DEPARTMENT OF THE ARMY
HEADQUARTERS, U.S. ARMY OPERATIONS SUPPORT COMMAND
1 ROCK ISLAND ARSENAL
ROCK ISLAND, IL 61299-6000

REPLY TO
ATTENTION OF:

August 10, 2001

Safety/Rad Waste Team

Mr. Larry Camper
US Nuclear Regulatory Commission
Chief, Decommissioning Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards
Washington, DC 20555-0001

Dear Mr. Camper:

We are pleased to submit (enclosure) the final decommissioning reports for the Lake City Army Ammunition Plant Building 3A and 600-Yard Bullet Catcher decommissioning efforts. We appreciate the level of attention and support your staff has provided on this project.

Our point of contact for questions or comments is Mr. Mike Styvaert, AMSOS-SF, (309) 782-0880, electronic mail address amsos-sf@osc.army.mil.

Sincerely,

Glenn S. Leach
For Rosalene E. Graham
Chief, Safety/Rad Waste Team

Enclosure

Printed On Recycled Paper

Copy Furnished:

Lieutenant Colonel Ronald Alberto, Commander, Lake City Army Ammunition Plant, Independence, Missouri 64051-0330

Commander, Lake City Army Ammunition Plant, Attention: SIOLC-EN/Mr. Garth Anderson, Independence, Missouri 64051-0330

U.S. Environmental Protection Agency, Attention: Mr. Scott Marquess, Project Manager, Region VII, Federal Facilities and Special Emphasis Branch, Superfund Division, 726 Minnesota Avenue, Kansas City, Kansas 66101

State of Missouri, Department of Natural Resources, Hazardous Waste Program, Mr. Mitch Scherzinger, 1730 East Elm Street, Jefferson City, Missouri 65101

U.S. Nuclear Regulatory Commission, Region III, Attention: Mr. Bruce Jorgensen, Decommissioning Branch, Lisle, Illinois 60532

# 600-YARD BULLET CATCHER
# FINAL STATUS SURVEY REPORT

## LAKE CITY ARMY AMMUNITION PLANT
Lake City, Missouri

Contract Number
DAAA09-00G-002/0003

**Prepared By:**

Cabrera Services, Inc.
809 Main Street
East Hartford, CT 06108

01-3030.03, Revision 3

August, 2001

# TABLE OF CONTENTS

**Executive Summary** ..... iii

**1.0 Background Information** ..... 1

**2.0 Site Information** ..... 1
- 2.1 Site Description ..... 1
- 2.2 Site Conditions at the Time of Final Survey ..... 2
- 2.3 Identity of Potential Contaminants and Guidelines ..... 2

**3.0 Final Status Survey Overview** ..... 3
- 3.1 Survey Objectives ..... 3
- 3.2 Organization and Responsibilities ..... 3
- 3.3 Instrumentation ..... 4
- 3.4 Survey Procedures ..... 4
  - 3.4.1 Area Classification ..... 4
  - 3.4.2 Reference Grids ..... 4
  - 3.4.3 Surface Scans ..... 5
  - 3.4.4 Surface Activity Measurements ..... 5
  - 3.4.5 Exposure Rate Measurements ..... 6
  - 3.4.6 Soil Sampling ..... 6
  - 3.4.7 Special Measurements and Samples ..... 7
- 3.5 Background Level Determinations ..... 8
- 3.6 Sample Analysis ..... 8
- 3.7 Data Interpretation ..... 9
- 3.8 Records ..... 9

**4.0 Survey Findings and Results** ..... 9
- 4.1 Background Levels (Table E-1) ..... 9
- 4.2 Bullet Catcher Surveys ..... 10
- 4.3 Data Evaluation ..... 13
- 4.4 Residual Activity Inventory ..... 13

**5.0 Summary** ..... 13

**6.0 References** ..... 14

## TABLES

Table 1 Instrumentation for Radiological Surveys ..... T-1
Table 2 Classification of Lake City AAP 600 Yard Bullet Catcher Surfaces ..... T-2

Table F-1 Summary of Surface Activity Results ..... T-3
Table F-2 Summary of Soil Sampling Results ..... T-4
Table F-3 Summary of Exposure Rate Measurements ..... T-5

## FIGURES

Figure D-1 Map of the Lake City 600 Yard Bullet Catcher Area ..... F-1
Figure D-2 Diagram of the LCAAP Bullet Catcher Area ..... F-2
Figure D-3 Organization Chart for Remediation and Final Status Survey Activities ..... F-3

Figure 1. Firing Range Site Reference (Background) Area Map ..... F-4
Figure 2. Original Grid (10-ft. by 10-ft.) Layout Map ..... F-5
Figure 3. Exposure rates on Original Grid Pre-Remediation ..... F-6
Figure 4. Initial Walkover Map – Gamma Emission Scan (By Global Position) ..... F-7
Figure 5. New Grid (10m by 10m) Layout Map and Soil Sample Pattern ..... F-8
Figure 6. Exposure rates on Original Grid Post-Remediation ..... F-9
Figure 7. Soil Sample Location Map and Results above Background Post Remediation . F-10
Figure 8. Final Walkover Survey – Gamma Emission Scan (by Global Position) ..... F-11

**APPENDICES**

Appendix 1 Survey and Sampling Results ..... A-1
Appendix 2 Quality Assurance Data ..... A-2

# EXECUTIVE SUMMARY

The purpose of this project was to remove depleted uranium from the 600-Yard Bullet Catcher on the firing range at the Lake City Army Ammunition Plant and conduct a survey to demonstrate that the site meets the guidelines for release. Remedial actions were completed and final release surveys and sampling was performed in accordance with NUREG/CR-5849, 'Manual for Conducting Radiological Surveys in Support of License Termination'. All surveys conducted after remediation of these properties indicate that the land at this site is suitable for release without radiological restriction.

The objective of this project was to remediate the 600-Yard Bullet Catcher and surrounding area so that the soil concentration is below release limits prescribed by the Nuclear Regulatory Commission's (NRC) guidelines for unrestricted use. This criterion is prescribed in the NRC Policy, 'Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, and Special Nuclear Material, Policy and Guidance Directive FC 83-23, November 4, 1983. The acceptable contamination criterion for depleted uranium in soil is 35 pCi/gm (total uranium). The decommissioning plan had an additional criterion that the dose rate should not exceed 10 micro-R/hour above background.

The 600-Yard Bullet Catcher and surrounding area was contaminated with depleted uranium (DU) waste from the Army's demilitarization activities associated with the XM-101 DU spotting projectile during the 1960's and 1970's. The small bullet catcher on the north side of the large 600-Yard Bullet Catcher was used as the primary target for demilitarization of DU projectiles on the range. Most of this bullet catcher has now been removed and disposed of as radioactive waste. Only the non-radioactive wooden shell remains at the site.

Weathering and removal/replacement of the sand from the catch box and immediately adjacent areas resulted in migration of activity from the catch box to low-lying areas adjacent to the 500-yard butt, a twenty-foot high man-made hill adjacent to the catch box area. The soil in this area was predominantly loose sand, which was in some areas heavily spotted with DU projectile fragments and other projectiles such as 20 mm HE rounds, 50 caliber rounds, and several various small caliber rounds.

During the Allied Technology Group, Inc. (ATG) characterization survey in 1993-1994, the 600-Yard Bullet Catcher and surrounding area were the most affected in terms of projectile accumulation, spallation, and spreadable activity. Surveys confirmed that the activity deposited in the catch box had spread from the structure to outside the box and adjacent to the large mound identified as the 500-yard butt. This original survey of the bullet catcher was performed by a layout of 320 grids, whose dimensions were 10-ft. by 10-ft. The grids were subdivided into one-foot by one-foot representative areas in which 32,000 readings were taken to identify indications of activity in areas around the bullet catcher and the 500-yard mound. Background readings determined during that characterization ranged from 10 to 15 μR/hr with a median background response of about 13 μR/hr. The highest background reading in this area was 15 μR/hr. Background radiation levels used for this evaluation of the bullet catcher area ranged from 10 to 11 μR/hr for an area of the range to the south of the bullet catcher away from normal firing activities.

The majority of the radioactive material in the area of the 600-Yard Bullet Catcher was found within the sand of the bullet catcher. The 500-yard butt (south-east side), the sand adjacent to the butt, the hill adjacent to the bullet catcher, and along the road leading away from the bullet catcher showed indications of radiation emissions above background. The road-bed was heavily laden with fragments near the bullet catcher to approximately two feet below the normal sand surface.

The depth of contamination, based on observation during in-process surveys, was as deep as three feet in some areas in and around the bullet catcher. The depth was due to the sand which had accumulated above the clay soil over the years. This activity was removed by excavation of the fragments and the soil that surrounded them.

All material, tools, and equipment used on the site were released in accordance with the NRC criteria given in 'Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material; July, 1982'. Any materials and equipment released from the site for re-use by members of the public had no detectable radioactive material on their surfaces.

The site has been evaluated in accordance with NUREG 5849 and the following information describes the current state of the facility.

- Soil concentrations at the 600 yard bullet catcher site meet the NRC release criteria of NUREG/CR-5849.

- Exposure rates measured over the 600 yard bullet catcher site at 1 meter above the soil surface and on contact with the soil surface are less than the original exposure rates measured throughout this area. All original grids are less than 5 micro-R/hour above background.

- The bullet catcher structure meets the NRC release guidelines. All radioactive material previously within this structure has been removed and a survey verified that no residual surface contamination exists in its surfaces.

- The road which was discussed during the project as containing radioactive material in its asphalt and possibly under it, has been removed. The asphalt, road bed, and soil surveyed under the area of road was removed and disposed of as radioactive waste.

# 1.0 Background Information

Lake City Army Ammunition Plant (LCAAP) is located on U.S. Highway 7 and 78 between Independence and Blue Springs, Missouri. The plant was built by the U.S. Army in 1941 and was operated by Remington Arms from 1941 to 1985. Olin Ordnance operated the plant from 1985 through April of 2000. The current operators, Alliant Techsystems, manufacture and test small caliber munitions for the U.S. Army.

LCAAP had a small-scale depleted uranium (DU) projectile development operation during the 1960's and 1970's. Developmental planning of the XM-101 DU spotting projectile started in 1959 and by 1961, LCAAP was manufacturing approximately 8,000 rounds per month. The XM-101 (later M-101) round consisted of a fuzed, 20mm projectile with a body constructed from DU. LCAAP also produced an XM-106 round identical to the XM-101, but without the explosive components. The installation designed, manufactured, and tested, and in later years demilitarized some 75,000 20mm DU spotter rounds. The spotter rounds were approximately 6 inches in length, 20mm in diameter and weighed approximately 1 pound each. The machined DU body made up 45% of the round's one-pound weight and contained a fuzed white phosphorous charge for illumination of the projectiles path.

These munitions were designed as high trajectory, low velocity lob rounds with primary ranges of 2,188 yards and 1,750 yards. Initially, DU operations consisted of test firing of approximately 2,000 XM-101 rounds to target areas at 1,600 and 2,000 meters. Radiation surveys have identified the impact areas at 1,750 yards and 2,188 yards as containing radioactive material (DU), see Reference 1.

All DU operations (manufacturing, testing and demilitarization) from 1960 through 1985 were performed under Remington's Nuclear Regulatory Commission (NRC) license. In 1985, Olin Ordnance Corporation became the LCAAP operating contractor. The depleted uranium (DU) operations was added to the U.S. Army (then HQ, AMCCOM) Headquarters Operations Support Command (HQ, OSC) NRC license for storage and possession of source material, SUC-1380.

There are no current plans to cease operations at the Lake City Army Ammunition Plant. The Army will continue to use the firing range for ballistic testing of small caliber (non-radioactive) conventional ammunition. It is anticipated that in the event that the Army was to stop operations at the site, the land would be designated for industrial use.

# 2.0 Site Information

## 2.1 Site Description

The area of concern for this report is the small bullet catcher and its surrounding land located at the north side of the 600 yard marker on the Lake City Firing Range. The bullet catcher is approximately 25' by 25' and the affected area around the front of the bullet catcher is approximately 200' by 350'. Figure D1 is a map of the area around the bullet catcher on the firing range.

All radioactive material located and removed was within an area bounded by the road on the south side, the 500 yard butt on the northwest side, the 600 yard center bullet catcher mound to the southeast, and an open field to the north. Figure D2 shows this layout.
LCAAP produced approximately 75,000 rounds of XM-101 ammunition from January 1961 to December 1963. By 1968, the Davy Crockett program had been terminated and LCAAP was left with an estimated 44,000 spotter rounds to dispose.

In 1971, Remington Arms Company, Inc. proposed procedures for the disposal of the remaining rounds of XM-101 ammunition. In 1976, an additional 40 rounds were discovered and a temporary permit was obtained to dispose of them in the same manner as the original disposal operation. Since the rounds were fuzed, the safest demilitarization methodology involved shooting the rounds into a sand filled catch box, identified as the "600-Yard Bullet Catcher." The catch box was filled with sand as an impact material. The impact material was periodically replaced in the catch box. The used material was transported to another location on the firing range called Area 10 (The Sand-pile).

Because of the nature of the radioactive material, small hard fragments of various shape and weight in various stages of decomposition through oxidation, the area soil concentrations are heterogeneous. The initial concentration of uranium in the soil was from No Detectable Activity (NDA) to several hundred pico-curies per gram. (Reference 1). The highest concentrations in samples of the soil at the time of characterization were up to approximately 600 pico-curies per gram.

Figure 4 on page F-7 of the 'Figures' section provides the results of a walkover survey with a 2" by 2" sodium iodide (gamma) detector with global position correlation. This survey provided evidence that the DU fragments had not drifted from the activity configuration determined in the characterization survey.

## 2.2 Site Conditions at the Time of Final Survey

After the remediation, all excavation and soil moving equipment was surveyed and released from the affected area. All potentially contaminated materials and soil had been transferred to 40 (25 yard) inter-modal containers for transport to a waste disposal site. The site was mostly dry with some areas where rainwater had collected and sat as standing water.

A final grid structure (Figure 5) was established to enable us to identify locations where readings were above background during the walkover survey. The identification of these areas with the GPS system allowed easy extraction of fragments that were missed during the major remediation activities.

The bullet catcher structure was empty (all radioactive material removed from the area and containerized for shipment to WCS), the roof and metal walls removed and disposed of as radioactive waste.

The road in front of the bullet catcher has been removed and disposed of as radioactive waste. The soil under the area of road closest to the bullet catcher was removed and disposed of as radioactive waste.

## 2.3 Identity of Potential Contaminants and Release Guidelines

Based on the knowledge of site operations (firing DU rounds) and the results of the characterization survey conducted in 1993 and 1994, the significant radionuclides were those directly associated with the decay of depleted uranium. Specifically, the radionuclides of concern from a cleanup and eventual release of the site are:

| | |
|---|---|
| U-238, Pa-234m, Pa-234, Th-234 | 83.1% |
| U-234 | 15% |
| U-235 | 1.9% |

On the basis of this combination of contaminants, the guidelines for cleanup of the site are:

***35 pCi/gram is the limiting concentration in soil.***

That is the grid average must be less than 35 pico-curies per gram.

Each soil sample represents the activity concentration in 25% of a grid, so if a sample result is greater than 35 pCi/g, it can be as high as 70 pCi/g provided that no other samples in the grid are greater than the guideline.

If two samples adjacent to each other in a grid are greater than the guideline, the limit for the average of the two is (100/50)^.5 * 35 pCi/gram = 49.5 pCi/g.

***Exposure rate at 1 meter above the soil must be less than 10 micro-R/hour above background.***

***The fixed surface contamination limit for Depleted Uranium is 5000 dpm/100 $cm^2$.***

***The transferable surface contamination limit for Depleted Uranium is 1000 dpm/100 $cm^2$.***

# 3.0 Final Status Survey Overview

## 3.1 Survey Objectives

The purpose of this final status survey was to demonstrate that the radiological conditions at the 600 Yard Bullet Catcher at the Lake City Army Ammunition Plant site satisfy the NRC guidelines and that the site can, therefore, be released from licensing restrictions for future use without radiological controls. The specific objectives of the survey demonstrate that:

A. Activity in Soil

- The average soil activity concentrations are at or below the guideline values established as acceptable by the NRC.
- Reasonable efforts have been made to identify evaluate, and remove, if necessary, areas where the residual soil concentration exceeded the soil concentration guideline (35 pCi/gram).

B. Exposure Rate

- Exposure rates do not exceed 10 μR/hour above background at 1 meter above the soil surface. Exposure rates may be averaged over a 100 $m^2$ grid area. Maximum exposure rates may not exceed 10 μR/hour above background.

C. Surface Activity of the Bullet Catcher

- The surfaces of the bullet catcher do not have loose surface contamination above the limit of 1000 dpm/100 $cm^2$ or fixed contamination above the limit of 5000 dpm/100 $cm^2$

The objective of the survey was to demonstrate at a 95% minimum level of confidence, that the above conditions have been met.

## 3.2 Organization and Responsibilities

The survey design and implementation was conducted by Cabrera Services, Inc. This included analytical evaluation of smears and air samples in accordance with Cabrera Services, Inc. and Allied Technology Group procedures. Ten percent of the samples taken and analyzed by Cabrera Services, Inc. were sent to Paragon laboratories for verification.

QA/QC actions for the final status survey were monitored by the project manager, Mr. David Watters. The organization chart for the remediation and final status survey is included as Figure D-3, page F-3.

## 3.3 Instrumentation

Table 1 lists the instrumentation used for final status survey measurements, along with parameters and detection sensitivities for the instrumentation and survey technique used. The combination of instrument and technique were chosen to provide a detection of small fragments on the surface of the soil and larger fragments deeper in the soil. This was found to be typical of the fragments of activity at the bullet catcher site.

All instruments were calibrated a minimum of every 6 months using a certified calibration laboratory with NIST traceable sources. Operational and background checks were performed before each work shift. Quality Assurance check information and calibration data for radiation detection instruments are included in Appendix 2.

The GPS system used was calibrated to a common location each day before and after use. The system variation was found to be within 0.1 to 0.5 meters each day.

## 3.4 Survey Procedures

Survey planning and procedures were in accordance with the Lake City Army Ammunition Plant Site Decommissioning plan for the 600 Yard Bullet Catcher Area.

### *3.4.1 Area Classification*

- **Affected Areas** are areas that have a potential for radioactive contamination in excess of the radionuclide cleanup guidelines. This includes areas where radioactive materials were used and stored, where records indicate spills or other unusual occurrences that could have resulted in the spread of contamination, and where radioactive materials were buried. Areas immediately surrounding or adjacent to locations where radioactive materials were used or stored, spilled, or buried were included in this classification because of the potential for inadvertent spread of contamination.

  The total area surveyed which was classified as affected was 33.25 grids of 900 square ft (29,925 square ft).

- **Unaffected Areas** are all areas not classified as affected. These areas are not expected to contain residual activity, based on a knowledge of site history and previous survey information.

  The total unaffected area surveyed was approximately 1,000 $m^2$ (approximately 11,000 square ft). 700 $m^2$ was a buffer area around the bullet catcher area and 300 $m^2$ was in the background reference area.

Table 2 lists the various site areas in each classification category.

### *3.4.2 Reference Grids*

The original grid system (10-ft. by 10-ft. grids) used by ATG during the characterization of the area was re-established before the pre-remediation survey. This enabled comparison of the first walkover surveys with the original characterization data. Two hundred grids having levels above background were

identified during the characterization. Once the grid system was established, confirmatory surveys were performed to ensure reproducibility of earlier readings and locations. The confirmatory surveys were completed with 2" by 2" NaI detectors and a global positioning system (GPS). The results are very similar to the original surveys performed by ATG with 1" by 1" Ludlum Model 19 micro-R meters even though the sensitivity of the 2" by 2" is much greater. The original grids and their layout pattern are shown in Figure 2. The grids that were indicated as requiring remediation from the characterization report are shaded in that figure.

Once the identified radioactive material was removed from the 600-Yard Bullet Catcher area, the area grids were not removed, as planned, but were then considered as 1/9$^{th}$ of 30 ft x 30 ft grids, (actually the grids were 30' by 30') to preserve the configuration of the original grids. In accordance with the guidance of NUREG/CR-5849, (33.25) 30 ft. x 30 ft. grids replaced the original 300 10-ft. x 10-ft. grids. A detailed release survey of the area was then performed in accordance with the guidance of NUREG/CR-5849.

### *3.4.3 Surface Scans*

The final survey entailed conducting a 100% surface scan of the affected areas using a 2" x 2" NaI detector with associated count rate meter (Ludlum 2221). The response of this instrument is measured in counts per minute (cpm), the response is not converted to activity because no direct detection efficiency is appropriate for the source to detector geometry for this situation. This part of the survey was to 'find' the activity in the soil.

During the walkover with the 2" by 2" NaI detector and subsequently with a pancake GM detector, any areas of increased response were remediated upon identification. In this situation, again, there is no direct correlation to activity because the depth at which the activity may be (and the correlation of activity at that depth) is not known. It was found that the pancake GM detector offered a much more sensitive method to recognize very low level surface activity (below the detection sensitivity of the 2" by 2" NaI detector.

In addition, a Ludlum Model 19 micro-R meter was used for measuring gamma exposure rate in units of micro-R/hour, on contact with the ground surface and at one (1) meter above the ground surface at the center of each 10' by 10' affected grid and in the center of each unaffected grid.

The area defined by a 10 meter additional grid around the affected area grid was surveyed as an unaffected (buffer) area with 25% scanned for increased gamma detector response with the 2" by 2" NaI detector to ensure that no radioactive material was left at the site.

The bullet catcher structure was surveyed for the presence of radioactive materials using the 2" by 2" NaI detector to ensure that no fragments remained in the wood surface and using a pancake GM detector to quantify the activity which might remain on the surface for release of the wood.

### *3.4.4 Surface Activity Measurements*

**<u>Direct Measurements</u>**

Direct measurements of gamma emissions and beta emissions from the soil surface were taken using the instrumentation described in Table 1. Measurements with the gamma detector were taken using a scan technique where the detector was passed

over the soil at a height of 1 to 2 inches at a rate of 2 to 4 inches per second.

Measurements with the pancake GM detector were taken at as close to the ground surface as possible without rupturing the detector window (typically 1" or less) and the scan rate for this instrument was 1 to 2 inches per second.

The gamma scan was correlated to global position using an integrated Trimble GPS system. The count rate was polled from the Ludlum 2221 by the GPS data logger at intervals of 2 seconds. The data was transferred to a personal computer and converted to an Excel file, then transferred directly into a surface plotting program called Surfer. The plots of Figures 4 (before remediation) and 8 (after remediation) resulted from this data.

**Removable Contamination Measurements**

A smear survey for removable contamination was conducted upon arrival at the site. The only surfaces from which removable contamination could be identified were large oxidizing pieces of DU fragments.

A smear survey of the bullet catcher structure was completed after removal of all material from its interior. At this time the roof of the structure and the metal walls were gone from the structure. All that remained was the wooden vertical beams and side planks. The MDA (Minimum Detectable Activity) for activity on smears was 9.8 dpm for alpha emitting activity and 122 dpm for beta emitting activity. The smears were taken with cloth smear pads over an area of 100 $cm^2$.

### *3.4.5 Exposure Rate Measurements*

Gamma exposure rates were measured on contact with the ground surface and at 1 meter above the ground surface at the center of each original (10' by 10') grid and in the reference area grid using a Ludlum Model 19 micro-R meter.

### *3.4.6 Soil Sampling*

Soil samples were extracted from the surface using a hollow tip hand auger and mixing the soil that was collected in a stainless steel bowl. The bowl and sampling equipment were washed between each sample. The samples taken at a depth of one meter were also taken with a hollow tip auger after using a power auger to reach the one meter depth. In steep hill areas where the power auger could not be used the hand auger was used to reach the depth. The sample was taken at the one meter depth after reaching that depth with the hand auger in that case.

Samples were analyzed for $^{238}U$ activity concentration by measuring the 1,001 keV gamma line from $^{234m}Pa$, which was assumed to be in secular equilibrium with $^{238}U$. This gamma line was selected as opposed to the 63 keV line from $^{234}$Thorium because of the significant attenuation afforded the lower energy gamma in traversing the soil sample to interact in the detector, and the heterogeneous nature of the activity in the soil.

Total uranium activity concentrations were inferred from measured $^{238}U$ using a site-specific activity ratio of $^{238}U$ : $^{Total}U$ of 0.831 : 1 and a soil moisture correction factor of 1.25. Sample mass was estimated using a triple-beam balance, which was checked daily using calibration weights.

The moisture content of the soil can vary significantly, depending on geographic location, time after rainfall, etc., and can have significant impact on detection of

radionuclides with beta and low-energy gamma emissions. The laboratory QA samples have confirmed that the 25% used to adjust the activity concentration in the soil samples was reasonable.

The samples at the site were analyzed without drying them first. It is anticipated that this would have little effect on the overall outcome of the status of the bullet catcher area. However, 10% of the samples were been sent to Paragon laboratories for verification of the Cabrera results. The results of that analysis have been received and are discussed in section 4.2.

The Cabrera Services, Inc. sample results were modified to account for total uranium and moisture content. The application of these factors (/0.831) and (*1.25) is as follows to determine total uranium concentration in dry soil for comparison to the release guideline:

Total Uranium Concentration = ($^{234m}$Pa Result) * 1.25 / .831
Total Uranium Concentration = ($^{234m}$Pa Result) * 1.508

**Surface**

Samples (450 to 900) grams each were taken at locations as described in the D&D plan. In each 30 ft x 30 ft grid, 4 samples were taken and analyzed for uranium daughter products by gamma spectroscopy, at the soil surface to identify the presence of uranium above natural concentrations. This resulted in the analysis of 135 surface soil samples.

Figure 5. indicates the soil sampling location grid system. Figure 7. provides a visual indication of the location of samples that indicated concentrations above background and the result of those analyses.

The MDC (Minimum Detectable Activity Concentration) for surface soil samples ranged from 11.1 to 37 pico-curies per gram with an average of 26.2 pCi/gram and a standard deviation of 4.5 pCi/gram. The $\mu_\alpha$Value for this MDC is 26.6 pCi/gram.

**Subsurface**

Samples were also taken at 1 meter below the ground surface in each of the areas from which surface samples were taken. These samples were also analyzed for uranium daughter products by gamma spectroscopy, to identify the presence of uranium above natural concentrations.

One hundred thirty seven (135) sub-surface soil samples were collected and analyzed for soil activity concentration by gamma spectroscopy. The method of analysis was similar to that for surface samples and the same correction factors for total uranium and moisture content correction were used.

The MDC for subsurface samples ranged from 14.7 to 34.1 pico-curies per gram with an average of 22.3 pCi/gram and a standard deviation of 3.6 pCi/gram. The $\mu_\alpha$ value is 22.8 pCi/gram.

*3.4.7 Special Measurements and Samples*

After the gamma walkover survey, a detailed investigation of the soil surface was conducted using a GM pancake detector and Ludlum Model 3 rate-meter. This instrument allowed detection of very small quantities of uranium on the surface of the soil which was not detectable by the gamma detectors. The emissions from very

small fragments and particles of DU may not be detected by gamma detectors, however, since the beta emissions are very energetic, the thin window GM detector is more sensitive to this surface activity.

## 3.5 Background Determination

Background exposure rates were determined by taking 54 measurements in an area 10 meters by 30 meters that was off of the firing range but close enough to have similar soil characteristics.

Fifteen background soil samples were taken from this same area for analyzed for uranium daughter products by gamma spectroscopy, to identify the natural concentration of uranium in the soil. In the analysis of soil sample results, two factors were used to adjust the gamma spectroscopy result to pCi/gram total uranium dry weight. The first factor relates the $^{234m}$Pa activity to total uranium concentration (/0.831) and the second factor (1.25) corrects the result for sample water content.

## 3.6 Sample Analysis Details

Smear samples were analyzed for removable contamination (gross alpha and gross beta emissions) using the Ludlum 2929 dual channel scalar with a 43-10-1 alpha/beta scintillation detector. Smear samples were counted for 2 minutes.

Air sample filters were also analyzed for gross alpha and gross beta emissions using the Ludlum 2929 dual channel scalar with a 43-10-1 alpha/beta scintillation detector. Air samples were counted for 20 minutes.

A 60% relative efficiency coaxial high purity germanium detector (HPGe) detector was used to quantify DU activity concentrations in soil/sediment samples. A Canberra Industries, Inc. model GC6020 HPGe detector coupled to an Inspector-2000 digital signal processor/power supply/multi-channel analyzer was used to perform the analyses. An ISOXSHLD lead shield assembly was used to provide detector shielding. Canberra Genie-2K Version 1.4 gamma analysis software was used to control the system and analyze/store spectral data. Efficiency/energy calibration of the system utilized sources traceable to NIST. The system was operated in accordance with a written and approved procedure. Daily quality control checks were performed by measuring peak energy, resolution, and efficiency for a low energy (88.01 keV from $^{109}$Cd) and a high energy (1,332.5 keV from $^{60}$Co) peak. Control charts were plotted and reviewed daily for each of these parameters.

Samples were analyzed for $^{238}$U activity concentration by measuring the 1,001 keV gamma line from $^{234m}$Pa, which was assumed to be in secular equilibrium with $^{238}$U. Total uranium activity concentrations were inferred from measured $^{238}$U using a site-specific activity ratio of $^{238}$U : $^{Total}$U of 0.831 : 1. Sample mass was estimated using a triple-beam balance, which was checked daily using calibration weights.

The results tabulation of soil sample analysis is included in Appendix 1, Section 1 for all samples taken in the affected area, Section 2 for samples taken in the unaffected area around the affected area and Section 3 for samples taken in the background area.

Due to the large number of pages generated in the analysis of these samples, the complete analysis report of each sample is not included in this report. The original records of the sample analysis are retained by the United States Army Operations Support Command where they are available for review.

Ten percent of the soil samples from each area were evaluated by Paragon Analytics, Inc. in addition to the analysis by Cabrera Services, Inc., the Paragon results confirm the results presented by Cabrera's analysis.

### 3.7 Data Interpretation

The raw data from instrument measurements was evaluated to provide the results of the analysis in units suitable for comparison to guideline values. The exposure rate meters used provided results in micro-R/hour for comparison to the exposure rate guideline and the gamma spectroscopy system reported soil sample results in pCi/gram for comparison with the uranium soil concentration guideline.

The average activity concentrations in the remaining soil were used to estimate the total residual activity of uranium at the site.

### 3.8 Records

All original documents will be retained at the Lake City Army Ammunition. In addition, a copy of all documents associated with the project will be maintained by Cabrera Services as needed to resolve comments concerning the reports of this project.

## 4.0 Survey Findings and Results

Appendix 1 provides the results of all soil sampling to demonstrate compliance with the soil concentration guidelines.

### 4.1 Background Levels

**Background Exposure Rate**

The background exposure rate on contact with the soil surface ranged from 9 to 10 μR/hour. The average of these measurements was 9.8 μR/hour for 27 measurements with a standard deviation of 0.4μR/hour. The $t_{0.95}$ value was determined from NUREG 5849 to be 1.703 and the 95% value for the exposure rate on contact with the background soil was 9.9 μR/hour.

The background exposure rate at 1 meter above the ground surface ranged from 10 to 11 μR/hour. The average of these measurements was 10.1 μR/hour for 27 measurements with a standard deviation of 0.32 μR/hour. The 95% value for the exposure rate on contact with the background soil was 10.2 μR/hour. Background exposure rate data is provided in Figure 1, page F-4.

**Background Frisker Response**

The background count rate on the model 3 rate-meter with the 44-9 probe ranged from 20 to 50 cpm.

### Background Response for Smear Counting

The MDC for activity on smears measured with the Ludlum 2929 alpha – beta scintillation detector was 9.8 dpm/100 $cm^2$ for alpha emitting activity and 121.6 dpm/100 $cm^2$ for beta-gamma emitting activity. The survey that uses this information is provided as Appendix 1, Section 6.

### Background Soil Concentration

The activity concentration determined for the background soil samples was -12.6 to 18.8 pico-curies per gram (pCi/g). The average of these measurements was 4.4 pCi/g for 15 measurements with a standard deviation of 9.8 pCi/gram. The $t_{0.95}$ value was determined from NUREG 5849 to be 1.753 and the 95% value ($\mu_\alpha$) is 8.9 pCi/gram. These measurements are corrected to the total uranium concentration in dry soil. The MDC for analysis of background soil ranged from 17.4 to 31.1 pCi/gram. The average MDC was 26.4 pCi/g with a standard deviation of 3.6 pCi/g and a 95% value of 28 pCi/gram. There was no detectable uranium activity in the background samples. Appendix 1, Section 3 provides the background soil sample data.

### Background Soil Concentration Quality Assurance

The background Quality Assurance samples analyzed at Paragon Analytics ranged from 0.6 to 2.8 pCi/g. The average of these measurements was 1.6 pCi/g for 5 measurements with a standard deviation of 1.03 pCi/g and a 95% value of 2.6 pCi/g. The MDC for these samples ranged from 3.1 to 4.7 pCi/g with an average of 3.7 pCi/g, standard deviation of 0.7 pCi/g and a 95% value of 4.3 pCi/g. Appendix 1, Section 5 provides quality assurance analysis data for soil samples.

## 4.2 Bullet Catcher Area Surveys

**Scans**

Scans of the residual soil in the bullet catcher area indicate that the uranium levels are similar to background after the removal of all of the contaminated soil from the area. The range of count rate observed after remediation was 6,535 to 16,904 cpm for 28954 readings. The average count rate in the scan was 12,403, the standard deviation was 1,110, and the 95% level ($\mu_\alpha$) was 12,413. The count rate data collected is too voluminous to provide a hard copy. This data is in excel format on the final report compact disc. This data was used to create the plots in Figure 4, page F-7 and Figure 8, page F-11.

In addition, twenty Unaffected Area Grids were established as a buffer area on the perimeter of the affected area. For the unaffected grids surrounding the affected area of the 600-Yard Bullet Catcher, a 25% scan of the entire grid was performed using a 2" x 2" NaI detector with the Ludlum 2221 count rate meter. No activity above MDC was identified in the unaffected areas scans. The range of values in this scan was approximately 8,000 cpm to approximately 15,000 cpm. The survey was not tracked with the GPS data collection system.

A gamma scan of the remaining bullet catcher frame indicated that no fragments of DU remained on the structure. The range of response in this survey was 12,012 to 14,697 cpm. The average response was 13,581 cpm with a standard deviation of 782 cpm. The 95% level ($\mu_\alpha$) was determined to be 13,745. These statistics were determined from the data provided in Attachment 1 – Section 6. A detailed beta scan with a pancake GM detector was completed with a pancake probe GM detector

at an approximate detector to surface distance of ¼ to ½ of an inch. The response did not exceed background, this indicated that there is no residual contamination on the wood. See table F-1 for the result of this survey.

**Exposure Rates**

Exposure rate surveys were completed periodically during the remediation. The most extensive evaluation of exposure rate was completed post remediation and is reported in Figure 6, page F-9.

Two hundred twenty six readings were taken on contact with the soil in the bullet catcher area. The readings ranged from 7 to 12 μR/hour with an average of 9.43 μR/hour and standard deviation of 0.78 μR/hour.

Two hundred twenty six readings were taken at 1 meter above the soil surface in the bullet catcher area. The readings ranged from 7 to 11 μR/hour with an average of 8.58 μR/hour and standard deviation of 0.71 μR/hour.

Sixteen readings were taken on contact with the soil on the 500 yard butt (large hill within the area). The readings ranged from 9 to 11 μR/hour with and average of 9.75 μR/hour and a standard deviation of 0.58 μR/hour.

Sixteen readings were taken at 1 meter above the soil surface on the 500 yard butt. The readings ranged from 9 to 10 μR/hour with and average of 8.94 μR/hour and a standard deviation of 0.44 μR/hour.

Eight readings were taken of the exposure rate in the remediated bullet catcher structure. Four readings taken at 1 meter above the soil surface were all 10 μR/hour. The four readings taken on contact with the soil surface ranged from 10 to 11 μR/hour with an average of 10.5 and a standard deviation of 0.58 μR/hour.

Thirty eight readings of the exposure rate were taken on contact with the soil surface in the unaffected area (buffer around the bullet catcher affected area). The readings ranged from 8 to 10 μR/hour with an average of 9.2 μR/hour and a standard deviation of 0.53 μR/hour. The 95% level for this area is 9.4 μR/hour.

Thirty eight readings of the exposure rate were taken at 1 meter above the soil surface in the unaffected area. The readings ranged from 7 to 9 μR/hour with an average of 8.2 μR/hour and a standard deviation of 0.53 μR/hour. The 95% level for this area is 8.4 μR/hour.

All locations in the affected area satisfied the guideline of 10 μR/hour above background.

**Uranium Concentrations in soil.**

Appendix 1, section 1 and section 2 provide the results of surface and sub-surface soil sampling in the bullet catcher area. The Unaffected Area sample results are given in Appendix 1, Section 3. The background soil sample results are given in Appendix 1, Section 4, and the QA comparison evaluation by Paragon Analytics is included as Section 5.

After the remediation, two areas were found to be above the limiting concentration of 35 pCi/gram total uranium. The activity in these areas was removed. After removal of the small amounts found at the surface of each area, the areas were re-

sampled and no activity was detected. The areas were on the surface of the soil and the affected samples were LC-B3-BC-4S, LC-B3-BC-5S, and LC-B3-BC-2S. After remediation, two samples were taken (one in each grid), to verify the cleanup. The samples were labeled LC-B3-BC-4SR (a composite with sample locations LC-B3-BC-4S, LC-B3-BC-5S) and LC-B3-BC-2SR.

**Affected Area Surface Soil**

One hundred thirty five surface soil samples were taken at the 600 yard bullet catcher area. These samples ranged in activity concentration from -39.1 pCi/g to 37.6 pCi/g. The average concentration was 4.1 pCi/g with a standard deviation of 11.3 pCi/g. The 95% level was 5.7 pCi/g. Eight of the samples analyzed exceeded MDC values. Of these eight samples, one exceeded the soil concentration guideline.

The one sample that exceeded the guideline level after correction of the soil activity for total uranium and for moisture content in was sample LC-C5-BC-4S. The guideline value is 35 pico-Curies per gram (total uranium) at the 95% confidence level. The level detected at this location was 37.6 pico-Curies per gram (total uranium). This grid meets the release criteria because there are no other samples in that grid that exceed the guideline level, and the concentration is less than 70 pCi/gram (total uranium). This sample result was verified within 2% of the total uranium moisture corrected activity concentration reported by Paragon Analytics.

There were two samples of surface soil where the MDC (after correction of the soil activity for total uranium and for 25% moisture content) exceeded the guideline level. These samples were taken at sample locations LC-C3-BC-5S and LC-F5-BC-2S. However, the activity concentration reported was less than the guideline for both of these samples. Even if they were treated as indications of activity above the guideline level, these grids still meet the release criteria similar to grid C5-4S. The MDC was less than 70 pCi/gram (total uranium) and there were no two samples in each grid that exceeded the release criteria.

**Affected Area Subsurface Soil**

One hundred thirty five soil samples were taken at a depth of one meter at the 600 yard bullet catcher area. These samples ranged in activity from -19.4 pCi/g to 21.2 pCi/g. The average concentration was 1.4 pCi/gram with a standard deviation of 9.1 pCi/gram. The $t_{0.95}$ and $\mu_\alpha$ for these samples were 1.658 and 2.7 pCi/gram respectively. No samples of affected area soil showed activity in excess of the MDC for the counting system, and, no subsurface soil samples showed detectable activity in the QA samples.

**Affected Area Quality Assurance Samples**

Forty three samples of the affected area soil were sent to Paragon Analytics for analysis. The activity concentration ranged from -0.1 to 36.8 pCi/g. One sample in this group (LC-B5-BC-4S) was found to be in excess of the soil concentration guideline of 35 pCi/g. The activity concentration of that sample was reported by Paragon Analytics to be 36.8 pCi/g. This confirmed agreement between the analysis conducted on site and the laboratory analysis at Paragon. The average concentration reported for this group was 3.2 pCi/g with a standard deviation of 5.6 pCi/g. The 95% level for the activity concentration in this group was 4.6 pCi/g.

The MDC for affected area samples at Paragon ranged from 1.4 to 4.8 pCi/g,

averaged 3.0 pCi/gram, and had a standard deviation of 0.94 pCi/g. The 95% level for this value was 3.3 pCi/g.

**Unaffected Area Soil Samples**

A total of 38 soil samples were taken in the unaffected area, 19 from the surface and 19 at a depth of 1 meter below the soil surface. The results ranged from -24.8 pCi/g to 22.4 pCi/g. The average concentration was 3.8 pCi/g with a standard deviation o f 10.9 pCi/g. The 95% level for these samples was 6.8 pCi/gram. The sample data is in Appendix 1, Section 4.

None of the samples taken in the affected area showed detectable activity above the MDC for the analysis. However, 1 sample did have a MDC value in excess of the soil guideline (35 pCi/g). The activity concentration reported for this sample was 22.4 pCi/g with an MDC of 39.4 pCi/g. The sample was taken at sample location LC-A5-BC-5S. Because there were no other samples in that area that indicated the presence of activity and the sample itself did not indicate the presence of activity, a reanalysis of this sample is not necessary.

**Unaffected Quality Assurance Samples**

Seven samples from this group were sent to Paragon analytics for separate analysis. The range of activity concentration in these samples was from -2 pCi/g to 2.8 pCi/g with an average of 0.9 pCi/g and a standard deviation of 1.58 pCi/g. The 95% level was 2.1 pCi/g. The MDC for these samples ranged from 2.3 pCi/g to 4.7 pCi/g. The average MDC was 3.6 pCi/g with a standard deviation of 0.87 pCi/g. The 95% level for the MDC was 4.2 pCi/g. The data for this evaluation is given in Appendix 1, section 5.

### 4.3 Data Evaluation

Tables F-1, F-2, and F-3 summarize the statistics of measurements in the survey units. Comparisons of averages with guidelines indicated that the guidelines were satisfied for all survey units at the 95% confidence level conditions.

### 4.4 Residual Activity Inventory

These calculations assume that the soil density is 1.6 grams/cc and the affected volume of soil in surface grids is the affected area, 33.25 * 900 $ft^2$/grid by 6 inches deep. The affected volume is therefore, 14,962.5 cubic feet or 4.2369E8 cubic cm.

The 95% level activity concentration ($\mu_\alpha$) in the soil, from all of the surface soil samples, is 5.7 pCi/gram.

The residual activity is: 4.2369E8 cc * 1.6 g/cc * 5.7 pCi/g = 3.86E3 micro-curies.

Total uranium activity remaining at the site: 3860 micro-curies.

## 5.0 Summary

In June and July 2001, surveys of the 600 Yard Bullet Catcher area at the Lake City Army Ammunition Plant Firing Range were conducted after completing the remediation of the area for radioactive materials. Results of the survey demonstrate that the decontamination actions taken were effective in reducing residual activity at the site. The soil and remaining

wood structure of the bullet catcher at the site meet the NRC limits for release for unrestricted use.

## 6.0 References


1. ATG Report, "Characterization of Lake City Army Ammunition Plant Firing Range for Depleted Uranium", T. O'Dou, 1993.

2. U.S. Nuclear Regulatory Commission, 'Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of License for Byproduct, Source or Special Nuclear Material.'

3. Construction Diagrams for M101 Projectiles, Part Number 7258884, October 1964

4. U.S. Nuclear Regulatory Commission, DRAFT NUREG/CR-5849, "Manual for Conducting Radiological Surveys in Support of License Termination", February 1993

5. LCAAP Bullet Catcher Decommissioning Plan, Revision 3, March 2001, Cabrera Services, Inc.

Table 1.
INSTRUMENTATION FOR RADIOLOGICAL SURVEYS

| Type of Measurement | ID | Instrumentation Detector | Instrumentation Meter | Background | $4\pi$ Efficiency (%) | Detection Sensitivity |
|---|---|---|---|---|---|---|
| Surface Activity (smears) | 1 | Dual phosphor $\alpha$–$\beta$ scintillator Ludlum 43-10-1 | Dual channel Scaler Ludlum 2929 | < 1 cpm alpha<br>< 50 cpm beta | 20 % alpha<br>19 % beta | 10 dpm/100 $cm^2$<br>122 dpm/100 $cm^2$ |
| Surface Scans gamma | 2 | 2" by 2" gamma scintillation (NaI) Ludlum 44-10 | Single channel analyzer/scaler Ludlum 2221 | 12000 cpm | NA | 15,000 cpm * |
| Surface Scans beta | 3 | Thin window GM - pancake type Ludlum 44-9 | Ratemeter Ludlum 3 | 30 cpm | 10% | 1000 dpm |
| Exposure Rates | 4 | 1" by 1" gamma scintillation (NaI) Internal | Ratemeter Ludlum 19 | 10 ur/hr | < 1% | 3 micro-r/hour |

NUREG/CR 5849 indicates that a 25% increase above background is discernable. 25% of 12,000 is 3,000 cpm so 15,000 is the assigned detection sensitivity (12,000 cpm + 3,000 cpm).

Table 2.
Classification of Lake City AAP 600 Yard Bullet Catcher Surfaces
and Areas According to Contamination Potential

| Plant Area | Building | Structure | Classification of Contamination Potential | Remarks |
|---|---|---|---|---|
| Firing Range | 600 Yard Bullet Catcher | North side Bullet Catcher (BC) | Affected | This was the accumulation area for projectiles fired. |
| Firing Range | 600 Yard Bullet Catcher | North side Soil around the front of the BC | Affected | This area is where fragments landed or migrated to. |
| Firing Range | 600 Yard Bullet Catcher | 500 Yard Butt | Affected | This area is affected because of projectile fragmentation |
| Firing Range | 600 Yard Bullet Catcher | Road leading to the BC | Affected | In addition to fragmentation, droppings accumulated on the road during transportation. |

Table F-1
Summary of Surface Activity Results
at the Lake City Army Ammunition Plant - Independence, MO

| Building/ Area and Surface | Surface Area ($m^2$) | Average Total Activity (dpm/100 $cm^2$) | | | | | | μ | n |
|---|---|---|---|---|---|---|---|---|---|
| | | Alpha | | | Beta-Gamma | | | | |
| | | n | $x^{(2)}$ | $s^{(3)}$ | n | $x^{(2)}$ | $s^{(3)}$ | | |
| Bullet Catcher Walls - Smears Surface Activity Measurements | 75 | 31 | 1 dpm | 2 dpm | 31 | 4 dpm | 20 dpm | 10 (βeta) 1.6 (Alpha) | 31 |
| Bullet Catcher Walls - Direct Scan with GM | 75 | NA | NA | NA | 100% Scan | NDA | NA | NA | NA |

Survey results are listed in Appendix 1, Section6

There was no activity detected above background on any smear from the bullet catcher.

