreadsheet. An efficiency for a different instrument was incorrectly entered for SU25. After the error was corrected, the unity rule calculation came to 0.73, which meets the criterion. Appendix B2 and the text will be revised to show the new results.*

2. Not enough detailed information is provided to determine the Methodology of determining how instrument alpha efficiency was determined for the instrumentation used in the field. Please provide the size of alpha source used, the NIST certified value for the source, and the calculation to determine alpha efficiency.

*Reply: The efficiencies were determined by a vendor, Ludlum Instruments. PIKA obtained the certificates for sources used by Ludlum, and these will be added to Appendix E of the FSSR. The method used is as follows. A nominal 2 inch diameter Pu-239 source is placed under the detector and a one minute count is taken. The result (net of background) is ratioed to the 2 pi source emission rate, as certified by the source vendor. Alpha backscatter was ignored, since it is less than a 1.5% correction (per the source vendor). Also, they do a linearity check over the entire 100cm$^2$ detector area. They move the source around the detector area, looking for non-linearity. If they find a problem, they fail the calibration.*

*An example for one instrument (LMI 2360, SN 193654) is:*

*Source #5282 (Eberline), 2 pi emission rate: 18,100 ± 541 per minute.*

*Count rate over source (per Ludlum), 9260 cpm.*

*Ratio: 9260/18100 = 0.51, which is the instrument efficiency.*

3. It appears from your alpha surveys that you are using a surface efficiency of 0.5 for alpha contamination. Per ISO-7503 recommendations, the alpha surface efficiency should be 0.25. The 0.25 surface efficiency for alpha is in agreement with NUREG01507, Minimum Detectable Concentrations with typical Radiation Survey Instruments for Various Contaminants and Field Conditions. Please

specify the surface efficiency value used and its basis or adjust all of your alpha measurements and reevaluate the survey units.

*Reply: A surface efficiency of 0.5 was applied to the instrument efficiencies, as you noted. After further review, PIKA agrees that a surface efficiency of 0.25 is more appropriate for surfaces such as concrete walls and floors. For other surfaces, however, we feel that a higher surface efficiency is warranted. A number of survey units have a surface of metal siding, which has a much smoother surface than concrete. This is also true of the smooth steel of the storage vaults. NUREG-1507, Table 5.5, presents a surface efficiency of 0.555 for stainless steel and Th-230, using a ZnS detector. This roughly matches our conditions with smooth metal surfaces, U-234, -235 and -238 having similar emissions, and the Ludlum 43-93 ZnS scintillation probe.*

*Alpha activities will be re-calculated for all concrete surface survey units and the FSSR will be revised accordingly.*

4. The removable surface activity survey did not appear to account for a alpha self-absorption factor for counting the wipes. Please justify the self-absorption factor of 1.0 or adjust the results of the wipe tests and evaluate.

*Reply: The wipe test efficiency was determined using a spiked fiber wipe, similar to what is used in the field. This was prepared as a counting standard by Eckert & Ziegler to accurately determine the efficiency of our wipe counter (Ludlum Model 2929). The standard rests in an aluminum planchette that is similar to the planchettes used in counting the field wipes. PIKA feels that this counting standard accurately reflects conditions that could affect results, including self-absorption. A copy of the source certification will be added to Appendix E of the FSSR.*

5. Appendix E does not appear to have the certificates of calibration For the instruments used in Appendix B. Please provide these certificates.

*Reply: There were five instruments used, one for beta scanning (Ludlum Model 2350-1), one for gamma scanning (Ludlum Model 2221/FIDLER), and three for alpha static measurements (Ludlum Model 2360). Appendix E will be updated to include certificates of calibration for each of these.*

6. SU28, after being recalculated, is above the DCGL. I believe your plan says that you will re-investigate any point above the DCGL. I would suggest you resurvey that point with a longer count time and better statistics. If it is lower than the DCGL, modify the report with an explanation. If it is above the DCGL then, split into two class one areas and resurvey, modify report as necessary.

*Reply: This area of SU 28 was investigated and alpha levels similar to the original survey were found. Also, the investigation attempted to confirm the background value for the metal siding surface of this SU. We discovered that a background for this material was never measured. Alpha backgrounds were taken on the three un-affected sides of Bldg. 1100E. The average of sixteen one-minute counts at various locations was 7.1 cpm. This compares to 9.4 cpm in SU28. Thus, the survey unit is not elevated above the DCGL[1].*

*The calculations for fixed readings (Appendix B2) will be updated with the correct background and investigational readings. The investigation survey report will be included in Appendix B4.*

[1] We suspect the high backgrounds are due to radon daughters plating out on the metal siding. Another building on the base, with the same siding and paint, exhibited similar alpha backgrounds.