$x_{(a)}$ Average
$s_{(b)}$ Standard deviation
$\mu_\alpha$ Comparison Value
n total number of samples for 95% confidence level

Number of smears with detectable surface activity: 0

Number of areas with detectable activity by direct survey with pancake GM 0

Table F-2.
Summary of Soil Sampling Results
at the Lake City Army Ammunition Plant - Independence, MO

| Survey Unit | Dose Rate µR/hour Range (1) Low to High | Type of Samples | Range pCi/gram Low to High | Total Uranium Activity (pCi/gram) (Includes Background) $x_{(a)}$ | $s_{(b)}$ | $t_{0.95}$ | $\mu_\alpha$ | n | Guidelines/ Conditions Satisfied |
|---|---|---|---|---|---|---|---|---|---|
| Affected Area Surface soil | 8 to 10 | Surface | -39.1 to 37.6 | 4.1 | 11.3 | 1.658 | 5.7 | 135 | Yes/Yes |
| Affected Area Subsurface soil | 8 to 10 | Sub-surface | -19.4 to 21.2 | 1.4 | 9.1 | 1.658 | 2.7 | 135 | Yes/Yes |
| Affected Area QA Samples | 7 to 10 | Both | -0.1 to 36.8 | 3.2 | 5.6 | 1.683 | 4.6 | 43 | Yes/Yes |
| Unaffected Area | 7 to 9 | Both | -24.8 to 22.4 | 3.8 | 10.9 | 1.687 | 6.8 | 38 | Yes/Yes |
| Unaffected Area QA Samples | 7 to 9 | Both | -2 to 2.8 | 0.9 | 1.58 | 1.895 | 2.1 | 7 | Yes/Yes |
| Background Area | 10 to 11 | Surface | -12.6 to 18.8 | 4.4 | 9.8 | 1.753 | 8.9 | 15 | NA |
| Background QA Samples | 10 to 11 | Surface | 0.6 to 2.8 | 1.6 | 1.03 | 2.015 | 2.6 | 5 | NA |

Affected Area Surface Soil Sample Results are listed in Appendix 1, Section 1
Affected Area Subsurface Soil Sample Results are listed in Appendix 1, Section 2
Quality Assurance Soil Sample Results are listed in Appendix 1, Section 5
Unaffected Area Soil Sample Results are listed in Appendix 1, Section 4
Background Soil Sample Results are listed in Appendix 1, Section 3

$x_{(a)}$ Average
$s_{(b)}$ Standard deviation
$\mu_\alpha$ Comparison Value
n total number of samples for 95% confidence level
Sample results and MDA used in calculation are corrected to total uranium activity.
An additional correction was made to account for an estimate 25% moisture in the samples.
(1) Exposure rate at 1 meter above the ground in sample grid, measured with a micro-R meter (1" by 1" NaI).

Table F-3.
Summary of Exposure Rate Measurements
at the Lake City Army Ammunition Plant - Independence, MO

| Survey Unit | Type of Measurement | Exposure Rate (Includes Background) $x_{(a)}$ | $s_{(b)}$ | $\mu_\alpha$ | $\tau_{0.95}$ | n | Guidelines/ Conditions Satisfied |
|---|---|---|---|---|---|---|---|
| Bullet Catcher | 1 m above ground | | | | | | |
| Area | General | 8.58 | 0.71 | 8.66 | 1.655 | 226 | yes/yes |
| Bullet Catcher | contact with ground | | | | | | |
| Area | General | 9.43 | 0.78 | 9.52 | 1.655 | 226 | yes/yes |
| 500 Yard | 1 m above ground | | | | | | |
| Butt | General | 8.94 | 0.44 | 9.13 | 1.746 | 16 | yes/yes |
| 500 Yard | contact with ground | | | | | | |
| Butt | General | 9.75 | 0.58 | 10.00 | 1.746 | 16 | yes/yes |
| Unaffected | 1 m above ground | | | | | | |
| Area | General | 8.2 | 0.53 | 8.35 | 1.687 | 38 | yes/yes |
| Unaffected | contact with ground | | | | | | |
| Area | General | 9.2 | 0.53 | 9.35 | 1.687 | 38 | yes/yes |
| Background | 1 m above ground | | | | | | |
| Area | ALL | 10.11 | 0.32 | 10.21 | 1.703 | 27 | NA |
| Background | contact with ground | | | | | | |
| Area | ALL | 9.81 | 0.4 | 9.94 | 1.703 | 27 | NA |

Affected Area (Bullet Catcher) Exposure Rate Measurements Post Remediation are listed in Figure 6, Page F-9
Unaffected Area Exposure Rate Measurements Post Remediation are listed in Appendix 1, Section 4
Background Exposure Rate Measurements are listed in Figure 1, Page F-4

$x_{(a)}$ Average
$s_{(b)}$ Standard deviation
$\mu_\alpha$ Comparison Value
n total number of samples for 95% confidence level

The exposure rate compliance guideline is 10 microR/hour above background
Since background is 10 microR/hour, the guideline is 20 uR/hour.

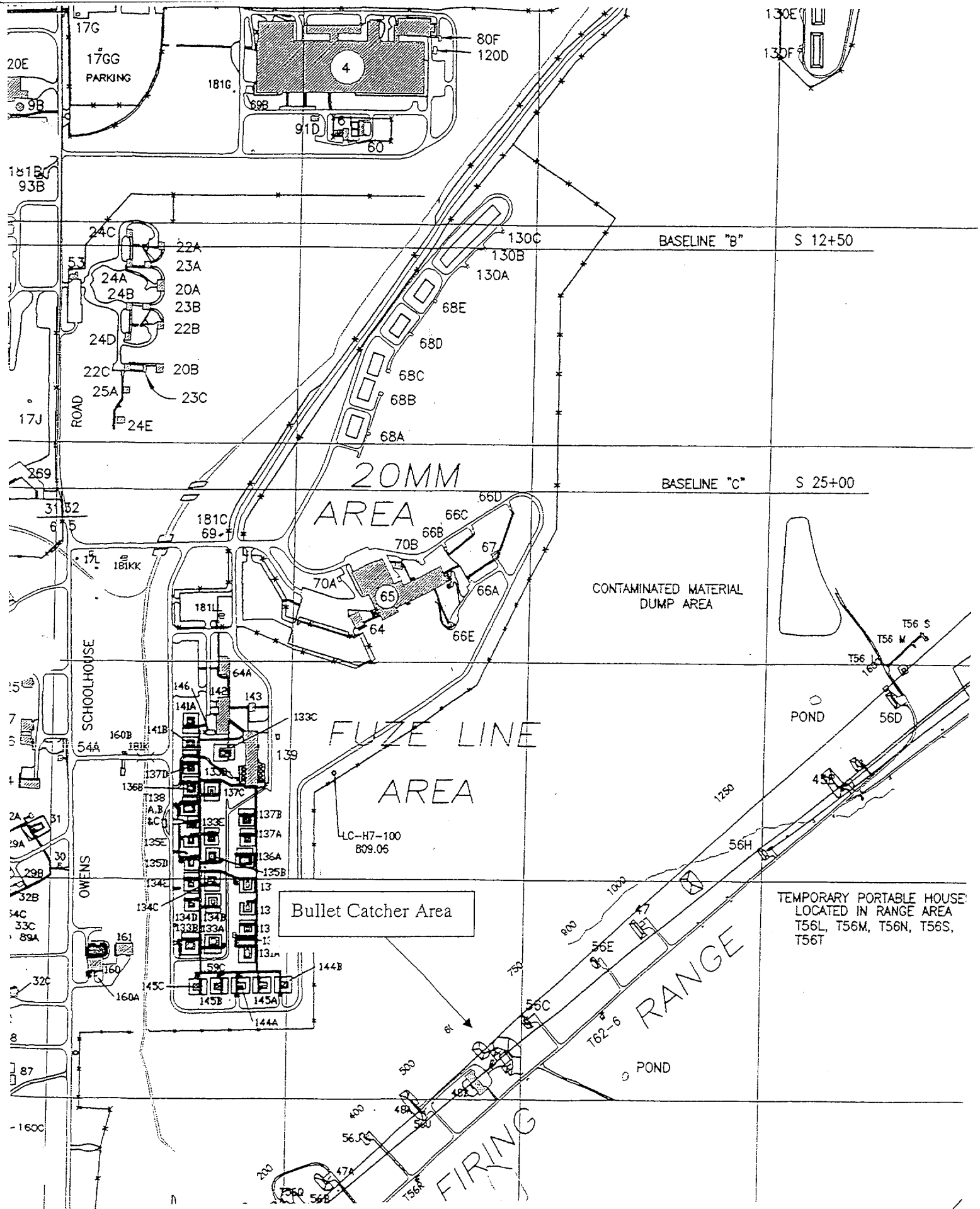



Figure D1: Map of the Firing Range and 600 Yard Bullet Catcher Location
Lake City Army Ammunition Plant, Independence, MO

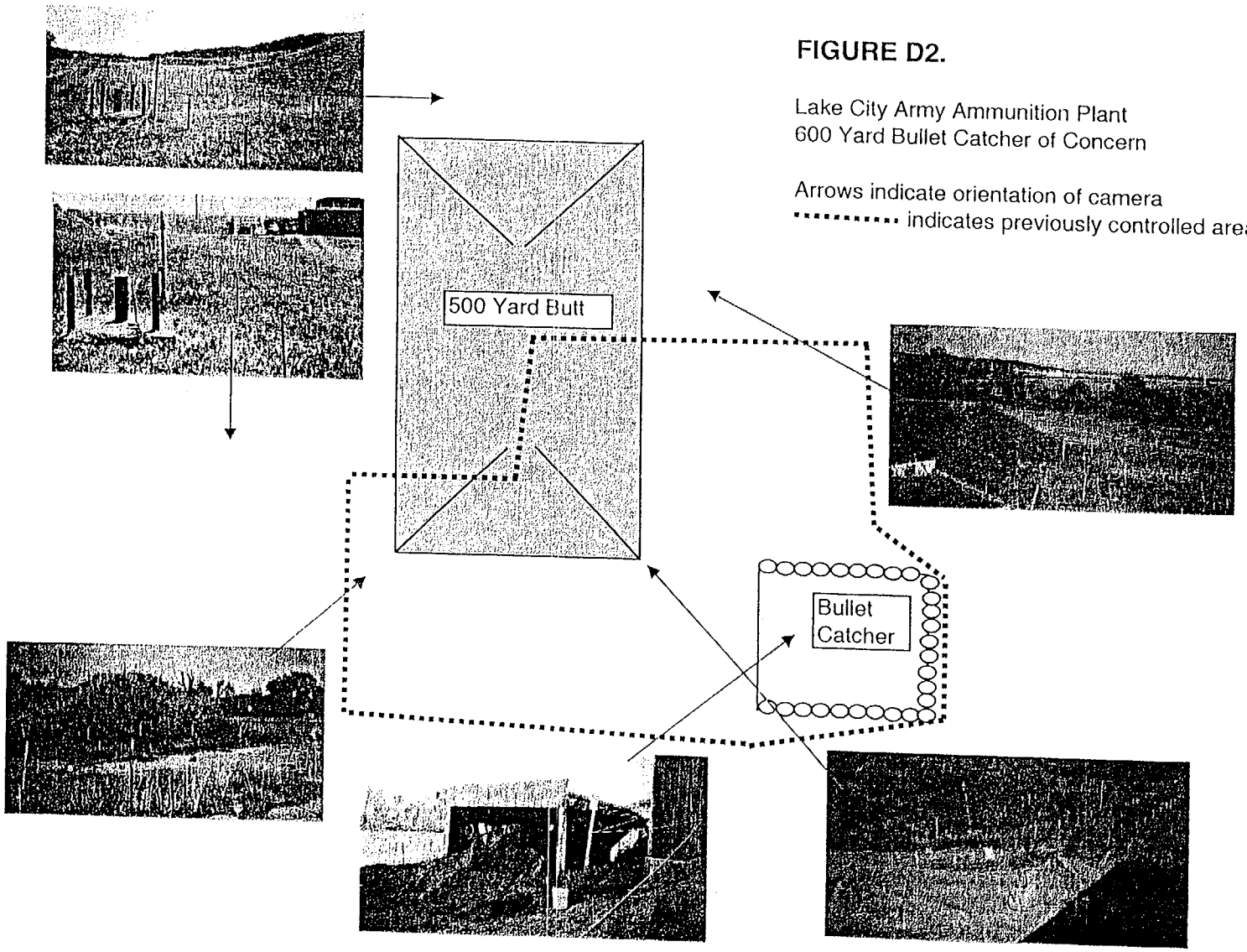



**FIGURE D2.**

Lake City Army Ammunition Plant
600 Yard Bullet Catcher of Concern

Arrows indicate orientation of camera
..... indicates previously controlled area

Cabrera Services, Inc.
Lake City Army Ammunition Plant

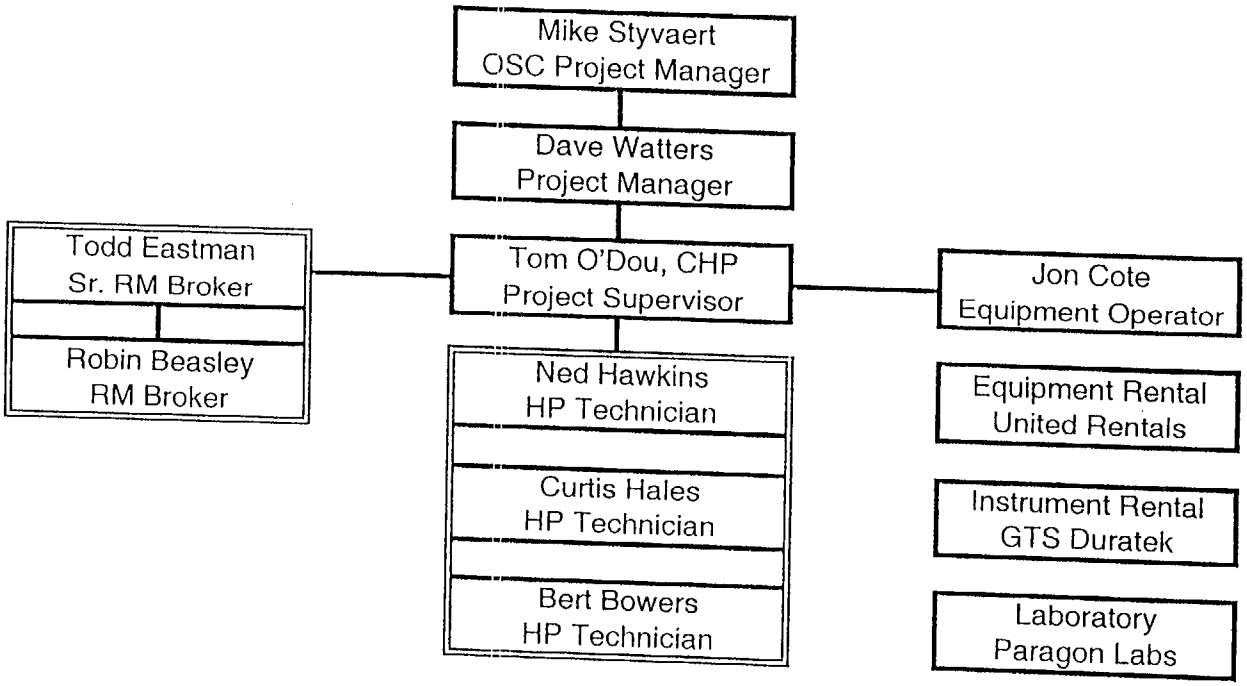



FIGURE D3: Organization Chart for Remediation and Final Status Survey Activities

Lake City Army Ammunition Plant
600 Yard Bullet Catcher Remediation
Background Reference Area Grids

Sample Date: May 3, 2001
Survey Date: July 16, 2001

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| REF#3 | | REF#4 | REF#8 | | REF#9 | REF#13 | | REF#14 |
| | REF#1 | | | REF#6 | | | REF#11 | |
| | | | | | | | | |
| REF#2 | | REF#5 | REF#7 | | REF#10 | REF#12 | | REF#15 |
| | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 10 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 10 | 10 | 10 | 10 | 10 | 10 | 9 | 10 | 10 |
| 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 10 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 10 |
| 10 | 10 | 10 | 11 | 10 | 10 | 11 | 10 | 10 |
| 10 | 10 | 9 | 10 | 9 | 10 | 9 | 10 | 10 |

Toward bullet catcher →

| | | | | |
|---|---|---|---|---|
| Average reading at 1 meter above ground surface | 10.11 | +/- | 0.32 | micro-r/hour |
| Average reading on contact with the ground surface | 9.81 | +/- | 0.40 | micro-r/hour |

=1 meter above ground surface

= contact with ground surface

O indicates soil sample location

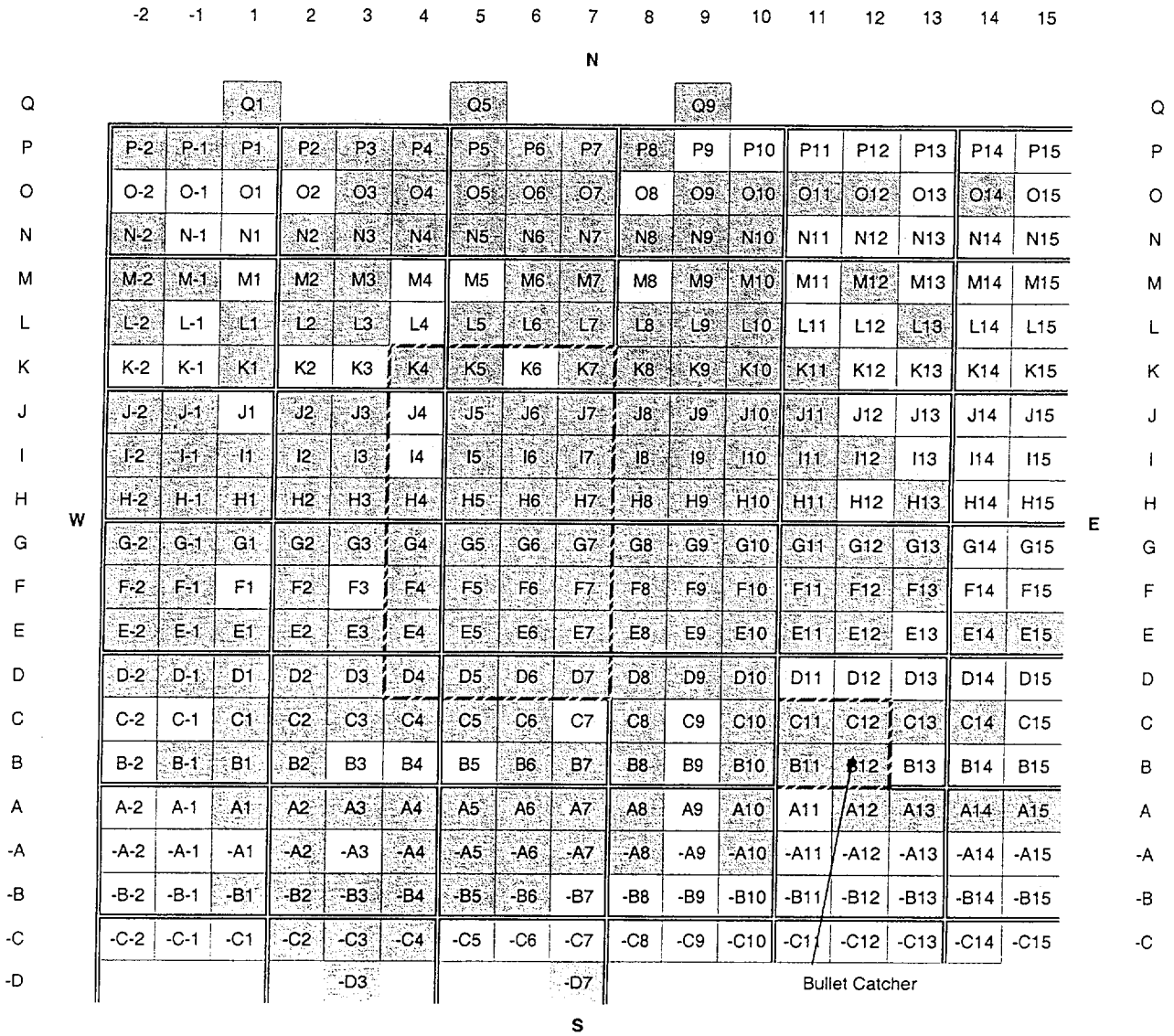
Instrument: Model 19 Serial Number 87111 Calibration Due: 3/27/2002

Figure 1.

Lake City Army Ammunition Plant
600 Yard Bullet Catcher Area Original Grid Pattern

**Figure 2.**

Cabrera Services, Inc.
July, 2001




This diagram shows the original grid configuration from the ATG characterization and provides a depiction of the grids at this area that would require some degree of remediation based on section 2.1.2.2 section 14.

The double lines indicate the 10m by 10m grid pattern that was made from the original grid configuration.

The notation of the new grid configuration is shown in the sample grid guide.

Lake City Army Ammunition Plant
Cabrera Servces, Inc. - Dose Rate Profile of 600 Yard Bullet Catcher Area (Pre-Remediation)

May 12, 2001

Figure 3.

All readings in micro-r per hour

1 meter above ground surface

Monitoring Well

Contact with ground surface

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 10 | | | 10 | 10 | 10 | 10 | 12 | 12 | 12 | 16 | 12 | 14 | 12 | 14 | 14 | 20 | 14 | 16 | 12 | 20 | 10 | 15 | 11 | 12 | 10 | 10 | | | |
| 12 | 15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | 10 | 10 | 10 | 10 | 10 | 11 | 15 | 10 | 12 | 12 | 14 | 10 | 11 | 10 | 15 | 11 | 12 | 15 | 20 | 18 | 22 | 10 | 12 | 10 | 10 | 10 | 10 | | | |
| 10 | 10 | | | 12 | 15 | | | | | | | | | | | | | | | 10 | 10 | | | | | 10 | 10 | | | |
| 10 | 10 | | | 15 | 15 | | | | | | 500 Yard Butt | | | | | | | | | 14 | 20 | | | | | 11 | 12 | | | |
| 10 | 10 | | | 14 | 15 | | | | | 12 | 12 | | | 12 | 12 | | | | | 13 | 15 | | | | | 10 | 12 | | | |
| 10 | 10 | | | 12 | 12 | | | | 10 | 10 | | 15 | 10 | | 15 | 12 | | | | 10 | 16 | | | | | 13 | 15 | | | |
| 10 | 10 | | | 12 | 20 | | | | | | | | | | | | | | | 20 | 24 | | | | | 12 | 15 | | | |
| 10 | 10 | | | 15 | 15 | | | | 12 | 12 | | 12 | 16 | | 20 | 14 | | | | 20 | 23 | | | | | 15 | 15 | | | |
| 11 | 11 | | | 10 | 14 | | | | | | | | | | | | | | | 15 | 15 | | | | | 15 | 20 | | | |
| 10 | 14 | | | 10 | 13 | | | | 12 | 15 | | 25 | 20 | | 25 | 22 | | | | 16 | 15 | 15 | 30 | 11 | 21 | 15 | 23 | | | |
| 12 | 16 | | | 10 | 14 | | | | | | | | | | | | | 15 | 18 | 16 | 20 | 25 | 22 | 20 | 30 | 30 | 35 | 11 | 14 | |
| 10 | 16 | | | 15 | 15 | 16 | 15 | | 12 | 12 | | 17 | 15 | | 25 | 16 | | 20 | 30 | 16 | 80 | 40 | 80 | 45 | 50 | 20 | 30 | 14 | 12 | |
| 10 | 15 | | | 12 | 15 | 12 | 15 | | | 20 | 14 | | | 21 | 15 | | | 15 | 40 | 25 | 120 | 40 | 60 | 35 | 50 | 12 | 40 | 10 | 15 | 9 | 9 |
| 10 | 10 | 10 | 10 | 10 | 10 | 10 | 20 | | | | | | | | | | | 12 | 30 | 15 | 15 | 20 | 60 | 50 | 140 | 30 | 30 | 20 | 10 | 10 | 10 |
| | | | | 10 | 10 | 12 | 15 | 15 | 15 | 15 | 20 | 20 | 20 | 20 | 25 | 20 | 30 | 15 | 50 | 15 | 22 | 20 | 25 | 35 | 60 | 120 | 130 | | | |
| | | | | 10 | 10 | 12 | 10 | 10 | 20 | 20 | 30 | 12 | 25 | 10 | 20 | 12 | 15 | 10 | 12 | 10 | 20 | | | | | | | | | |
| | | | | 10 | 9 | 10 | 10 | 10 | 10 | 12 | 10 | 12 | 15 | 10 | 20 | 9 | 12 | 9 | 10 | 10 | 10 | | | | | | | | | |
| | | | | 11 | 9 | 11 | 10 | 12 | 11 | 12 | 12 | 10 | 15 | 11 | 20 | 10 | 12 | 10 | 10 | 10 | 10 | | | | | | | | | |
| | | | | | | | 15 | 10 | 20 | 12 | 15 | 10 | 15 | 10 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | | | | | | | | | |

600 Yard Bullet Catcher

* Average reading at 1 meter above ground surface = 13.39 +/- 5.86 micro-r/hour (1 sigma)
* Average reading on contact with ground surface = 18.59 +/- 14.75 micro-r/hour (1 sigma)
* = excluding the 500 Yard butt and bullet catcher

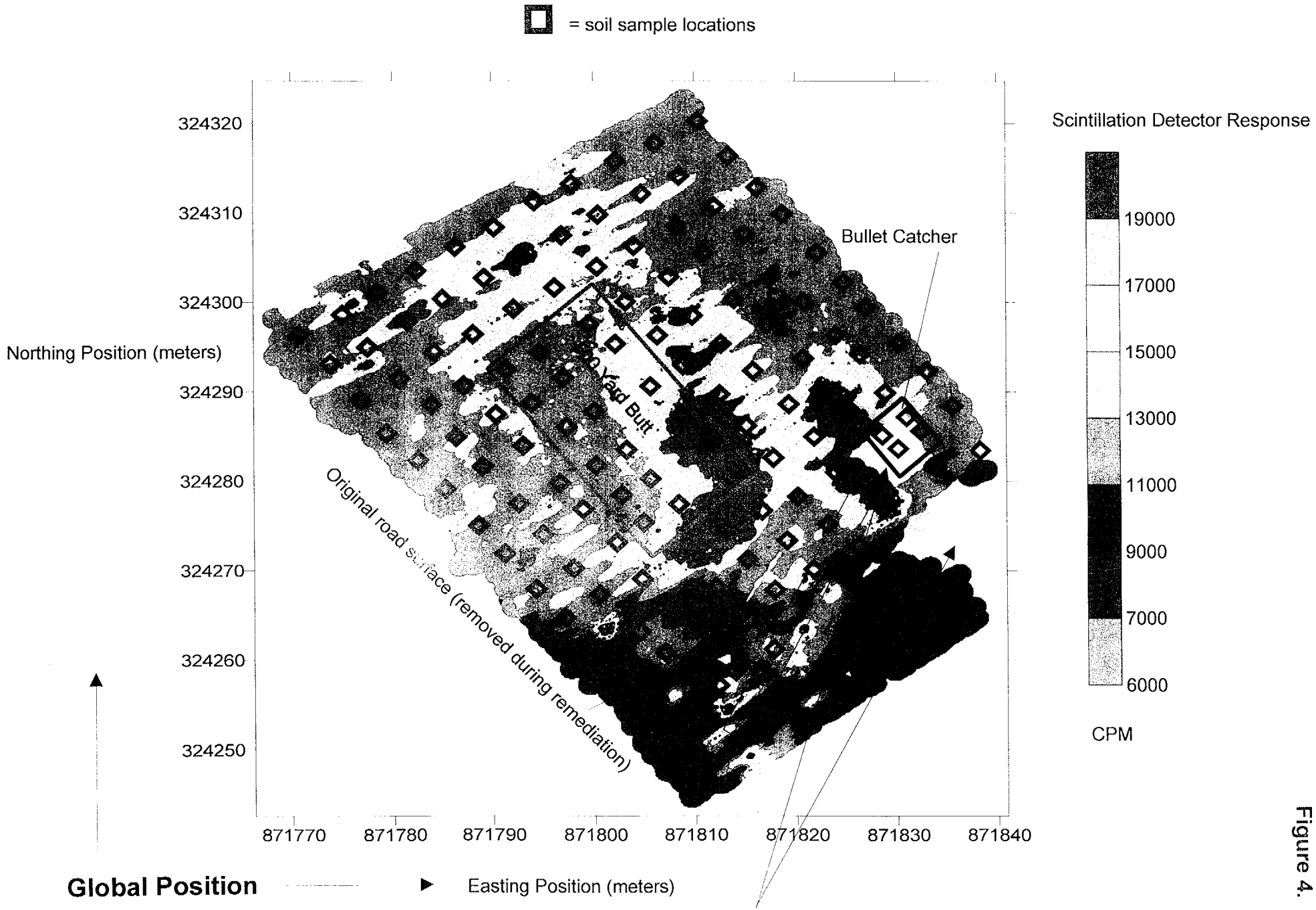
Average reading at 1 meter above ground surface on the 500 yard butt: 14.06 +/- 3.23 micro-r/hour (1 sigma)
Average reading on contact with the ground surface on the 500 yard butt: 16.39 +/- 5.05 micro-r/hour (1 sigma)

Average reading at 1 meter above ground surface in the bullet catcher: 59 +/- 41.71 micro-r/hour (1 sigma)
Average reading on contact with the ground surface in the bullet catcher: 90 +/- 53.54 micro-r/hour (1 sigma)

Lak `ity Army Ammunition Plant

Gamma Radiation Surface Scan Pre-Remediation - With Overlay of the Soil Sample Locations

Cabrera Services, Inc. - July, 2001




The blank space in and next to the bullet catcher is due to the inability to collect GPS data in that area. The Bullet catcher steel walls were a very effective satellite shield.

Figure 4.

Lake City Army Ammunition Plant

600 Yard Bullet Catcher Area Soil Sample Pattern After Remediation

Cabrera Services, Inc.

July, 2001

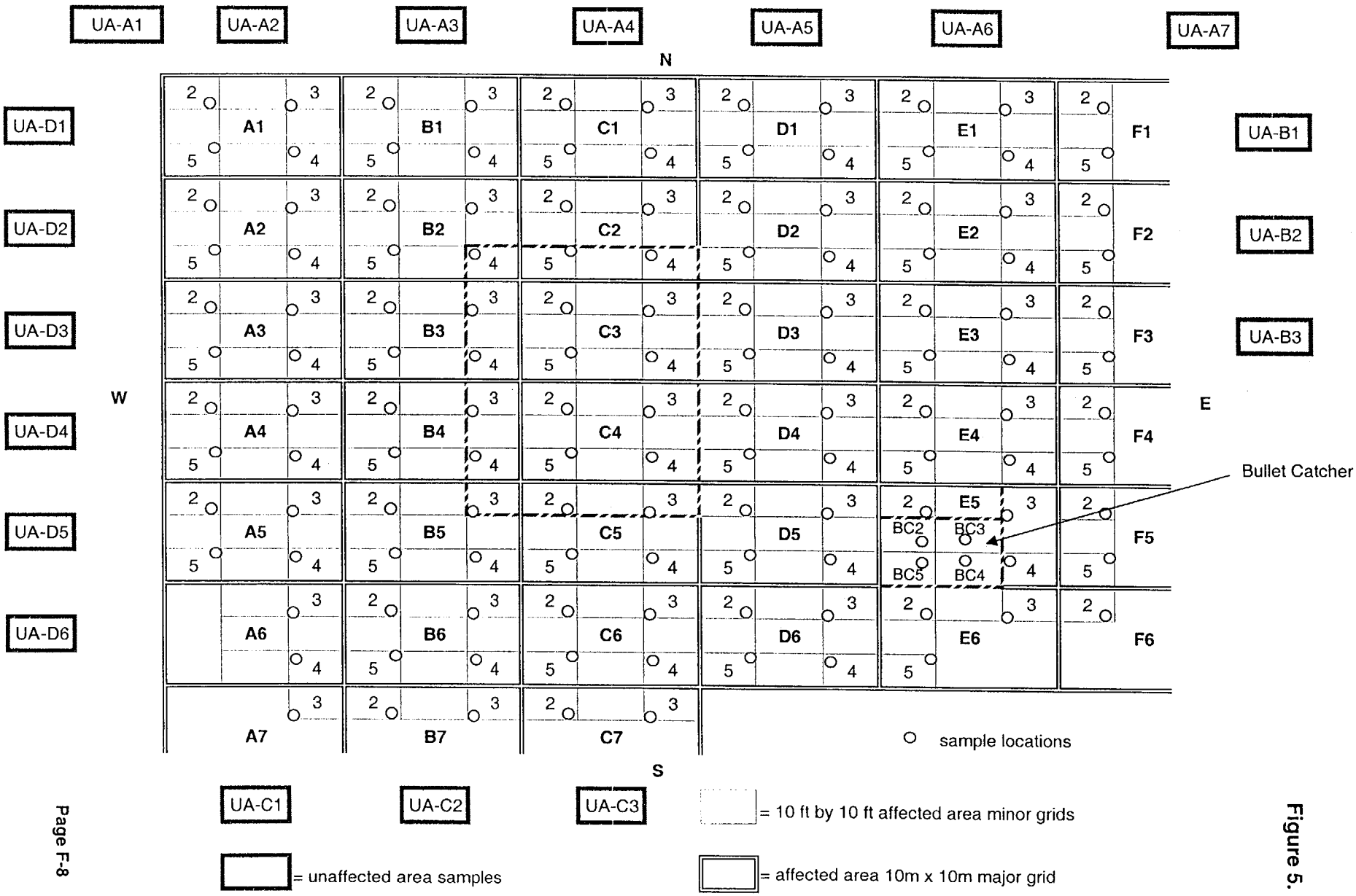



Figure 5.

Lake City Army Ammunition Plant
Cabrera Services, Inc. - Dose Rate Profile of 600 Yard Bullet Catcher Area - Post Remediation

July 16, 2001

**Figure 6**

All readings in micro-r per hour

1 meter above ground surface

Contact with ground surface

Monitoring Well

| GRIDS | A | | | | | | B | | | | | | C | | | | | | D | | | | | | E | | | | | | F | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 8 | | | 10 | 8 | 10 | 8 | 10 | 8 | 10 | 8 | 10 | 9 | 10 | 9 | 10 | 9 | 10 | 9 | 10 | 9 | 9 | 8 | 10 | 9 | 10 | 9 | 9 | 8 | 10 | 9 |
| | 10 | 9 | 9 | 8 | 10 | 9 | 9 | 8 | 10 | 9 | 10 | 9 | 9 | 8 | 10 | 9 | 10 | 9 | 10 | 9 | 10 | 9 | 9 | 8 | 9 | 8 | 9 | 9 | 10 | 8 | 9 | 8 |
| | 10 | 8 | 9 | 8 | 9 | 8 | 9 | 8 | 9 | 8 | 10 | 9 | 9 | 9 | 10 | 9 | 9 | 9 | 10 | 9 | 10 | 9 | 9 | 8 | 10 | 9 | 9 | 9 | 9 | 8 | 10 | 9 |
| 2 | 9 | 9 | 9 | 8 | 9 | 8 | 10 | 9 | 9 | 8 | 10 | 9 | 10 | 9 | 10 | 9 | 11 | 10 | 10 | 9 | 9 | 8 | 9 | 8 | 9 | 8 | 9 | 9 | 10 | 9 | 9 | 8 |
| | 10 | 8 | 11 | 9 | 9 | 8 | 9 | 8 | | | | | 500 Yard Butt | | | | | | 10 | 9 | 10 | 9 | 10 | 9 | 9 | 9 | 8 | 8 | 10 | 8 | 9 | 8 |
| | 9 | 8 | 9 | 9 | 10 | 9 | 9 | 8 | | | 10 | 9 | | | 10 | 9 | | | 9 | 8 | 10 | 9 | 9 | 8 | 10 | 9 | 8 | 8 | 9 | 8 | 9 | 8 |
| 3 | 10 | 9 | 8 | 8 | 9 | 9 | 9 | 8 | | 10 | 9 | | 9 | 9 | | 10 | 9 | | 10 | 9 | 10 | 9 | 10 | 9 | 9 | 9 | 8 | 8 | 9 | 8 | 10 | 9 |
| | 10 | 9 | 9 | 8 | 10 | 8 | 9 | 8 | | | | | | | | | | | 9 | 8 | 10 | 9 | 9 | 8 | 10 | 9 | 8 | 8 | 9 | 8 | 10 | 9 |
| | 9 | 9 | 10 | 9 | 9 | 8 | 10 | 9 | | 9 | 8 | | 9 | 9 | | 11 | 10 | | 9 | 10 | 10 | 9 | 9 | 8 | 8 | 8 | 9 | 9 | 10 | 9 | 9 | 8 |
| 4 | 9 | 9 | 10 | 9 | 9 | 8 | 9 | 8 | | | | | | | | | | | 9 | 10 | 11 | 9 | 11 | 10 | 8 | 8 | 9 | 9 | 10 | 9 | 9 | 8 |
| | 10 | 10 | 9 | 8 | 9 | 8 | 9 | 8 | | 9 | 9 | | 10 | 9 | | 10 | 9 | | 9 | 10 | 9 | 9 | 10 | 9 | 10 | 9 | 10 | 9 | 10 | 9 | 9 | 9 |
| | 9 | 8 | 8 | 7 | 8 | 8 | 9 | 8 | | | | | | | | | | | 10 | 10 | 9 | 8 | 9 | 8 | 11 | 10 | 10 | 9 | 10 | 9 | 9 | 8 |
| 5 | 9 | 8 | 10 | 8 | 9 | 8 | 9 | 8 | | 9 | 8 | | 10 | 9 | | 10 | 9 | | 10 | 10 | 10 | 9 | 9 | 9 | 10 | 10 | 10 | 9 | 9 | 8 | 9 | 9 |
| | 8 | 8 | 10 | 9 | 9 | 8 | 9 | 9 | | | 10 | 9 | | | 10 | 9 | | | 11 | 10 | 11 | 10 | 10 | 9 | 11 | 10 | 10 | 9 | 9 | 9 | 10 | 9 |
| | 7 | 7 | 9 | 8 | 8 | 8 | 9 | 9 | | | | | | | | | | | 10 | 9 | 10 | 10 | 9 | 8 | 10 | 10 | 11 | 10 | | | 10 | 9 |
| 6 | | | | | 8 | 8 | 11 | 10 | 11 | 10 | 10 | 9 | 12 | 11 | 11 | 10 | 10 | 9 | 9 | 8 | 10 | 9 | 9 | 8 | 10 | 10 | 11 | 10 | | | 10 | 9 |
| | | | | | 10 | 9 | 11 | 10 | 11 | 9 | 10 | 9 | 9 | 8 | 10 | 9 | 9 | 9 | 9 | 8 | 10 | 9 | | | | | | | | | | |
| | | | | | 10 | 9 | 10 | 9 | 8 | 8 | 9 | 8 | 9 | 8 | 9 | 8 | 9 | 8 | 9 | 8 | 9 | 8 | | | | | | | | | | |
| 7 | | | | | 10 | 9 | 8 | 8 | 8 | 8 | 8 | 7 | 9 | 8 | 9 | 8 | 9 | 8 | 8 | 7 | 9 | 8 | | | | | | | | | | |
| | | | | | | | | | 10 | 9 | 8 | 7 | 9 | 8 | 9 | 8 | 8 | 7 | 8 | 7 | 8 | 7 | | | | | | | | | | |

600 Yard Bullet Catcher

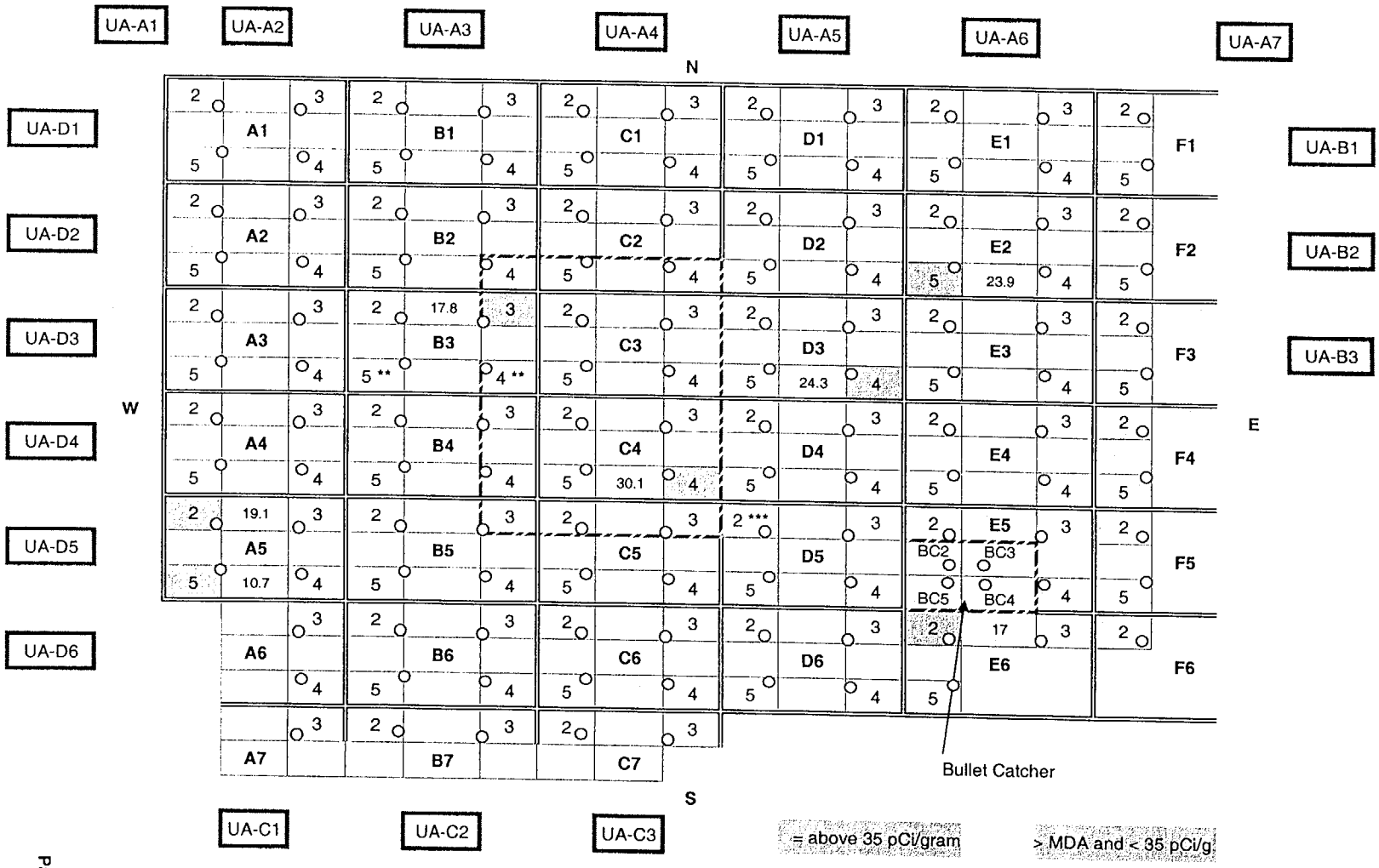
| | | | | |
|---|---|---|---|---|
| * Average reading at 1 meter above ground surface = | 8.58 +/- 0.71 | micro-r/hour | (1 sigma) | 226 Readings |
| * Average reading on contact with ground surface = | 9.43 +/- 0.78 | micro-r/hour | (1 sigma) | 226 Readings |

* = excluding the 500 Yard butt and bullet catcher

| | | | | |
|---|---|---|---|---|
| Average reading at 1 meter above ground surface on the 500 yard butt: | 8.94 +/- 0.44 | micro-r/hour | (1 sigma) | 16 Readings |
| Average reading on contact with the ground surface on the 500 yard butt: | 9.75 +/- 0.58 | micro-r/hour | (1 sigma) | 16 Readings |
| Average reading at 1 meter above ground surface in the bullet catcher: | 10 +/- 0.00 | micro-r/hour | (1 sigma) | 4 Readings |
| Average reading on contact with the ground surface in the bullet catcher: | 11 +/- 0.58 | micro-r/hour | (1 sigma) | 4 Readings |

Lake City Army Ammunition Plant
600 Yard Bullet Catcher Area Soil Sample Pattern After Remediation - Samples above MDA

Cabrera Services, Inc.
July, 2001




= affected Area

= unaffected area samples

○ indicates sample locations

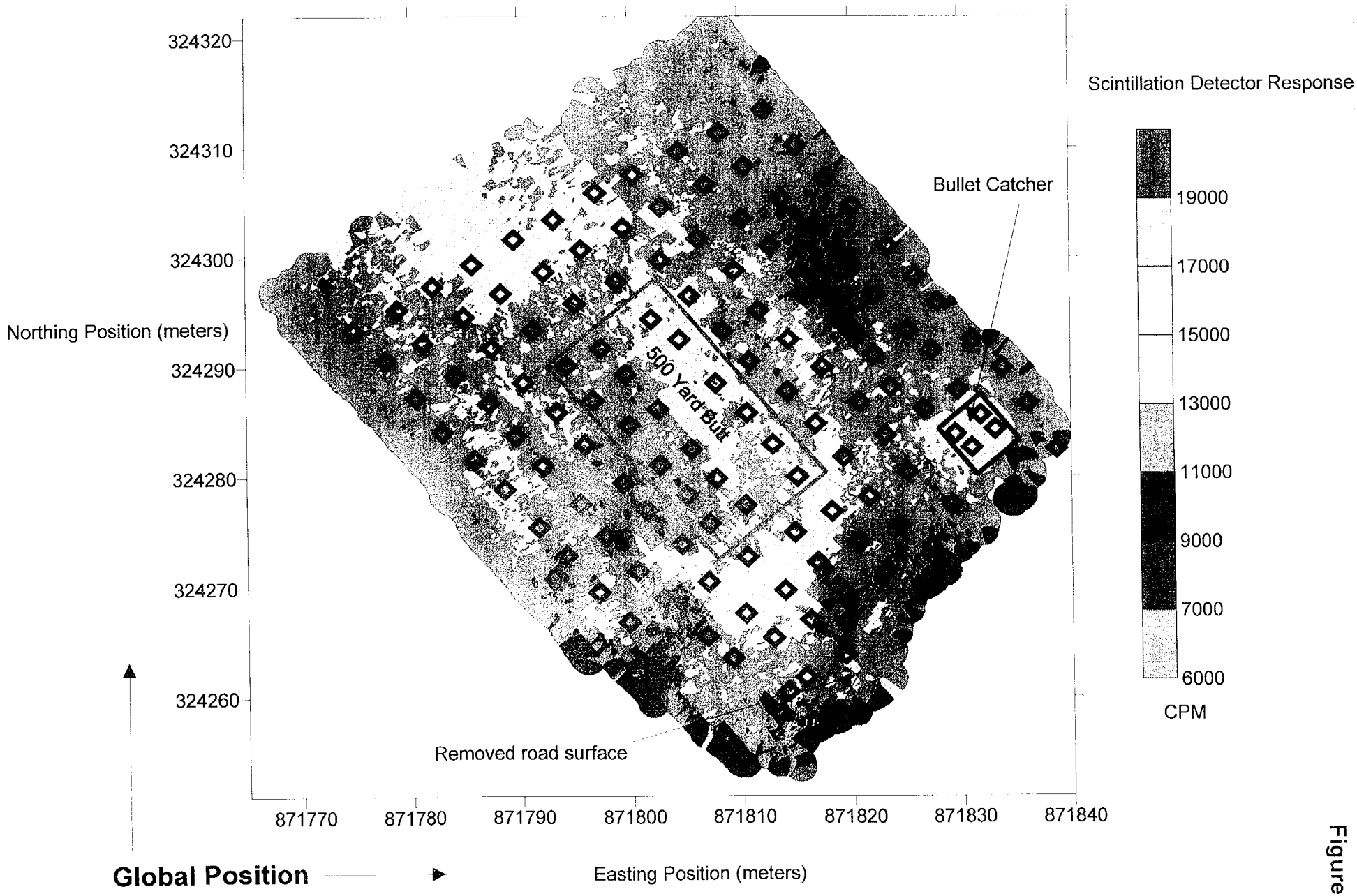
** Areas LC-B3-BC-4S and LC-B3-BC-5S were resampled with composite LC-B3-BC-5SR, MDA = 12.5 pCi/g, Result = -3.7 pCi/g
*** Area LC-D5-BC-2S was resampled with sample LC-D5-BC-2SR, MDA = 12.6 pCi/g, Result = -1.2 pCi/g

Figure 7.

Lak ;ity Army Ammunition Plant

Soil Sample Locations on Remediated Site - Final Status

Cabrera Services, Inc. - July, 2001




The blank space next to the bullet catcher is due to the inability to collect GPS data in that area. The large Bullet catcher steel walls are a very effective satellite shield.

Figure 8.

Lake City Army Ammunition Plant
600 Yard Bullet Catcher - Surface Soil Sample Results
Cabrera Services, Inc.

Moisture content of the soil: 25.0 percent

| Sample ID | Sample Mass (grams) | Exposure Rate contact µR/hour | Exposure Rate at 1 meter µR/hour | Measured Activity Concentration (pCi/gram) [1] U-238 [2] Result | U-238 MDC | Total-U [3] Result | Total-U MDC | Moisture-Corrected Total-U [4] Result | Moisture-Corrected Total-U MDC | Moisture-Corrected Total-U MDC or Result >MDC | Grid Average Result [5] | Average of MDA or Result (IF > MDA) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LC-A1-BC-2S | 495 | 10 | 8 | 1.7 | 18.9 | 2.0 | 22.7 | 2.5 | 28.4 | 28.4 | 3 | 24 |
| LC-A1-BC-3S | 613 | 10 | 8 | 6.0 | 14.9 | 7.3 | 17.9 | 9.1 | 22.4 | 22.4 | | |
| LC-A1-BC-4S | 596 | 9 | 8 | 4.3 | 14.6 | 5.2 | 17.6 | 6.5 | 22.0 | 22.0 | | |
| LC-A1-BC-5S | 553 | 10 | 8 | -4.0 | 15.3 | -4.8 | 18.4 | -6.0 | 23.0 | 23.0 | | |
| LC-A2-BC-2S | 572 | 9 | 9 | 7.6 | 16.4 | 9.1 | 19.7 | 11.4 | 24.7 | 24.7 | 1 | 24 |
| LC-A2-BC-3S | 604 | 9 | 8 | -0.6 | 18.2 | -0.7 | 21.9 | -0.9 | 27.4 | 27.4 | | |
| LC-A2-BC-4S | 545 | 9 | 9 | -10.3 | 16.4 | -12.4 | 19.7 | -15.5 | 24.7 | 24.7 | | |
| LC-A2-BC-5S | 601 | 9 | 8 | 5.9 | 13.7 | 7.1 | 16.5 | 8.9 | 20.6 | 20.6 | | |
| LC-A3-BC-2S | 578 | 10 | 9 | 0.4 | 16.2 | 0.5 | 19.5 | 0.6 | 24.4 | 24.4 | 8 | 22 |
| LC-A3-BC-3S | 699 | 9 | 8 | 0.9 | 12.6 | 1.1 | 15.2 | 1.4 | 19.0 | 19.0 | | |
| LC-A3-BC-4S | 724 | 9 | 9 | 10.9 | 13.6 | 13.1 | 16.4 | **16.4** | 20.5 | 20.5 | | |
| LC-A3-BC-5S | 626 | 9 | 9 | 8.8 | 15.8 | 10.6 | 19.0 | 13.2 | 23.8 | 23.8 | | |
| LC-A4-BC-2S | 646 | 9 | 9 | 7.2 | 14.3 | 8.7 | 17.2 | 10.8 | 21.5 | 21.5 | 9 | 20 |
| LC-A4-BC-3S | 734 | 9 | 8 | 10.1 | 12.3 | 12.2 | 14.8 | **15.2** | 18.5 | 18.5 | | |
| LC-A4-BC-4S | 723 | 8 | 8 | 6.8 | 13.8 | 8.2 | 16.6 | 10.2 | 20.8 | 20.8 | | |
| LC-A4-BC-5S | 645 | 9 | 8 | -0.2 | 13.8 | -0.2 | 16.6 | -0.3 | 20.8 | 20.8 | | |
| LC-A5-BC-2S | 607 | 9 | 8 | 15.9 | 17.8 | 19.1 | 21.4 | **23.9** | 26.8 | 26.8 | 13 | 20 |
| LC-A5-BC-3S | 710 | 9 | 8 | 6.8 | 15.0 | 8.2 | 18.1 | 10.2 | 22.6 | 22.6 | | |
| LC-A5-BC-4S | 749 | 8 | 9 | 2.2 | 12.8 | 2.6 | 15.4 | 3.3 | 19.3 | 19.3 | | |
| LC-A5-BC-5S | 687 | 7 | 7 | 8.9 | 7.4 | 10.7 | 8.9 | **13.4** | 11.1 | 13.4 | | |
| LC-A6-BC-3S | 740 | 8 | 8 | 4.8 | 16.6 | 5.8 | 20.0 | 7.2 | 25.0 | 25.0 | 5 | 23 |
| LC-A6-BC-4S | 900 | 10 | 9 | 1.5 | 14.1 | 1.8 | 17.0 | 2.3 | 21.2 | 21.2 | | |
| LC-A7-BC-3S | 817 | 10 | 9 | -1.7 | 14.1 | -2.0 | 17.0 | -2.5 | 21.2 | 21.2 | -3 | 21 |
| LC-B1-BC-2S | 649 | 10 | 8 | 3.5 | 18.1 | 4.2 | 21.8 | 5.2 | 27.2 | 27.2 | 11 | 29 |
| LC-B1-BC-3S | 522 | 10 | 8 | 7.1 | 20.9 | 8.5 | 25.2 | 10.6 | 31.4 | 31.4 | | |
| LC-B1-BC-4S | 536 | 10 | 9 | 8.2 | 19.6 | 9.9 | 23.6 | 12.3 | 29.5 | 29.5 | | |
| LC-B1-BC-5S | 617 | 9 | 8 | 10.7 | 18.7 | 12.9 | 22.5 | 16.1 | 28.1 | 28.1 | | |
| LC-B2-BC-2S | 589 | 10 | 9 | -2.2 | 20.6 | -2.6 | 24.8 | -3.3 | 31.0 | 31.0 | -2 | 27 |
| LC-B2-BC-3S | 658 | 10 | 9 | 0.7 | 15.3 | 0.8 | 18.4 | 1.1 | 23.0 | 23.0 | | |
| LC-B2-BC-4S | 561 | 10 | 9 | -1.8 | 19.5 | -2.2 | 23.5 | -2.7 | 29.3 | 29.3 | | |
| LC-B2-BC-5S | 610 | 9 | 8 | -1.9 | 16.1 | -2.3 | 19.4 | -2.9 | 24.2 | 24.2 | | |
| LC-B3-BC-2S | 622 | 9 | 8 | 9.7 | 21.8 | 11.6 | 26.2 | 14.5 | 32.8 | 32.8 | 10 | 25 |
| LC-B3-BC-3Sa | 849 | 10 | 9 | 14.8 | 15.7 | 17.8 | 18.9 | **22.3** | 23.6 | 23.6 | | |
| LC-B3-BC-4SR | 646 | 9 | 8 | -3.7 | 12.5 | -4.5 | 15.0 | -5.6 | 18.8 | 18.8 | | |
| COMPOSITE | THIS IS ONE SAMPLE 50% from AREA 4S and 50% from AREA 5S of GRID B3 | | | | | | | | | | | |
| LC-B3-BC-5SR | 646 | 10 | 9 | -3.7 | 12.5 | -4.5 | 15.0 | -5.6 | 18.8 | 18.8 | | |
| LC-B4-BC-2S | 637 | 9 | 8 | -5.4 | 17.8 | -6.5 | 21.4 | -8.2 | 26.8 | 26.8 | -7 | 25 |
| LC-B4-BC-3S | 606 | 9 | 9 | 0.7 | 16.6 | 0.8 | 20.0 | 1.1 | 25.0 | 25.0 | | |
| LC-B4-BC-4S | 818 | 9 | 9 | -8.7 | 16.8 | -10.5 | 20.2 | -13.1 | 25.3 | 25.3 | | |
| LC-B4-BC-5S | 659 | 9 | 8 | -4.8 | 16.6 | -5.8 | 20.0 | -7.2 | 25.0 | 25.0 | | |
| LC-B5-BC-2S | 606 | 9 | 8 | 8.2 | 15.2 | 9.9 | 18.3 | 12.3 | 22.9 | 22.9 | 6 | 25 |
| LC-B5-BC-3S | 619 | 9 | 8 | 5.1 | 21.3 | 6.1 | 25.6 | 7.7 | 32.0 | 32.0 | | |
| LC-B5-BC-4S | 766 | 10 | 9 | 1.5 | 15.1 | 1.8 | 18.2 | 2.2 | 22.7 | 22.7 | | |
| LC-B5-BC-5S | 758 | 9 | 9 | 1.4 | 15.0 | 1.7 | 18.1 | 2.2 | 22.6 | 22.6 | | |
| LC-B6-BC-2S | 705 | 11 | 10 | -14.7 | 14.6 | -17.7 | 17.6 | -22.1 | 22.0 | 22.0 | 3 | 24 |
| LC-B6-BC-3S | 817 | 10 | 9 | 14.3 | 19.4 | 17.2 | 23.3 | 21.5 | 29.2 | 29.2 | | |
| LC-B6-BC-4S | 834 | 9 | 8 | 2.9 | 12.8 | 3.5 | 15.4 | 4.3 | 19.3 | 19.3 | | |
| LC-B6-BC-5S | 744 | 10 | 9 | 6.2 | 16.3 | 7.5 | 19.6 | 9.3 | 24.5 | 24.5 | | |
| LC-B7-BC-2S | 851 | 8 | 8 | 2.1 | 13.6 | 2.6 | 16.4 | 3.2 | 20.5 | 20.5 | 10 | 25 |
| LC-B7-BC-3S | 665 | 8 | 7 | 11.4 | 19.1 | 13.7 | 23.0 | 17.1 | 28.7 | 28.7 | | |
| LC-BC2-BCS | 893 | 10 | 10 | -5.4 | 10.7 | -6.5 | 12.9 | -8.1 | 16.1 | 16.1 | -3 | 19 |
| LC-BC3-BCS | 792 | 11 | 10 | -1.3 | 13.8 | -1.6 | 16.6 | -2.0 | 20.8 | 20.8 | | |
| LC-BC4-BCS | 879 | 11 | 10 | 1.2 | 13.6 | 1.4 | 16.4 | 1.7 | 20.5 | 20.5 | | |
| LC-BC5-BCS | 830 | 10 | 10 | -3.4 | 11.8 | -4.1 | 14.2 | -5.1 | 17.7 | 17.7 | | |

Samples were taken with a hand auger to a depth of 6 inches from the surface.
Samples LC-B3-BC-4SR and LC-B3-BC-5SR are a single composite sample from two areas.

Lake City Army Ammunition Plant
600 Yard Bullet Catcher - Surface Soil Sample Results
Cabrera Services, Inc.

| Sample ID | Sample Mass (grams) | Exposure Rate contact µR/hour | Exposure Rate at 1 meter µR/hour | Measured Activity Concentration (pCi/gram) [1] U-238 [2] Result | U-238 MDC | Total-U [3] Result | Total-U MDC | Moisture-Corrected Total-U [4] Result | Moisture-Corrected Total-U MDC | Moisture-Corrected Total-U MDC or Result >MDC | Grid Average Result [5] | Average of MDA or Result (IF > MDA) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LC-C1-BC-2S | 618 | 10 | 9 | -3.9 | 18.0 | -4.7 | 21.7 | -5.9 | 27.1 | 27.1 | -6 | 26 |
| LC-C1-BC-3S | 678 | 10 | 9 | 0.7 | 15.1 | 0.8 | 18.2 | 1.1 | 22.7 | 22.7 | | |
| LC-C1-BC-4S | 605 | 9 | 9 | -4.5 | 19.4 | -5.5 | 23.3 | -6.8 | 29.2 | 29.2 | | |
| LC-C1-BC-5S | 557 | 9 | 9 | -9.5 | 17.6 | -11.4 | 21.2 | -14.3 | 26.5 | 26.5 | | |
| LC-C2-BC-2S | 676 | 10 | 9 | -4.8 | 15.8 | -5.8 | 19.0 | -7.2 | 23.8 | 23.8 | -4 | 24 |
| LC-C2-BC-3S | 564 | 11 | 10 | 0.3 | 17.8 | 0.3 | 21.4 | 0.4 | 26.8 | 26.8 | | |
| LC-C2-BC-4S | 565 | 10 | 9 | -1.2 | 19.7 | -1.4 | 23.7 | -1.8 | 29.6 | 29.6 | | |
| LC-C2-BC-5S | 831 | 10 | 9 | -5.5 | 11.8 | -6.7 | 14.2 | -8.3 | 17.7 | 17.7 | | |
| LC-C3-BC-2S | 564 | 9 | 9 | -1.7 | 19.4 | -2.0 | 23.3 | -2.6 | 29.2 | 29.2 | -3 | 30 |
| LC-C3-BC-3S | 612 | 10 | 9 | -5.7 | 16.8 | -6.9 | 20.2 | -8.6 | 25.3 | 25.3 | | |
| LC-C3-BC-4S | 588 | 11 | 10 | -5.7 | 20.6 | -6.9 | 24.8 | -8.6 | 31.0 | 31.0 | | |
| LC-C3-BC-5S | 573 | 9 | 9 | 5.3 | 24.2 | 6.4 | 29.1 | 8.0 | **36.4** | **36.4** | | |
| LC-C4-BC-2S | 577 | 10 | 9 | 11.3 | 22.3 | 13.6 | 26.8 | 17.0 | 33.5 | 33.5 | 6 | 31 |
| LC-C4-BC-3S | 603 | 10 | 9 | 0.9 | 20.1 | 1.1 | 24.2 | 1.4 | 30.2 | 30.2 | | |
| LC-C4-BC-4S | 523 | 10 | 9 | 7.8 | 19.6 | 9.4 | 23.6 | 11.7 | 29.5 | 29.5 | | |
| LC-C4-BC-5S | 578 | 10 | 9 | -3.1 | 19.6 | -3.7 | 23.6 | -4.7 | 29.5 | 29.5 | | |
| LC-C5-BC-2S | 597 | 10 | 9 | 0.6 | 20.6 | 0.7 | 24.8 | 0.9 | 31.0 | 31.0 | 9 | 33 |
| LC-C5-BC-3S | 507 | 10 | 9 | -3.5 | 22.4 | -4.2 | 27.0 | -5.3 | 33.7 | 33.7 | | |
| LC-C5-BC-4S | 685 | 10 | 9 | 25.0 | 12.0 | 30.1 | 14.4 | **37.6** | 18.1 | **37.6** | | |
| LC-C5-BC-5S | 643 | 10 | 9 | 2.8 | 18.8 | 3.4 | 22.6 | 4.2 | 28.3 | 28.3 | | |
| LC-C6-BC-2S | 697 | 12 | 11 | 8.8 | 18.2 | 10.6 | 21.9 | 13.2 | 27.4 | 27.4 | 10 | 24 |
| LC-C6-BC-3S | 815 | 10 | 9 | 8.7 | 16.0 | 10.5 | 19.3 | 13.1 | 24.1 | 24.1 | | |
| LC-C6-BC-4S | 811 | 9 | 8 | 3.9 | 14.0 | 4.7 | 16.8 | 5.9 | 21.1 | 21.1 | | |
| LC-C6-BC-5S | 818 | 9 | 8 | 4.6 | 15.9 | 5.6 | 19.1 | 7.0 | 23.9 | 23.9 | | |
| LC-C7-BC-2S | 654 | 9 | 8 | 12.5 | 19.7 | 15.0 | 23.7 | 18.8 | 29.6 | 29.6 | 11 | 29 |
| LC-C7-BC-3S | 704 | 9 | 8 | 2.2 | 18.3 | 2.6 | 22.0 | 3.3 | 27.5 | 27.5 | | |
| LC-D1-BC-2S | 576 | 10 | 9 | 10.1 | 19.3 | 12.2 | 23.2 | 15.3 | 29.0 | 29.0 | 9 | 27 |
| LC-D1-BC-3S | 599 | 9 | 8 | 9.0 | 19.6 | 10.8 | 23.6 | 13.5 | 29.5 | 29.5 | | |
| LC-D1-BC-4S | 610 | 9 | 8 | -4.4 | 15.3 | -5.3 | 18.4 | -6.6 | 23.0 | 23.0 | | |
| LC-D1-BC-5S | 641 | 10 | 9 | 8.1 | 17.0 | 9.8 | 20.5 | 12.2 | 25.6 | 25.6 | | |
| LC-D2-BC-2S | 624 | 10 | 9 | 6.9 | 19.1 | 8.3 | 23.0 | 10.3 | 28.7 | 28.7 | 5 | 27 |
| LC-D2-BC-3S | 618 | 9 | 8 | -4.8 | 16.6 | -5.7 | 20.0 | -7.2 | 25.0 | 25.0 | | |
| LC-D2-BC-4S | 619 | 9 | 8 | 6.3 | 18.0 | 7.6 | 21.7 | 9.5 | 27.1 | 27.1 | | |
| LC-D2-BC-5S | 634 | 9 | 8 | 5.1 | 16.9 | 6.2 | 20.3 | 7.7 | 25.4 | 25.4 | | |
| LC-D3-BC-2S | 679 | 10 | 9 | 8.7 | 18.4 | 10.5 | 22.1 | 13.1 | 27.7 | 27.7 | 11 | 28 |
| LC-D3-BC-3S | 614 | 10 | 9 | 5.3 | 20.1 | 6.4 | 24.2 | 8.0 | 30.2 | 30.2 | | |
| LC-D3-BC-4S | 737 | 9 | 8 | 20.2 | 20.1 | 24.3 | 24.2 | **30.4** | 30.2 | 30.4 | | |
| LC-D3-BC-5S | 713 | 9 | 10 | -4.9 | 15.6 | -5.9 | 18.8 | -7.4 | 23.5 | 23.5 | | |
| LC-D4-BC-2S | 680 | 9 | 10 | -7.3 | 16.7 | -8.8 | 20.1 | -11.0 | 25.1 | 25.1 | 2 | 26 |
| LC-D4-BC-3S | 733 | 11 | 10 | 3.9 | 18.5 | 4.7 | 22.3 | 5.9 | 27.8 | 27.8 | | |
| LC-D4-BC-4S | 721 | 9 | 8 | 2.4 | 16.8 | 2.9 | 20.2 | 3.6 | 25.3 | 25.3 | | |
| LC-D4-BC-5S | 625 | 10 | 10 | 6.8 | 17.8 | 8.2 | 21.4 | 10.2 | 26.8 | 26.8 | | |
| LC-D5-BC-2SR | 670 | 10 | 10 | -1.2 | 12.6 | -1.4 | 15.2 | -1.8 | 19.0 | 19.0 | -2 | 24 |
| LC-D5-BC-3S | 640 | 9 | 9 | -1.1 | 18.0 | -1.3 | 21.7 | -1.7 | 27.1 | 27.1 | | |
| LC-D5-BC-4S | 757 | 9 | 8 | 2.9 | 15.5 | 3.5 | 18.7 | 4.4 | 23.3 | 23.3 | | |
| LC-D5-BC-5S | 656 | 10 | 9 | -4.7 | 17.0 | -5.7 | 20.5 | -7.1 | 25.6 | 25.6 | | |
| LC-D6-BC-2S | 868 | 9 | 8 | -1.0 | 12.8 | -1.2 | 15.4 | -1.5 | 19.3 | 19.3 | -5 | 23 |
| LC-D6-BC-3S | 737 | 9 | 8 | 5.2 | 16.5 | 6.3 | 19.9 | 7.8 | 24.8 | 24.8 | | |
| LC-D6-BC-4S | 752 | 9 | 8 | -7.8 | 14.5 | -9.4 | 17.4 | -11.7 | 21.8 | 21.8 | | |
| LC-D6-BC-5S | 680 | 9 | 8 | -8.6 | 16.1 | -10.4 | 19.4 | -13.0 | 24.2 | 24.2 | | |

Samples were taken with a hand auger to a depth of 6 inches from the surface.
Samples LC-B3-BC-4SR and LC-B3-BC-5SR are a single composite sample from two areas.

Lake City Army Ammunition Plant
600 Yard Bullet Catcher - Surface Soil Sample Results
Cabrera Services, Inc.

| Sample ID | Sample Mass (grams) | Exposure Rate contact µR/hour | Exposure Rate at 1 meter µR/hour | Measured Activity Concentration (pCi/gram) [1] U-238 [2] Result | U-238 [2] MDC | Total-U [3] Result | Total-U [3] MDC | Moisture-Corrected Total-U [4] Result | Moisture-Corrected Total-U [4] MDC | Moisture-Corrected Total-U [4] MDC or Result >MDC | Grid Average Result [5] | Average of MDA or Result (IF > MDA) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LC-E1-BC-2S | 655 | 10 | 9 | -8.6 | 16.7 | -10.3 | 20.1 | -12.9 | 25.1 | 25.1 | -19 | 25 |
| LC-E1-BC-3S | 571 | 9 | 8 | -8.3 | 17.2 | -10.0 | 20.7 | -12.6 | 25.9 | 25.9 | | |
| LC-E1-BC-4S | 636 | 9 | 8 | -6.4 | 15.0 | -7.7 | 18.1 | -9.6 | 22.6 | 22.6 | | |
| LC-E1-BC-5S | 644 | 10 | 9 | -26.0 | 18.2 | -31.3 | 21.9 | -39.1 | 27.4 | 27.4 | | |
| LC-E2-BC-2S | 645 | 9 | 8 | 10.6 | 18.2 | 12.7 | 21.9 | 15.9 | 27.4 | 27.4 | 19 | 30 |
| LC-E2-BC-3S | 655 | 10 | 9 | 5.1 | 18.5 | 6.1 | 22.3 | 7.6 | 27.8 | 27.8 | | |
| LC-E2-BC-4S | 628 | 9 | 8 | 14.0 | 22.8 | 16.9 | 27.4 | 21.1 | 34.3 | 34.3 | | |
| LC-E2-BC-5S | 632 | 10 | 9 | 19.8 | 21.1 | 23.9 | 25.4 | **29.8** | 31.7 | 31.7 | | |
| LC-E3-BC-2S | 598 | 9 | 9 | 9.8 | 19.9 | 11.8 | 23.9 | 14.7 | 29.9 | 29.9 | 11 | 29 |
| LC-E3-BC-3S | 592 | 9 | 8 | 7.7 | 17.7 | 9.3 | 21.3 | 11.6 | 26.6 | 26.6 | | |
| LC-E3-BC-4S | 551 | 10 | 9 | -0.4 | 21.6 | -0.5 | 26.0 | -0.6 | 32.5 | 32.5 | | |
| LC-E3-BC-5S | 625 | 8 | 8 | 11.3 | 17.5 | 13.6 | 21.1 | 17.0 | 26.3 | 26.3 | | |
| LC-E4-BC-2S | 621 | 8 | 8 | -0.8 | 20.1 | -1.0 | 24.2 | -1.2 | 30.2 | 30.2 | -4 | 29 |
| LC-E4-BC-3S | 632 | 10 | 9 | -2.9 | 18.3 | -3.5 | 22.0 | -4.4 | 27.5 | 27.5 | | |
| LC-E4-BC-4S | 618 | 10 | 9 | 0.3 | 19.9 | 0.4 | 23.9 | 0.5 | 29.9 | 29.9 | | |
| LC-E4-BC-5S | 656 | 11 | 10 | -7.5 | 18.4 | -9.0 | 22.1 | -11.3 | 27.7 | 27.7 | | |
| LC-E5-BC-2S | 684 | 10 | 10 | 8.3 | 17.4 | 10.0 | 20.9 | 12.5 | 26.2 | 26.2 | 5 | 27 |
| LC-E5-BC-3S | 612 | 9 | 8 | -1.8 | 17.9 | -2.2 | 21.5 | -2.7 | 26.9 | 26.9 | | |
| LC-E6-BC-2S | 695 | 10 | 10 | -4.6 | 14.1 | -5.5 | 17.0 | -6.9 | 21.2 | 21.2 | 8 | 27 |
| LC-E6-BC-3S | 577 | 10 | 10 | 18.2 | 22.9 | 21.9 | 27.6 | 27.3 | 34.4 | 34.4 | | |
| LC-E6-BC-5S | 628 | 10 | 10 | 2.4 | 16.0 | 2.8 | 19.3 | 3.5 | 24.1 | 24.1 | | |
| LC-F1-BC-2S | 614 | 10 | 9 | 14.0 | 22.3 | 16.8 | 26.8 | 21.1 | 33.5 | 33.5 | 15 | 29 |
| LC-F1-BC-5S | 653 | 10 | 9 | 6.4 | 16.4 | 7.7 | 19.7 | 9.6 | 24.7 | 24.7 | | |
| LC-F2-BC-2S | 547 | 9 | 8 | 6.5 | 22.5 | 7.8 | 27.1 | 9.8 | 33.8 | 33.8 | 16 | 32 |
| LC-F2-BC-5S | 656 | 9 | 8 | 14.9 | 19.6 | 17.9 | 23.6 | 22.4 | 29.5 | 29.5 | | |
| LC-F3-BC-2S | 547 | 10 | 9 | 8.5 | 17.9 | 10.2 | 21.5 | 12.8 | 26.9 | 26.9 | 15 | 29 |
| LC-F3-BC-5S | 533 | 9 | 8 | 10.8 | 20.9 | 13.0 | 25.2 | 16.2 | 31.4 | 31.4 | | |
| LC-F4-BC-2S | 537 | 9 | 8 | 3.5 | 22.9 | 4.2 | 27.6 | 5.3 | 34.4 | 34.4 | 8 | 33 |
| LC-F4-BC-5S | 548 | 9 | 8 | 6.9 | 21.4 | 8.3 | 25.8 | 10.4 | 32.2 | 32.2 | | |
| LC-F5-BC-2S | 485 | 9 | 9 | 9.0 | 24.6 | 10.8 | 29.6 | 13.5 | **37.0** | **37.0** | 10 | 33 |
| LC-F5-BC-5S | 558 | 10 | 9 | 4.1 | 18.8 | 4.9 | 22.6 | 6.1 | 28.3 | 28.3 | | |
| LC-F6-BC-2S | 536 | 10 | 9 | -4.0 | 18.3 | -4.8 | 22.0 | -6.0 | 27.5 | 27.5 | -6 | 28 |

| | MDC pCi/g | Activity pCi/g | MDC pCi/g | MDC or Result if >MDC pCi/g |
|---|---|---|---|---|
| **Maximum:** | 29.6 | 37.6 | 37.0 | 37.6 |
| **Minimum:** | 8.9 | -39.1 | 11.1 | 13.4 |
| **Median:** | 20.9 | 3.6 | 26.2 | 26.3 |
| **Average:** | 20.7 | 4.1 | 25.9 | 26.1 |
| **n:** | 135 | 135 | 135 | 135 |
| **$S_x$:** | 3.6 | 11.3 | 4.5 | 4.6 |
| $t_{0.95}$: | 1.657 | 1.657 | 1.657 | 1.657 |
| $\mu_x$: | 21.3 | 5.7 | 26.6 | 26.7 |
| **Number of samples with activity > MDA:** | - | 8 | - | - |
| **Number of samples with activity > 35 pCi/g:** | - | 1 | - | - |
| **Number of samples with MDA > 35 pCi/g:** | - | - | - | 2 |

| KEY |
|---|
| Suffix D = 1 meter depth |
| Suffix S = surface sample |
| Suffix R = Resample after remediation |
| BCS = Bullet catcher surface soil |

299.25

**Notes:**
[1] Minimum detectable activity concentrations (MDCs) reported at the 95% confidence level
[2] U-238 activity concentrations based on measurement of the Pa-234m 1001 keV gamma line assuming secular equilibrium
[3] Total uranium based on site-specific activity ratio of U-238:U-total of 0.831:1
[4] Correction based on assumed moisture content of 25%
[5] Grid average based on moisture corrected total uranium results

Samples were taken with a hand auger to a depth of 6 inches from the surface.
Samples LC-B3-BC-4SR and LC-B3-BC-5SR are a single composite sample from two areas.

Lake City Army Ammunition Plant
600 Yard Bullet Catcher - 1 Meter Depth Soil Sample Results
Cabrera Services, Inc.

| | | Exposure Rate | Exposure Rate | Measured Activity Concentration (pCi/gram) [1] | | | | | | | Grid Average Result [5] | Average of MDA or Result (IF > MDA) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | U-238 [2] | | Total-U [3] | | Moisture-Corrected Total-U [4] | | | | |
| Sample ID | Sample Mass (grams) | contact µR/hour | at 1 meter µR/hour | Result | MDC | Result | MDC | Result | MDC | MDC or Result >MDC | | |
| LC-C1-BC-2D | 800 | 10 | 9 | -8.4 | 14.2 | -10.1 | 17.1 | -12.7 | 21.4 | 21.4 | -4 | 23 |
| LC-C1-BC-3D | 783 | 10 | 9 | 4.1 | 13.7 | 4.9 | 16.5 | 6.2 | 20.6 | 20.6 | | |
| LC-C1-BC-4D | 699 | 9 | 9 | -5.2 | 16.2 | -6.2 | 19.5 | -7.8 | 24.4 | 24.4 | | |
| LC-C1-BC-5D | 783 | 9 | 9 | -0.3 | 16.2 | -0.4 | 19.5 | -0.5 | 24.4 | 24.4 | | |
| LC-C2-BC-2D | 871 | 10 | 9 | -4.1 | 12.1 | -4.9 | 14.6 | -6.1 | 18.2 | 18.2 | 2 | 22 |
| LC-C2-BC-3D | 726 | 11 | 10 | -2.1 | 15.1 | -2.5 | 18.2 | -3.1 | 22.7 | 22.7 | | |
| LC-C2-BC-4D | 889 | 10 | 9 | 7.7 | 14.5 | 9.3 | 17.4 | 11.6 | 21.8 | 21.8 | | |
| LC-C2-BC-5D | 741 | 10 | 9 | 5.0 | 17.3 | 6.0 | 20.8 | 7.5 | 26.0 | 26.0 | | |
| LC-C3-BC-2D | 693 | 9 | 9 | 10.9 | 17.2 | 13.1 | 20.7 | 16.4 | 25.9 | 25.9 | 6 | 27 |
| LC-C3-BC-3D | 667 | 10 | 9 | 1.0 | 15.4 | 1.2 | 18.5 | 1.5 | 23.2 | 23.2 | | |
| LC-C3-BC-4D | 624 | 11 | 10 | 5.6 | 18.5 | 6.7 | 22.3 | 8.4 | 27.8 | 27.8 | | |
| LC-C3-BC-5D | 619 | 9 | 9 | -2.4 | 19.9 | -2.9 | 23.9 | -3.6 | 29.9 | 29.9 | | |
| LC-C4-BC-2D | 703 | 10 | 9 | 5.6 | 16.7 | 6.7 | 20.1 | 8.4 | 25.1 | 25.1 | 1 | 26 |
| LC-C4-BC-3D | 719 | 10 | 9 | -7.1 | 14.6 | -8.5 | 17.6 | -10.7 | 22.0 | 22.0 | | |
| LC-C4-BC-4D | 633 | 10 | 9 | 2.9 | 20.0 | 3.5 | 24.1 | 4.4 | 30.1 | 30.1 | | |
| LC-C4-BC-5D | 656 | 10 | 9 | 1.6 | 18.2 | 1.9 | 21.9 | 2.4 | 27.4 | 27.4 | | |
| LC-C5-BC-2D | 598 | 10 | 9 | -7.8 | 22.7 | -9.4 | 27.3 | -11.7 | 34.1 | 34.1 | 4 | 25 |
| LC-C5-BC-3D | 819 | 10 | 9 | 3.1 | 14.4 | 3.7 | 17.3 | 4.7 | 21.7 | 21.7 | | |
| LC-C5-BC-4D | 826 | 10 | 9 | 6.6 | 14.2 | 7.9 | 17.1 | 9.9 | 21.4 | 21.4 | | |
| LC-C5-BC-5D | 817 | 10 | 9 | 8.9 | 15.5 | 10.7 | 18.7 | 13.4 | 23.3 | 23.3 | | |
| LC-C6-BC-2D | 789 | 12 | 11 | 6.1 | 14.4 | 7.3 | 17.3 | 9.2 | 21.7 | 21.7 | 12 | 24 |
| LC-C6-BC-3D | 901 | 10 | 9 | 6.8 | 14.8 | 8.2 | 17.8 | 10.2 | 22.3 | 22.3 | | |
| LC-C6-BC-4D | 684 | 9 | 8 | 13.0 | 19.3 | 15.6 | 23.2 | 19.6 | 29.0 | 29.0 | | |
| LC-C6-BC-5D | 876 | 9 | 8 | 5.6 | 14.0 | 6.7 | 16.8 | 8.4 | 21.1 | 21.1 | | |
| LC-C7-BC-2D | 898 | 9 | 8 | 8.9 | 14.5 | 10.7 | 17.4 | 13.4 | 21.8 | 21.8 | 5 | 22 |
| LC-C7-BC-3D | 921 | 9 | 8 | -2.9 | 14.1 | -3.5 | 17.0 | -4.4 | 21.2 | 21.2 | | |
| LC-D1-BC-2D | 734 | 10 | 9 | -5.4 | 14.0 | -6.5 | 16.8 | -8.2 | 21.1 | 21.1 | 2 | 23 |
| LC-D1-BC-3D | 713 | 9 | 8 | -2.0 | 17.3 | -2.4 | 20.8 | -3.0 | 26.0 | 26.0 | | |
| LC-D1-BC-4D | 753 | 9 | 8 | 5.8 | 13.0 | 7.0 | 15.6 | 8.7 | 19.6 | 19.6 | | |
| LC-D1-BC-5D | 726 | 10 | 9 | 8.0 | 17.2 | 9.6 | 20.7 | 12.0 | 25.9 | 25.9 | | |
| LC-D2-BC-2D | 751 | 10 | 9 | 3.1 | 17.6 | 3.8 | 21.2 | 4.7 | 26.5 | 26.5 | -5 | 24 |
| LC-D2-BC-3D | 706 | 9 | 8 | 1.6 | 16.3 | 2.0 | 19.6 | 2.5 | 24.5 | 24.5 | | |
| LC-D2-BC-4D | 776 | 9 | 8 | -4.9 | 12.0 | -5.9 | 14.4 | -7.3 | 18.1 | 18.1 | | |
| LC-D2-BC-5D | 725 | 9 | 8 | -12.9 | 17.5 | -15.5 | 21.1 | -19.4 | 26.3 | 26.3 | | |
| LC-D3-BC-2D | 748 | 10 | 9 | 4.5 | 16.0 | 5.4 | 19.3 | 6.8 | 24.1 | 24.1 | 5 | 22 |
| LC-D3-BC-3D | 797 | 10 | 9 | -2.8 | 14.2 | -3.4 | 17.1 | -4.2 | 21.4 | 21.4 | | |
| LC-D3-BC-4D | 781 | 9 | 8 | 9.3 | 16.0 | 11.2 | 19.3 | 14.0 | 24.1 | 24.1 | | |
| LC-D3-BC-5D | 904 | 9 | 10 | 3.4 | 12.5 | 4.1 | 15.0 | 5.2 | 18.8 | 18.8 | | |
| LC-D4-BC-2D | 676 | 9 | 10 | -10.0 | 14.5 | -12.0 | 17.4 | -15.0 | 21.8 | 21.8 | 4 | 23 |
| LC-D4-BC-3D | 789 | 11 | 10 | 9.3 | 16.7 | 11.2 | 20.1 | 14.0 | 25.1 | 25.1 | | |
| LC-D4-BC-4D | 873 | 9 | 8 | 8.7 | 15.9 | 10.5 | 19.1 | 13.1 | 23.9 | 23.9 | | |
| LC-D4-BC-5D | 865 | 10 | 10 | 3.3 | 14.4 | 4.0 | 17.3 | 5.0 | 21.7 | 21.7 | | |
| LC-D5-BC-2D | 900 | 10 | 10 | -1.7 | 14.7 | -2.1 | 17.7 | -2.6 | 22.1 | 22.1 | 0 | 22 |
| LC-D5-BC-3D | 795 | 9 | 9 | -2.5 | 13.5 | -3.0 | 16.2 | -3.8 | 20.3 | 20.3 | | |
| LC-D5-BC-4D | 728 | 9 | 8 | 5.6 | 17.2 | 6.7 | 20.7 | 8.4 | 25.9 | 25.9 | | |
| LC-D5-BC-5D | 816 | 10 | 9 | -2.2 | 13.9 | -2.6 | 16.7 | -3.3 | 20.9 | 20.9 | | |
| LC-D6-BC-2D | 715 | 9 | 8 | -1.7 | 16.1 | -2.0 | 19.4 | -2.6 | 24.2 | 24.2 | 2 | 22 |
| LC-D6-BC-3D | 831 | 9 | 8 | 2.9 | 15.0 | 3.5 | 18.1 | 4.4 | 22.6 | 22.6 | | |
| LC-D6-BC-4D | 822 | 9 | 8 | 9.8 | 15.0 | 11.8 | 18.1 | 14.8 | 22.6 | 22.6 | | |
| LC-D6-BC-5D | 881 | 9 | 8 | -5.7 | 12.4 | -6.8 | 14.9 | -8.5 | 18.7 | 18.7 | | |
| LC-E1-BC-2D | 724 | 10 | 9 | -0.9 | 15.7 | -1.0 | 18.9 | -1.3 | 23.6 | 23.6 | 0 | 24 |
| LC-E1-BC-3D | 749 | 9 | 8 | -8.9 | 15.4 | -10.7 | 18.5 | -13.4 | 23.2 | 23.2 | | |
| LC-E1-BC-4D | 734 | 9 | 8 | -0.8 | 15.4 | -0.9 | 18.5 | -1.2 | 23.2 | 23.2 | | |
| LC-E1-BC-5D | 729 | 10 | 9 | 11.7 | 17.6 | 14.1 | 21.2 | 17.6 | 26.5 | 26.5 | | |
| LC-E2-BC-2D | 716 | 9 | 8 | 2.2 | 15.0 | 2.6 | 18.1 | 3.3 | 22.6 | 22.6 | 0 | 23 |
| LC-E2-BC-3D | 720 | 10 | 9 | -5.8 | 14.6 | -7.0 | 17.6 | -8.7 | 22.0 | 22.0 | | |
| LC-E2-BC-4D | 739 | 9 | 8 | 4.9 | 15.3 | 5.9 | 18.4 | 7.4 | 23.0 | 23.0 | | |
| LC-E2-BC-5D | 740 | 10 | 9 | -1.0 | 15.0 | -1.2 | 18.1 | -1.5 | 22.6 | 22.6 | | |

Samples were taken with a hollow tip auger at a depth of 1 meter. A Power auger was used to get to that depth before the sample was taken.

Lake City Army Ammunition Plant
600 Yard Bullet Catcher - 1 Meter Depth Soil Sample Results
Cabrera Services, Inc.

Moisture content of the soil: 25 percent

| | | Exposure Rate | Exposure Rate | Measured Activity Concentration (pCi/gram) [1] | | | | | | | Grid Average Result [5] | Average of MDA or Result (IF > MDA) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | U-238 [2] | | Total-U [3] | | Moisture-Corrected Total-U [4] | | | | |
| Sample ID | Sample Mass (grams) | contact µR/hour | at 1 meter µR/hour | Result | MDC | Result | MDC | Result | MDC | MDC or Result >MDC | | |
| LC-A1-BC-2D | 695 | 10 | 8 | -1.2 | 13.0 | -1.5 | 15.6 | -1.8 | 19.6 | 19.6 | -4 | 19 |
| LC-A1-BC-3D | 734 | 10 | 8 | 1.8 | 12.9 | 2.2 | 15.5 | 2.7 | 19.4 | 19.4 | | |
| LC-A1-BC-4D | 693 | 9 | 8 | -4.9 | 12.2 | -5.8 | 14.7 | -7.3 | 18.4 | 18.4 | | |
| LC-A1-BC-5D | 721 | 10 | 8 | -5.1 | 13.3 | -6.2 | 16.0 | -7.7 | 20.0 | 20.0 | | |
| LC-A2-BC-2D | 690 | 9 | 9 | -7.7 | 11.5 | -9.3 | 13.8 | -11.6 | 17.3 | 17.3 | -5 | 19 |
| LC-A2-BC-3D | 765 | 9 | 8 | 5.4 | 14.9 | 6.5 | 17.9 | 8.1 | 22.4 | 22.4 | | |
| LC-A2-BC-4D | 817 | 9 | 9 | -1.1 | 12.0 | -1.3 | 14.4 | -1.6 | 18.1 | 18.1 | | |
| LC-A2-BC-5D | 734 | 9 | 8 | -8.7 | 11.0 | -10.5 | 13.2 | -13.2 | 16.5 | 16.5 | | |
| LC-A3-BC-2D | 784 | 10 | 9 | 6.3 | 13.1 | 7.6 | 15.8 | 9.5 | 19.7 | 19.7 | 2 | 17 |
| LC-A3-BC-3D | 773 | 9 | 8 | -1.5 | 11.5 | -1.8 | 13.8 | -2.3 | 17.3 | 17.3 | | |
| LC-A3-BC-4D | 917 | 9 | 9 | -0.7 | 9.8 | -0.8 | 11.8 | -1.1 | 14.7 | 14.7 | | |
| LC-A3-BC-5D | 748 | 9 | 9 | 1.1 | 11.9 | 1.3 | 14.3 | 1.7 | 17.9 | 17.9 | | |
| LC-A4-BC-2D | 806 | 9 | 9 | 2.0 | 12.0 | 2.4 | 14.4 | 3.0 | 18.1 | 18.1 | 2 | 17 |
| LC-A4-BC-3D | 792 | 9 | 8 | -0.7 | 11.1 | -0.8 | 13.4 | -1.1 | 16.7 | 16.7 | | |
| LC-A4-BC-4D | 833 | 8 | 8 | 5.9 | 12.3 | 7.1 | 14.8 | 8.9 | 18.5 | 18.5 | | |
| LC-A4-BC-5D | 922 | 9 | 8 | -1.3 | 10.9 | -1.5 | 13.1 | -1.9 | 16.4 | 16.4 | | |
| LC-A5-BC-2D | 804 | 9 | 8 | 1.6 | 11.8 | 2.0 | 14.2 | 2.4 | 17.7 | 17.7 | 3 | 18 |
| LC-A5-BC-3D | 870 | 9 | 8 | -3.0 | 10.5 | -3.6 | 12.6 | -4.5 | 15.8 | 15.8 | | |
| LC-A5-BC-4D | 796 | 8 | 9 | 9.1 | 13.5 | 11.0 | 16.2 | 13.7 | 20.3 | 20.3 | | |
| LC-A5-BC-5D | 790 | 7 | 7 | 0.2 | 10.8 | 0.2 | 13.0 | 0.3 | 16.2 | 16.2 | | |
| LC-A6-BC-3D | 842 | 8 | 8 | 9.8 | 16.1 | 11.8 | 19.4 | 14.8 | 24.2 | 24.2 | 5 | 20 |
| LC-A6-BC-4D | 942 | 10 | 9 | -3.0 | 9.9 | -3.6 | 11.9 | -4.5 | 14.9 | 14.9 | | |
| LC-A7-BC-3D | 887 | 10 | 9 | 5.1 | 12.8 | 6.2 | 15.4 | 7.7 | 19.3 | 19.3 | 8 | 19 |
| LC-B1-BC-2D | 835 | 10 | 8 | 3.5 | 12.8 | 4.2 | 15.4 | 5.3 | 19.3 | 19.3 | -1 | 21 |
| LC-B1-BC-3D | 818 | 10 | 8 | -1.4 | 15.0 | -1.7 | 18.1 | -2.2 | 22.6 | 22.6 | | |
| LC-B1-BC-4D | 802 | 10 | 9 | 2.6 | 15.3 | 3.1 | 18.4 | 3.9 | 23.0 | 23.0 | | |
| LC-B1-BC-5D | 772 | 9 | 8 | -7.2 | 13.0 | -8.7 | 15.6 | -10.8 | 19.6 | 19.6 | | |
| LC-B2-BC-2D | 825 | 10 | 9 | -10.2 | 14.5 | -12.3 | 17.4 | -15.3 | 21.8 | 21.8 | -2 | 21 |
| LC-B2-BC-3D | 796 | 10 | 9 | -6.3 | 13.2 | -7.5 | 15.9 | -9.4 | 19.9 | 19.9 | | |
| LC-B2-BC-4D | 822 | 10 | 9 | 2.1 | 13.0 | 2.5 | 15.6 | 3.1 | 19.6 | 19.6 | | |
| LC-B2-BC-5D | 776 | 9 | 8 | 9.1 | 15.6 | 11.0 | 18.8 | 13.7 | 23.5 | 23.5 | | |
| LC-B3-BC-2D | 833 | 9 | 8 | -2.7 | 15.9 | -3.3 | 19.1 | -4.1 | 23.9 | 23.9 | -5 | 23 |
| LC-B3-BC-3D | 820 | 10 | 9 | -3.2 | 15.0 | -3.8 | 18.1 | -4.8 | 22.6 | 22.6 | | |
| LC-B3-BC-4D | 722 | 9 | 8 | -1.6 | 15.7 | -1.9 | 18.9 | -2.4 | 23.6 | 23.6 | | |
| LC-B3-BC-5D | 815 | 10 | 9 | -4.5 | 13.7 | -5.4 | 16.5 | -6.8 | 20.6 | 20.6 | | |
| LC-B4-BC-2D | 893 | 9 | 8 | -3.5 | 11.1 | -4.2 | 13.4 | -5.3 | 16.7 | 16.7 | 6 | 22 |
| LC-B4-BC-3D | 728 | 9 | 9 | 8.8 | 17.6 | 10.5 | 21.2 | 13.2 | 26.5 | 26.5 | | |
| LC-B4-BC-4D | 703 | 9 | 9 | 6.6 | 15.5 | 7.9 | 18.7 | 9.9 | 23.3 | 23.3 | | |
| LC-B4-BC-5D | 868 | 9 | 8 | 3.7 | 13.0 | 4.5 | 15.6 | 5.6 | 19.6 | 19.6 | | |
| LC-B5-BC-2D | 866 | 9 | 8 | 10.6 | 16.0 | 12.8 | 19.3 | 15.9 | 24.1 | 24.1 | 8 | 25 |
| LC-B5-BC-3D | 661 | 9 | 8 | 7.9 | 21.5 | 9.5 | 25.9 | 11.9 | 32.3 | 32.3 | | |
| LC-B5-BC-4D | 917 | 10 | 9 | -1.6 | 14.0 | -1.9 | 16.8 | -2.4 | 21.1 | 21.1 | | |
| LC-B5-BC-5D | 871 | 9 | 9 | 5.1 | 14.5 | 6.1 | 17.4 | 7.6 | 21.8 | 21.8 | | |
| LC-B6-BC-2D | 893 | 11 | 10 | -0.2 | 12.2 | -0.2 | 14.7 | -0.3 | 18.4 | 18.4 | -3 | 19 |
| LC-B6-BC-3D | 897 | 10 | 9 | 9.0 | 14.3 | 10.8 | 17.2 | 13.5 | 21.5 | 21.5 | | |
| LC-B6-BC-4D | 846 | 9 | 8 | -8.1 | 13.6 | -9.7 | 16.4 | -12.2 | 20.5 | 20.5 | | |
| LC-B6-BC-5D | 905 | 10 | 9 | -8.9 | 10.8 | -10.7 | 13.0 | -13.4 | 16.2 | 16.2 | | |
| LC-B7-BC-2D | 834 | 8 | 8 | 4.4 | 13.1 | 5.3 | 15.8 | 6.6 | 19.7 | 19.7 | -2 | 22 |
| LC-B7-BC-3D | 685 | 8 | 7 | -6.7 | 15.6 | -8.1 | 18.8 | -10.1 | 23.5 | 23.5 | | |
| LC-BC2-BCD | 906 | 10 | 10 | 0.1 | 12.7 | 0.1 | 15.3 | 0.2 | 19.1 | 19.1 | 1 | 20 |
| LC-BC3-BCD | 806 | 11 | 10 | -0.9 | 15.5 | -1.1 | 18.7 | -1.4 | 23.3 | 23.3 | | |
| LC-BC4-BCD | 832 | 11 | 10 | 5.6 | 12.6 | 6.7 | 15.2 | 8.4 | 19.0 | 19.0 | | |
| LC-BC5-BCD | 913 | 10 | 10 | -0.9 | 13.7 | -1.1 | 16.5 | -1.4 | 20.6 | 20.6 | | |

Samples were taken with a hollow tip auger at a depth of 1 meter. A Power auger was used to get to that depth before the sample was taken.

Lake City Army Ammunition Plant
600 Yard Bullet Catcher - 1 Meter Depth Soil Sample Results
Cabrera Services, Inc.

| | | Exposure Rate | Exposure Rate | Measured Activity Concentration (pCi/gram) [1] | | | | | | | Grid Average Result [5] | Average of MDA or Result (IF > MDA) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | U-238 [2] | | Total-U [3] | | Moisture-Corrected Total-U [4] | | | | |
| Sample ID | Sample Mass (grams) | contact µR/hour | at 1 meter µR/hour | Result | MDC | Result | MDC | Result | MDC | MDC or Result >MDC | | |
| LC-E3-BC-2D | 860 | 9 | 9 | 3.1 | 13.9 | 3.8 | 16.7 | 4.7 | 20.9 | 20.9 | 0 | 22 |
| LC-E3-BC-3D | 883 | 9 | 8 | -3.4 | 10.5 | -4.1 | 12.6 | -5.2 | 15.8 | 15.8 | | |
| LC-E3-BC-4D | 714 | 10 | 9 | 11.7 | 17.2 | 14.1 | 20.7 | 17.6 | 25.9 | 25.9 | | |
| LC-E3-BC-5D | 667 | 8 | 8 | -10.8 | 17.3 | -13.0 | 20.8 | -16.2 | 26.0 | 26.0 | | |
| LC-E4-BC-2D | 663 | 8 | 8 | 6.8 | 17.1 | 8.2 | 20.6 | 10.2 | 25.7 | 25.7 | 3 | 27 |
| LC-E4-BC-3D | 598 | 10 | 9 | -9.3 | 17.2 | -11.2 | 20.7 | -14.0 | 25.9 | 25.9 | | |
| LC-E4-BC-4D | 695 | 10 | 9 | 4.6 | 18.5 | 5.5 | 22.3 | 6.9 | 27.8 | 27.8 | | |
| LC-E4-BC-5D | 632 | 11 | 10 | 6.0 | 19.5 | 7.2 | 23.5 | 9.0 | 29.3 | 29.3 | | |
| LC-E5-BC-2D | 777 | 10 | 10 | -5.1 | 14.3 | -6.1 | 17.2 | -7.7 | 21.5 | 21.5 | -2 | 22 |
| LC-E5-BC-3D | 770 | 9 | 8 | 2.7 | 14.7 | 3.2 | 17.7 | 4.1 | 22.1 | 22.1 | | |
| LC-E6-BC-2D | 793 | 10 | 10 | 14.1 | 15.3 | 17.0 | 18.4 | 21.2 | 23.0 | 23.0 | 13 | 24 |
| LC-E6-BC-3D | 747 | 10 | 10 | 10.4 | 15.2 | 12.5 | 18.3 | 15.6 | 22.9 | 22.9 | | |
| LC-E6-BC-5D | 738 | 10 | 10 | 1.8 | 16.7 | 2.1 | 20.1 | 2.6 | 25.1 | 25.1 | | |
| LC-F1-BC-2D | 827 | 10 | 9 | 3.1 | 14.0 | 3.7 | 16.8 | 4.7 | 21.1 | 21.1 | -2 | 23 |
| LC-F1-BC-5D | 696 | 10 | 9 | -5.3 | 16.0 | -6.4 | 19.3 | -8.0 | 24.1 | 24.1 | | |
| LC-F2-BC-2D | 852 | 9 | 8 | 1.8 | 14.2 | 2.2 | 17.1 | 2.7 | 21.4 | 21.4 | -5 | 22 |
| LC-F2-BC-5D | 740 | 9 | 8 | -9.0 | 15.6 | -10.8 | 18.8 | -13.5 | 23.5 | 23.5 | | |
| LC-F3-BC-2D | 668 | 10 | 9 | -0.3 | 18.4 | -0.4 | 22.1 | -0.5 | 27.7 | 27.7 | 1 | 26 |
| LC-F3-BC-5D | 716 | 9 | 8 | 1.8 | 16.1 | 2.2 | 19.4 | 2.7 | 24.2 | 24.2 | | |
| LC-F4-BC-2D | 582 | 9 | 8 | -7.6 | 16.0 | -9.1 | 19.3 | -11.4 | 24.1 | 24.1 | 4 | 25 |
| LC-F4-BC-5D | 647 | 9 | 8 | 12.6 | 17.8 | 15.2 | 21.4 | 19.0 | 26.8 | 26.8 | | |
| LC-F5-BC-2D | 613 | 9 | 9 | -9.2 | 19.1 | -11.1 | 23.0 | -13.8 | 28.7 | 28.7 | -7 | 28 |
| LC-F5-BC-5D | 599 | 10 | 9 | 0.5 | 17.9 | 0.7 | 21.5 | 0.8 | 26.9 | 26.9 | | |
| LC-F6-BC-2D | 759 | 10 | 9 | -1.1 | 12.3 | -1.4 | 14.8 | -1.7 | 18.5 | 18.5 | -2 | 19 |

| | MDC pCi/g | Activity pCi/g | MDC pCi/g | MDC or Result if >MDC pCi/g |
|---|---|---|---|---|
| **Maximum:** | 27.3 | 21.2 | 34.1 | 34.1 |
| **Minimum:** | 11.8 | -19.4 | 14.7 | 14.7 |
| **Median:** | 17.7 | 1.7 | 22.1 | 22.1 |
| **Average:** | 17.8 | 1.4 | 22.3 | 22.3 |
| **n:** | 135 | 135 | 135 | 135 |
| **$S_x$:** | 2.9 | 9.1 | 3.6 | 3.6 |
| **$t_{0.95}$:** | 1.657 | 1.657 | 1.657 | 1.657 |
| **$\mu_x$ :** | 18.2 | 2.7 | 22.8 | 22.8 |
| **Number of samples with activity > MDA:** | - | 1 | - | - |
| **Number of samples with activity > 35 pCi/g:** | - | 0 | - | - |
| **Number of samples with MDA > 35 pCi/g:** | - | - | - | 0 |

| KEY |
|---|
| Suffix D = 1 meter depth |
| Suffix S = surface sample |

BCD = Bullet catcher soil at 1 meter depth

**Notes:**
[1] Minimum detectable activity concentrations (MDCs) reported at the 95% confidence level
[2] U-238 activity concentrations based on measurement of the Pa-234m 1001 keV gamma line assuming secular equilibrium
[3] Total uranium based on site-specific activity ratio of U-238:U-total of 0.831:1
[4] Correction based on assumed moisture content of 25%
[5] Grid average based on moisture corrected total uranium results

Samples were taken with a hollow tip auger at a depth of 1 meter. A Power auger was used to get to that depth before the sample was taken.

Lake City Army Ammunition Plant
600 Yard Bullet Catcher - Background Soil Samples
Cabrera Services, Inc.

Moisture content of the soil: 25 percent

| Sample ID | Sample Mass (grams) | Exposure Rate - contact µR/hour | Exposure Rate - 1m µR/hour | Measured Activity Concentration (pCi/gram) [1] U-238 [2] Result | U-238 [2] MDC | Total-U [3] Result | Total-U [3] MDC | Moisture-Corrected Total-U [4] Result | Moisture-Corrected Total-U [4] MDC | Moisture-Corrected Total-U [4] MDC or Result if>MDC | Grid Average Result [5] | Average of MDA or Result (IF > MDA) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ref#1 | 739 | 10 | 10 | 1.8 | 11.6 | 2.2 | 14.0 | 2.7 | 17.4 | 17.4 | | |
| Ref#2 | 459 | 10 | 10 | -4.3 | 19.6 | -5.2 | 23.6 | -6.5 | 29.5 | 29.5 | | |
| Ref#3 | 486 | 10 | 10 | 9.1 | 17.6 | 11.0 | 21.2 | 13.7 | 26.5 | 26.5 | | |
| Ref#4 | 528 | 10 | 10 | -8.4 | 14.3 | -10.1 | 17.2 | -12.6 | 21.5 | 21.5 | | |
| Ref#5 | 481 | 9 | 10 | 11.4 | 17.8 | 13.7 | 21.4 | 17.1 | 26.8 | 26.8 | | |
| Ref#6 | 525 | 10 | 10 | 2.4 | 17.2 | 2.9 | 20.7 | 3.6 | 25.9 | 25.9 | | |
| Ref#7 | 470 | 10 | 11 | -2.9 | 19.7 | -3.5 | 23.7 | -4.4 | 29.6 | 29.6 | | |
| Ref#8 | 476 | 10 | 10 | -0.6 | 18.5 | -0.7 | 22.3 | -0.9 | 27.8 | 27.8 | 4 | 26 |
| Ref#9 | 533 | 10 | 10 | -5.1 | 14.7 | -6.1 | 17.7 | -7.7 | 22.1 | 22.1 | | |
| Ref#10 | 472 | 10 | 10 | 5.2 | 17.7 | 6.3 | 21.3 | 7.8 | 26.6 | 26.6 | | |
| Ref#11 | 519 | 9 | 10 | 7.5 | 17.8 | 9.0 | 21.4 | 11.3 | 26.8 | 26.8 | | |
| Ref#12 | 479 | 9 | 11 | 11.4 | 17.9 | 13.7 | 21.5 | 17.1 | 26.9 | 26.9 | | |
| Ref#13 | 486 | 9 | 10 | 2.5 | 18.4 | 3.0 | 22.1 | 3.8 | 27.7 | 27.7 | | |
| Ref#14 | 459 | 10 | 10 | 1.8 | 19.4 | 2.0 | 23.3 | 2.5 | 29.2 | 29.2 | | |
| Ref#15 | 436 | 10 | 10 | 12.5 | 20.7 | 15.0 | 24.9 | 18.8 | 31.1 | 31.1 | | |

All background samples are from the surface.

| | Activity pCi/g | MDC pCi/g | MDC or Result if >MDC pCi/g |
|---|---|---|---|
| **Maximum:** | 18.8 | 31.1 | 31.1 |
| **Minimum:** | -12.6 | 17.4 | 17.4 |
| **Average:** | 4.4 | 26.4 | 26.4 |
| **n:** | 15 | 15 | 15 |
| $S_x$: | 9.8 | 3.6 | 3.6 |
| $t_{0.95}$: | 1.753 | 1.753 | 1.753 |
| $\mu_\alpha$: | 8.9 | 28.0 | 28.0 |

**Notes:** [1] Minimum detectable activity concentrations (MDCs) reported at the 95% confidence level
[2] U-238 activity concentrations based on measurement of the Pa-234m 1001 keV gamma line assuming secular equilibrium
[3] Total uranium based on site-specific activity ratio of U-238:U-total of 0.831:1
[4] Correction based on assumed moisture content of 25%
[5] Grid average based on moisture corrected total uranium results

Lake City Army Ammunition Plant
600 Yard Bullet Catcher - Unaffected Area Soil Sample Results
Cabrera Services, Inc.

Moisture content of the soil: 25.0 percent

| Sample ID | Sample Mass (grams) | Exposure Rate - contact µR/hour | Exposure Rate - 1m µR/hour | Measured Activity Concentration (pCi/gram) [1] U-238 [2] Result | U-238 [2] MDC | Total-U [3] Result | Total-U [3] MDC | Moisture-Corrected Total-U [4] Result | Moisture-Corrected Total-U [4] MDC | Moisture-Corrected Total-U [4] MDC or Result >MDC | Grid Average Result [5] | Average of MDA or Result (IF > MDA) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LC-A1-UA-1S | 589 | 10 | 8 | -11.0 | 16.2 | -13.2 | 19.5 | -16.5 | 24.4 | 24.4 | 5 | 27 |
| LC-A1-UA-1D | 855 | 10 | 8 | 9.6 | 15 | 11.6 | 18.1 | 14.4 | 22.6 | 22.6 | | |
| LC-A2-UA-2S | 607 | 9 | 9 | 11.0 | 21.2 | 13.2 | 25.5 | 16.5 | 31.9 | 31.9 | | |
| LC-A2-UA-2D | 855 | 9 | 9 | -0.6 | 15.4 | -0.7 | 18.5 | -0.9 | 23.2 | 23.2 | | |
| LC-A3-UA-3S | 598 | 10 | 8 | 12.9 | 19 | 15.5 | 22.9 | 19.4 | 28.6 | 28.6 | | |
| LC-A3-UA-3D | 886 | 10 | 8 | 8.7 | 12.8 | 10.5 | 15.4 | 13.1 | 19.3 | 19.3 | | |
| LC-A4-UA-4S | 544 | 9 | 8 | 4.0 | 21.6 | 4.8 | 26.0 | 6.0 | 32.5 | 32.5 | | |
| LC-A4-UA-4D | 846 | 9 | 8 | 7.1 | 17.1 | 8.5 | 20.6 | 10.7 | 25.7 | 25.7 | | |
| LC-A5-UA-5S | 587 | 9 | 8 | 14.9 | 26.2 | 17.9 | 31.5 | 22.4 | 39.4 | **39.4** | | |
| LC-A5-UA-5D | 828 | 9 | 8 | -1.5 | 14.2 | -1.8 | 17.1 | -2.3 | 21.4 | 21.4 | | |
| LC-A6-UA-6S | 554 | 9 | 9 | 2.6 | 19.7 | 3.1 | 23.7 | 3.9 | 29.6 | 29.6 | | |
| LC-A6-UA-6D | 798 | 9 | 9 | -7.0 | 12.9 | -8.4 | 15.5 | -10.5 | 19.4 | 19.4 | | |
| LC-A7-UA-7S | 600 | 9 | 8 | 2.9 | 18.9 | 3.5 | 22.7 | 4.4 | 28.4 | 28.4 | | |
| LC-A7-UA-7D | 727 | 9 | 8 | -6.4 | 17.9 | -7.7 | 21.5 | -9.6 | 26.9 | 26.9 | | |
| LC-B1-UA-1S | 567 | 9 | 8 | -5.0 | 19.3 | -6.0 | 23.2 | -7.5 | 29.0 | 29.0 | 3 | 27 |
| LC-B1-UA-1D | 740 | 9 | 8 | 0.2 | 15.6 | 0.2 | 18.8 | 0.3 | 23.5 | 23.5 | | |
| LC-B2-UA-2S | 635 | 9 | 9 | -0.8 | 18.8 | -1.0 | 22.6 | -1.2 | 28.3 | 28.3 | | |
| LC-B2-UA-2D | 820 | 9 | 9 | 2.5 | 15 | 3.0 | 18.1 | 3.8 | 22.6 | 22.6 | | |
| LC-B3-UA-3S | 515 | 9 | 8 | 14.9 | 22 | 17.9 | 26.5 | 22.4 | 33.1 | 33.1 | | |
| LC-B3-UA-3D | 627 | 9 | 8 | -0.3 | 15.6 | -0.4 | 18.8 | -0.5 | 23.5 | 23.5 | | |
| LC-C1-UA-1S | 992 | 10 | 8 | 2.2 | 11.2 | 2.6 | 13.5 | 3.2 | 16.8 | 16.8 | -3 | 21 |
| LC-C1-UA-1D | 765 | 10 | 8 | -8.6 | 14.3 | -10.4 | 17.2 | -13.0 | 21.5 | 21.5 | | |
| LC-C2-UA-2S | 779 | 9 | 9 | 1.0 | 13.5 | 1.2 | 16.2 | 1.4 | 20.3 | 20.3 | | |
| LC-C2-UA-2D | 734 | 9 | 9 | -16.5 | 16.3 | -19.9 | 19.6 | -24.8 | 24.5 | 24.5 | | |
| LC-C3-UA-3S | 839 | 10 | 8 | 2.7 | 14.7 | 3.2 | 17.7 | 4.0 | 22.1 | 22.1 | | |
| LC-C3-UA-3D | 884 | 10 | 8 | 6.6 | 13.7 | 7.9 | 16.5 | 9.9 | 20.6 | 20.6 | | |
| LC-D1-UA-1S | 697 | 10 | 8 | 13.3 | 18.2 | 16.0 | 21.9 | 20.0 | 27.4 | 27.4 | 6 | 24 |
| LC-D1-UA-1D | 850 | 10 | 8 | -6.2 | 12.6 | -7.5 | 15.2 | -9.4 | 19.0 | 19.0 | | |
| LC-D2-UA-2S | 657 | 9 | 7 | 10.0 | 17.5 | 12.0 | 21.1 | 15.0 | 26.3 | 26.3 | | |
| LC-D2-UA-2D | 694 | 9 | 7 | 8.7 | 19.3 | 10.5 | 23.2 | 13.1 | 29.0 | 29.0 | | |
| LC-D3-UA-3S | 665 | 9 | 8 | 0.2 | 16.4 | 0.2 | 19.7 | 0.3 | 24.7 | 24.7 | | |
| LC-D3-UA-3D | 802 | 9 | 8 | 2.5 | 13.6 | 3.0 | 16.4 | 3.8 | 20.5 | 20.5 | | |
| LC-D4-UA-4S | 562 | 8 | 9 | 3.2 | 20.5 | 3.9 | 24.7 | 4.8 | 30.8 | 30.8 | | |
| LC-D4-UA-4D | 859 | 8 | 9 | 7.0 | 16.1 | 8.4 | 19.4 | 10.5 | 24.2 | 24.2 | | |
| LC-D5-UA-5S | 624 | 9 | 8 | 1.1 | 18.2 | 1.3 | 21.9 | 1.7 | 27.4 | 27.4 | | |
| LC-D5-UA-5D | 805 | 9 | 8 | 10.0 | 16 | 12.0 | 19.3 | 15.0 | 24.1 | 24.1 | | |
| LC-D6-UA-6S | 802 | 9 | 8 | 2.5 | 13.6 | 3.0 | 16.4 | 3.8 | 20.5 | 20.5 | | |
| LC-D6-UA-6D | 834 | 9 | 8 | -2.1 | 13.3 | -2.5 | 16.0 | -3.1 | 20.0 | 20.0 | | |

| KEY |
|---|
| Suffix D = 1 meter depth |
| Suffix S = surface sample |

| | Contact µR/hour | 1 meter µR/hour | | MDC pCi/g | Activity pCi/g | MDC pCi/g | MDC or Result if >MDC pCi/g |
|---|---|---|---|---|---|---|---|
| | 10.0 | 9.0 | **Maximum:** | 31.5 | 22.4 | 39.4 | **39.4** |
| | 8.0 | 7.0 | **Minimum:** | 13.5 | -24.8 | 16.8 | 16.8 |
| | 9.0 | 8.0 | **Median:** | 19.4 | 3.8 | 24.3 | 24.3 |
| | 9.2 | 8.2 | **Average:** | 20.1 | 3.8 | 25.1 | 25.1 |
| | 38.0 | 38.0 | **n:** | 38.0 | 38.0 | 38.0 | 38.0 |
| | 0.53 | 0.53 | **$S_x$:** | 3.8 | 10.9 | 4.8 | 4.8 |
| | 1.687 | 1.687 | **$t_{0.95}$:** | 1.687 | 1.687 | 1.687 | 1.687 |
| | 9.4 | 8.4 | **$\mu_{LL}$:** | 21.1 | 6.8 | 26.4 | 26.4 |
| | | | **Number of samples with activity > MDA:** | - | 0 | - | - |
| | | | **Number of samples with activity > 35 pCi/g:** | - | 0 | - | - |
| | | | **Number of samples with MDA > 35 pCi/g:** | - | - | - | 0 |

**Notes:**
[1] Minimum detectable activity concentrations (MDCs) reported at the 95% confidence level
[2] U-238 activity concentrations based on measurement of the Pa-234m 1001 keV gamma line assuming secular equilibrium
[3] Total uranium based on site-specific activity ratio of U-238:U-total of 0.831:1
[4] Correction based on assumed moisture content of 25%
[5] Grid average based on moisture corrected total uranium results

Lake City Army Ammunition Plant
Laboratory Soil Sample Analysis Results - QA Check and Comparison of Results to Original Cabrera Services Analysis
Cabrera Services, Inc.

| Cabrera Sample Number | Paragon Lab ID | Exposure Rate contact µR/hour | Exposure Rate at 1 m µR/hour | Paragon Analysis Result[1] Result pCi/gram | Error pCi/gram | MDC pCi/gram | Paragon Total Uranium[2] pCi/gram | Cabrera Total Uranium[2] pCi/gram | Cabrera MDC pCi/gram | Cabrera Error[3] pCi/gram | Quality Assurance Checks - Reanalysis |
|---|---|---|---|---|---|---|---|---|---|---|---|
| REF #3 | 0107193-1 | 10 | 10 | 1.2 | 1.6 | 2.6 | 1.4 | 13.7 | 26.5 | NA | |
| REF #5 | 0107196-2 | 9 | 10 | 0.6 | 1.9 | 3.3 | 0.7 | 17.1 | 26.8 | NA | |
| REF #8 | 0107196-3 | 10 | 10 | 2.2 | 1.8 | 2.8 | 2.6 | -0.9 | 27.8 | NA | |
| REF #12 | 0107196-4 | 9 | 11 | 0.5 | 1.6 | 2.7 | 0.6 | 17.1 | 26.9 | NA | Background Grid Soil Samples |
| REF #13 | 0107196-5 | 9 | 10 | 2.3 | 2.4 | 3.9 | 2.8 | 3.8 | 27.7 | NA | |
| | | | | | | | | | | | |
| REF #3 | 0107193-1-D1 | 10 | 10 | 0.2 | 2.3 | 4.1 | 0.2 | 14.0 | 26.5 | NA | Duplicate Analysis of sample REF#3 |
| REF #13 | 0107196-5-D1 | 9 | 10 | 1.6 | 1.4 | 2.2 | 1.9 | 4.0 | 27.7 | NA | Duplicate Analysis of sample REF#13 |
| | | | | | | | | | | | |
| LC-A1-UA-1S | 0107196-6 | 10 | 8 | 1.1 | 2 | 3.4 | 1.3 | -16.5 | 24.4 | NA | |
| LC-A3-UA-3D | 0107196-7 | 10 | 8 | 0.6 | 1.4 | 2.4 | 0.7 | 13.1 | 19.3 | NA | |
| LC-A6-UA-6S | 0107196-8 | 9 | 9 | -1.7 | 2.1 | 3.9 | -2.0 | 3.9 | 29.6 | NA | Unaffected Area Soil Samples |
| LC-B1-UA-1S | 0107196-9 | 9 | 8 | 2.3 | 1.6 | 2.5 | 2.8 | 22.4 | 29.0 | NA | |
| LC-C2-UA-2D | 0107196-10 | 9 | 8 | 2 | 1.9 | 3 | 2.4 | -24.8 | 24.5 | NA | |
| LC-D2-UA-2D | 0107196-11 | 9 | 7 | 0.9 | 1.1 | 1.9 | 1.1 | 3.8 | 29.0 | NA | |
| LC-D4-UA-4D | 0107196-12 | 8 | 9 | 0.3 | 2.1 | 3.6 | 0.4 | 10.5 | 24.2 | NA | |
| | | | | | | | | | | | |
| LC-A1-BC-3S | 0107197-7 | 10 | 8 | 4.2 | 1.8 | 2.6 | 5.1 | 9.1 | 22.4 | NA | |
| LC-A1-BC-4D | 0107197-8 | 9 | 8 | 1.9 | 1.3 | 2 | 2.3 | -7.3 | 18.4 | NA | |
| LC-A3-BC-5S | 0107197-9 | 9 | 9 | 5.1 | 2.8 | 3.9 | 6.1 | 13.2 | 23.8 | NA | |
| LC-A4-BC-3D | 0107197-10 | 9 | 8 | 2.7 | 1.4 | 2 | 3.2 | -1.1 | 16.7 | NA | Affected Area Soil Samples |
| LC-A5-BC-2D | 0107197-11 | 9 | 8 | 1.6 | 1.3 | 2 | 1.9 | 2.4 | 17.7 | NA | |
| LC-A6-BC-3D | 0107197-12 | 8 | 8 | 2.5 | 2 | 3.2 | 3.0 | 14.8 | 24.2 | NA | |
| LC-A7-BC-3S | 0107197-13 | 10 | 9 | 1.72 | 0.76 | 1.2 | 2.1 | -2.5 | 21.2 | NA | |
| | | | | | | | | | | | |
| LC-B1-BC-2D | 0107196-20 | 10 | 8 | 0 | 1.3 | 2.4 | 0.0 | 5.3 | 19.3 | NA | |
| LC-B2-BC-3S | 0107197-1 | 10 | 9 | 1.8 | 1.3 | 2.1 | 2.2 | 1.1 | 23.0 | NA | |
| LC-B3-BC-4S | 0107197-2 | 9 | 8 | 2.8 | 2 | 3 | 3.4 | -5.6 | 18.8 | NA | |
| LC-B4-BC-4D | 0107197-3 | 9 | 9 | 0.9 | 1.2 | 2 | 1.1 | 9.9 | 23.3 | NA | |
| LC-B5-BC-3D | 0107197-4 | 9 | 8 | 1.4 | 0.95 | 1.8 | 1.7 | 11.9 | 32.3 | NA | |
| LC-B6-BC-2S | 0107197-5 | 11 | 10 | 4.2 | 1.3 | 1.8 | 5.1 | -22.1 | 22.0 | NA | |
| LC-B7-BC-3D | 0107197-6 | 8 | 7 | 1.9 | 2.2 | 3.6 | 2.3 | -10.1 | 23.5 | NA | |
| | | | | | | | | | | | |
| LC-B2-BC-3S | 0107197-1-D1 | 10 | 9 | -0.1 | 2 | 3.6 | -0.1 | 1.1 | 23.0 | NA | Duplicate Analysis of sample LC-B2-BC-3S |
| LC-B6-BC-2S | 0107197-5-D1 | 11 | 10 | 4.2 | 1.3 | 1.8 | 5.1 | -22.1 | 22.0 | NA | Duplicate Analysis of sample LC-B6-BC-2S |
| | | | | | | | | | | | |
| LC-C1-BC-3S | 0107196-14 | 10 | 9 | 3.3 | 1.9 | 3.6 | 4.0 | 1.1 | 22.7 | NA | |
| LC-C2-BC-3S | 0107196-13 | 11 | 10 | 0.7 | 1.1 | 1.8 | 0.8 | 0.4 | 26.8 | NA | |
| LC-C3-BC-2S | 0107196-17 | 9 | 9 | 4.2 | 2.7 | 4 | 5.1 | -2.6 | 29.2 | NA | |
| LC-C4-BC-5D | 0107196-16 | 10 | 9 | 0.63 | 0.88 | 1.5 | 0.8 | 2.4 | 27.4 | NA | |
| LC-C5-BC-4S | 0107196-15 | 10 | 9 | 30.6 | 6 | 3.7 | **36.8** | **37.6** | 18.1 | 10.0 | 2.08% difference[4] |
| LC-C6-BC-3D | 0107196-18 | 10 | 9 | 8.5 | 2.1 | 2.1 | 10.2 | 10.2 | 22.3 | NA | |
| LC-C7-BC-3D | 0107196-19 | 9 | 8 | 0.1 | 1.5 | 2.7 | 0.1 | -4.4 | 21.2 | NA | |
| | | | | | | | | | | | |
| LC-D1-BC-5S | 0107197-14 | 10 | 9 | 1.11 | 0.96 | 1.8 | 1.3 | 12.2 | 25.6 | NA | |
| LC-D2-BC-4D | 0107197-15 | 9 | 8 | 1.5 | 1.9 | 3.1 | 1.8 | -7.3 | 18.1 | NA | |
| LC-D3-BC-3D | 0107197-16 | 10 | 9 | 1.17 | 0.99 | 1.9 | 1.4 | -4.2 | 21.4 | NA | |
| LC-D4-BC-2D | 0107198-1 | 9 | 10 | 1.5 | 1.2 | 1.9 | 1.8 | -15.0 | 25.1 | NA | |
| LC-D5-BC-4S | 0107198-2 | 9 | 8 | 1.5 | 1.4 | 2.1 | 1.8 | 4.4 | 23.3 | NA | |
| LC-D6-BC-2S | 0107198-3 | 9 | 8 | 0.4 | 1.1 | 1.9 | 0.5 | -1.5 | 19.3 | NA | |

Lake City Army Ammunition Plant
Laboratory Soil Sample Analysis Results - QA Check and Comparison of Results to Original Cabrera Services Analysis
Cabrera Services, Inc.

| Cabrera Sample Number | Paragon Lab ID | Exposure Rate contact µR/hour | Exposure Rate at 1 m µR/hour | Paragon Analysis Result (1) Result pCi/gram | Error pCi/gram | MDC pCi/gram | Paragon Total Uranium (2) pCi/gram | Cabrera Total Uranium (2) pCi/gram | Cabrera MDC pCi/gram | Cabrera Error (3) pCi/gram | Quality Assurance Checks - Reanalysis |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LC-D4-BC-2D | 0107198-1-D1 | 9 | 10 | 0.5 | 1.7 | 3 | 0.6 | -15.0 | 25.1 | NA | Duplicate Analysis of sample LC-D4-BC-2D |
| LC-E1-BC-2D | 0107198-4 | 10 | 9 | 2 | 1 | 1.8 | 2.4 | -1.3 | 23.6 | NA | |
| LC-E2-BC-4S | 0107198-5 | 9 | 8 | 1.3 | 1.9 | 3.1 | 1.6 | 21.1 | 34.3 | NA | |
| LC-E3-BC-5D | 0107198-6 | 8 | 8 | 0.9 | 1.3 | 2.1 | 1.1 | -16.2 | 26.0 | NA | |
| LC-E4-BC-4S | 0107198-7 | 10 | 9 | 3 | 1.2 | 2.2 | 3.6 | 0.5 | 29.9 | NA | |
| LC-E5-BC-2D | 0107198-8 | 10 | 10 | 1.8 | 2.4 | 4 | 2.2 | -5.8 | 21.5 | NA | |
| LC-E6-BC-2D | 0107198-9 | 10 | 10 | 1.8 | 1.4 | 2.3 | 2.2 | 21.2 | 23.0 | NA | |
| LC-E2-BC-4S | 0107198-5-D1 | 9 | 8 | 0.9 | 1.3 | 2.2 | 1.1 | 21.1 | 34.3 | NA | Duplicate Analysis of sample LC-E2-BC-4S |
| LC-F1-BC-2D | 0107198-10 | 10 | 9 | 1 | 1.5 | 2.6 | 1.2 | 4.7 | 21.1 | NA | |
| LC-F2-BC-5S | 0107198-11 | 9 | 8 | 1.3 | 1.4 | 2.2 | 1.6 | 22.4 | 29.5 | NA | |
| LC-F3-BC-5S | 0107198-12 | 9 | 8 | 2 | 1 | 1.8 | 2.4 | 16.2 | 31.4 | NA | |
| LC-F4-BC-2S | 0107198-13 | 9 | 8 | 2.1 | 2.3 | 3.7 | 2.5 | 5.3 | 34.4 | NA | |
| LC-F5-BC-2S | 0107198-14 | 9 | 9 | 2.8 | 1.8 | 2.7 | 3.4 | 13.5 | 37.0 | NA | |
| LC-F6-BC-2S | 0107198-15 | 10 | 9 | -0.1 | 2.1 | 3.7 | -0.1 | -6.0 | 27.5 | NA | |

| | | QA Result (Total Uranuim) | | | | QA MDC (total Uranium) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Background Statistics: | Range | 0.6 | to | 2.8 | pCi/g | 3.1 | to | 4.7 | pCi/g |
| | Average | 1.6 | | | | 3.7 | | | |
| | n | 5 | | | | 5 | | | |
| | $S_x$ | 1.03 | | | | 0.7 | | | |
| | $t_{0.95}$ | 2.015 | | | | 2.015 | | | |
| | $\mu_\alpha$ | 2.6 | | | | 4.3 | | | |

| | | QA Result (Total Uranuim) | | | | QA MDC (total Uranium) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Unaffected Area Statistics | Range | -2.0 | to | 2.8 | pCi/g | 2.3 | to | 4.7 | pCi/g |
| | Average | 0.9 | | | | 3.6 | | | |
| | n | 7 | | | | 7 | | | |
| | $S_x$ | 1.58 | | | | 0.87 | | | |
| | $t_{0.95}$ | 1.895 | | | | 1.895 | | | |
| | $\mu_\alpha$ | 2.1 | | | | 4.2 | | | |

| | | QA Result (Total Uranuim) | | | | QA MDC (total Uranium) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Affected Area Statistics | Range | -0.1 | to | 36.8 | pCi/g | 1.4 | to | 4.8 | pCi/g |
| | Average | 3.2 | | | | 3.0 | | | |
| | n | 43 | | | | 43 | | | |
| | $S_x$ | 5.60 | | | | 0.94 | | | |
| | $t_{0.95}$ | 1.683 | | | | 1.683 | | | |
| | $\mu_\alpha$ | 4.6 | | | | 3.3 | | | |

| KEY |
|---|
| Suffix D = 1 meter depth |
| Suffix S = surface sample |

(1) - Raw sample analysis data for $^{238}U$ based on analysis of $^{234m}Pa$ in dry soil.
(2) - Determined from the $^{238}U$ concentration from the ratio - $^{238}U$ / Total Uranium = 0.831
(3) - Error not reported for concentration less than MDC.
(4) - The only QA sample that indicated activity was compared to the original sample in that area.
Cabrera sample results are corrected by +25% for moisture content, Paragon samples were dried before analysis.

# Cabrera Services, Inc.
## *Direct Reading Survey - After Remediation*

Lake City Army Ammunition Plant
600 Yard Bullet Catcher Readings with NaI
7/7/01 - Cabrera Services, Inc.

Readings taken on contact with soil

Readings taken on walls

| | Back Left | | | Back | | Back Right | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 14021 | 13462 | 13572 | 13762 | 13291 | 14072 | 13519 | 13182 | 12788 | |
| Left Right | 13201 | 14157 | 14208 | 13522 | 14667 | 14488 | 13871 | 13229 | 13027 | Right Left |
| | 12964 | 14368 | 14637 | 13573 | 14546 | 13651 | 14456 | 12960 | 13921 | |
| Left | 12030 | 14057 | 14291 | 14283 | 14676 | 14270 | 14421 | 12403 | 12012 | Right |
| | 12589 | 14502 | 14171 | 13406 | 13882 | 14168 | 13386 | 13381 | 12121 | |
| | 12012 | 14461 | 13561 | 14120 | 13833 | 13993 | 12902 | 13390 | 12396 | |
| Left Left | 12034 | 14221 | 13860 | 13910 | 13681 | 14697 | 12957 | 12176 | 12221 | Right Right |

Scan on inside with Ludlum Model 3 Serial Number 166511 completed 6/25
No detectable activity identifed on wooden surfaces.
Background response was about 30 to 60 cpm - no readings above that level.

Scan on inside surfaces with Ludlum Model 44-10 on Ludlum 2221 Serial Number 97841
No increases in response above background on 7/3/01

Smear 1 is at top, 2 at center, 3 at bottom - smears taken 7/6/01

| | | | |
|---|---|---|---|
| Range of Response: | 12012 | to | 14697 |
| Average Response: | 13581 | | |
| Standard Deviation: | 781.84 | | |
| Number of Measurements: | 63 | | |
| t0.95 | 1.667 | | |
| $\mu_\alpha$ | 13745 | | |

Appen
Sectio

# Cabrera Services, Inc.

## *Smear Data Analysis Form - After Remediation*

600 Yard Bullet Catcher Structure

| Instrument | | Scaler | Probe |
|---|---|---|---|
| | Make: | Ludlum | Ludlum |
| | Model: | 2929 | 43-10-1 |
| | Serial Number: | 118407 | 92751 |

| Survey Information | |
|---|---|
| Date: | 07/07/2001 |
| Base: | Lake City AAP |
| 600 Yard Bullet Catcher Cleanup Project | |

| Daily Checks | | Source | Background |
|---|---|---|---|
| | Beta | SAT | 940 |
| | Alpha | SAT | 4 |
| | Count Time (minutes) | 2 | 20 |

| Radionuclides | Source Information | | |
|---|---|---|---|
| $^{99}Tc$ | 17300 | dpm | 05-Jun-01 |
| $^{230}Th$ | 22800 | dpm | 11-Jun-01 |

| Detector Information | | |
|---|---|---|
| Alpha Efficiency | 0.216 | c/d |
| Alpha Background | 0.2 | cpm |
| Alpha MDA | 9.8 | dpm |
| Beta Efficiency | 0.19 | c/d |
| Beta Background | 47 | cpm |
| Beta MDA | 121.8 | dpm |

Sample Count Time (minutes): 2.00

Specific Survey Location: Bullet Catcher Shell

| Sample Number | Sample Location | Gross Alpha Counts/2 min | Net Alpha cpm | Alpha dpm | Gross Beta Counts/2 min | Net Beta cpm | Beta dpm | Technician initials |
|---|---|---|---|---|---|---|---|---|
| 1 | Back Right 1 | 1 | 0.3 | 1.39 | 88 | -3 | -15.79 | NH |
| 2 | Back Right 2 | 2 | 0.8 | 3.70 | 85 | -4.5 | -23.68 | NH |
| 3 | Back Right 3 | 1 | 0.3 | 1.39 | 93 | -0.5 | -2.63 | NH |
| 4 | Back Center 1 | 0 | -0.2 | -0.93 | 84 | -5 | -26.32 | NH |
| 5 | Back Center 2 | 0 | -0.2 | -0.93 | 87 | -3.5 | -18.42 | NH |
| 6 | Back Center 3 | 1 | 0.3 | 1.39 | 93 | -0.5 | -2.63 | NH |
| 7 | Back Left 1 | 0 | -0.2 | -0.93 | 86 | -4 | -21.05 | NH |
| 8 | Back Left 2 | 0 | -0.2 | -0.93 | 96 | 1 | 5.26 | NH |
| 9 | Back Left 3 | 2 | 0.8 | 3.70 | 95 | 0.5 | 2.63 | NH |
| 10 | Left Right 1 | 0 | -0.2 | -0.93 | 88 | -3 | -15.79 | NH |
| 11 | Left Right 2 | 1 | 0.3 | 1.39 | 102 | 4 | 21.05 | NH |
| 12 | Left Right 3 | 0 | -0.2 | -0.93 | 101 | 3.5 | 18.42 | NH |
| 13 | Left Center 1 | 0 | -0.2 | -0.93 | 93 | -0.5 | -2.63 | NH |
| 14 | Left Center 2 | 0 | -0.2 | -0.93 | 99 | 2.5 | 13.16 | NH |
| 15 | Left Center 3 | 2 | 0.8 | 3.70 | 105 | 5.5 | 28.95 | NH |
| 16 | Left Left 1 | 0 | -0.2 | -0.93 | 106 | 6 | 31.58 | NH |
| 17 | Left Left 2 | 1 | 0.3 | 1.39 | 83 | -5.5 | -28.95 | NH |
| 18 | Left Left 3 | 1 | 0.3 | 1.39 | 89 | -2.5 | -13.16 | NH |
| 19 | Right Right 1 | 1 | 0.3 | 1.39 | 102 | 4 | 21.05 | NH |
| 20 | Right Right 2 | 0 | -0.2 | -0.93 | 100 | 3 | 15.79 | NH |
| 21 | Right Right 3 | 1 | 0.3 | 1.39 | 109 | 7.5 | 39.47 | NH |
| 22 | Right Center 1 | 1 | 0.3 | 1.39 | 89 | -2.5 | -13.16 | NH |
| 23 | Right Center 2 | 2 | 0.8 | 3.70 | 99 | 2.5 | 13.16 | NH |
| 24 | Right Center 3 | 1 | 0.3 | 1.39 | 98 | 2 | 10.53 | NH |
| 25 | Right Left 1 | 1 | 0.3 | 1.39 | 99 | 2.5 | 13.16 | NH |
| 26 | Right Left 2 | 0 | -0.2 | -0.93 | 107 | 6.5 | 34.21 | NH |
| 27 | Right Left 3 | 0 | -0.2 | -0.93 | 102 | 4 | 21.05 | NH |
| 28 | Outside Left 1 | 1 | 0.3 | 1.39 | 100 | 3 | 15.79 | NH |
| 29 | Outside Left 2 | 2 | 0.8 | 3.70 | 99 | 2.5 | 13.16 | NH |
| 30 | Outside Left 3 | 0 | -0.2 | -0.93 | 87 | -3.5 | -18.42 | NH |
| 31 | Outside Right 1 | 0 | -0.2 | -0.93 | 102 | 4 | 21.05 | NH |
| | | | | | | | | |
| | | Average: | | 0.72 | Average: | | 4.41 | |
| | | t | 1.697 | | t | 1.697 | | |
| | | n | | 31.00 | n | | 31.00 | |
| | | s | | 1.71 | s | | 19.57 | |
| | | μ | 1.23828983 | dpm | μ | 10.37843685 | dpm | |
| | | | | | | | | |

Review note: All samples show no detectable activity above the Minimum Detectable Activity specified.

# Lake City Army Ammunition Plant Radiological Remediation of the 600-Yard Bullet Catcher

# Appendix 2
# Instrument
# Quality Assurance Data

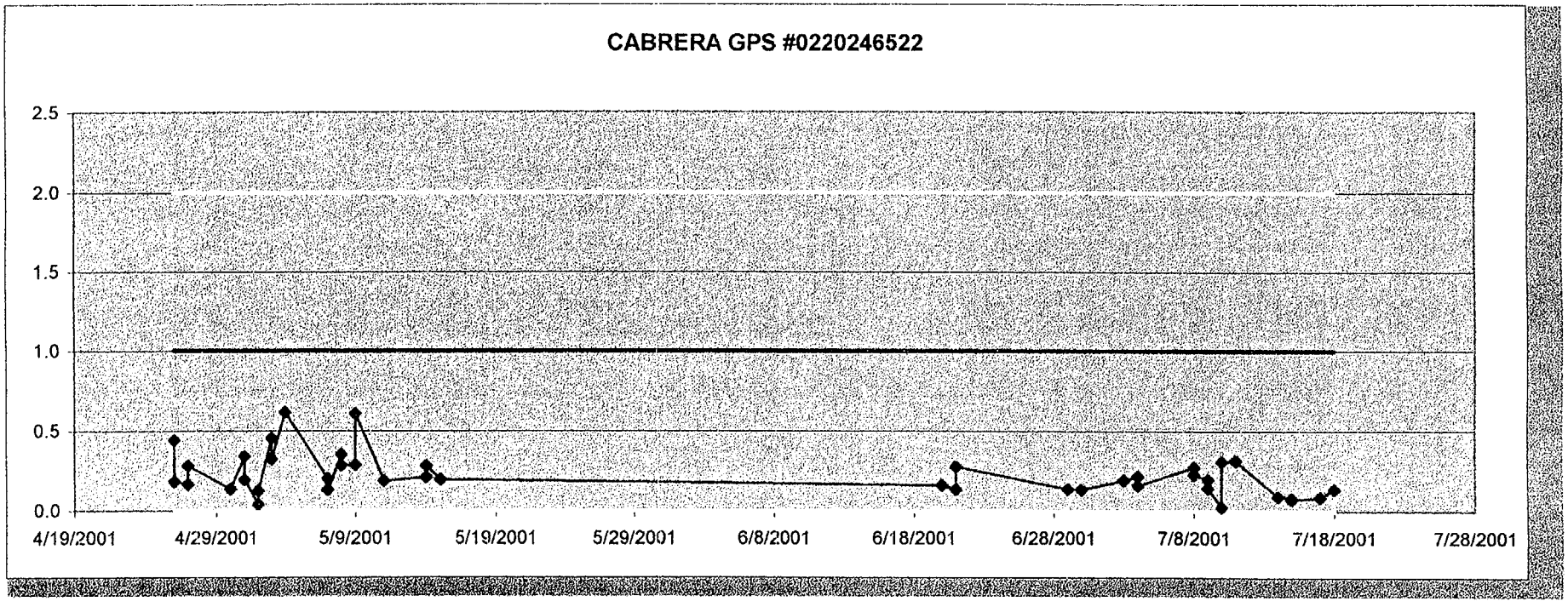
Cabrera Services, Inc.
Lake City Army Ammunition Plant
GPS Quality Assurance Data

| Trimble #0220246522 | | | | |
|---|---|---|---|---|
| QC Daily GPS | | | | |
| Date | Northing | Easting | Offset | P/F |
| 4/26/2001 | 323852.786 | 871312.492 | 0.4 | Pass |
| 4/26/2001 | 323852.967 | 871311.28 | 0.2 | Pass |
| 4/27/2001 | 323853.975 | 871311.602 | 0.2 | Pass |
| 4/27/2001 | 323852.763 | 871311.729 | 0.3 | Pass |
| 4/30/2001 | 323853.903 | 871311.553 | 0.1 | Pass |
| 5/1/2001 | 323854.555 | 871311.77 | 0.3 | Pass |
| 5/1/2001 | 323854.179 | 871311.405 | 0.2 | Pass |
| 5/2/2001 | 323853.651 | 871311.172 | 0.0 | Pass |
| 5/2/2001 | 323853.963 | 871311.185 | 0.1 | Pass |
| 5/3/2001 | 323854.892 | 871311.919 | 0.5 | Pass |
| 5/3/2001 | 323854.081 | 871312.187 | 0.3 | Pass |
| 5/4/2001 | 323855.336 | 871310.299 | 0.6 | Pass |
| 5/7/2001 | 323854.102 | 871311.647 | 0.2 | Pass |
| 5/7/2001 | 323853.251 | 871311.57 | 0.1 | Pass |
| 5/8/2001 | 323854.525 | 871311.885 | 0.3 | Pass |
| 5/8/2001 | 323853.851 | 871312.144 | 0.3 | Pass |
| 5/9/2001 | 323854.256 | 871311.893 | 0.3 | Pass |
| 5/9/2001 | 323851.869 | 871312.331 | 0.6 | Pass |
| 5/11/2001 | 323853.245 | 871311.79 | 0.2 | Pass |
| 5/14/2001 | 323853.493 | 871311.95 | 0.2 | Pass |
| 5/14/2001 | 323852.654 | 871311.43 | 0.3 | Pass |
| 5/15/2001 | 323854.089 | 871311.632 | 0.2 | Pass |
| 6/20/2001 | 323853.692 | 871311.78 | 0.2 | Pass |
| 6/21/2001 | 323853.886 | 871311.564 | 0.1 | Pass |
| 6/21/2001 | 323854.247 | 871311.864 | 0.3 | Pass |
| 6/29/2001 | 323853.725 | 871311.695 | 0.1 | Pass |
| 6/30/2001 | 323853.985 | 871311.38 | 0.1 | Pass |
| 7/3/2001 | 323854.023 | 871311.696 | 0.2 | Pass |
| 7/4/2001 | 323853.137 | 871311.839 | 0.2 | Pass |
| 7/4/2001 | 323853.051 | 871311.408 | 0.2 | Pass |
| 7/8/2001 | 323854.347 | 871310.834 | 0.3 | Pass |
| 7/8/2001 | 323854.193 | 871311.679 | 0.2 | Pass |
| 7/9/2001 | 323853.734 | 871311.892 | 0.2 | Pass |
| 7/9/2001 | 323853.344 | 871311.689 | 0.1 | Pass |
| 7/10/2001 | 323853.636 | 871311.298 | 0.0 | Pass |
| 7/10/2001 | 323852.812 | 871311.955 | 0.3 | Pass |
| 7/11/2001 | 323852.81 | 871311.971 | 0.3 | Pass |
| 7/14/2001 | 323853.775 | 871311.481 | 0.1 | Pass |
| 7/15/2001 | 323853.821 | 871311.308 | 0.1 | Pass |
| 7/15/2001 | 323853.57 | 871311.023 | 0.1 | Pass |
| 7/17/2001 | 323853.62 | 871311.548 | 0.1 | Pass |
| 7/18/2001 | 323853.798 | 871311.657 | 0.1 | Pass |

Cabrera Services, Inc.
Lake City Army Ammunition Plant
Initial GPS QA Point

| Trimble #0220246522 | | |
|---|---|---|
| **Initial GPS Readings** | | |
| **Date** | **Northing** | **Easting** |
| 5/2/2001 | 323852.907 | 871311.482 |
| | 323852.642 | 871311.672 |
| | 323854.004 | 871311.033 |
| | 323854.122 | 871311.111 |
| | 323854.118 | 871311.04 |
| | Average | |
| | 323853.559 | 871311.268 |

Cabrera Services, Inc.
Lake City Army Ammunition Plant
GPS QA Data Graph



# CABRERA SERVICES, Inc.
## Ludlum Model 2929
## Serial Number 163827

**Counting System Efficiency Data Sheet**

| | |
|---|---|
| Instrument Model Number | 2929 |
| Instrument Serial Number | 118407 |
| Last Calibration Date | 2/23/2001 |
| Detector Model Number | 43-10-1 |
| Detector Serial Number | PR092751 |
| Todays Date | 5/15/2001 |
| Data Collected By | Ned Hawkins |

| | | | | |
|---|---|---|---|---|
| Alpha Source Serial No. | 19800 dpm | ← Initial Alpha Activity | Date: | 12/16/1995 |
| Beta Source Serial No. | 22866 dpm | ← Initial Beta Activity | Date: | 6/24/1983 |

| | | |
|---|---|---|
| Alpha Source Decay Time | 1896 Days | 5.2 Years |
| Beta Source Decay Time | 6393 Days | 17.5 Years |

| | | | |
|---|---|---|---|
| Alpha Emitting Radionuclide | Th-230 | Half Life: | 8.00E+04 Years |
| Beta Emitting Radionuclide | Tc-99 | Half Life: | 2.13E+05 Years |

| | | | |
|---|---|---|---|
| Alpha Decay Factor | 0.999955025 | Todays Activity | 19799 dpm |
| Beta Decay Factor | 0.999943043 | Todays Activity | 22865 dpm |

| | | |
|---|---|---|
| Alpha Response (10 min) | 79391 Counts | 7939.1 cpm |
| Beta Response (10 min) | 72965 Counts | 7296.5 cpm |

| | | |
|---|---|---|
| Alpha Detection Efficiency: | 0.40 counts/disintegration | Determined by T. Mason from sources on site |
| Beta Detection Efficiency: | 0.32 counts/disintegration | Determined by T. Mason from sources on site |

| | |
|---|---|
| Calibrated Alpha Detection Efficiency: | 0.22 counts/disintegration |
| Calibrated Beta Detection Efficiency: | 0.18 counts/disintegration |

* Note the efficiency values are corrected based on response of Cabrera sources to the response of calibration standards used by the calibration laboratory.

# CABRERA SERVICES, Inc.

## Ludlum Model 2929

## Serial Number 163827

| | |
|---|---|
| Air sample count time (minutes): | 20 |
| Smear sample count time (minutes): | 2 |
| Background count time (minutes): | 20 |

| | | |
|---|---|---|
| Beta | Efficiency | 0.22 c/d |
| Alpha | Efficiency | 0.18 c/d |

| | Alpha Background | Beta Background | Air Samples Alpha MDA | Air Samples Beta MDA | Smears Alpha MDA | Smears Beta MDA |
|---|---|---|---|---|---|---|
| 4/24/2001 | 3 | 997 | 4.9 dpm | 36.1 dpm | 9.8 dpm | 108.2 dpm |
| 4/24/2001 | 2 | 817 | 4.5 dpm | 32.9 dpm | 8.5 dpm | 98.2 dpm |
| 4/24/2001 | 0 | 833 | 2.7 dpm | 33.2 dpm | 2.7 dpm | 99.2 dpm |
| 4/24/2001 | 3 | 796 | 4.9 dpm | 32.5 dpm | 9.8 dpm | 97.0 dpm |
| 4/24/2001 | 1 | 884 | 4.0 dpm | 34.1 dpm | 6.8 dpm | 102.1 dpm |
| 4/24/2001 | 1 | 822 | 4.0 dpm | 33.0 dpm | 6.8 dpm | 98.5 dpm |
| 4/24/2001 | 1 | 833 | 4.0 dpm | 33.2 dpm | 6.8 dpm | 99.2 dpm |
| 4/24/2001 | 0 | 788 | 2.7 dpm | 32.4 dpm | 2.7 dpm | 96.5 dpm |
| 4/24/2001 | 0 | 830 | 2.7 dpm | 33.2 dpm | 2.7 dpm | 99.0 dpm |
| 4/24/2001 | 1 | 859 | 4.0 dpm | 33.7 dpm | 6.8 dpm | 100.7 dpm |
| 4/27/2001 | 1 | 910 | 4.0 dpm | 34.6 dpm | 6.8 dpm | 103.5 dpm |
| 4/30/2001 | 1 | 859 | 4.0 dpm | 33.7 dpm | 6.8 dpm | 100.7 dpm |
| 5/1/2001 | 1 | 846 | 4.0 dpm | 33.4 dpm | 6.8 dpm | 99.9 dpm |
| 5/2/2001 | 1 | 861 | 4.0 dpm | 33.7 dpm | 6.8 dpm | 100.8 dpm |
| 5/3/2001 | 0 | 822 | 2.7 dpm | 33.0 dpm | 2.7 dpm | 98.5 dpm |
| 5/4/2001 | 1 | 841 | 4.0 dpm | 33.4 dpm | 6.8 dpm | 99.6 dpm |
| 5/7/2001 | 0 | 813 | 2.7 dpm | 32.8 dpm | 2.7 dpm | 98.0 dpm |
| 5/8/2001 | 3 | 882 | 4.9 dpm | 34.1 dpm | 9.8 dpm | 102.0 dpm |
| 5/9/2001 | 1 | 929 | 4.0 dpm | 34.9 dpm | 6.8 dpm | 104.6 dpm |
| 5/11/2001 | 0 | 844 | 2.7 dpm | 33.4 dpm | 2.7 dpm | 99.8 dpm |
| 5/14/2001 | 2 | 816 | 4.5 dpm | 32.9 dpm | 8.5 dpm | 98.2 dpm |
| 5/15/2001 | 2 | 864 | 4.5 dpm | 33.8 dpm | 8.5 dpm | 100.9 dpm |
| 5/17/2001 | 0 | 1016 | 2.7 dpm | 36.4 dpm | 2.7 dpm | 109.2 dpm |
| 5/18/2001 | 0 | 895 | 2.7 dpm | 34.3 dpm | 2.7 dpm | 102.7 dpm |
| 5/21/2001 | 5 | 910 | 5.6 dpm | 34.6 dpm | 11.8 dpm | 103.5 dpm |
| 5/22/2001 | 1 | 950 | 4.0 dpm | 35.3 dpm | 6.8 dpm | 105.7 dpm |
| 5/23/2001 | 3 | 951 | 4.9 dpm | 35.3 dpm | 9.8 dpm | 105.8 dpm |
| 5/24/2001 | 5 | 929 | 5.6 dpm | 34.9 dpm | 11.8 dpm | 104.6 dpm |
| 5/25/2001 | 5 | 968 | 5.6 dpm | 35.6 dpm | 11.8 dpm | 106.7 dpm |
| 5/29/2001 | 2 | 967 | 4.5 dpm | 35.6 dpm | 8.5 dpm | 106.6 dpm |
| 5/30/2001 | 3 | 992 | 4.9 dpm | 36.0 dpm | 9.8 dpm | 108.0 dpm |
| 5/31/2001 | 1 | 1031 | 4.0 dpm | 36.6 dpm | 6.8 dpm | 110.0 dpm |
| 6/1/2001 | 1 | 931 | 4.0 dpm | 35.0 dpm | 6.8 dpm | 104.7 dpm |
| 6/2/2001 | 0 | 959 | 2.7 dpm | 35.4 dpm | 2.7 dpm | 106.2 dpm |
| 6/3/2001 | 5 | 996 | 5.6 dpm | 36.1 dpm | 11.8 dpm | 108.2 dpm |
| 6/7/2001 | 0 | 976 | 2.7 dpm | 35.7 dpm | 2.7 dpm | 107.1 dpm |
| 6/8/2001 | 1 | 969 | 4.0 dpm | 35.6 dpm | 6.8 dpm | 106.7 dpm |
| 6/9/2001 | 2 | 994 | 4.5 dpm | 36.0 dpm | 8.5 dpm | 108.1 dpm |
| 6/10/2001 | 3 | 926 | 4.9 dpm | 34.9 dpm | 9.8 dpm | 104.4 dpm |
| 6/11/2001 | 0 | 970 | 2.7 dpm | 35.6 dpm | 2.7 dpm | 106.8 dpm |
| 6/12/2001 | 2 | 977 | 4.5 dpm | 35.7 dpm | 8.5 dpm | 107.2 dpm |
| 6/13/2001 | 2 | 931 | 4.5 dpm | 35.0 dpm | 8.5 dpm | 104.7 dpm |

# CABRERA SERVICES, Inc.
## Ludlum Model 2929
## Serial Number 118407

**Counting System Efficiency Data Sheet**

| | |
|---|---|
| Instrument Model Number | 2929 |
| Instrument Serial Number | 118407 |
| Last Calibration Date | 4/16/2001 |
| Detector Model Number | 43-10-1 |
| Detector Serial Number | PR092751 |
| Todays Date | 5/15/2001 |
| Data Collected By | Ned Hawkins |

| | | | | |
|---|---|---|---|---|
| Alpha Source Serial No. | 19800 dpm ← | Initial Activity | Date: | 12/16/1995 |
| Beta Source Serial No. | 22866 dpm ← | Initial Activity | Date: | 8/24/1983 |

| | | | |
|---|---|---|---|
| Alpha Source Decay Time | 1948 Days | 5.3 Years | |
| Beta Source Decay Time | 6445 Days | 17.6 Years | |
| Alpha Emitting Radionuclide | Th-230 | Half Life: | 8.00E+04 Years |
| Beta Emitting Radionuclide | Tc-99 | Half Life: | 2.13E+05 Years |

| | | | |
|---|---|---|---|
| Alpha Decay Factor | 0.99995 | Todays Activity | 19799 dpm |
| Beta Decay Factor | 0.99994 | Todays Activity | 22865 dpm |

| | | |
|---|---|---|
| Alpha Response (10 min) | 77547 Counts | 7754.7 cpm |
| Beta Response (10 min) | 78016 Counts | 7801.6 cpm |

| | |
|---|---|
| Alpha Detection Efficiency: | 0.39 counts/disintegration |
| Beta Detection Efficiency: | 0.34 counts/disintegration |

| | |
|---|---|
| Calibrated Alpha Detection Efficiency: | 0.216 counts/disintegration |
| Calibrated Beta Detection Efficiency: | 0.19 counts/disintegration |

# CABRERA SERVICES, Inc.

## Ludlum Model 2929

## Serial Number 118407

| | |
|---|---|
| Air sample count time (minutes): | 20 |
| Smear sample count time (minutes): | 2 |
| Background count time (minutes): | 20 |

| | | |
|---|---|---|
| Beta | Efficiency | 0.19 c/d |
| Alpha | Efficiency | 0.216 c/d |

| | Alpha Background | Beta Background | Air Samples Alpha MDA | Air Samples Beta MDA | Smears Alpha MDA | Smears Beta MDA |
|---|---|---|---|---|---|---|
| 4/24/2001 | 6 | 913 | 5.3 dpm | 39.7 dpm | 11.0 dpm | 119.6 dpm |
| 4/24/2001 | 3 | 834 | 4.6 dpm | 38.0 dpm | 8.6 dpm | 114.5 dpm |
| 4/24/2001 | 1 | 813 | 3.8 dpm | 37.6 dpm | 6.1 dpm | 113.0 dpm |
| 4/24/2001 | 3 | 831 | 4.6 dpm | 38.0 dpm | 8.6 dpm | 114.3 dpm |
| 4/24/2001 | 1 | 805 | 3.8 dpm | 37.4 dpm | 6.1 dpm | 112.5 dpm |
| 4/24/2001 | 2 | 844 | 4.2 dpm | 38.3 dpm | 7.5 dpm | 115.1 dpm |
| 4/24/2001 | 3 | 843 | 4.6 dpm | 38.2 dpm | 8.6 dpm | 115.1 dpm |
| 4/24/2001 | 3 | 863 | 4.6 dpm | 38.7 dpm | 8.6 dpm | 116.4 dpm |
| 4/24/2001 | 1 | 807 | 3.8 dpm | 37.5 dpm | 6.1 dpm | 112.6 dpm |
| 4/24/2001 | 4 | 865 | 4.9 dpm | 38.7 dpm | 9.5 dpm | 116.5 dpm |
| 4/27/2001 | 0 | 854 | 2.7 dpm | 38.5 dpm | 2.7 dpm | 115.8 dpm |
| 4/30/2001 | 2 | 864 | 4.2 dpm | 38.7 dpm | 7.5 dpm | 116.5 dpm |
| 5/1/2001 | 4 | 858 | 4.9 dpm | 38.6 dpm | 9.5 dpm | 116.1 dpm |
| 5/2/2001 | 2 | 830 | 4.2 dpm | 38.0 dpm | 7.5 dpm | 114.2 dpm |
| 5/3/2001 | 3 | 897 | 4.6 dpm | 39.4 dpm | 8.6 dpm | 118.6 dpm |
| 5/4/2001 | 4 | 905 | 4.9 dpm | 39.5 dpm | 9.5 dpm | 119.1 dpm |
| 5/7/2001 | 1 | 862 | 3.8 dpm | 38.6 dpm | 6.1 dpm | 116.3 dpm |
| 5/8/2001 | 4 | 854 | 4.9 dpm | 38.5 dpm | 9.5 dpm | 115.8 dpm |
| 5/9/2001 | 3 | 834 | 4.6 dpm | 38.0 dpm | 8.6 dpm | 114.5 dpm |
| 5/11/2001 | 4 | 852 | 4.9 dpm | 38.4 dpm | 9.5 dpm | 115.7 dpm |
| 5/14/2001 | 2 | 855 | 4.2 dpm | 38.5 dpm | 7.5 dpm | 115.9 dpm |
| 5/15/2001 | 4 | 876 | 4.9 dpm | 38.9 dpm | 9.5 dpm | 117.2 dpm |
| 5/17/2001 | 3 | 908 | 4.6 dpm | 39.6 dpm | 8.6 dpm | 119.3 dpm |
| 5/18/2001 | 3 | 873 | 4.6 dpm | 38.9 dpm | 8.6 dpm | 117.0 dpm |
| 5/21/2001 | 5 | 819 | 5.1 dpm | 37.7 dpm | 10.3 dpm | 113.5 dpm |
| 5/22/2001 | 1 | 948 | 3.8 dpm | 40.4 dpm | 6.1 dpm | 121.9 dpm |
| 5/23/2001 | 5 | 899 | 5.1 dpm | 39.4 dpm | 10.3 dpm | 118.7 dpm |
| 5/24/2001 | 3 | 877 | 4.6 dpm | 38.9 dpm | 8.6 dpm | 117.3 dpm |
| 5/25/2001 | 3 | 836 | 4.6 dpm | 38.1 dpm | 8.6 dpm | 114.6 dpm |
| 5/29/2001 | 3 | 943 | 4.6 dpm | 40.3 dpm | 8.6 dpm | 121.5 dpm |
| 5/30/2001 | 3 | 889 | 4.6 dpm | 39.2 dpm | 8.6 dpm | 118.1 dpm |
| 5/31/2001 | 2 | 925 | 4.2 dpm | 39.9 dpm | 7.5 dpm | 120.4 dpm |
| 6/1/2001 | 2 | 914 | 4.2 dpm | 39.7 dpm | 7.5 dpm | 119.7 dpm |
| 6/2/2001 | 0 | 858 | 2.7 dpm | 38.6 dpm | 2.7 dpm | 116.1 dpm |
| 6/3/2001 | 4 | 916 | 4.9 dpm | 39.7 dpm | 9.5 dpm | 119.8 dpm |
| 6/7/2001 | 2 | 836 | 4.2 dpm | 38.1 dpm | 7.5 dpm | 114.6 dpm |
| 6/8/2001 | 4 | 894 | 4.9 dpm | 39.3 dpm | 9.5 dpm | 118.4 dpm |
| 6/9/2001 | 4 | 898 | 4.9 dpm | 39.4 dpm | 9.5 dpm | 118.7 dpm |
| 6/10/2001 | 4 | 909 | 4.9 dpm | 39.6 dpm | 9.5 dpm | 119.4 dpm |
| 6/11/2001 | 3 | 890 | 4.6 dpm | 39.2 dpm | 8.6 dpm | 118.2 dpm |
| 6/12/2001 | 3 | 903 | 4.6 dpm | 39.5 dpm | 8.6 dpm | 119.0 dpm |
| 6/13/2001 | 4 | 875 | 4.9 dpm | 38.9 dpm | 9.5 dpm | 117.2 dpm |

# CABRERA SERVICES, Inc.
## Ludlum Model 2929
## Serial Number 163827

**Counting System Efficiency Data Sheet**

| | |
|---|---|
| Instrument Model Number | 2929 |
| Instrument Serial Number | 118407 |
| Last Calibration Date | 2/23/2001 |
| Detector Model Number | 43-10-1 |
| Detector Serial Number | PR092751 |
| Todays Date | 6/16/2001 |
| Data Collected By | Tom O'Dou |

| | |
|---|---|
| Alpha Source Serial Number | 2897-01 DNS-11 |
| Beta Source Serial Number | 2898-01 DNS-12 |

| | | | | |
|---|---|---|---|---|
| Alpha Source Activity | 22800 dpm ← | Initial Alpha Activity | Date: | 6/11/2001 |
| Beta Source Activity | 17300 dpm ← | Initial Beta Activity | Date: | 6/5/2001 |

| | | |
|---|---|---|
| Alpha Source Decay Time | 5 Days | 0.0137 Years |
| Beta Source Decay Time | 11 Days | 0.0301 Years |

| | | | |
|---|---|---|---|
| Alpha Emitting Radionuclide | Th-230 | Half Life: | 8.00E+04 Years |
| Beta Emitting Radionuclide | Tc-99 | Half Life: | 2.13E+05 Years |

| | | | |
|---|---|---|---|
| Alpha Decay Factor | 0.999999881 | Todays Activity | 22800 dpm |
| Beta Decay Factor | 0.999999902 | Todays Activity | 17300 dpm |

| | | |
|---|---|---|
| Alpha Response (10 min) | 82334 Counts | 8233.4 cpm |
| Beta Response (10 min) | 36352 Counts | 3635.2 cpm |

| | | |
|---|---|---|
| Alpha Background (10 min) | 5 Counts | 0.5 cpm |
| Beta Background (10 min) | 469 Counts | 46.9 cpm |

| | |
|---|---|
| Alpha Detection Efficiency: | 0.36 counts/disintegration |
| Beta Detection Efficiency: | 0.21 counts/disintegration |

# CABRERA SERVICES, Inc.

## Ludlum Model 2929

## Serial Number 163827

| | |
|---|---|
| Air sample count time (minutes): | 20 |
| Smear sample count time (minutes): | 2 |
| Background count time (minutes): | 20 |

| | | |
|---|---|---|
| Beta | Efficiency | 0.22 c/d |
| Alpha | Efficiency | 0.18 c/d |

| | Alpha Background | Beta Background | Air Samples Alpha MDA | Air Samples Beta MDA | Smears Alpha MDA | Smears Beta MDA |
|---|---|---|---|---|---|---|
| 6/14/2001 | 2 | 940 | 4.5 dpm | 35.1 dpm | 8.5 dpm | 105.2 dpm |
| 6/15/2001 | 3 | 1005 | 4.9 dpm | 36.2 dpm | 9.8 dpm | 108.7 dpm |
| 6/16/2001 | 2 | 986 | 4.5 dpm | 35.9 dpm | 8.5 dpm | 107.6 dpm |
| 6/17/2001 | 1 | 940 | 4.0 dpm | 35.1 dpm | 6.8 dpm | 105.2 dpm |
| 6/18/2001 | 3 | 924 | 4.9 dpm | 34.8 dpm | 9.8 dpm | 104.3 dpm |
| 6/19/2001 | 2 | 952 | 4.5 dpm | 35.3 dpm | 8.5 dpm | 105.8 dpm |
| 6/20/2001 | 0 | 956 | 2.7 dpm | 35.4 dpm | 2.7 dpm | 106.0 dpm |
| 6/21/2001 | 2 | 941 | 4.5 dpm | 35.1 dpm | 8.5 dpm | 105.2 dpm |
| 6/24/2001 | 1 | 865 | 4.0 dpm | 33.8 dpm | 6.8 dpm | 101.0 dpm |
| 6/25/2001 | 4 | 881 | 5.3 dpm | 34.1 dpm | 10.9 dpm | 101.9 dpm |
| 6/26/2001 | 1 | 897 | 4.0 dpm | 34.4 dpm | 6.8 dpm | 102.8 dpm |
| 6/27/2001 | 2 | 907 | 4.5 dpm | 34.5 dpm | 8.5 dpm | 103.4 dpm |
| 6/28/2001 | 2 | 882 | 4.5 dpm | 34.1 dpm | 8.5 dpm | 102.0 dpm |
| 6/29/2001 | 3 | 906 | 4.9 dpm | 34.5 dpm | 9.8 dpm | 103.3 dpm |
| 6/30/2001 | 4 | 871 | 5.3 dpm | 33.9 dpm | 10.9 dpm | 101.3 dpm |
| 7/1/2001 | 3 | 892 | 4.9 dpm | 34.3 dpm | 9.8 dpm | 102.5 dpm |
| 7/2/2001 | 4 | 880 | 5.3 dpm | 34.1 dpm | 10.9 dpm | 101.8 dpm |
| 7/3/2001 | 2 | 885 | 4.5 dpm | 34.1 dpm | 8.5 dpm | 102.1 dpm |
| 7/4/2001 | 1 | 909 | 4.0 dpm | 34.6 dpm | 6.8 dpm | 103.5 dpm |
| 7/5/2001 | 1 | 960 | 4.0 dpm | 35.5 dpm | 6.8 dpm | 106.3 dpm |
| 7/6/2001 | 1 | 941 | 4.0 dpm | 35.1 dpm | 6.8 dpm | 105.2 dpm |
| 7/7/2001 | 4 | 920 | 5.3 dpm | 34.8 dpm | 10.9 dpm | 104.1 dpm |
| 7/8/2001 | 2 | 863 | 4.5 dpm | 33.8 dpm | 8.5 dpm | 100.9 dpm |
| 7/9/2001 | 1 | 1000 | 4.0 dpm | 36.1 dpm | 6.8 dpm | 108.4 dpm |
| 7/10/2001 | 2 | 962 | 4.5 dpm | 35.5 dpm | 8.5 dpm | 106.4 dpm |
| 7/11/2001 | 1 | 1146 | 4.0 dpm | 38.5 dpm | 6.8 dpm | 115.8 dpm |
| 7/12/2001 | 2 | 937 | 4.5 dpm | 35.1 dpm | 8.5 dpm | 105.0 dpm |
| 7/13/2001 | 1 | 880 | 4.0 dpm | 34.1 dpm | 6.8 dpm | 101.8 dpm |
| 7/14/2001 | 2 | 967 | 4.5 dpm | 35.6 dpm | 8.5 dpm | 106.6 dpm |
| 7/15/2001 | 3 | 944 | 4.9 dpm | 35.2 dpm | 9.8 dpm | 105.4 dpm |
| 7/16/2001 | 3 | 942 | 4.9 dpm | 35.1 dpm | 9.8 dpm | 105.3 dpm |

# CABRERA SERVICES, Inc.
## Ludlum Model 2929
## Serial Number 118407

Counting System Efficiency Data Sheet

| | |
|---|---|
| Instrument Model Number | 2929 |
| Instrument Serial Number | 118407 |
| Last Calibration Date | 4/16/2001 |
| Detector Model Number | 43-10-1 |
| Detector Serial Number | PR092751 |
| Todays Date | 6/16/2001 |
| Data Collected By | Tom O'Dou |

| | | | | |
|---|---|---|---|---|
| Alpha Source Serial Number | 2897-01 DNS-11 | | | |
| Beta Source Serial Number | 2898-01 DNS-12 | | | |
| Alpha Source Activity | 22800 dpm ← | Initial Activity | Date: | 6/1/2001 |
| Beta Source Activity | 17300 dpm ← | Initial Activity | Date: | 6/5/2001 |
| Alpha Source Decay Time | 15 Days | 0.0411 Years | | |
| Beta Source Decay Time | 11 Days | 0.0301 Years | | |
| Alpha Emitting Radionuclide | Th-230 | Half Life: | 8.00E+04 Years | |
| Beta Emitting Radionuclide | Tc-99 | Half Life: | 2.13E+05 Years | |
| Alpha Decay Factor | 1.00000 | Todays Activity | 22800 dpm | |
| Beta Decay Factor | 1.00000 | Todays Activity | 17300 dpm | |
| Alpha Response (10 min) | 80748 Counts | 8074.8 cpm | | |
| Beta Response (10 min) | 39690 Counts | 3969 cpm | | |
| Alpha Background (10 min) | 3 Counts | 0.3 cpm | | |
| Beta Background (10 min) | 409 Counts | 40.9 cpm | | |
| Alpha Detection Efficiency: | 0.35 counts/disintegration | | | |
| Beta Detection Efficiency: | 0.23 counts/disintegration | | | |
| Calibrated Alpha Detection Efficiency: | 0.216 counts/disintegration | | | |
| Calibrated Beta Detection Efficiency: | 0.19 counts/disintegration | | | |

# CABRERA SERVICES, Inc.

## Ludlum Model 2929

## Serial Number 118407

Air sample count time (minutes):
Smear sample count time (minutes):
Background count time (minutes):

| | | |
|---|---|---|
| Beta | Efficiency | 0.19 c/d |
| Alpha | Efficiency | 0.216 c/d |

| | Alpha Background | Beta Background | Air Samples Alpha MDA | Air Samples Beta MDA | Smears Alpha MDA | Smears Beta MDA |
|---|---|---|---|---|---|---|
| 6/14/2001 | 2 | 880 | 4.2 dpm | 39.0 dpm | 7.5 dpm | 117.5 dpm |
| 6/15/2001 | 4 | 864 | 4.9 dpm | 38.7 dpm | 9.5 dpm | 116.5 dpm |
| 6/16/2001 | 3 | 873 | 4.6 dpm | 38.9 dpm | 8.6 dpm | 117.0 dpm |
| 6/17/2001 | 1 | 911 | 3.8 dpm | 39.6 dpm | 6.1 dpm | 119.5 dpm |
| 6/18/2001 | 4 | 886 | 4.9 dpm | 39.1 dpm | 9.5 dpm | 117.9 dpm |
| 6/19/2001 | 1 | 889 | 3.8 dpm | 39.2 dpm | 6.1 dpm | 118.1 dpm |
| 6/20/2001 | 4 | 863 | 4.9 dpm | 38.7 dpm | 9.5 dpm | 116.4 dpm |
| 6/21/2001 | 2 | 825 | 4.2 dpm | 37.9 dpm | 7.5 dpm | 113.9 dpm |
| 6/22/2001 | 1 | 918 | 3.8 dpm | 39.8 dpm | 6.1 dpm | 120.0 dpm |
| 6/23/2001 | 4 | 933 | 4.9 dpm | 40.1 dpm | 9.5 dpm | 120.9 dpm |
| 6/24/2001 | 2 | 903 | 4.2 dpm | 39.5 dpm | 7.5 dpm | 119.0 dpm |
| 6/25/2001 | 4 | 891 | 4.9 dpm | 39.2 dpm | 9.5 dpm | 118.2 dpm |
| 6/26/2001 | 1 | 838 | 3.8 dpm | 38.1 dpm | 6.1 dpm | 114.7 dpm |
| 6/27/2001 | 2 | 973 | 4.2 dpm | 40.9 dpm | 7.5 dpm | 123.4 dpm |
| 6/28/2001 | 2 | 912 | 4.2 dpm | 39.7 dpm | 7.5 dpm | 119.6 dpm |
| 6/29/2001 | 3 | 878 | 4.6 dpm | 39.0 dpm | 8.6 dpm | 117.4 dpm |
| 6/30/2001 | 2 | 902 | 4.2 dpm | 39.5 dpm | 7.5 dpm | 118.9 dpm |
| 7/1/2001 | 4 | 915 | 4.9 dpm | 39.7 dpm | 9.5 dpm | 119.8 dpm |
| 7/2/2001 | 2 | 905 | 4.2 dpm | 39.5 dpm | 7.5 dpm | 119.1 dpm |
| 7/3/2001 | 4 | 889 | 4.9 dpm | 39.2 dpm | 9.5 dpm | 118.1 dpm |
| 7/4/2001 | 2 | 857 | 4.2 dpm | 38.5 dpm | 7.5 dpm | 116.0 dpm |
| 7/5/2001 | 2 | 929 | 4.2 dpm | 40.0 dpm | 7.5 dpm | 120.7 dpm |
| 7/6/2001 | 3 | 887 | 4.6 dpm | 39.2 dpm | 8.6 dpm | 118.0 dpm |
| 7/7/2001 | 4 | 940 | 4.9 dpm | 40.2 dpm | 9.5 dpm | 121.4 dpm |
| 7/8/2001 | 4 | 870 | 4.9 dpm | 38.8 dpm | 9.5 dpm | 116.8 dpm |
| 7/9/2001 | 4 | 909 | 4.9 dpm | 39.6 dpm | 9.5 dpm | 119.4 dpm |
| 7/10/2001 | 3 | 954 | 4.6 dpm | 40.5 dpm | 8.6 dpm | 122.2 dpm |
| 7/11/2001 | 4 | 1054 | 4.9 dpm | 42.4 dpm | 9.5 dpm | 128.3 dpm |
| 7/12/2001 | 2 | 886 | 4.2 dpm | 39.1 dpm | 7.5 dpm | 117.9 dpm |
| 7/13/2001 | 1 | 844 | 3.8 dpm | 38.3 dpm | 6.1 dpm | 115.1 dpm |
| 7/14/2001 | 2 | 880 | 4.2 dpm | 39.0 dpm | 7.5 dpm | 117.5 dpm |
| 7/15/2001 | 3 | 906 | 4.6 dpm | 39.5 dpm | 8.6 dpm | 119.2 dpm |
| 7/16/2001 | 1 | 877 | 3.8 dpm | 38.9 dpm | 6.1 dpm | 117.3 dpm |
| 7/17/2001 | 1 | 858 | 3.8 dpm | 38.6 dpm | 6.1 dpm | 116.1 dpm |
| 7/18/2001 | 1 | 894 | 3.8 dpm | 39.3 dpm | 6.1 dpm | 118.4 dpm |
| 7/19/2001 | 4 | 873 | 4.9 dpm | 38.9 dpm | 9.5 dpm | 117.0 dpm |

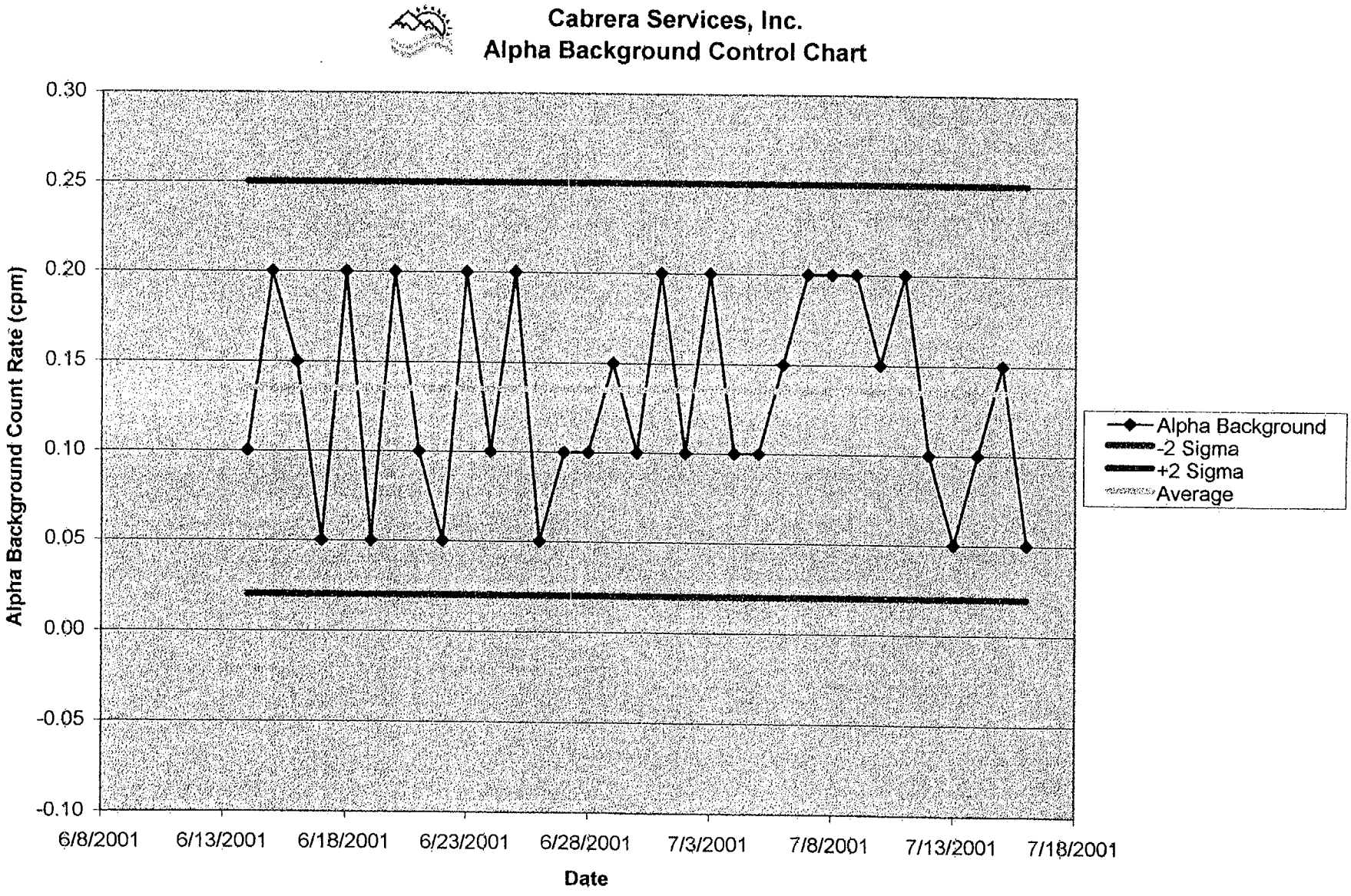
20
2
20

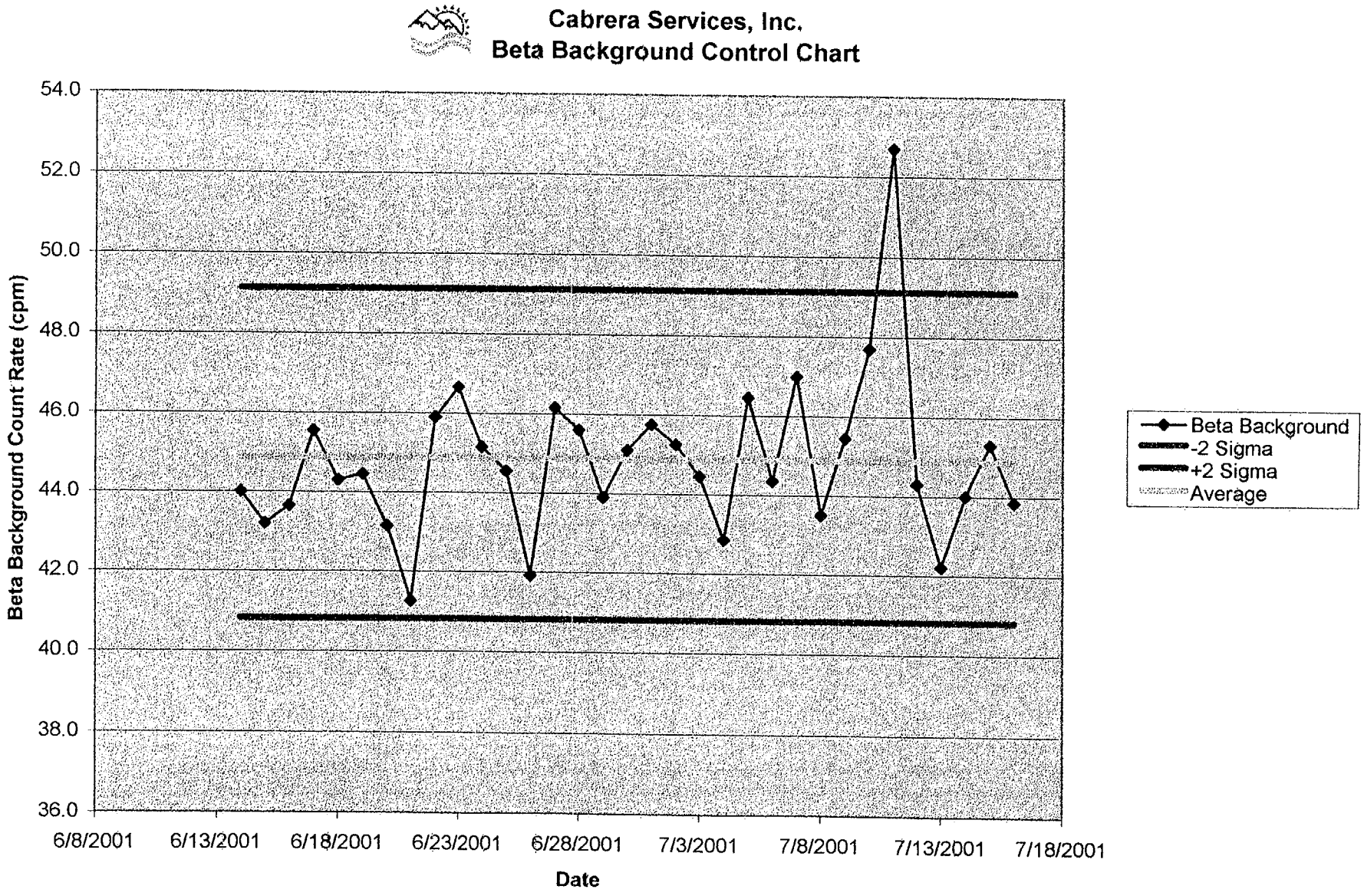
# Lake City Army Ammunition Plant
# Cabrera Services, Inc.
# Counting System Setup Data

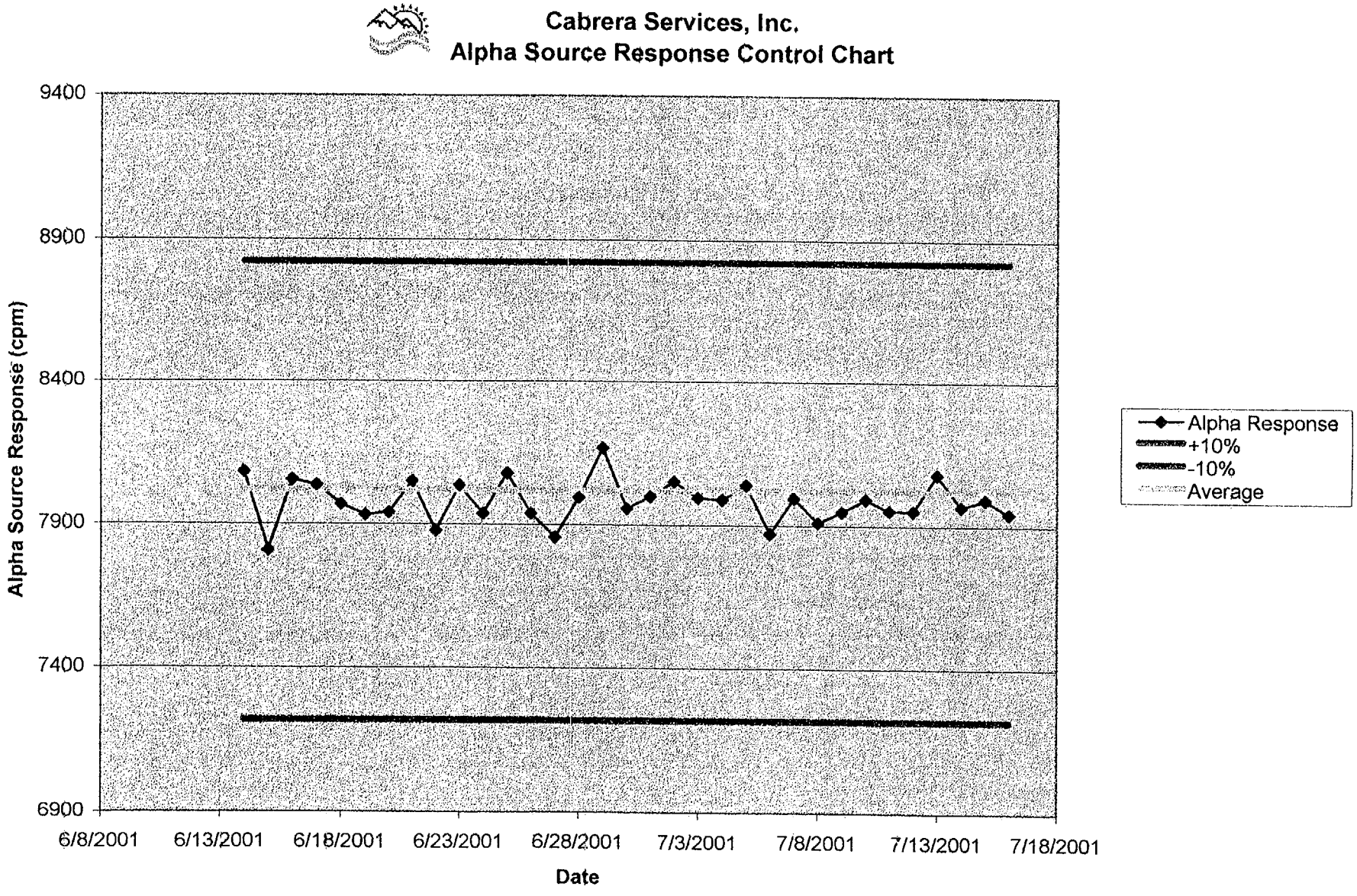
| | Original Sources | | | | | | | | New Sources | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Model 2929 SN: 118407 | | Model 2929 SN: 163827 | | Model 2224 SN: 162426 | | Model 2221 SN: 97841 | Model 2221 SN: 163673 | Model 2929 SN: 118407 | | Model 2929 SN: 163827 | |
| Count # | Tc-99 | Th-230 | Tc-99 | Th-230 | Tc-101 | Th-232 | Cs-137 | Cs-137 | Tc-99 | Th-230 | Tc-99 | Th-230 |
| 1 | 15378 | 15588 | 14556 | 16185 | 6108 | 3551 | 65117 | 16541 | 8018 | 15991 | 7983 | 16465 |
| 2 | 15444 | 15611 | 14694 | 15997 | 6168 | 3532 | 64752 | 16188 | 8060 | 16148 | 8082 | 16582 |
| 3 | 15418 | 15607 | 14681 | 15987 | 6236 | 3544 | 64992 | 16502 | 8238 | 16003 | 7796 | 16468 |
| 4 | 15478 | 15616 | 14647 | 16079 | 6228 | 3578 | 65019 | 16563 | 8068 | 16092 | 7958 | 16221 |
| 5 | 15547 | 15617 | 14731 | 16146 | 6117 | 3524 | 64628 | 16389 | 7925 | 15901 | 7937 | 16174 |
| 6 | 15490 | 15676 | 14899 | 15972 | 6040 | 3548 | 64616 | 16628 | 8009 | 16125 | 7837 | 16293 |
| 7 | 15720 | 15374 | 14618 | 16081 | 5995 | 3563 | 65142 | 16434 | 8037 | 15904 | 7809 | 16536 |
| 8 | 15797 | 15544 | 14523 | 15951 | 5993 | 3601 | 65017 | 16641 | 7878 | 16046 | 7820 | 16683 |
| 9 | 15543 | 15782 | 14436 | 16084 | 6010 | 3558 | 64896 | 16404 | 7823 | 16024 | 7845 | 16386 |
| 10 | 15509 | 15706 | 14500 | 16161 | 6108 | 3617 | 65045 | 16622 | 7975 | 16180 | 7891 | 16425 |
| 11 | 15662 | 15791 | 14370 | 16144 | 6063 | 3507 | 64966 | 16569 | 8034 | 16039 | 8135 | 16441 |
| 12 | 15560 | 15817 | 14546 | 16291 | 6189 | 3524 | 65356 | 16244 | 7943 | 15937 | 7968 | 16301 |
| 13 | 15786 | 15467 | 14765 | 16070 | 5969 | 3531 | 65421 | 16346 | 7967 | 15914 | 7798 | 16630 |
| 14 | 15694 | 15595 | 14717 | 15806 | 5895 | 3562 | 65330 | 16432 | 7952 | 16093 | 7932 | 16423 |
| 15 | 15596 | 15599 | 14604 | 16316 | 6012 | 3537 | 65217 | 16779 | 8124 | 15949 | 8051 | 16332 |
| 16 | 15466 | 15605 | 14630 | 15882 | 5878 | 3548 | 64788 | 16586 | 7824 | 16217 | 7828 | 16756 |
| 17 | 15347 | 15482 | 14612 | 15999 | 5818 | 3395 | 64995 | 16379 | 7877 | 15968 | 7879 | 16374 |
| 18 | 15598 | 15823 | 14454 | 16022 | 5901 | 3460 | 65356 | 16624 | 8066 | 16238 | 7814 | 16328 |
| 19 | 15416 | 15544 | 14627 | 16071 | 5997 | 3612 | 65149 | 16591 | 7862 | 15842 | 7922 | 16520 |
| 20 | 15327 | 15610 | 14732 | 16128 | 5823 | 3523 | 64827 | 16665 | 8155 | 16144 | 7873 | 16460 |
| Avg | 15539 | 15623 | 14617 | 16069 | 6027 | 3541 | 65031 | 16506 | 7992 | 16038 | 7908 | 16440 |
| Stdev | 139 | 118 | 126 | 124 | 126 | 50 | 236 | 150 | 111 | 114 | 99 | 149 |
| **Chi2/n-1** | **1.2** | **0.9** | **1.1** | **1.0** | **2.6** | **0.7** | **0.9** | **1.4** | **1.5** | **0.8** | **1.2** | **1.4** |
| **Chi2** | **24** | **17** | **21** | **18** | **50** | **13** | **16** | **26** | **29** | **15** | **23** | **26** |
| 1 Tail Prob. | 0.21 | 0.60 | 0.36 | 0.50 | 0.00 | 0.82 | 0.64 | 0.13 | 0.06 | 0.70 | 0.22 | 0.14 |
| Pass/Fail? | Pass | Pass | Pass | Pass | Fail | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Max | 15797 | 15823 | 14899 | 16316 | 6236 | 3617 | 65421 | 16779 | 8238 | 16238 | 8135 | 16756 |
| Min | 15327 | 15374 | 14370 | 15806 | 5818 | 3395 | 64616 | 16188 | 7823 | 15842 | 7796 | 16174 |

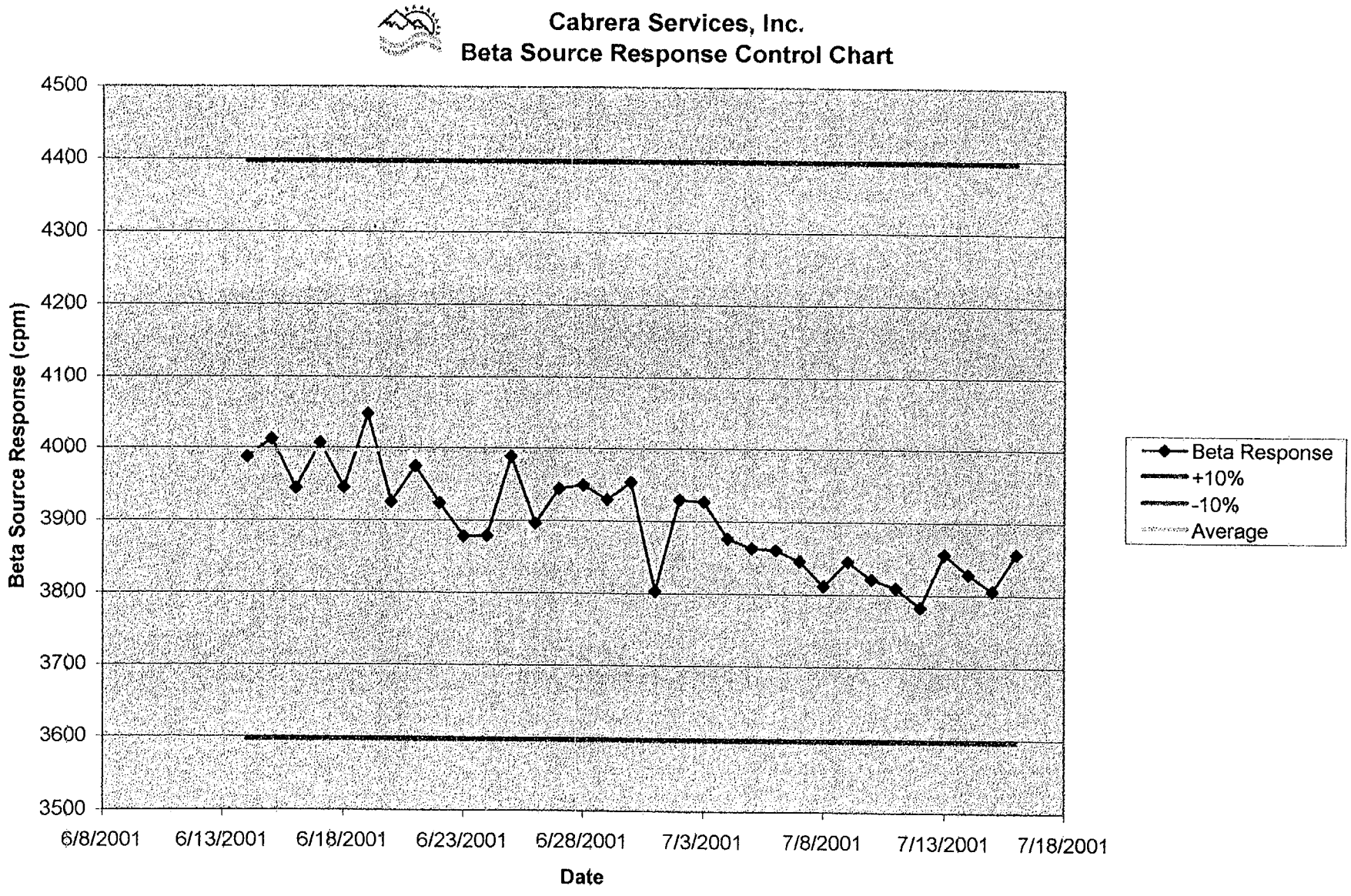
Cabrera Services, Inc.
Smear Counter QA Checks

| SN: 118407 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Date | 20 Min Background | | 2 Min Source Check | | Background Rate (cpm) | | Source Rate (cpm) | |
| | Alpha | Beta | Alpha | Beta | Alpha | Beta | Alpha | Beta |
| 6/14/2001 | 2 | 880 | 16161 | 7974 | 0.10 | 44.0 | 8081 | 3987 |
| 6/15/2001 | 4 | 864 | 15616 | 8024 | 0.20 | 43.2 | 7808 | 4012 |
| 6/16/2001 | 3 | 873 | 16109 | 7887 | 0.15 | 43.7 | 8055 | 3944 |
| 6/17/2001 | 1 | 911 | 16072 | 8014 | 0.05 | 45.6 | 8036 | 4007 |
| 6/18/2001 | 4 | 886 | 15934 | 7890 | 0.20 | 44.3 | 7967 | 3945 |
| 6/19/2001 | 1 | 889 | 15863 | 8095 | 0.05 | 44.5 | 7932 | 4048 |
| 6/20/2001 | 4 | 863 | 15879 | 7850 | 0.20 | 43.2 | 7940 | 3925 |
| 6/21/2001 | 2 | 825 | 16100 | 7948 | 0.10 | 41.3 | 8050 | 3974 |
| 6/22/2001 | 1 | 918 | 15751 | 7847 | 0.05 | 45.9 | 7876 | 3924 |
| 6/23/2001 | 4 | 933 | 16070 | 7755 | 0.20 | 46.7 | 8035 | 3878 |
| 6/24/2001 | 2 | 903 | 15874 | 7756 | 0.1 | 45.15 | 7937 | 3878 |
| 6/25/2001 | 4 | 891 | 16157 | 7977 | 0.2 | 44.55 | 8078.5 | 3988.5 |
| 6/26/2001 | 1 | 838 | 15877 | 7792 | 0.05 | 41.9 | 7938.5 | 3896 |
| 6/27/2001 | 2 | 923 | 15710 | 7888 | 0.1 | 46.15 | 7855 | 3944 |
| 6/28/2001 | 2 | 912 | 15988 | 7899 | 0.1 | 45.6 | 7994 | 3949.5 |
| 6/29/2001 | 3 | 878 | 16333 | 7859 | 0.15 | 43.9 | 8166.5 | 3929.5 |
| 6/30/2001 | 2 | 902 | 15913 | 7907 | 0.1 | 45.1 | 7956.5 | 3953.5 |
| 7/1/2001 | 4 | 915 | 15997 | 7605 | 0.2 | 45.75 | 7998.5 | 3802.5 |
| 7/2/2001 | 2 | 905 | 16101 | 7859 | 0.1 | 45.25 | 8050.5 | 3929.5 |
| 7/3/2001 | 4 | 889 | 15990 | 7853 | 0.2 | 44.45 | 7995 | 3926.5 |
| 7/4/2001 | 2 | 857 | 15977 | 7752 | 0.1 | 42.85 | 7988.5 | 3876 |
| 7/5/2001 | 2 | 929 | 16079 | 7726 | 0.1 | 46.45 | 8039.5 | 3863 |
| 7/6/2001 | 3 | 887 | 15741 | 7721 | 0.15 | 44.35 | 7870.5 | 3860.5 |
| 7/7/2001 | 4 | 940 | 15989 | 7691 | 0.2 | 47 | 7994.5 | 3845.5 |
| 7/8/2001 | 4 | 870 | 15819 | 7622 | 0.2 | 43.5 | 7909.5 | 3811 |
| 7/9/2001 | 4 | 909 | 15895 | 7691 | 0.2 | 45.45 | 7947.5 | 3845.5 |
| 7/10/2001 | 3 | 954 | 15984 | 7642 | 0.15 | 47.7 | 7992 | 3821 |
| 7/11/2001 | 4 | 1054 | 15904 | 7618 | 0.2 | 52.7 | 7952 | 3809 |
| 7/12/2001 | 2 | 886 | 15902 | 7565 | 0.1 | 44.3 | 7951 | 3782.5 |
| 7/13/2001 | 1 | 844 | 16156 | 7712 | 0.05 | 42.2 | 8078 | 3856 |
| 7/14/2001 | 2 | 880 | 15933 | 7656 | 0.1 | 44 | 7966.5 | 3828 |
| 7/15/2001 | 3 | 906 | 15983 | 7611 | 0.15 | 45.3 | 7991.5 | 3805.5 |
| 7/16/2001 | 1 | 877 | 15883 | 7713 | 0.05 | 43.85 | 7941.5 | 3856.5 |


Cabrera Services, Inc.
Alpha Background Control Chart
Alpha Background Count Rate (cpm)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
6/8/2001
6/13/2001
6/18/2001
6/23/2001
6/28/2001
7/3/2001
7/8/2001
7/13/2001
7/18/2001
Date
Alpha Background
-2 Sigma
+2 Sigma
Average

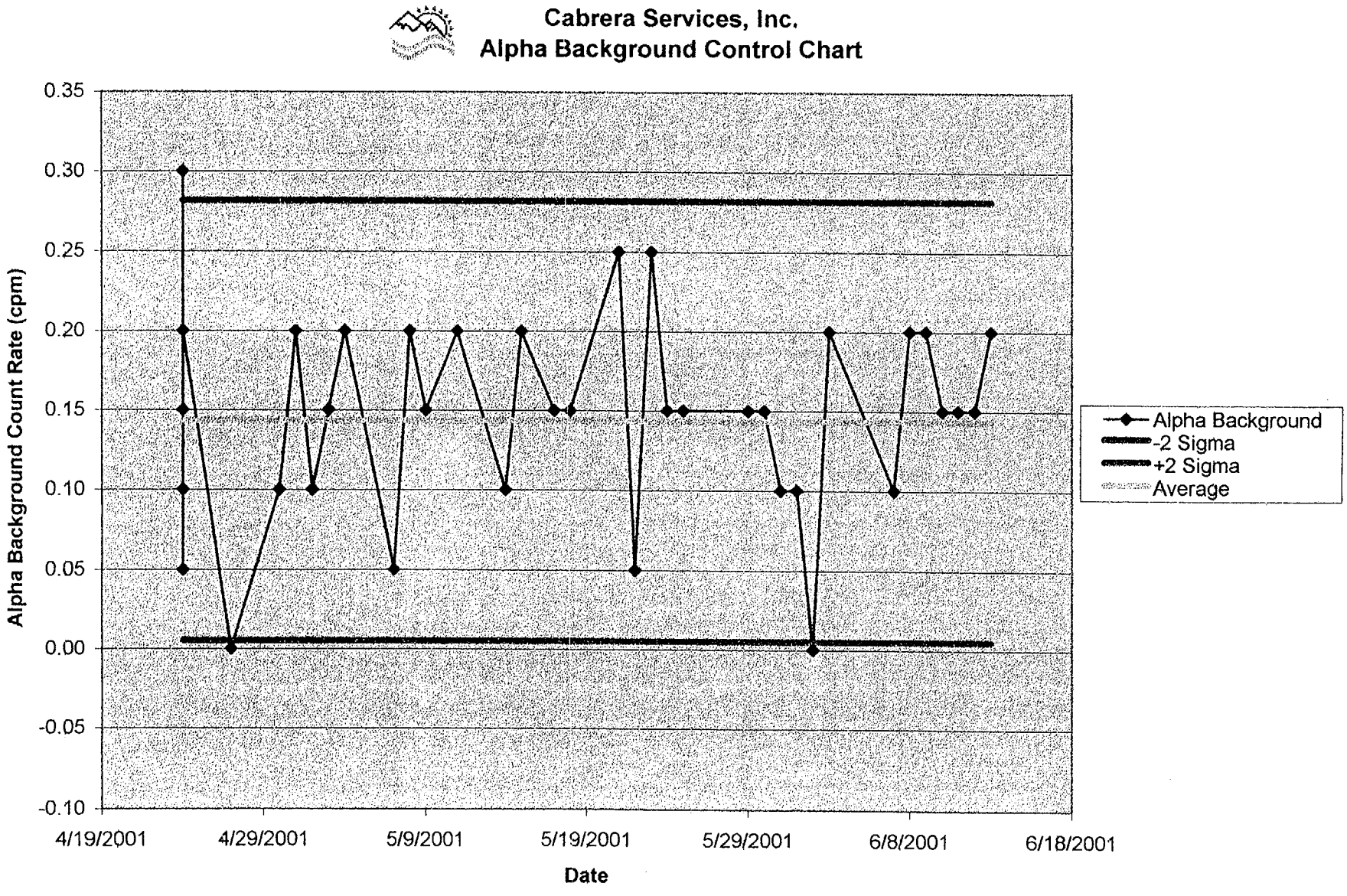

Cabrera Services, Inc.
Beta Background Control Chart
Beta Background Count Rate (cpm)
54.0
52.0
50.0
48.0
46.0
44.0
42.0
40.0
38.0
36.0
6/8/2001
6/13/2001
6/18/2001
6/23/2001
6/28/2001
7/3/2001
7/8/2001
7/13/2001
7/18/2001
Date
Beta Background
-2 Sigma
+2 Sigma
Average

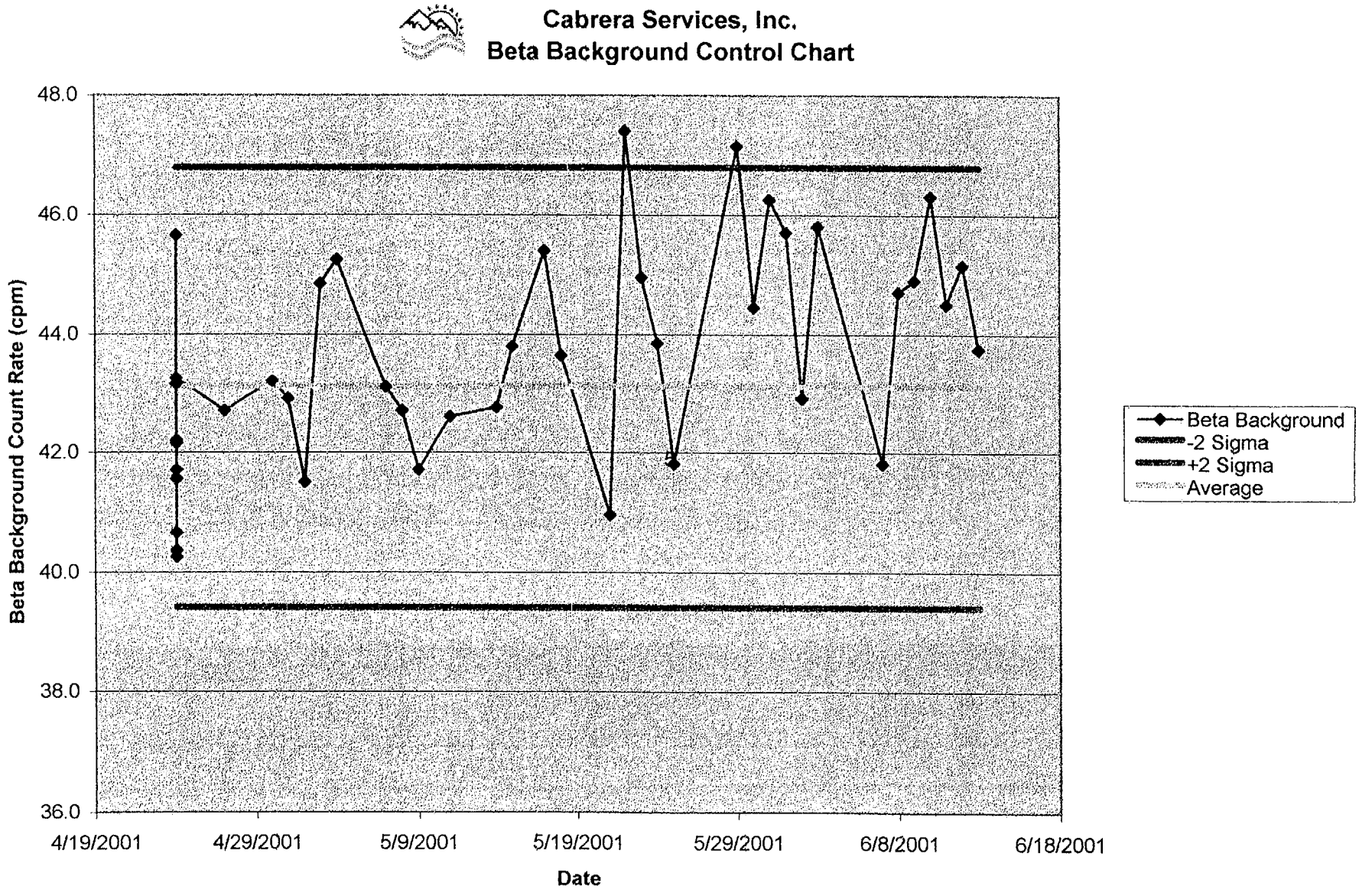

Cabrera Services, Inc.
Alpha Source Response Control Chart
9400
8900
8400
7900
7400
6900
Alpha Source Response (cpm)
6/8/2001
6/13/2001
6/18/2001
6/23/2001
6/28/2001
7/3/2001
7/8/2001
7/13/2001
7/18/2001
Date
Alpha Response
+10%
-10%
Average

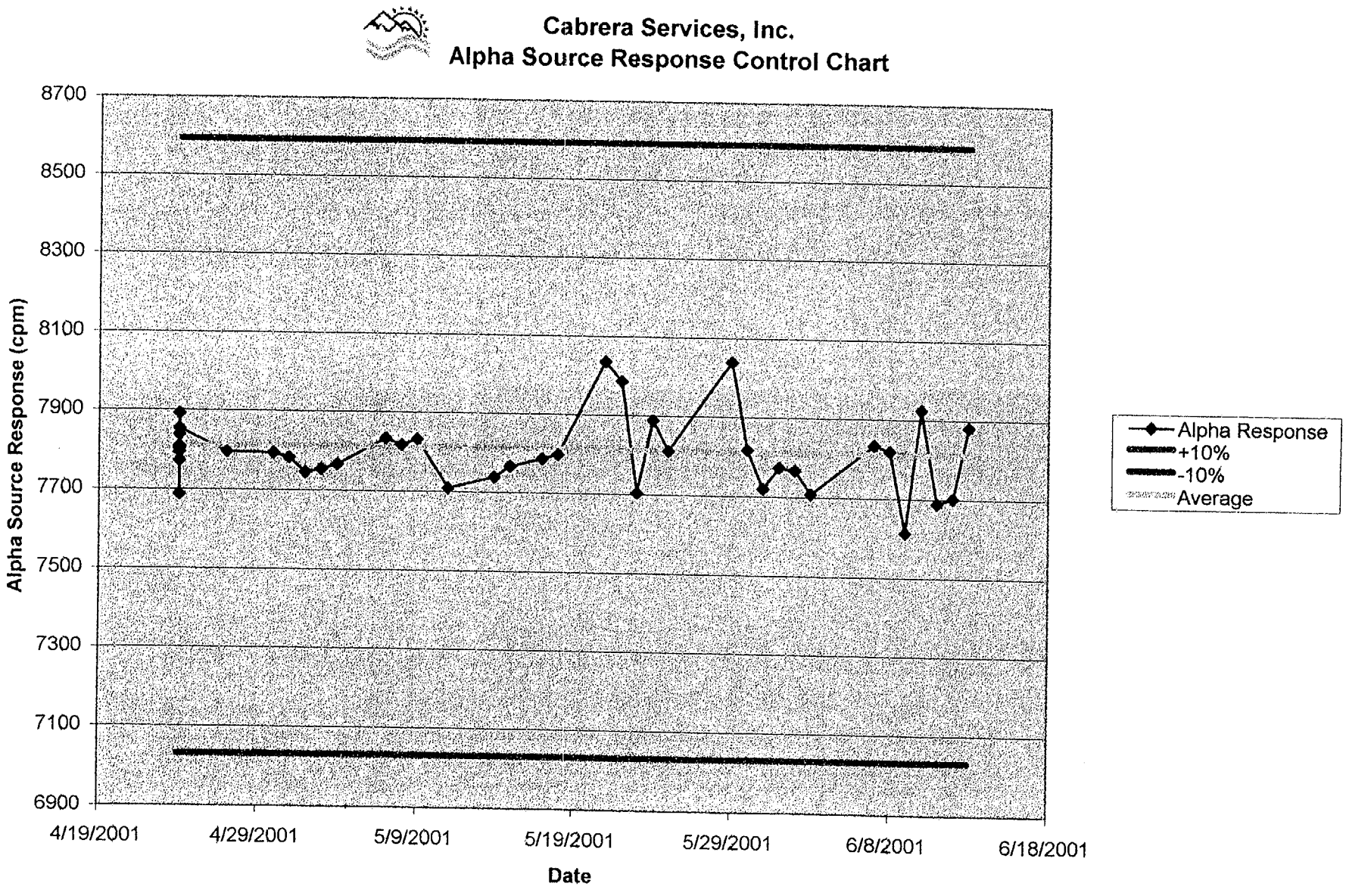

Cabrera Services, Inc.
Beta Source Response Control Chart
Beta Source Response (cpm)
4500
4400
4300
4200
4100
4000
3900
3800
3700
3600
3500
6/8/2001
6/13/2001
6/18/2001
6/23/2001
6/28/2001
7/3/2001
7/8/2001
7/13/2001
7/18/2001
Date
Beta Response
+10%
-10%
Average

Cabrera Services, Inc.
Smear Counter QA Checks

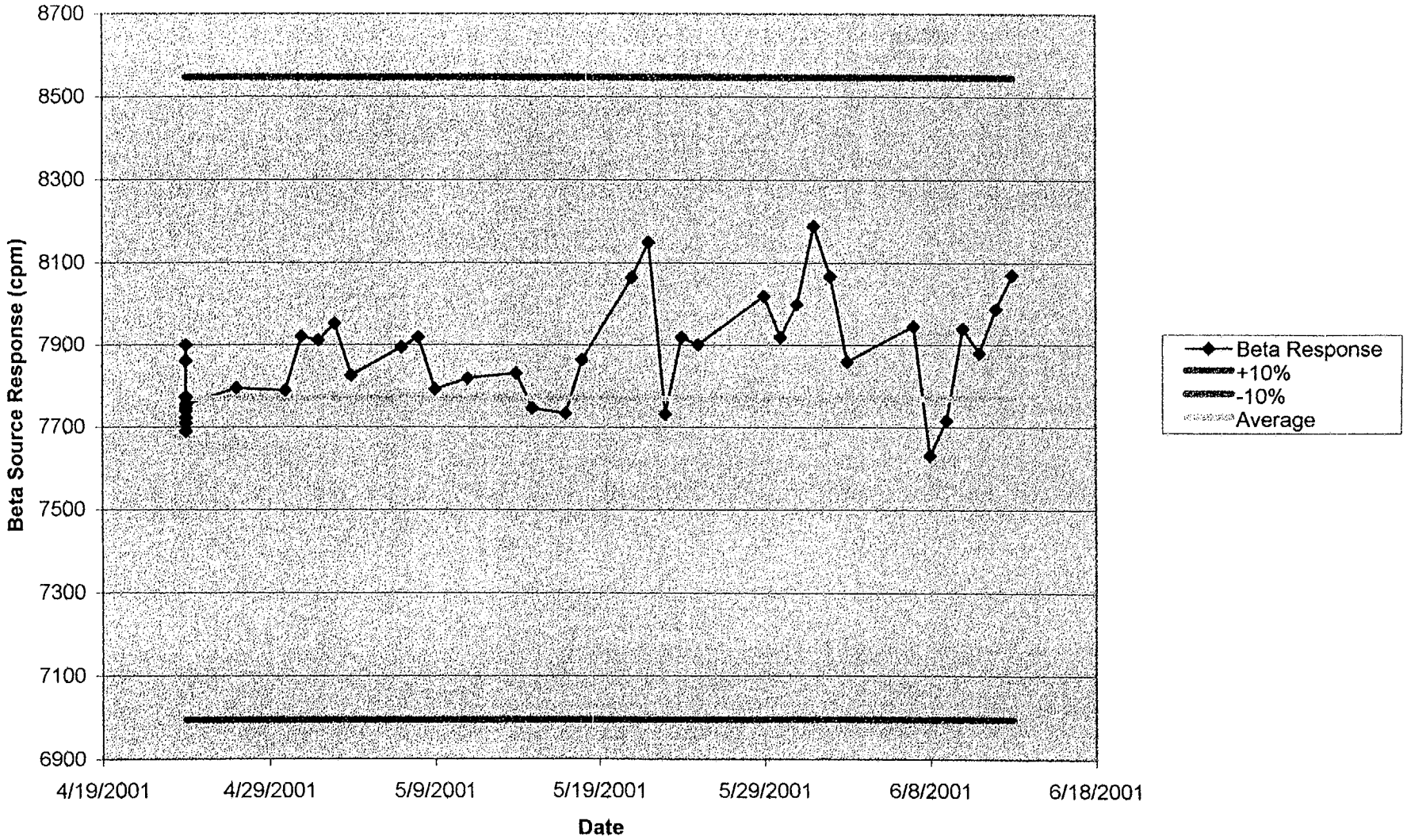
| SN: 118407 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Date | 20 Min Background | | 2 Min Source Check | | Background Rate (cpm) | | Source Rate (cpm) | |
| | Alpha | Beta | Alpha | Beta | Alpha | Beta | Alpha | Beta |
| 4/24/2001 | 6 | 913 | 15588 | 15378 | 0.30 | 45.7 | 7794 | 7689 |
| 4/24/2001 | 3 | 834 | 15611 | 15444 | 0.15 | 41.7 | 7806 | 7722 |
| 4/24/2001 | 1 | 813 | 15607 | 15418 | 0.05 | 40.7 | 7804 | 7709 |
| 4/24/2001 | 3 | 831 | 15616 | 15478 | 0.15 | 41.6 | 7808 | 7739 |
| 4/24/2001 | 1 | 805 | 15617 | 15547 | 0.05 | 40.3 | 7809 | 7774 |
| 4/24/2001 | 2 | 844 | 15676 | 15490 | 0.10 | 42.2 | 7838 | 7745 |
| 4/24/2001 | 3 | 843 | 15374 | 15720 | 0.15 | 42.2 | 7687 | 7860 |
| 4/24/2001 | 3 | 863 | 15544 | 15797 | 0.15 | 43.2 | 7772 | 7899 |
| 4/24/2001 | 1 | 807 | 15782 | 15543 | 0.05 | 40.4 | 7891 | 7772 |
| 4/24/2001 | 4 | 865 | 15706 | 15509 | 0.20 | 43.3 | 7853 | 7755 |
| 4/27/2001 | 0 | 854 | 15589 | 15590 | 0 | 42.7 | 7794.5 | 7795 |
| 4/30/2001 | 2 | 864 | 15586 | 15577 | 0.1 | 43.2 | 7793 | 7788.5 |
| 5/1/2001 | 4 | 858 | 15564 | 15840 | 0.2 | 42.9 | 7782 | 7920 |
| 5/2/2001 | 2 | 830 | 15491 | 15822 | 0.1 | 41.5 | 7745.5 | 7911 |
| 5/3/2001 | 3 | 897 | 15506 | 15903 | 0.15 | 44.85 | 7753 | 7951.5 |
| 5/4/2001 | 4 | 905 | 15531 | 15651 | 0.2 | 45.25 | 7765.5 | 7825.5 |
| 5/7/2001 | 1 | 862 | 15666 | 15787 | 0.05 | 43.1 | 7833 | 7893.5 |
| 5/8/2001 | 4 | 854 | 15632 | 15836 | 0.2 | 42.7 | 7816 | 7918 |
| 5/9/2001 | 3 | 834 | 15663 | 15584 | 0.15 | 41.7 | 7831.5 | 7792 |
| 5/11/2001 | 4 | 852 | 15416 | 15636 | 0.2 | 42.6 | 7708 | 7818 |
| 5/14/2001 | 2 | 855 | 15476 | 15662 | 0.1 | 42.75 | 7738 | 7831 |
| 5/15/2001 | 4 | 876 | 15530 | 15492 | 0.2 | 43.8 | 7765 | 7746 |
| 5/17/2001 | 3 | 908 | 15572 | 15465 | 0.15 | 45.4 | 7786 | 7732.5 |
| 5/18/2001 | 3 | 873 | 15594 | 15726 | 0.15 | 43.65 | 7797 | 7863 |
| 5/21/2001 | 5 | 819 | 16073 | 16130 | 0.25 | 40.95 | 8036.5 | 8065 |
| 5/22/2001 | 1 | 948 | 15970 | 16299 | 0.05 | 47.4 | 7985 | 8149.5 |
| 5/23/2001 | 5 | 899 | 15407 | 15462 | 0.25 | 44.95 | 7703.5 | 7731 |
| 5/24/2001 | 3 | 877 | 15776 | 15836 | 0.15 | 43.85 | 7888 | 7918 |
| 5/25/2001 | 3 | 836 | 15621 | 15800 | 0.15 | 41.8 | 7810.5 | 7900 |
| 5/29/2001 | 3 | 943 | 16079 | 16039 | 0.15 | 47.15 | 8039.5 | 8019.5 |
| 5/30/2001 | 3 | 889 | 15633 | 15836 | 0.15 | 44.45 | 7816.5 | 7918 |
| 5/31/2001 | 2 | 925 | 15439 | 15999 | 0.1 | 46.25 | 7719.5 | 7999.5 |
| 6/1/2001 | 2 | 914 | 15547 | 16375 | 0.1 | 45.7 | 7773.5 | 8187.5 |
| 6/2/2001 | 0 | 858 | 15533 | 16136 | 0 | 42.9 | 7766.5 | 8068 |
| 6/3/2001 | 4 | 916 | 15414 | 15719 | 0.2 | 45.8 | 7707 | 7859.5 |
| 6/7/2001 | 2 | 836 | 15666 | 15892 | 0.1 | 41.8 | 7833 | 7946 |
| 6/8/2001 | 4 | 894 | 15636 | 15263 | 0.2 | 44.7 | 7818 | 7631.5 |
| 6/9/2001 | 4 | 898 | 15225 | 15431 | 0.2 | 44.9 | 7612.5 | 7715.5 |
| 6/10/2001 | 3 | 926 | 15847 | 15878 | 0.15 | 46.3 | 7923.5 | 7939 |
| 6/11/2001 | 3 | 890 | 15376 | 15758 | 0.15 | 44.5 | 7688 | 7879 |
| 6/12/2001 | 3 | 903 | 15403 | 15975 | 0.15 | 45.15 | 7701.5 | 7987.5 |
| 6/13/2001 | 4 | 875 | 15761 | 16141 | 0.2 | 43.75 | 7880.5 | 8070.5 |


Cabrera Services, Inc.
Alpha Background Control Chart
Alpha Background Count Rate (cpm)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
4/19/2001
4/29/2001
5/9/2001
5/19/2001
5/29/2001
6/8/2001
6/18/2001
Date
Alpha Background
-2 Sigma
+2 Sigma
Average


Cabrera Services, Inc.
Beta Background Control Chart
48.0
46.0
44.0
42.0
40.0
38.0
36.0
Beta Background Count Rate (cpm)
4/19/2001
4/29/2001
5/9/2001
5/19/2001
5/29/2001
6/8/2001
6/18/2001
Date
Beta Background
-2 Sigma
+2 Sigma
Average

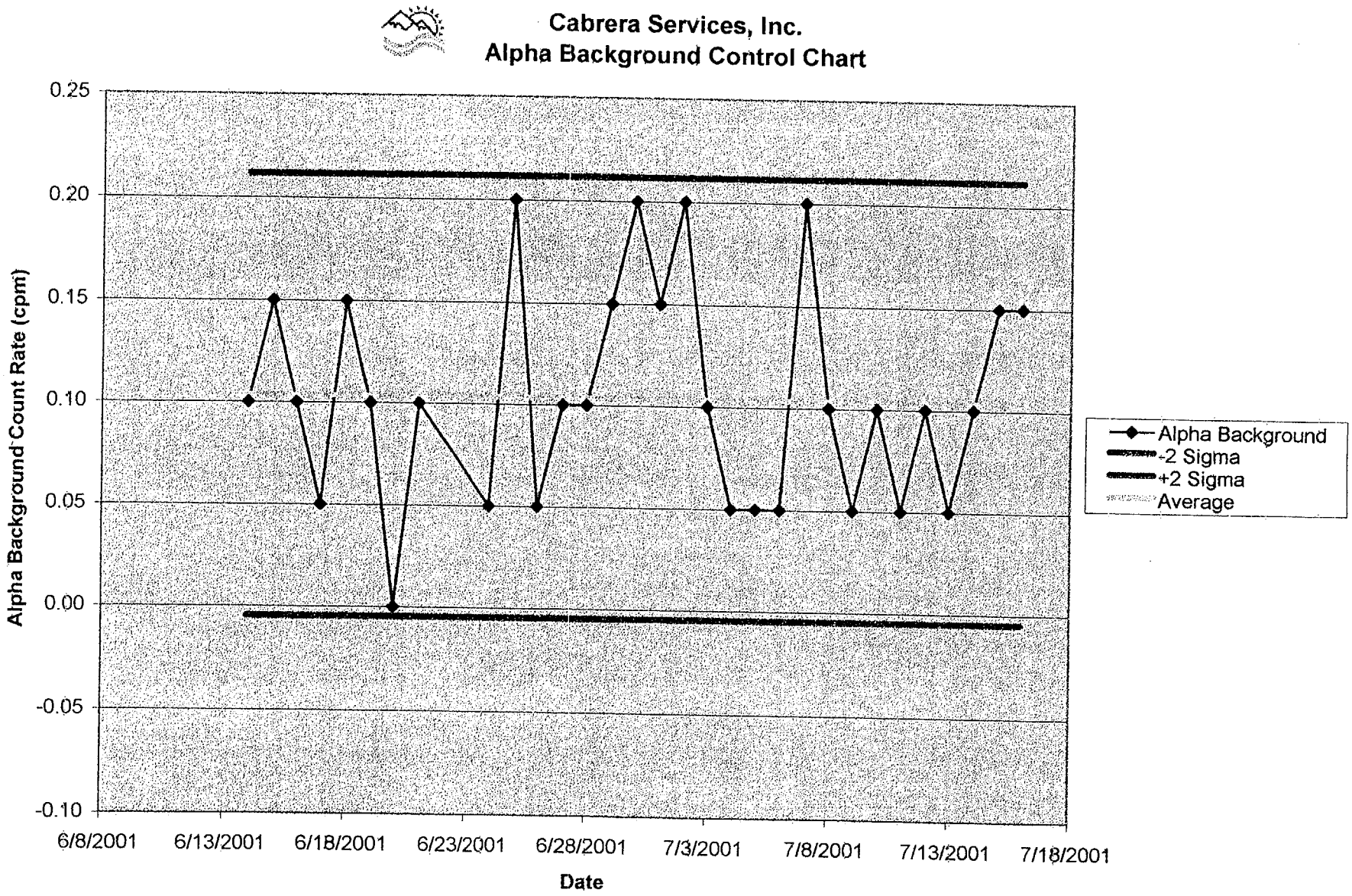

Cabrera Services, Inc.
Alpha Source Response Control Chart
Alpha Source Response (cpm)
8700
8500
8300
8100
7900
7700
7500
7300
7100
6900
4/19/2001
4/29/2001
5/9/2001
5/19/2001
5/29/2001
6/8/2001
6/18/2001
Date
Alpha Response
+10%
-10%
Average

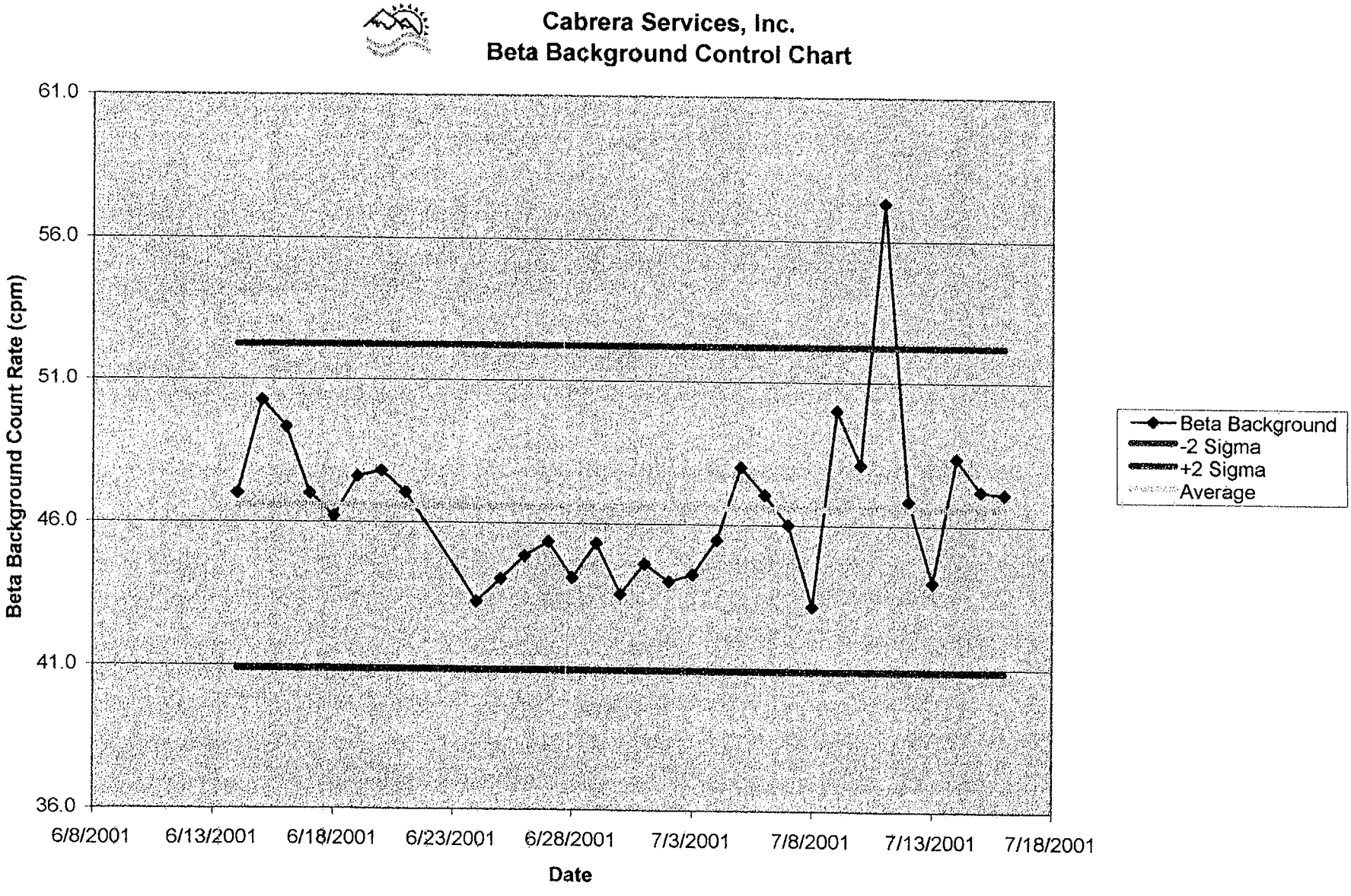
**Cabrera Services, Inc.**
**Beta Source Response Control Chart**



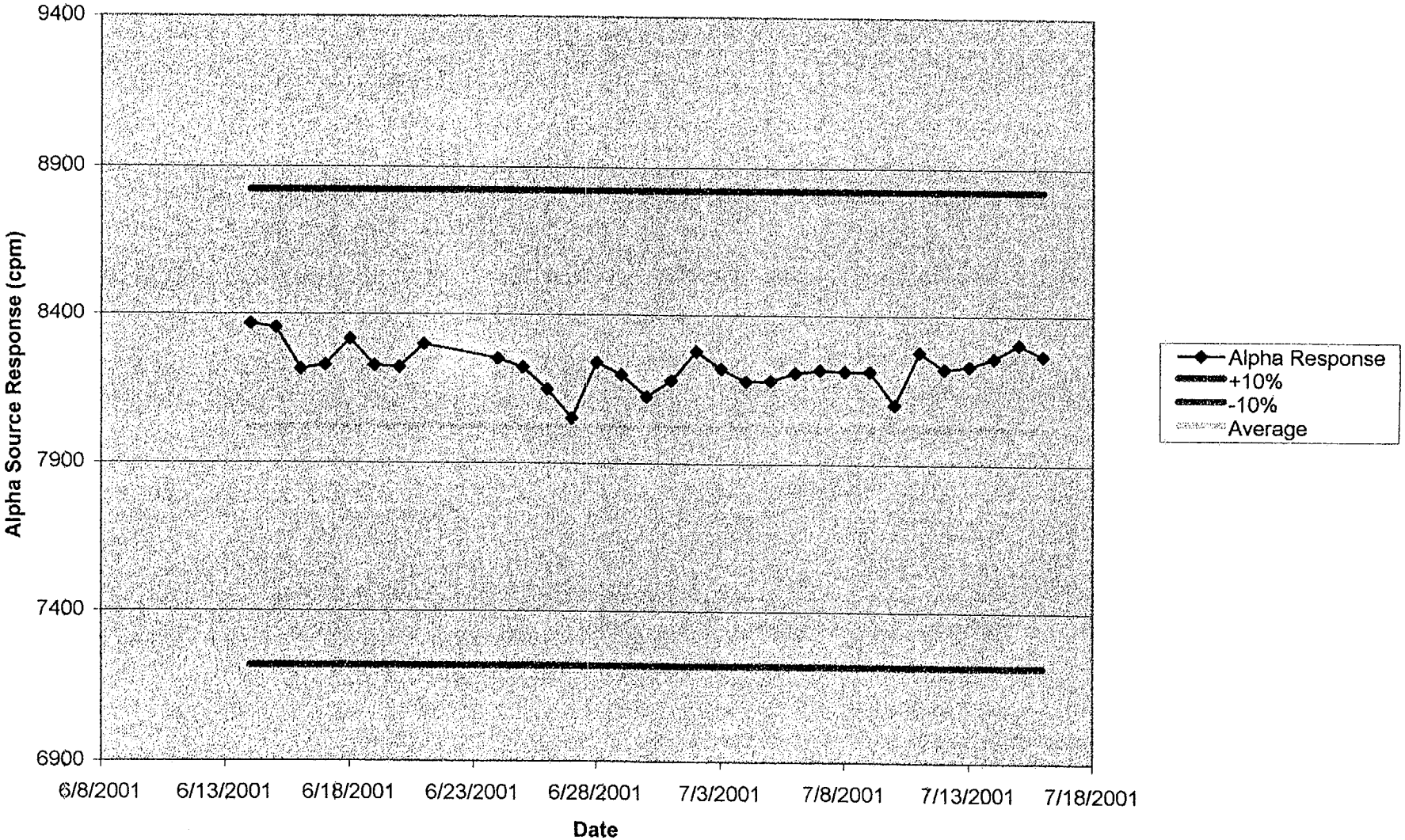
Cabrera Services, Inc.
Smear Counter QA Checks

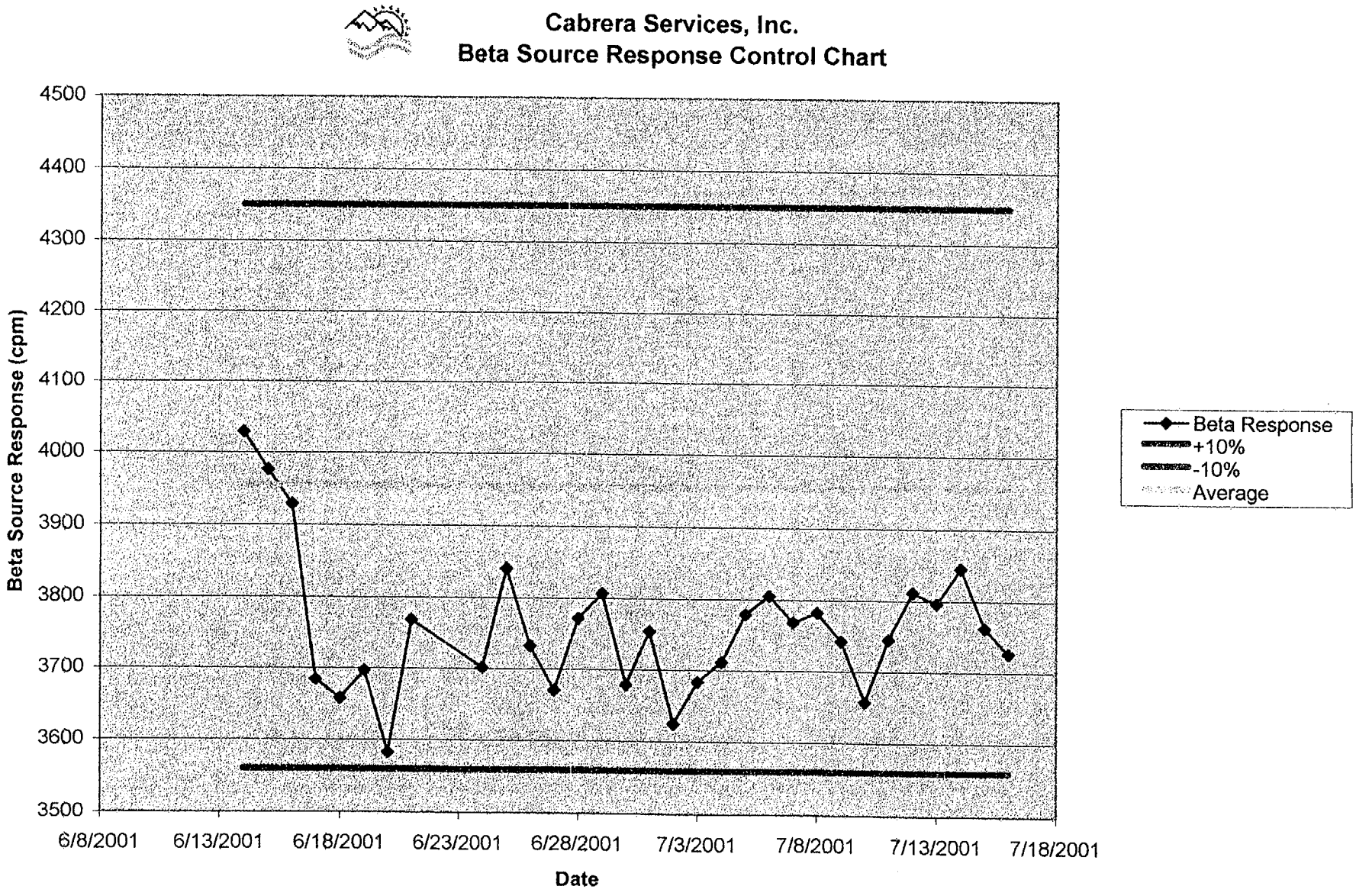
| SN: 163827 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Date | 20 Min Background | | 2 Min Source Check | | Background Rate (cpm) | | Source Rate (cpm) | |
| | Alpha | Beta | Alpha | Beta | Alpha | Beta | Alpha | Beta |
| 6/14/2001 | 2 | 940 | 16733 | 8056 | 0.10 | 47.0 | 8367 | 4028 |
| 6/15/2001 | 3 | 1005 | 16707 | 7953 | 0.15 | 50.3 | 8354 | 3977 |
| 6/16/2001 | 2 | 986 | 16426 | 7857 | 0.10 | 49.3 | 8213 | 3929 |
| 6/17/2001 | 1 | 940 | 16455 | 7368 | 0.05 | 47.0 | 8228 | 3684 |
| 6/18/2001 | 3 | 924 | 16631 | 7316 | 0.15 | 46.2 | 8316 | 3658 |
| 6/19/2001 | 2 | 952 | 16454 | 7394 | 0.10 | 47.6 | 8227 | 3697 |
| 6/20/2001 | 0 | 956 | 16441 | 7164 | 0.00 | 47.8 | 8221 | 3582 |
| 6/21/2001 | 2 | 941 | 16596 | 7536 | 0.10 | 47.1 | 8298 | 3768 |
| 6/24/2001 | 1 | 865 | 16500 | 7403 | 0.05 | 43.3 | 8250 | 3702 |
| 6/25/2001 | 4 | 881 | 16444 | 7680 | 0.20 | 44.1 | 8222 | 3840 |
| 6/26/2001 | 1 | 897 | 16297 | 7465 | 0.05 | 44.85 | 8148.5 | 3732.5 |
| 6/27/2001 | 2 | 907 | 16103 | 7341 | 0.1 | 45.35 | 8051.5 | 3670.5 |
| 6/28/2001 | 2 | 882 | 16478 | 7543 | 0.1 | 44.1 | 8239 | 3771.5 |
| 6/29/2001 | 3 | 906 | 16397 | 7613 | 0.15 | 45.3 | 8198.5 | 3806.5 |
| 6/30/2001 | 4 | 871 | 16249 | 7358 | 0.2 | 43.55 | 8124.5 | 3679 |
| 7/1/2001 | 3 | 892 | 16357 | 7508 | 0.15 | 44.6 | 8178.5 | 3754 |
| 7/2/2001 | 4 | 880 | 16555 | 7249 | 0.2 | 44 | 8277.5 | 3624.5 |
| 7/3/2001 | 2 | 885 | 16438 | 7366 | 0.1 | 44.25 | 8219 | 3683 |
| 7/4/2001 | 1 | 909 | 16353 | 7423 | 0.05 | 45.45 | 8176.5 | 3711.5 |
| 7/5/2001 | 1 | 960 | 16358 | 7558 | 0.05 | 48 | 8179 | 3779 |
| 7/6/2001 | 1 | 941 | 16412 | 7610 | 0.05 | 47.05 | 8206 | 3805 |
| 7/7/2001 | 4 | 920 | 16432 | 7536 | 0.2 | 46 | 8216 | 3768 |
| 7/8/2001 | 2 | 863 | 16424 | 7564 | 0.1 | 43.15 | 8212 | 3782 |
| 7/9/2001 | 1 | 1000 | 16425 | 7484 | 0.05 | 50 | 8212.5 | 3742 |
| 7/10/2001 | 2 | 962 | 16201 | 7314 | 0.1 | 48.1 | 8100.5 | 3657 |
| 7/11/2001 | 1 | 1146 | 16554 | 7490 | 0.05 | 57.3 | 8277 | 3745 |
| 7/12/2001 | 2 | 937 | 16440 | 7622 | 0.1 | 46.85 | 8220 | 3811 |
| 7/13/2001 | 1 | 880 | 16460 | 7592 | 0.05 | 44 | 8230 | 3796 |
| 7/14/2001 | 2 | 967 | 16514 | 7690 | 0.1 | 48.35 | 8257 | 3845 |
| 7/15/2001 | 3 | 944 | 16609 | 7524 | 0.15 | 47.2 | 8304.5 | 3762 |
| 7/16/2001 | 3 | 942 | 16531 | 7452 | 0.15 | 47.1 | 8265.5 | 3726 |


Cabrera Services, Inc.
Alpha Background Control Chart
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
Alpha Background Count Rate (cpm)
6/8/2001
6/13/2001
6/18/2001
6/23/2001
6/28/2001
7/3/2001
7/8/2001
7/13/2001
7/18/2001
Date
Alpha Background
-2 Sigma
+2 Sigma
Average


Cabrera Services, Inc.
Beta Background Control Chart
61.0
56.0
51.0
46.0
41.0
36.0
Beta Background Count Rate (cpm)
6/8/2001
6/13/2001
6/18/2001
6/23/2001
6/28/2001
7/3/2001
7/8/2001
7/13/2001
7/18/2001
Date
Beta Background
-2 Sigma
+2 Sigma
Average

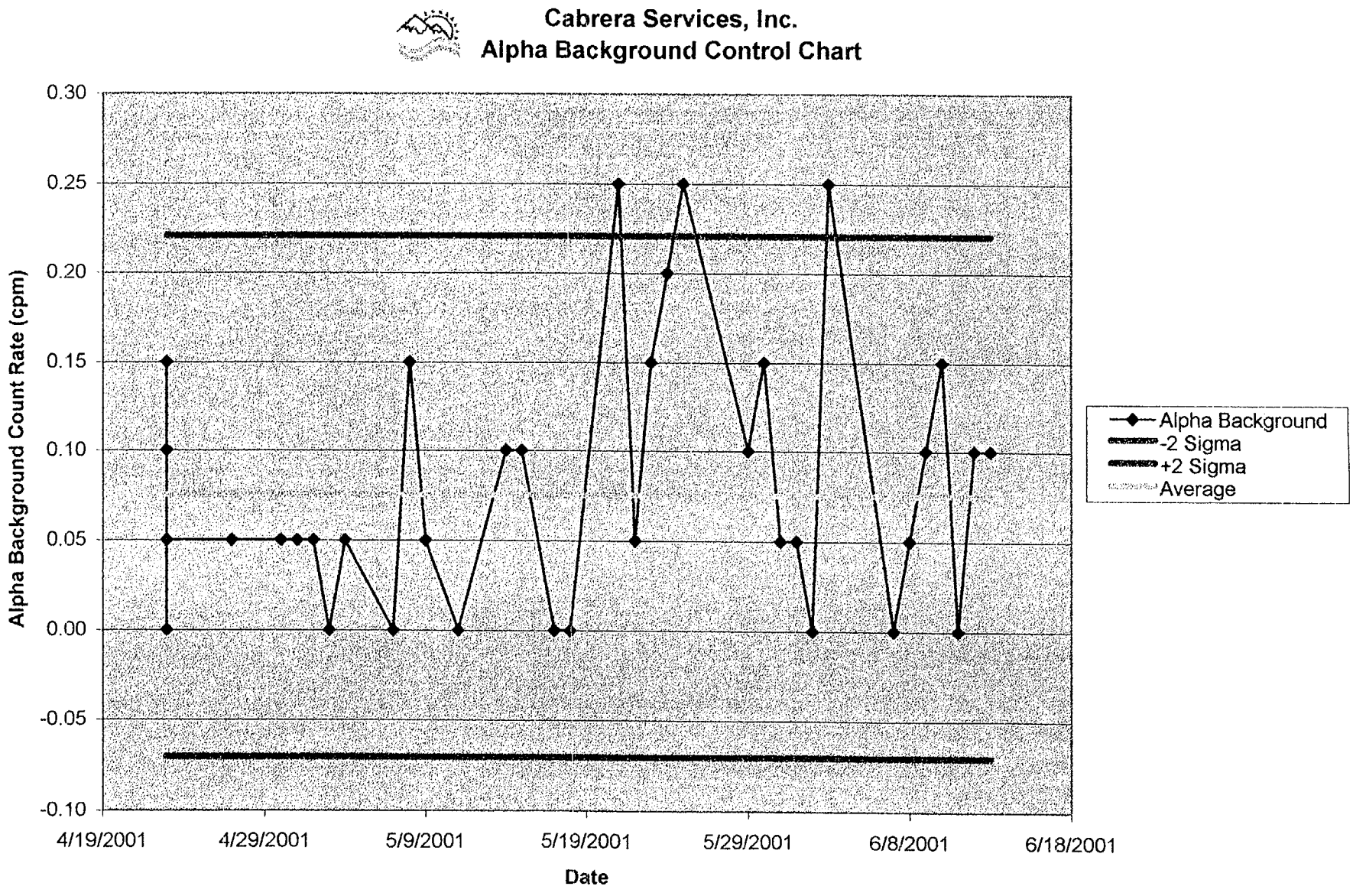
## Cabrera Services, Inc.
## Alpha Source Response Control Chart

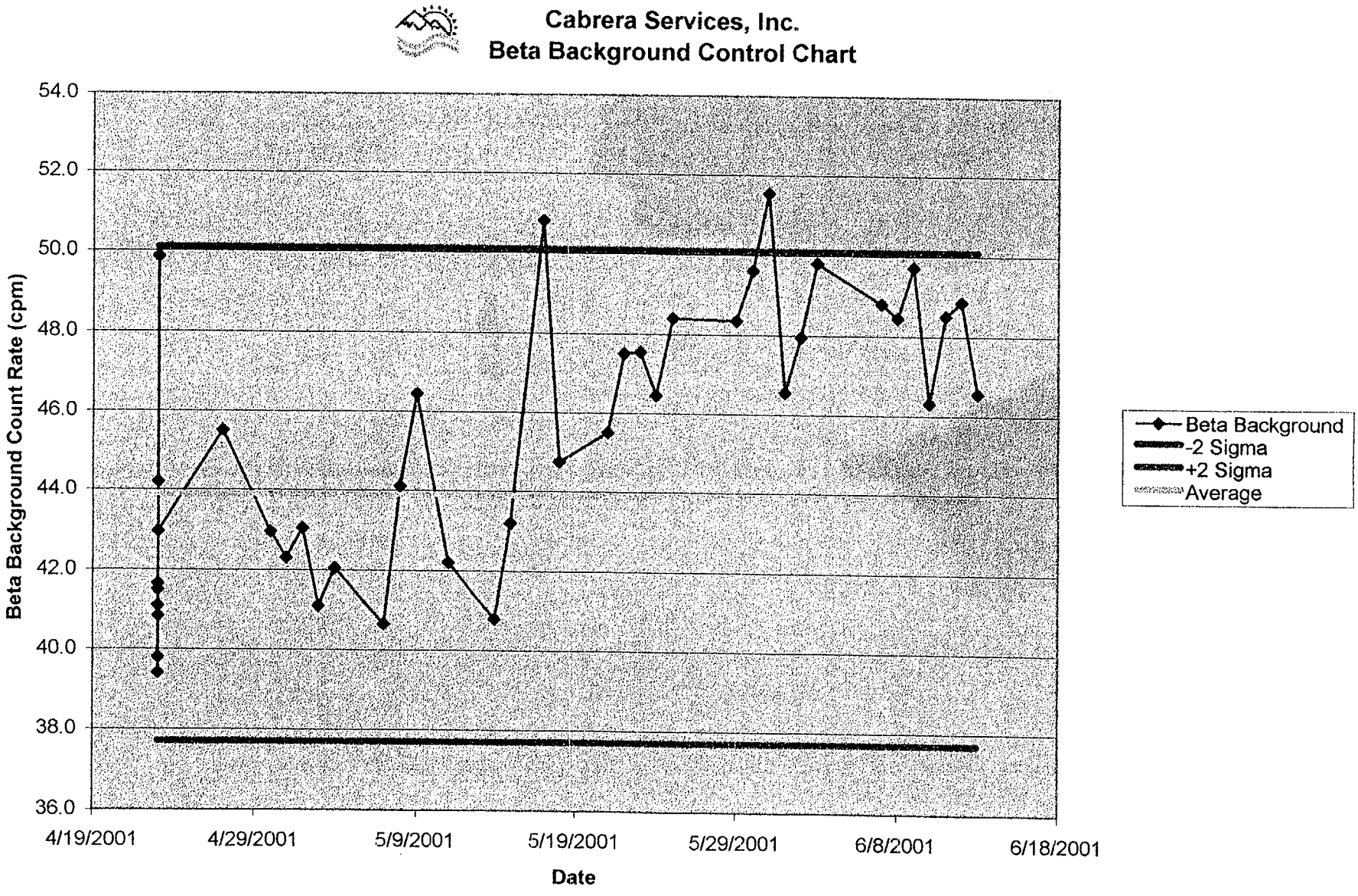


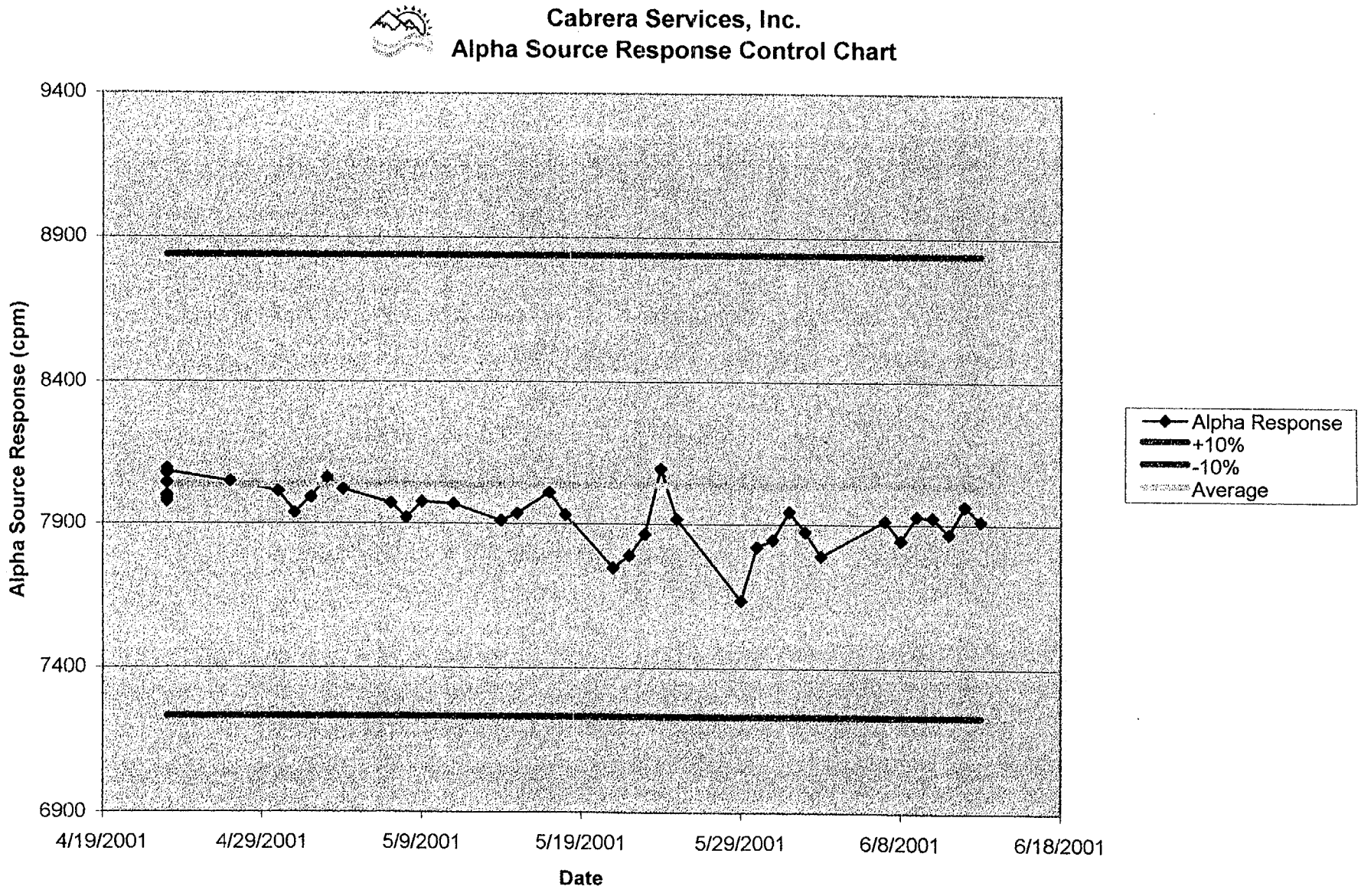

Cabrera Services, Inc.
Beta Source Response Control Chart
Beta Source Response (cpm)
4500
4400
4300
4200
4100
4000
3900
3800
3700
3600
3500
6/8/2001
6/13/2001
6/18/2001
6/23/2001
6/28/2001
7/3/2001
7/8/2001
7/13/2001
7/18/2001
Date
Beta Response
+10%
-10%
Average

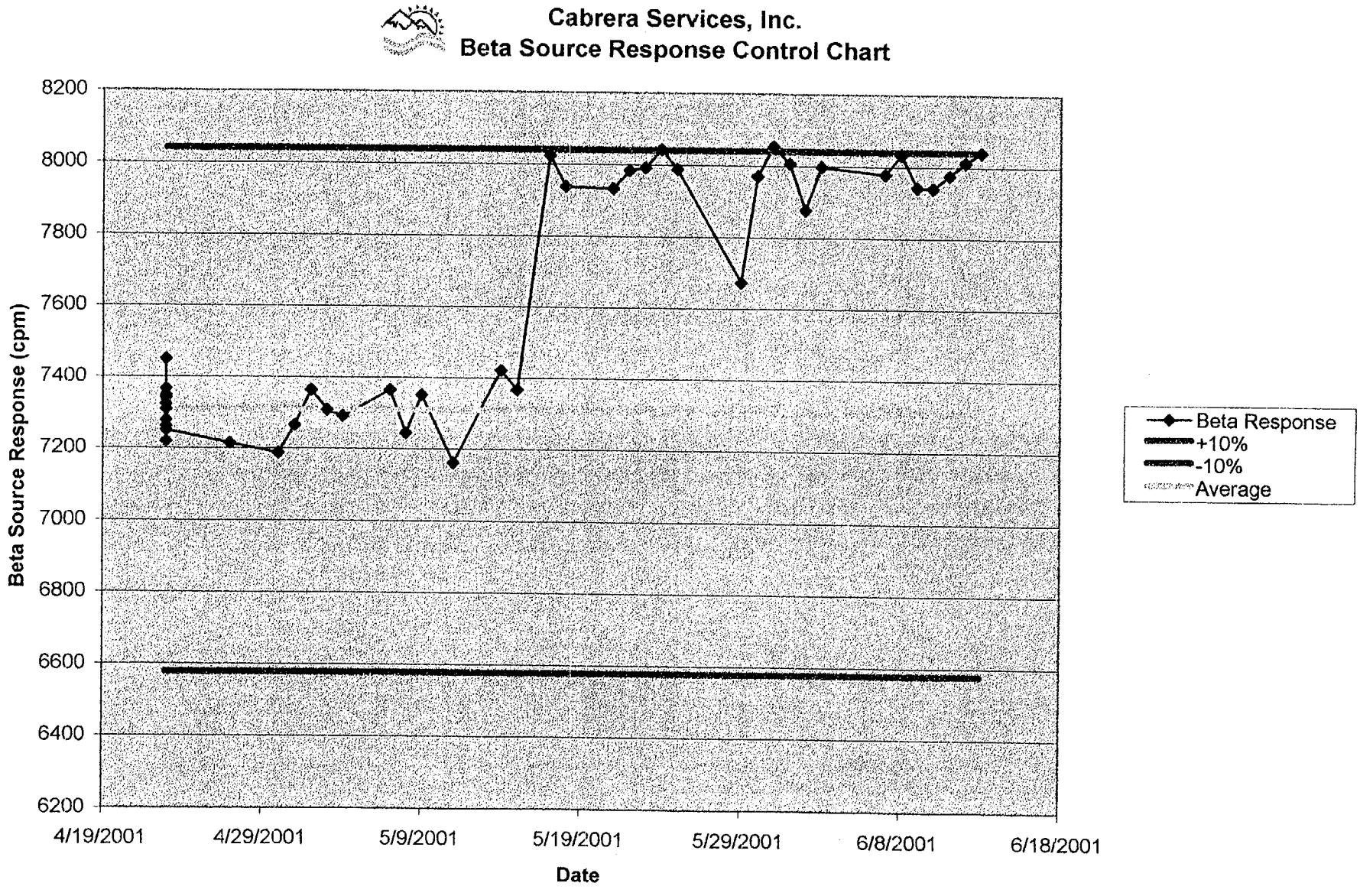
Cabrera Services, Inc.
Smear Counter QA Checks

| SN: 163827 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Date | 20 Min Background | | 2 Min Source Check | | Background Rate (cpm) | | Source Rate (cpm) | |
| | Alpha | Beta | Alpha | Beta | Alpha | Beta | Alpha | Beta |
| 4/23/2001 | 3 | 997 | 16185 | 14556 | 0.15 | 49.9 | 8093 | 7278 |
| 4/23/2001 | 2 | 817 | 15997 | 14694 | 0.10 | 40.9 | 7999 | 7347 |
| 4/23/2001 | 0 | 833 | 15987 | 14681 | 0.00 | 41.7 | 7994 | 7341 |
| 4/23/2001 | 3 | 796 | 16079 | 14647 | 0.15 | 39.8 | 8040 | 7324 |
| 4/23/2001 | 1 | 884 | 16146 | 14731 | 0.05 | 44.2 | 8073 | 7366 |
| 4/23/2001 | 1 | 822 | 15972 | 14899 | 0.05 | 41.1 | 7986 | 7450 |
| 4/23/2001 | 1 | 833 | 16081 | 14618 | 0.05 | 41.7 | 8041 | 7309 |
| 4/23/2001 | 0 | 788 | 15951 | 14523 | 0.00 | 39.4 | 7976 | 7262 |
| 4/23/2001 | 0 | 830 | 16084 | 14436 | 0.00 | 41.5 | 8042 | 7218 |
| 4/23/2001 | 1 | 859 | 16161 | 14500 | 0.05 | 43.0 | 8081 | 7250 |
| 4/27/2001 | 1 | 910 | 16094 | 14427 | 0.05 | 45.5 | 8047 | 7213.5 |
| 4/30/2001 | 1 | 859 | 16024 | 14372 | 0.05 | 42.95 | 8012 | 7186 |
| 5/1/2001 | 1 | 846 | 15874 | 14530 | 0.05 | 42.3 | 7937 | 7265 |
| 5/2/2001 | 1 | 861 | 15981 | 14725 | 0.05 | 43.05 | 7990.5 | 7362.5 |
| 5/3/2001 | 0 | 822 | 16119 | 14616 | 0 | 41.1 | 8059.5 | 7308 |
| 5/4/2001 | 1 | 841 | 16037 | 14581 | 0.05 | 42.05 | 8018.5 | 7290.5 |
| 5/7/2001 | 0 | 813 | 15941 | 14727 | 0 | 40.65 | 7970.5 | 7363.5 |
| 5/8/2001 | 3 | 882 | 15838 | 14488 | 0.15 | 44.1 | 7919 | 7244 |
| 5/9/2001 | 1 | 929 | 15949 | 14701 | 0.05 | 46.45 | 7974.5 | 7350.5 |
| 5/11/2001 | 0 | 844 | 15934 | 14321 | 0 | 42.2 | 7967 | 7160.5 |
| 5/14/2001 | 2 | 816 | 15818 | 14844 | 0.1 | 40.8 | 7909 | 7422 |
| 5/15/2001 | 2 | 864 | 15870 | 14732 | 0.1 | 43.2 | 7935 | 7366 |
| 5/17/2001 | 0 | 1016 | 16018 | 16044 | 0 | 50.8 | 8009 | 8022 |
| 5/18/2001 | 0 | 895 | 15863 | 15873 | 0 | 44.75 | 7931.5 | 7936.5 |
| 5/21/2001 | 5 | 910 | 15490 | 15863 | 0.25 | 45.5 | 7745 | 7931.5 |
| 5/22/2001 | 1 | 950 | 15576 | 15965 | 0.05 | 47.5 | 7788 | 7982.5 |
| 5/23/2001 | 3 | 951 | 15727 | 15982 | 0.15 | 47.55 | 7863.5 | 7991 |
| 5/24/2001 | 4 | 929 | 16185 | 16084 | 0.2 | 46.45 | 8092.5 | 8042 |
| 5/25/2001 | 5 | 968 | 15832 | 15974 | 0.25 | 48.4 | 7916 | 7987 |
| 5/29/2001 | 2 | 967 | 15269 | 15346 | 0.1 | 48.35 | 7634.5 | 7673 |
| 5/30/2001 | 3 | 992 | 15639 | 15938 | 0.15 | 49.6 | 7819.5 | 7969 |
| 5/31/2001 | 1 | 1031 | 15690 | 16106 | 0.05 | 51.55 | 7845 | 8053 |
| 6/1/2001 | 1 | 931 | 15887 | 16010 | 0.05 | 46.55 | 7943.5 | 8005 |
| 6/2/2001 | 0 | 959 | 15745 | 15753 | 0 | 47.95 | 7872.5 | 7876.5 |
| 6/3/2001 | 5 | 996 | 15577 | 15995 | 0.25 | 49.8 | 7788.5 | 7997.5 |
| 6/7/2001 | 0 | 976 | 15825 | 15955 | 0 | 48.8 | 7912.5 | 7977.5 |
| 6/8/2001 | 1 | 969 | 15686 | 16066 | 0.05 | 48.45 | 7843 | 8033 |
| 6/9/2001 | 2 | 994 | 15856 | 15881 | 0.1 | 49.7 | 7928 | 7940.5 |
| 6/10/2001 | 3 | 926 | 15847 | 15878 | 0.15 | 46.3 | 7923.5 | 7939 |
| 6/11/2001 | 0 | 970 | 15732 | 15950 | 0 | 48.5 | 7866 | 7975 |
| 6/12/2001 | 2 | 977 | 15927 | 16022 | 0.1 | 48.85 | 7963.5 | 8011 |
| 6/13/2001 | 2 | 931 | 15822 | 16079 | 0.1 | 46.55 | 7911 | 8039.5 |


Cabrera Services, Inc.
Alpha Background Control Chart
Alpha Background Count Rate (cpm)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
4/19/2001
4/29/2001
5/9/2001
5/19/2001
5/29/2001
6/8/2001
6/18/2001
Date
Alpha Background
-2 Sigma
+2 Sigma
Average


Cabrera Services, Inc.
Beta Background Control Chart
Beta Background Count Rate (cpm)
54.0
52.0
50.0
48.0
46.0
44.0
42.0
40.0
38.0
36.0
4/19/2001
4/29/2001
5/9/2001
5/19/2001
5/29/2001
6/8/2001
6/18/2001
Date
Beta Background
-2 Sigma
+2 Sigma
Average


Cabrera Services, Inc.
Alpha Source Response Control Chart
9400
8900
8400
7900
7400
6900
Alpha Source Response (cpm)
4/19/2001
4/29/2001
5/9/2001
5/19/2001
5/29/2001
6/8/2001
6/18/2001
Date
Alpha Response
+10%
-10%
Average


Cabrera Services, Inc.
Beta Source Response Control Chart
Beta Source Response (cpm)
8200
8000
7800
7600
7400
7200
7000
6800
6600
6400
6200
4/19/2001
4/29/2001
5/9/2001
5/19/2001
5/29/2001
6/8/2001
6/18/2001
Date
Beta Response
+10%
-10%
Average

EBERLINE SERVICES

# CERTIFICATE OF CALIBRATION

**Electroplated Beta Standard**

S.O.# 3759
P.O.# 01-325

**Description of Standard:**

Model No. DNS-12 Serial No. 2898-01 Isotope Tc-99

Electroplated on polished SS disc, 0.79 mm thick.

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

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

**Measurement Method:**

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

**Measurement Result:**

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

10,800 ± 432

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

17,300 ± 692 ( 0.00780 μCi)

The uncertainty of the measurement is 4 %, 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: Barbara M. Freiberg

Calibration Technician: Art Reust Q.A. Representative: [signature]

Calibration Date: 6-05-2001 Reviewed Date: 6/11/01

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

EBERLINE SERVICES

# CERTIFICATE OF CALIBRATION

**Electroplated Alpha Standard**

S.O.# 3759
P.O.# 01-325

**Description of Standard:**

Model No. DNS-11 Serial No. 2897-01 Isotope Th-230

Electroplated on polished SS disc, 0.79 mm thick.

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

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

**Measurement Method:**

The 2pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N 393/91.

**Measurement Result:**

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

11,400 ± 343

The total disintegration rate (dpm) assuming no backscatter of alpha particles from the surface of the disc, was:

22,800 ± 685 ( 0.0103 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: Barbara M. Fuhrey

Calibration Technician: Art Reust Q.A. Representative: [illegible]

Calibration Date: 6-11-2001 Reviewed Date: 6/14/01

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

GTS Instrument Services
2045 Route 286
Pittsburgh, PA 15239-2839
724/733-1900 Fax: 724/327-8189

# CALIBRATION CERTIFICATE

This Certificate will be accompanied by Calibration Charts or Readings where applicable

## CUSTOMER INFORMATION

Customer Name: GTS INSTRUMENT SERVICES
Customer Address:

Customer P.O.#
Work Order #

## INSTRUMENT INFORMATION

Instrument Manufacturer Ludlum
Model 19 Serial Number 87111 (345)
External Probe(s) Serial #

Calibration Method Pulser s/n 120935
$^{137}$Cs s/n 10263 200mCi

## INSTRUMENT CALIBRATION INFORMATION

| | Instrument Range | Calibration Standard Value | Instrument Response Before Calib. | Instrument Response After Calib. | Comment |
|---|---|---|---|---|---|
| 1 | 25 uR/hr | 2.14K CPM | | 10 uR/hr | All Calibrations Btn. + & - 10% |
| 2 | | 4.28K | | 20 | |
| 3 | | | | | Battery: OK |
| 4 | 50 | 2.14K | | 10 | |
| | | 8.56K | | 40 | Mechanical Zero: OK |
| | | | | | |
| 7 | 250 | 0.05 mR/hr | | 55 | Reset: OK |
| 8 | | 0.1 | | 100 | |
| 9 | | 0.2 | | 195 | Response: OK |
| 10 | | | | | |
| 11 | 500 | 0.1 | | 100 | Audio: OK |
| 12 | | 0.2 | | 200 | |
| 13 | | 0.4 | | 380 | Light: OK |
| 14 | | | | | |
| 15 | 5000 | 1 | | 1,000 | High Voltage = 657 Volts |
| 16 | | 2 | | 2,000 | |
| 17 | | 4 | | 3,800 | 1000 uR/hr = 214K CPM |
| 18 | | | | | |
| 19 | | | | | |
| 20 | | | | | |
| 21 | | | | | |
| 22 | | | | | |
| 23 | | | | | |

## STATEMENT OF CERTIFICATION

We Certify that the instrument listed above was calibrated and inspected prior to shipment and that it met all of the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology (We are not responsible for damage incurred during shipment or use of this instrument).

Instrument Calibrated by: James Christopher (Signed)
Calibration Date: 03-27-01
Next Calibration Due: 03-27-02

I certify that the above information is correct:
Administrative Coordinator
03-27-01
Date

GTS Instrument Services
2045 Route 286
Pittsburgh, PA 15239-2839
724/733-1900 Fax 724/327-8189

# ELECTRONIC CALIBRATION

## Electronic Calibration

1. Test Instrument: SEE
2. Pulse Rate: CAL
3. Amplitude: CERT
4. Time Period: ↳
5. Time Base: ↓
6. Counting Time: ↓
7. High Voltage: ↓
8. Counts: ↓

## Background Determination

9. Instrument Model: 2929/43-20-1
10. Serial Number: 118407/092751
11. Location: PGH, PA
12. Date: 4-16-01
13. Time: 1405
14. Test By: RCM
15. Time Period: 1
16. Time Base: X10
17. Counting Time: 10 MIN
18. Purge Time: N/A
19. Type of Radiation: [ ] Alpha [X] Beta
20. Background: 48.5 @ 750 V

## Efficiency Determination

21. Source & S/N: $Tc^{99}$ S-1256
22. Source DPM: 14260
23. Time Base: X1
24. Time Period: 1
25. Counting Time: 1 MIN
26. Average Count Rate $\left(\frac{\text{sum total A}}{10}\right)$ = 2755.3 CPM
27. 2 σ $(2\sqrt{\text{average count rate}})$ = 105.0
28. Chi Square Number $\left(\frac{\text{sum total C}}{\text{line 26}}\right)$ = 3.6
29. Chi Square Fit (2-22) = [X] Yes

If "NO" Contact Foreman [ ] No

30. Net Count Rate (line 26-line 20) 2706.8
31. Efficiency:

$\frac{\text{Net CPM (line 30)}}{\text{Source DPM (line 22)}}$ X 100= 19.0 %

| Trial # | CPM (A) | Difference from Ave. Count (B) | Difference Squared (C) |
|---|---|---|---|
| 1 | 2683 | 72.3 | 5227.3 |
| 2 | 2752 | 3.3 | 10.9 |
| 3 | 2747 | 8.3 | 68.9 |
| | 2756 | 0.7 | 0.5 |
| 5 | 2800 | 44.7 | 1998.1 |
| 6 | 2787 | 31.7 | 1004.9 |
| 7 | 2765 | 9.7 | 94.1 |
| 8 | 2724 | 31.3 | 979.7 |
| 9 | 2781 | 25.7 | 660.5 |
| 10 | 2759 | 7.7 | 7.3 |

TOTAL
A 275
B n/

GTS Instrument Services
2045 Route 286
Pittsburgh, PA 15239-2839
724/733-1900 Fax: 724/327-8189

# CALIBRATION CERTIFICATE

This Certificate will be accompanied by Calibration Charts or Readings where applicable

## CUSTOMER INFORMATION

Customer Name: GTS INSTRUMENT SERVICES
Customer Address: 2045 Rt. 286
Pittsburgh, PA 15239

Customer P.O.#
Work Order #

## INSTRUMENT INFORMATION

Instrument Manufacturer Ludlum
Model 2929 Serial Number 118407 (247)
External Probe(s) 43-10-1 Serial # 092751 (353)

Calibration Method Pulser s/n 101500
$^{99}$Tc s/n S-1256
$^{230}$Th s/n 11623

## INSTRUMENT CALIBRATION INFORMATION

| | Instrument Range | Calibration Standard Value | Instrument Response Before Calib. | Instrument Response After Calib. | Comment |
|---|---|---|---|---|---|
| 1 | BETA | | | | All Calibrations Btn. + & - 10% |
| 2 | 0.1 MIN | 40K CPM | 4,014 CPM | 4,014 CPM | HV Mechanical Zero: OK |
| 3 | | | | | |
| 4 | 1 | 40K | 40,133 | 40,133 | Audio: OK |
| 5 | 10 | 40K | 401,427 | 401,427 | High Voltage = 750 Volts = 3.02 on |
| 7 | | | | | dial |
| 8 | ALPHA | | 4,003 | 4,003 | |
| 9 | 0.1 MIN | 40K | | | BETA: |
| 10 | | | 40,130 | 40,130 | Input Sensitivity = 4mV |
| 11 | 1 | 40K | | | Window = 50mV |
| 12 | | | 401,386 | 401,386 | $^{99}$Tc Efficiency = 19.0% |
| 13 | 10 | 40K | | | |
| 14 | | | | | ALPHA |
| 15 | | | | | Input Sensitivity = 175mV |
| 16 | | | | | $^{230}$Th Efficiency = 21.6% |
| 17 | | | | | |
| 18 | | | | | |
| 19 | | | | | |
| 20 | | | | | |
| 21 | | | | | |
| 22 | | | | | |
| 23 | | | | | |

## STATEMENT OF CERTIFICATION

We Certify that the instrument listed above was calibrated and inspected prior to shipment and that it met all of the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology (We are not responsible for damage incurred during shipment or use of this instrument).

Instrument Calibrated by: (Signed)
Calibration Date: 04-16-01
Next Calibration Due: 04-16-02

I certify that the above information is correct:
Administrative Coordinator
04-16-01
Date

DURATEK
GTS Instrument Services
2045 Route 286
Pittsburgh, PA 15239-2839
724/733-1900 Fax 724/327-8189

# ELECTRONIC CALIBRATION

## Electronic Calibration

1. Test Instrument: SEE
2. Pulse Rate: CAL
3. Amplitude: CERT
4. Time Period: ↳
5. Time Base:
6. Counting Time:
7. High Voltage:
8. Counts:

## Background Determination

9. Instrument Model: 2929/43-60-1
10. Serial Number: 118407/092751
11. Location: PGH, PA
12. Date: 4-16-01
13. Time: 1350
14. Test By: RRM
15. Time Period: 1
16. Time Base: X10
17. Counting Time: 10 MIN
18. Purge Time: N/A
19. Type of Radiation: [X] Alpha [ ] Beta
20. Background: 0.6 @ 750 V

## Efficiency Determination

21. Source & S/N: $Th^{230}$ #11623
22. Source DPM: 17400
23. Time Base: X1
24. Time Period: 1
25. Counting Time: 1 MIN
26. Average Count Rate $\left(\frac{\text{sum total A}}{10}\right)$ = 3759.7 CPM
27. 2 σ $(2\sqrt{\text{average count rate}})$ = 122.6
28. Chi Square Number $\left(\frac{\text{sum total C}}{\text{line 26}}\right)$ = 8.2
29. Chi Square Fit (2-22) = [X] Yes

If "NO" Contact Foreman [ ] No

30. Net Count Rate (line 26-line 20) 3759.1
31. Efficiency:

$\frac{\text{Net CPM (line 30)}}{\text{Source DPM (line 22)}} \times 100 =$ 21.6%

| Trial # | CPM (A) | Difference from Ave. Count (B) | Difference Squared (C) |
|---|---|---|---|
| 1 | 3760 | 0.3 | 0.1 |
| 2 | 3750 | 9.7 | 94.1 |
| 3 | 3850 | 90.3 | 8154.1 |
| 4 | 3862 | 102.3 | 10465.3 |
| 5 | 3748 | 8.3 | 68.9 |
| 6 | 3766 | 6.3 | 39.7 |
| 8 | 3742 | 17.7 | 313.3 |
| 9 | 3721 | 38.7 | 1497.7 |

TOTAL A3759

Designer and Manufacturer of Scientific and Industrial Instruments

# CERTIFICATE OF CALIBRATION

**LUDLUM MEASUREMENTS, INC.**
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER CABRERA SERVICES ORDER NO. 259530/253545

g. Ludlum Measurements, Inc. Model 3 Serial No. 166511

Mfg. Ludlum Measurements, Inc. Model 44-9 Serial No. PR 171184

Cal. Date 19-Feb-01 Cal Due Date 19-Feb-02 Cal. Interval 1 Year Meterface 202-002

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 20 % Alt 702.8 mm Hg

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

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

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

Instrument Volt Set 900 V Input Sens. 37 mV Det. Oper. 900 V at 37 mV Threshold Dial Ratio = mV

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

**COMMENTS:**

Isotope Tc-99 s/n NI-EV at 14100cpm read 5000cpm on screen of 44-9 detector less 52cpm background for an efficiency of 35% 2pi
Isotope Th-230 s/n 9802110121 at 2999cpm read 950cpm on screen of 44-9 detector less 52cpm background for an efficiency of 30% 2pi
No "as founds" for detector - tube replaced

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* |
|---|---|---|---|
| X 100 | 400 Kcpm | 3.85 | 4 |
| X 100 | 100 Kcpm | 0.85 | 1 |
| X 10 | 40 Kcpm | 3.9 | 4 |
| X 10 | 10 Kcpm | 0.65 | 1 |
| X 1 | 4 Kcpm | 3.9 | 4 |
| X 1 | 1 Kcpm | 0.65 | 1 |
| X 0.1 | 400 cpm | 3.9 | 4 |
| X 0.1 | 100 cpm | 0.65 | 1 |

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

| | REFERENCE CAL. POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING* | | REFERENCE CAL. POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING* |
|---|---|---|---|---|---|---|---|
| Digital Readout | | | | 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:**

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

Alpha S/N ☐ Beta S/N ☐ Other

☑ m 500 S/N 54668 ☐ Oscilloscope S/N ☑ Multimeter S/N 57770265

Calibrated By: Date 19 Feb 01

Reviewed By: Date 22 Feb 01

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

FORM C22A 12/28/2000

☐ Passed Dielectric (Hi-Pot) and Continuity Test

Designer and Manufacturer
of
Scientific and Industrial
Instruments

**LUDLUM MEASUREMENTS, INC.**
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

# CONVERSION CHART

Customer CABRERA SERVICES Date 19-Feb-01 Order #. 259530/253545

Model 3 Serial No. 166511 Detector Model 44-9 Serial No. PR 171154

Source Cs-137 194.6 mCi Cs-137 20 mCi High Voltage 900 V

Input Sensitivity 37 mV

| Reference Point | "As Found" Readings (CPM): Meter Reading | Range/Scale | After Adjustment Readings (CPM): Meter Reading | Range/Scale |
|---|---|---|---|---|
| 150 mR/hr | Tube | Replaced | 3.45 (K) | x100 |
| 50 mR/hr | N/A | | 1.45 | x100 |
| 15 mR/hr | | | 4.8 | x10 |
| 5 mR/hr | | | 1.7 | x10 |
| 1.5 mR/hr | | | 0.45 | x10 |
| 1.0 mR/hr | | | 3.3 | x1 |

ature: Date 19 Feb 01

FORM C17-1A 05/20/98

Designer and Manufacturer of Scientific and Industrial Instruments

COPY

# CERTIFICATE OF CALIBRATION

**LUDLUM MEASUREMENTS, INC.**
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER CABRERA SERVICES ORDER NO. 259530/253545

Ifg. Ludlum Measurements, Inc. Model 3 Serial No. 79498

Mfg. Ludlum Measurements, Inc. Model 44-9 Serial No. PR 073107

Cal. Date 19-Feb-01 Cal Due Date 19-Feb-02 Cal. Interval 1 Year Meterface 202-002

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 20 % Alt 702.8 mm Hg

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

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

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

Instrument Volt Set 900 V Input Sens. 27 mV Det. Oper. 900 V at 27 mV Threshold Dial Ratio = mV

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

**COMMENTS:**

Isotope Tc-99 s/n NI-EV at 14100cpm read 5000cpm on screen of 44-9 detector less 60cpm background for an efficiency of 35% 2pi
Isotope Th-230 s/n 9802110121 at 2999cpm read 850cpm of screen of 44-9 detector less 60cpm background for an efficiency of 26% 2pi
No "as founds" - replaced noisy cable

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* |
|---|---|---|---|
| X 100 | 400 Kcpm | N/A | 4 |
| X 100 | 100 Kcpm | | 1 |
| X 10 | 40 Kcpm | | 4 |
| X 10 | 10 Kcpm | | 1 |
| X 1 | 4 Kcpm | | 4 |
| X 1 | 1 Kcpm | | 1 |
| X 0.1 | 400 cpm | | 4 |
| X 0.1 | 100 cpm | | 1 |

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

| | REFERENCE CAL. POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING* | | REFERENCE CAL. POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING* |
|---|---|---|---|---|---|---|---|
| tal dout | | | | Log Scale | | | |

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 ternational 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. bration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978 State of Texas Calibration License No. LO-1963

**rence Instruments and/or Sources:**

Gamma S/N ☐ 1162 ☑ G112 ☐ M565 ☐ S105 ☐ T1008 ☐ T879 ☐ E552 ☑ E551 ☐ Neutron Am-241 Be S/N T-304

/ /N ☐ Beta S/N ☐ Other

n 500 S/N 54668 ☐ Oscilloscope S/N ☑ Multimeter S/N 57770265

cted By: Date 19 Feb 01

ved By: Date 22 Feb 01

ficate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.
206 12/28/2000

Designer and Manufacturer of Scientific and Industrial Instruments

COPY

**LUDLUM MEASUREMENTS, INC.**
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

# CONVERSION CHART

Customer CABRERA SERVICES Date 19-Feb-01 Order #. 259530/253545

Model 3 Serial No. 79498 Detector Model 44-9 Serial No. PR 073107

Source Cs-137 194.6 mCi Cs-137 20 mCi

High Voltage 900 V

Input Sensitivity 27 mV

| Reference Point | "As Found" Readings (CPM): Meter Reading | Range/Scale | After Adjustment Readings (CPM): Meter Reading | Range/Scale |
|---|---|---|---|---|
| 150 mR/hr | N/A | | 2.1 (K) | x100 |
| 50 mR/hr | | | 1.1 | x100 |
| 15 mR/hr | | | 4.2 | x10 |
| 5 mR/hr | | | 1.6 | x10 |
| 1.5 mR/hr | | | 0.5 | x10 |
| 1.0 mR/hr | | | 3.3 | x1 |

Signature: [signature] Date 19 Feb 01

Designer and Manufacturer of Scientific and Industrial Instruments

# CERTIFICATE OF CALIBRATION

**LUDLUM MEASUREMENTS, INC.**
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER CABRERA SERVICES ORDER NO. 261837/254721

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 163673

Mfg. Ludlum Measurements, Inc. Model 44-10 Serial No. PR 166279

Cal. Date 13-Apr-01 Cal Due Date 13-Apr-02 Cal. Interval 1 Year Meterface 202-159

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 34 % Alt 702.8 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) 5.0 VDC

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

Instrument Volt Set Comments V Input Sens. Comments mV Det. Oper. Comments V at Comments mV Threshold Dial Ratio 100 = 10 mV

☑ HV Readout (2 points) Ref./Inst. 517 / 500 V Ref./Inst. 2010 / 2000 V

**COMMENTS:**

| | | |
|---|---|---|
| Peak settings | Gross Counts | Model 2221 currently set |
| High Voltage: 730v | ~~1000v~~ 950v | for gross counts |
| Threshold dial: 642 | 100(10mv) | High voltage set with detector |
| Window dial: 40 | n/a | connected. |
| Window Position: "IN" | "OUT" | |
| Resolution for Cs137: ≈1uCi 10% | n/a | Firmware:26-10-72 |

EFF: for Depleted Uranium #4595 1260cpm 6178cpm -Bg6071 = 107cpm 8.5% 2Pi.

Cal. with 9 39" Cable

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* |
|---|---|---|---|
| X 1000 | 400 Kcpm | 400 | 400 |
| X 1000 | 100 Kcpm | 100 | 100 |
| X 100 | 40 Kcpm | 400 | 400 |
| X 100 | 10 Kcpm | 100 | 100 |
| X 10 | 4 Kcpm | 400 | 400 |
| X 10 | 1 Kcpm | 100 | 100 |
| X 1 | 400 cpm | 400 | 400 |
| X 1 | 100 cpm | 100 | 100 |

*Uncertainty within ± 10% C.F. within ± 20%

ALL Range(s) Calibrated Electronically

| | REFERENCE CAL. POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING* | | REFERENCE CAL. POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING* |
|---|---|---|---|---|---|---|---|
| Digital Readout | 400 K cpm | 40108(a) | 40108(a) | Log Scale | 500 K cpm | 500k | 500K |
| | 40 K cpm | 4013 | 4013 | | 50 K cpm | 50k | 50k |
| | 4 K cpm | 401 | 401 | | 5 K cpm | 5 K | 5 K |
| | 400 cpm | 40 | 40 | | 500 cpm | 500 | 500 |
| | 40 cpm | 4 | 4 | | 50 cpm | 50 | 50 |

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 ☐ 1162 ☐ G112 ☐ M565 ☐ S105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Cs-137~1uCi AM241~0.77uCi

Ratemeter 500 S/N 54683 ☐ Oscilloscope S/N ☑ Multimeter S/N 70602489

Calibrated By: Duane Jackson Date 13-Apr-01

Reviewed By: Rhonda Harris Date 14 Apr 01

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

FORM C22A 12/28/2000

☐ Passed Dielectric (Hi-Pot) and Continuity Test

Designer and Manufacturer
of
Scientific and Industrial
Instruments

**LUDLUM MEASUREMENTS, INC.**
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

## Bench Test Data For Detector

Detector 44-10 Serial No. PR 166279

Customer CABRERA SERVICES Order #. 261837/254721

Counter 2221 Serial No. 163673 Counter Input Sensitivity 10 mV

Count Time 60sec. Source Distance Source to Detector Surface

Other

| High Voltage | Background | Isotope Am-241 Size ≈0.7μci | Isotope Size | Isotope Size | Isotope Size |
|---|---|---|---|---|---|
| 800 | 614 | 10216 | | | |
| 850 | 648 | 11507 | | | |
| 900 | 683 | 12963 | | | |
| 950 | 692 | 13441 | | | |
| 1000 | 705 | 13618 | | | |
| 1050 | 720 | 13635 | | | |
| 1100 | 757 | 13749 | | | |

Signature Duaine Jackson Date 13-Apr-01

FORM C4A 02/23/94

Designer and Manufacturer of Scientific and Industrial Instruments

# CERTIFICATE OF CALIBRATION

**LUDLUM MEASUREMENTS, INC.**
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER CABRERA SERVICES ORDER NO. 261837/254721

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 97841

Mfg. Ludlum Measurements, Inc. Model 44-10 Serial No. PR 166295

Cal. Date 13-Apr-01 Cal Due Date 13-Apr-02 Cal. Interval 1 Year Meterface 202-159

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 34 % Alt 702.8 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) 5.0 VDC
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set Comments V Input Sens. Comments mV Det. Oper. Comments V at Comments mV Threshold Dial Ratio 100 = 10 mV

☑ HV Readout (2 points) Ref./Inst. 507 / 500 V Ref./Inst. 1989 / 2000 V

**COMMENTS:**

| Peak settings | Gross Counts |
|---|---|
| High Voltage: 629v | 1000v |
| Threshold dial: 642 | 100(10mv) |
| Window dial: 40 | n/a |
| Window Position: "IN" | "OUT" |
| Resolution for Cs137: ≈1uCi 11% | n/a |

Model 2221 currently set for gross counts
High voltage set with detector connected.

Firmware:26-10-72

EFF: for Depleted Uranium #4595 1260cpm 6983cpm - Bg 6819 = 164cpm 13% 2pi

Cal. with a 39" Cable.

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* |
|---|---|---|---|
| X 1000 | 400 Kcpm | 400 | 400 |
| X 1000 | 100 Kcpm | 100 | 100 |
| X 100 | 40 Kcpm | 400 | 400 |
| X 100 | 10 Kcpm | 100 | 100 |
| X 10 | 4 Kcpm | 400 | 400 |
| X 10 | 1 Kcpm | 100 | 100 |
| X 1 | 400 cpm | 400 | 400 |
| X 1 | 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 | 400 K cpm | 40129(0) | 40129(0) |
| | 40 K cpm | 4012 | 4012 |
| | 4 K cpm | 401 | 401 |
| | 400 cpm | 40 | 40 |
| | 40 cpm | 4 | 4 |

| | REFERENCE CAL. POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING* |
|---|---|---|---|
| Log Scale | 500 K cpm | 495K | 495K |
| | 50 K cpm | 45K | 45K |
| | 5 K cpm | 4.5K | 4.5K |
| | 500 cpm | 500 | 500 |
| | 50 cpm | 50 | 50 |

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 ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Cs-137~1uCi AM241~0.77uCi

☐ Ion 500 S/N 54683 ☐ Oscilloscope S/N ☑ Multimeter S/N 70602489

Calibrated By: Duwain Jackson Date 13-Apr-01

Reviewed By: Rhonda Hafner Date 14 Apr 01

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

FORM C22A 12/28/2000

☐ Passed Dielectric (Hi-Pot) and Continuity Test

Designer and Manufacturer
of
Scientific and Industrial
Instruments

**LUDLUM MEASUREMENTS, INC.**
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

# Bench Test Data For Detector

Detector 44-10 Serial No. PR 166295

Customer CABRERA SERVICES

Order #. 261837/254721

Counter 2221 Serial No. 97841

Counter Input Sensitivity ~~Comments~~ 10 mV

Count Time 60sec.

Distance Source to Detector Surface

Other

| High Voltage | Background | Isotope Am-241 Size ~0.77μci | Isotope ____ Size ____ | Isotope ____ Size ____ | Isotope ____ Size ____ |
|---|---|---|---|---|---|
| 850 | 646 | 13152 | | | |
| 900 | 678 | 13221 | | | |
| 950 | 686 | 13286 | | | |
| 1000 | 688 | 13332 | | | |
| 1050 | 690 | 13362 | | | |
| 1100 | 764 | 13389 | | | |
| 1150 | 943 | 13629 | | | |

Signature Ducaine Jackson

Date 13-Apr-01

FORM C4A 02/23/94

Designer and Manufacturer of Scientific and Industrial Instruments

# CERTIFICATE OF CALIBRATION

**LUDLUM MEASUREMENTS, INC.**
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER CABRERA SERVICES ORDER NO. 259951 / 253739

Mfg. Ludlum Measurements, Inc. Model 2929 Serial No. 163827

Mfg. Ludlum Measurements, Inc. Model 43-10-1 Serial No. PR 171322

Cal. Date 1-Mar-01 Cal Due Date 1-Mar-02 Cal. Interval 1 Year Meterface 202-014

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 71 °F RH 20 % Alt 701.8 mm Hg

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

☑ Mechanical ck. ☑ Window Operation

☑ Audio ck.

☑ Meter Zeroed Alpha Sensitivity 175 mV Beta Sensitivity 4 mV Beta Window 50 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.

Instrument Volt Set 875 V = 348 on High Voltage dial. High Voltage set with detector connected.

☑ HV Readout (2 points) Ref./Inst. 494 / 500 V Ref./Inst. 2021 / 2000 V

**COMMENTS:**

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

| Alpha Channel Digital Readout | REFERENCE CAL POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING* |
|---|---|---|---|
| | 400K cpm | 399977 | 399977 |
| | 40K cpm | 39988 | 39988 |
| | 4K cpm | 3999 | 3999 |
| | 400 cpm | 400 | 400 |
| | 40 cpm | 40 | 40 |

| Beta/Gamma Channel Digital Readout | REFERENCE CAL POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING* |
|---|---|---|---|
| | 400K cpm | 399897 | 399897 |
| | 40K cpm | 39990 | 39990 |
| | 4K cpm | 3997 | 3997 |
| | 400 cpm | 400 | 400 |
| | 40 cpm | 40 | 40 |

*Uncertainty within ± 10% C.F. within ± 20%

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 ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ Neutron Am-241 Be S/N T-304

☑ Alpha S/N Pu-239 4337 ☑ Beta S/N Tc-99 Ni-EV, C-14 GV 471 ☐ Other

500 S/N 134709 ☐ Oscilloscope S/N ☑ Multimeter S/N 57390613

Calibrated By: Conrad Salinas Date 1 Mar 01

Reviewed By: Brooke Hain Date 2 Mar 01

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

FORM C25 12/28/2000

☑ Passed Dielectric (Hi-Pot) and Continuity Test

Designer and Manufacturer
of
Scientific and Industrial
Instruments

**LUDLUM MEASUREMENTS, INC.**
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

# Bench Test Data For Detector

Detector 43-10-1 Serial No. PR 171322

Customer CABRERA SERVICES

Counter 2929 Serial No. 163827

Count Time 1Minute

Other

Order #. 259951 / 253739

Alpha Input Sensitivity 175 mV

Beta Input Sensitivity 4 mV

Beta Window 50 mV

Distance Source to Detector Tray

| High Voltage | Background Alpha | Background Beta | Isotope Pu-239 Size 15700cpm Alpha | Isotope Pu-239 Size 15700cpm Beta | Isotope Tc-99 Size 14100cpm Alpha | Isotope Tc-99 Size 14100cpm Beta | Isotope C-14 Size 119983cpm Alpha | Isotope C-14 Size 119983cpm Beta |
|---|---|---|---|---|---|---|---|---|
| | | | 30,935 dpm | | 22.6K dpm | | 239,966 dpm | |
| 825 | 0 | 66 | 12280 | 297 | 1 | 6828 | 0 | 17375 |
| 850 | 0 | 70 | 12478 | 340 | 3 | 7291 | 0 | 22265 |
| 875 | 0 | 77 | 12709 | 335 | 4 | 8097 | 0 | 27966 |
| 900 | 0 | 52 | 12567 | 424 | 2 | 8505 | 0 | 33446 |
| 925 | 1 | 80 | 12544 | 542 | 6 | 8963 | 1 | 35551 |

☐ 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 Conrad Jakinda Date 1 Mar 01

FORM C4B 12/09/97

# REPORT OF CALIBRATION

**Electroplated Beta Source** 07 605/83

Description of Source:

Principal radionuclide Technetium 99

Electroplated on polished Ni (type of metal) disc, approximately 0.79 mm thick.

Diameter, 2.54 cm active, 3.18 cm total.

Radioactive material permanently fixed to the disc by heat treatment, without any covering over the active surface.

Calibration Date: August 24, 1983

Measurement Method:

The $2\pi$ beta emission rate was measured using an internal gas flow proportional chamber. Traceability to NBS has been demonstrated, the most recent intercomparison with NBS being June and July 1974 when the EIC–NBS agreement was within 0.3%.

Measurement Result:

The total number of beta particles emitted from the surface of the disc per minute on the above date was

14,500 ± 400

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

22,900 ± 700 (0.0103 uCi)

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 conceivable systematic error in this measurement.

Information on isotopic composition or radioactive impurities:

Calibrated by: Jim Arellano
(please print or type)

(signature)

eberline
Eberline Instrument Corporation
P.O. Box 3874
Albuquerque, New Mexico 87110

C400

THE SOURCE INC.

Radiation standards and check sources
2810 Siler Lane Santa Fe, NM 87501
(505)473-9538 FAX(505)473-5805

# Certificate of Calibration
## (Alpha Source)

The alpha source was measured in a gas proportional counter using P-10 as counting gas. The alpha emissions from the surface of the source were measured at its plateau voltage to determine its 2π cpm rate. Corrections were applied for background, coincidence loss and backscatter factors when applicable.
Alpha standard 93TH2204190 is our NIST referenced source used in establishing NIST traceability.
The calibration source was not manufactured by the The Source Inc.
Purity of the source was not checked only the alpha emission rate off the surface of the source .

REF.PO#
Model Recalibration

| | | | | |
|---|---|---|---|---|
| 10,100 | cpm ± | 505 | cpm 2π | |
| 19,800 | dpm ± | 990 | dpm 4π | |
| 0.00892 | microcurie | | | |
| 12-16-95 | date of measurement | | | |
| E121495 | source serial number | | | |
| 5.0 | overall uncertainty(percent) | | | |
| 1.5 | backscatter(percent) | | | |

Michael A. Ortiz/VP. Michael A. Ortiz
Calibration Manager

Charles L. Gonzales
Quality Assurance Manager

less than 20dpm leak test results(dpm /100cm$^2$)

# F&J SPECIALTY PRODUCTS, INC.

PO Box 2888
Ocala, Florida 34478-2888
Tel: (352) 680-1177 / (352) 680-1178
Fax: (352) 680-1454
Email: fandj@atlantic.net Internet: www.fjspecialty.com
*The Nucleus of Quality Air Monitoring Programs*


## Quality Control Procedure
## Actual Flow Rate vs. Indicated Flow Rate

CAL002 Rev. 0
Pg 1
2/21/2000

**General Information**

**Serial Number:** 002449

**PO #:** AN-30816/VERBAL

**Customer:** ATLANTIC NUCLEAR CORP.

1. A **Test Facility :** F&J Calibration Lab

B **Elevation :** Sea Level

C **Date of Test :** 9/13/00

D **Atmospheric Pressure :** 29.93

E. **Inlet Temperature to System :** 78.1

F. **Digital Venturi Calibrator :**

(A) Manufacturer : F&J SPECIALTY PRODUCTS, INC.
(B) Model # : D-812
(C) Serial # : 3135

G **Air Sampler System Model** LV-1

| (1) Air Sampler Observed Flow Rate CFM | (2) Temp. & Pressure Correction | Air Sampler STP Flow Rate (1) x (2) | Digital Calibrator STP Flow Rate |
|---|---|---|---|
| 3.50 | 0.9663 | 3.38 | 3.32 |
| 2.80 | 0.9729 | 2.72 | 2.62 |
| 2.10 | 0.9779 | 2.05 | 2.07 |
| 1.40 | 0.9832 | 1.38 | 1.43 |

***** The AVERAGE PERCENT DEVIATION ACROSS THE RANGE IS :** 2.60

*The Reference Flow Meter Device bears letters of certification traceable to the National Institute of Standards and Technology(NIST).*

# ACTUAL FLOW RATE vs. INDICATED FLOW RATE
## QUALITY CONTROL PROCEDURE FJ-1
**Serial #:** 002449

## II. TEST DATA

**Filters Utilized:**

**Particulate:** FP47M
**Charcoal / Silver Zeolite:** NONE

| (1) Flow Indicated on Rotometer (CFM) | (2) Atmospheric Pressure (in. Hg) | (3) Inlet Temperature (Degrees F) | (4) Gauge Pressure (in. Hg) | (5) Temperature and Pressure Correction | (6) Calculated Flow (1) X (5) (SCFM) | (7) Digital Calibrator STP Flow (SCFM) | (8) Percent Deviation ((7) - (6))/(7) (%) |
|---|---|---|---|---|---|---|---|
| 3.5 | 29.93 | 78.1000 | 1.5656 | 0.9663 | 3.38 | 3.32 | 1.87 |
| 2.8 | 29.93 | 78.1000 | 1.1760 | 0.9729 | 2.72 | 2.62 | 3.98 |
| 2.1 | 29.93 | 78.1000 | 0.8820 | 0.9779 | 2.05 | 2.07 | 0.80 |
| 1.4 | 29.93 | 78.1000 | 0.5660 | 0.9832 | 1.38 | 1.43 | 3.74 |

**(5) Temperature and Pressure Correction** = Sqr((((2) - (4)) / 29.92) * (530 / (460 + (3))))

**Average Deviation:** 2.60

**Performed by:** Noe Morales

**Date:** 9/13/2000

# Final Inspection Certificate

CAL009

Revision 0 Date: 2/14/2000

This is to certify that LV-1

Serial Number 002449 has been inspected

in accordance with Quality Control Procedure FJ1 and that this unit meets all specified operating requirements. Furthermore, this unit has been calibrated with the required tolerances and the Reference Flow Meter device bears letters of certification traceable to the National Institute of Standards and Technology(NIST).

Date: 9/13/00 QC Inspector: Paul J Cheries

F&J SPECIALTY PRODUCTS, INC. P.O. Box 2888, Ocala, Florida 34478-2888 (352) 680-1177

# F&J SPECIALTY PRODUCTS, INC.

PO Box 2888
Ocala, Florida 34478-2888
Tel: (352) 680-1177 • (352) 680-1178
Fax: (352) 680-1454
Email: fandj@atlantic.net Internet: www.fjspecialty.com
*The Nucleus of Quality Air Monitoring Programs*


## Quality Control Procedure
## Actual Flow Rate vs. Indicated Flow Rate



**General Information**

**Serial Number:** 002590

**PO #:** AN32377/01-265

**Customer:** ATLANTIC NUCLEAR CORPORATI

1. A **Test Facility :** F&J Calibration Lab

   B **Elevation :** Sea Level

   C **Date of Test :** 4/10/01

   D **Atmospheric Pressure :** 30.11

   E. **Inlet Temperature to System :** 74.2

   F. **Digital Venturi Calibrator :**

   **(A) Manufacturer** : F&J SPECIALTY PRODUCTS, INC.
   **(B) Model #** : D-812
   **(C) Serial #** : 3061

   G **Air Sampler System Model** LV-1

| (1) Air Sampler Observed Flow Rate CFM | (2) Temp. & Pressure Correction | Air Sampler STP Flow Rate (1) x (2) | Digital Calibrator STP Flow Rate |
|---|---|---|---|
| 3.50 | 0.9736 | 3.41 | 3.32 |
| 2.80 | 0.9795 | 2.74 | 2.68 |
| 2.10 | 0.9851 | 2.07 | 2.04 |
| 1.40 | 0.9900 | 1.39 | 1.41 |

***** The AVERAGE PERCENT DEVIATION ACROSS THE RANGE IS :** 2.02

*The Reference Flow Meter Device bears letters of certification traceable to the National Institute of Standards and Technology(NIST).*

# ACTUAL FLOW RATE vs. INDICATED FLOW RATE
## QUALITY CONTROL PROCEDURE FJ-1
**Serial #:** 002590

## II. TEST DATA

**Filters Utilized:**

**Particulate:** FP-47M
**Charcoal / Silver Zeolite:** NONE

| (1) Flow Indicated on Rotometer (CFM) | (2) Atmospheric Pressure (in. Hg) | (3) Inlet Temperature (Degrees F) | (4) Gauge Pressure (in. Hg) | (5) Temperature and Pressure Correction | (6) Calculated Flow (1) X (5) (SCFM) | (7) Digital Calibrator STP Flow (SCFM) | (8) Percent Deviation ((7) - (6))/(7) (%) |
|---|---|---|---|---|---|---|---|
| 3.5 | 30.11 | 74.2000 | 1.5215 | 0.9736 | 3.41 | 3.32 | 2.64 |
| 2.8 | 30.11 | 74.2000 | 1.1760 | 0.9795 | 2.74 | 2.68 | 2.34 |
| 2.1 | 30.11 | 74.2000 | 0.8452 | 0.9851 | 2.07 | 2.04 | 1.41 |
| 1.4 | 30.11 | 74.2000 | 0.5535 | 0.9900 | 1.39 | 1.41 | 1.70 |

**(5) Temperature and Pressure Correction** = Sqr((((2) - (4)) / 29.92) * (530 / (460 + (3))))

**Average Deviation:** 2.02

**Performed by:** Joe Morales

**Date:** 4/10/2001

# Final Inspection Certificate

CAL009

Revision 0 Date: 2/14/2000

This is to certify that LV-1

Serial Number 002590 has been inspected

in accordance with Quality Control Procedure FJ1 and that this unit meets all specified operating requirements. Furthermore, this unit has been calibrated with the required tolerances and the Reference Flow Meter device bears letters of certification traceable to the National Institute of Standards and Technology(NIST).

Date: 4/10/01 QC Inspector: Abel Morales

F&J SPECIALTY PRODUCTS, INC. P.O. Box 2888, Ocala, Florida 34478-2888 (352) 680-1177

# F&J SPECIALTY PRODUCTS, INC.

PO Box 2888
Ocala, Florida 34478-2888
Tel: (352) 680-1177 • (352) 680-1178
Fax: (352) 680-1454
Email: fandj@atlantic.net Internet: www.fjspecialty.com


*The Nucleus of Quality Air Monitoring Programs*

## Quality Control Procedure
## Actual Flow Rate vs. Indicated Flow Rate



**General Information** **Serial Number:** 002591

**PO #:** AN32377/01-265

**Customer:** ATLANTIC NUCLEAR CORPORATI

1. A **Test Facility :** F&J Calibration Lab

   B **Elevation :** Sea Level

   C **Date of Test :** 4/10/01

   D **Atmospheric Pressure :** 30.11

   E. **Inlet Temperature to System :** 73.1

   F. **Digital Venturi Calibrator :**

   (A) **Manufacturer** : F&J SPECIALTY PRODUCTS, INC.
   (B) **Model #** : D-812
   (C) **Serial #** : 3061

   G **Air Sampler System Model** LV-1

| (1) Air Sampler Observed Flow Rate CFM | (2) Temp. & Pressure Correction | Air Sampler STP Flow Rate (1) x (2) | Digital Calibrator STP Flow Rate |
|---|---|---|---|
| 3.50 | 0.9726 | 3.40 | 3.27 |
| 2.80 | 0.9792 | 2.74 | 2.65 |
| 2.10 | 0.9851 | 2.07 | 2.03 |
| 1.40 | 0.9907 | 1.39 | 1.40 |

***** The AVERAGE PERCENT DEVIATION ACROSS THE RANGE IS :** 2.60

*The Reference Flow Meter Device bears letters of certification traceable to the National Institute of Standards and Technology(NIST).*

# ACTUAL FLOW RATE vs. INDICATED FLOW RATE
## QUALITY CONTROL PROCEDURE FJ-1

**Serial #:** 002591

## II. TEST DATA

**Filters Utilized:**

**Particulate:** FP-47M
**Charcoal / Silver Zeolite:** NONE

| (1) Flow Indicated on Rotometer (CFM) | (2) Atmospheric Pressure (in. Hg) | (3) Inlet Temperature (Degrees F) | (4) Gauge Pressure (in. Hg) | (5) Temperature and Pressure Correction | (6) Calculated Flow (1) X (5) (SCFM) | (7) Digital Calibrator STP Flow (SCFM) | (8) Percent Deviation ((7) - (6))/(7) (%) |
|---|---|---|---|---|---|---|---|
| 3.5 | 30.11 | 73.1000 | 1.6391 | 0.9726 | 3.40 | 3.27 | 4.11 |
| 2.8 | 30.11 | 73.1000 | 1.2569 | 0.9792 | 2.74 | 2.65 | 3.46 |
| 2.1 | 30.11 | 73.1000 | 0.9041 | 0.9851 | 2.07 | 2.03 | 1.91 |
| 1.4 | 30.11 | 73.1000 | 0.5733 | 0.9907 | 1.39 | 1.40 | 0.93 |

**(5) Temperature and Pressure Correction** = Sqr((((2) - (4)) / 29.92) * (530 / (460 + (3))))

**Average Deviation:** 2.60

**Performed by:** Joe Mowder

**Date:** 4/10/2001

# Final Inspection Certificate

CAL009

Revision 0 Date: 2/14/2000

This is to certify that LV-1

Serial Number 002591 has been inspected

in accordance with Quality Control Procedure FJ1 and that this unit meets all specified operating requirements. Furthermore, this unit has been calibrated with the required tolerances and the Reference Flow Meter device bears letters of certification traceable to the National Institute of Standards and Technology(NIST).

Date: 4/10/01 QC Inspector: Abel Morales Jr

F&J SPECIALTY PRODUCTS, INC. P.O. Box 2888, Ocala, Florida 34478-2888 (352) 680-1177

# Lake City Army Ammunition Plant Radiological Remediation of the 600-Yard Bullet Catcher

## Appendix 3
## Procedure Supplements

# *Cabrera Services, Inc.*

# PROJECT WORK PLAN SUPPLEMENT

Decontamination, and
Final Status Surveys

## Lake City Army Ammunition Plant

Blue Springs, MO - May, 2001

Prepared By: _____ 5/21/01
Thomas J. O'Dou, CHP, RRPT, Project Manager

Reviewed By: _____
Dave Watters, Program Manager

# TABLE OF CONTENTS

Page

1.0 BACKGROUND ..... 1
- 1.1 Project Objective ..... 1
- 1.2 Management Approach ..... 1

2.0 SITE DESCRIPTION ..... 2
- 2.1 Type And Location Of Facility ..... 2
- 2.2 Ownership ..... 2
- 2.3 Facility Description ..... 2
- 2.4 Building ..... 3
- 2.5 Grounds ..... 3

3.0 OPERATING HISTORY ..... 3
- 3.1 Licensing and Operations ..... 3
- 3.2 Methods ..... 3
- 3.3 Waste-Disposal Practices ..... 3

4.0 PROJECT ACTIVITIES ..... 4
- 4.1 Objectives ..... 4
- 4.2 Results of Previous Surveys ..... 4
- 4.3 Decontamination Procedures ..... 4
- 4.4 PPE & Area Controls ..... 4

5.0 PROJECT PROCEDURES ..... 5
- 5.01 Waste Removal ..... 5
- 5.02 Safety Scans ..... 6
- 5.03 Containerization ..... 6
- 5.1 Material Packaging ..... 6
- 5.2 Equipment And Packaging Selected ..... 6
- 5.3 Instruments and Equipment ..... 7

6.0 FINAL STATUS SURVEYS ..... 7

7.0 DOCUMENTATION ..... 7

# SUPPLEMENTAL WORK PLAN(S) FOR ACTIVITIES
# at
# Lake City Army Ammunition Plant
# 600-Yard Bullet Catcher Area

## 1.0 BACKGROUND

This supplemental plan is to provide direction regarding additional actions needed to ensure appropriate removal and preparation of materials from the 600-yard bullet catcher for disposal. In addition, these actions will ensure removal of potentially energetic materials from the soil, minimized waste volume, and inclusion of safety precautions during operations to ensure protection of personnel during these additional actions.

These actions are required due to the discovery of the potentially energetic rounds during the initial phase of the remediation. As a result of this discovery, it is planned to evaluate all material on the ground in layers of approximately 6 inches to 12 inches for the presence of rounds potentially containing explosive residues. These rounds will be removed from the material before it is placed into the intermodal containers for ultimate disposal.

In that initial phase, two 20 cubic yard roll-off boxes were filled. These boxes will be surface evaluated for the presence of potentially explosive materials, a sampling of at least 20 rounds will be extracted and heated to identify if an explosive hazard exists. Should any of the rounds explode, the material will require processing to remove any remaining potentially explosive materials.

### 1.1 PROJECT OBJECTIVE

This supplement indicates the procedure required for removal of potentially energetic material from the sandy soil at the 600-yard bullet catcher at Lake City Army Ammunition Plant. This action is required to ensure that personnel safety is protected and that the waste acceptance criteria at Waste Consolidation Specialists and at Barnwell Radioactive Waste Disposal Site are met.

### 1.2 MANAGEMENT APPROACH

The project shall involve evaluating sandy soil from the 600-yard bullet catcher and surrounding area to remove potentially energetic materials from the soil.

Management shall ensure that all precautions necessary are taken to protect personnel from explosive hazards, chemical hazards, and radiological hazards as well as other day to day work hazards, which may be present at the site.

Radiation dosimetry shall be worn be all involved personnel. The dosimetry for the crew shall be provided by Cabrera Services, controlled by Cabrera procedures, and processed by a certified dosimetry vendor.

Based on the sampling results in the area, on site air sampling will be conducted during evaluation and removal operations until it is proven that it is no longer necessary. Site perimeter air sampling will be conducted for the duration of all removal operations.

Dose rate measurements during the initial remediation phase and during the characterization indicate that no person is likely to be exposed to a whole body dose greater that 1 millirem per hour. Provided analysis indicates the area background at approximately 14 micro-rem/hour. Contamination has been evaluated in the area and has not been detected on any equipment or personnel.

Work shall be performed in accordance with the project Health/Safety plan and project Quality Assurance Plan. This project plan is scheduled to be completed over a 10-week period beginning on or about May 18, 2001 with a daily work schedule that meets the security requirements of the base and firing schedule of the range.

## 2.0 SITE DESCRIPTION

The work site consists of three the bullet catcher and surrounding area, which is laden with depleted uranium fragments and some potentially energetic materials.

### 2.1 TYPE AND LOCATION OF FACILITY

The 600-yard bullet catcher is a steel structure located on the firing range at the Lake City Army Ammunition Plant. The site was designed to collect fired projectiles for testing and demilitarization. The facility is described in detail in the site-decommissioning plan.

### 2.2 OWNERSHIP

This base is owned by the United States Army and operated by Alliant Techsystems (ATK).

### 2.3 FACILITY DESCRIPTION

The 600-yard bullet catcher is approximately 20 feet wide by 15 feet high and 15 feet deep. The structure is made of a ½ inch steel frame with wood supports. A small earth cover (approximately 6 inches deep) is present atop the structure.

The bullet catcher was used for demilitarization of approximately 40,000 rounds of depleted uranium projectiles.

### 2.4 BUILDINGS

There are no other buildings in the area of concern.

### 2.5 GROUNDS

The area immediately outside the bullet catcher (approximately 300 feet in radius is suspected of containing non-homogeneous amounts of depleted uranium due to movement of the materials during the demilitarization actions taken at the site and due to migration of the materials from the bullet catcher by weathering.

## 3.0 OPERATING HISTORY

The operating history of the bullet catcher is described in detail in the decommissioning plan. Depleted uranium projectiles were fired into the bullet catcher for demilitarization as indicated in the characterization report for the range.

### 3.1 LICENSING AND OPERATIONS

This project and its remedial actions shall be conducted by Cabrera Services, Inc. under the NRC decommissioning plan approved for remediation of the site.

### 3.2 METHODS

The removal of projectiles and projectile fragments from the soil will be completed without removal of the soil from the area where it currently exists, there will be no processing of the soil prior to disposal. During this operation, personnel protective measures shall be taken and potentially energetic materials shall be removed from the soil to ensure minimization of dose and that the waste acceptance criteria for the selected waste site is met.

### 3.3 WASTE-DISPOSAL PRACTICES

There are known areas where radioactive fragments of depleted uranium projectiles are present. However, there has never been a case of radioactive contamination of personnel or equipment identified at the site.

Energetic materials will be removed from the sand and soil mixture at the 600-yard bullet catcher to ensure appropriate disposal of the waste. An alternative to removal of the energetic materials at the Lake City site is shipment to a vendor with UXO, and RCRA capability for removal of the explosive materials by burning before disposal at a radioactive materials disposal facility.

# 4.0 PROJECT ACTIVITIES

The primary concerns about this project from a management standpoint are the protection of personnel and the environment and meeting the waste acceptance criteria of the disposal facility for the waste sent there. All activities will be performed using the safest, most direct and efficient methods with regard to all applicable ALARA controls. ALARA means that dose (risk) to personnel will be maintained As Low As Reasonably Achievable.

## 4.1 OBJECTIVES

The objective of this scope of work is to separate potentially energetic materials from the soil at the 600-yard bullet catcher at Lake City Army Ammunition Plant, package waste material created for disposal, and conduct final status surveys while maintaining personnel safety. All non-radioactive materials will be surveyed for radioactive contamination prior to release from the area.

## 4.2 RESULTS OF PREVIOUS SURVEYS

This site has been surveyed many times over the years for characterization, control during experiments involving phyto-remediation, and preparation for remediation. At no time was radioactive contamination a concern because it was never found in all of the surveys conducted.

Dose rates in the area vary in general from background to approximately 100 micro-rem per hour above background. Dose rates as high as 1 millirem per hour were observed close to high concentrations of the material during the characterization.

## 4.3 DECONTAMINATION PROCEDURES

Should contamination be identified on personnel or equipment, Cabrera Services procedures for measurements of ionizing radiation and radioactivity shall be followed to ensure that all radioactive and/or contaminated materials are properly controlled.

Decontamination/Remediation shall be performed using routine methods, such as wipe down with a soft cloth, hand scraping and mechanical drilling and or scabbling of steel or wood. By application of the appropriate controls, contamination of personnel and tools is unlikely under the conditions at this site. Should a contamination incident occur, personnel and equipment will be decontaminated in accordance with Cabrera Services procedures.

## 4.4 PPE & AREA CONTROLS

Work areas will be established with regard to the known presence of depleted uranium fragments. All decisions regarding radiological health practices will be made in accordance with Cabrera Services procedures by the Cabrera Services, Inc. Radiation

Safety Officer or a Cabrera Services Health Physicist. The controlling document will be the RWP.

## 5.0 PROJECT PROCEDURES

A continuous posting shall be established to prevent migration of the material outside the area boundaries.

### 5.01 WASTE REMOVAL

**CAUTION**

**Materials shall not be transferred to the disposal container until a UXO individual has evaluated the materials for potentially energetic materials and a gamma scan has been done to identify the presence of large (potentially complete) fragments of depleted uranium rounds.**

This is necessary to ensure that no potentially explosive materials are sent to the waste disposal site.

1) The work area shall be posted and access controlled.
2) Lo-Vol air samplers shall be positioned in the work area breathing zones to monitor airborne activity during soil disturbances.
3) UXO cleared material will be transferred in batches to the containers.

### 5.02 SAFETY SCANS

The following items shall be followed conducting safety scans of the sand/soil for potentially explosive materials.

1) The work area shall be posted and access will be controlled.
2) A qualified UXO inspector shall be present in the area to conduct the scan.
3) The UXO inspector shall evaluate the top of the material for the presence of potentially explosive materials (steel jacket 20 mm rounds).
4) Proper EOD procedures shall be followed and coverage provided to ensure protection of personnel.
5) The material shall be evaluated for the presence of large fragments of depleted uranium using a gamma scintillation detector.
6) Any potentially explosive materials (DU containing or non-DU containing) shall be removed from the material by UXO personnel and placed in a lay-down area prior to transfer for disposal.
7) Large DU containing objects without the potential for explosion will be placed in a 55 gallon drum with other similar materials for disposal.

The disposal of materials shall be in accordance with figure D-1.

**Figure D-1**
**Disposal of Materials**

Soil/sand and small DU fragments – Waste Consolidation Specialists

20 mm projectiles – non-radioactive (potentially explosive) – Safety Clean
20 mm projectiles – radioactive (potentially explosive) – Perma Fix or Primex

Large DU fragments (not potentially explosive) – Barnwell S.C.

## 5.03 CONTAINERIZATION

The following items shall be considered when loading material into containers.

1) The work area shall be posted and access controlled.
2) Lo-Vol air samplers will be positioned in the work area breathing zone to monitor airborne activity during the transfer of the material to the containers.
3) The area immediately around the transfer containers shall be covered to collect spillage from the loading operation.
4) The containers shall be surveyed prior to their removal from the area to the container collection area.

## 5.1 MATERIAL PACKAGING

The handling, packaging, and shipping of radioactive sources and any contaminated materials generated during cleanup, are within the scope of routine materials handling. A certified radioactive materials broker is required for the shipping portion and a senior radiation protection technician is required for radiation protection job coverage.

Handling and packaging will be performed as follows:

**NOTE**

**LAYDOWN AREAS WILL NOT BE ALLOWED TO REMAIN WHEN CABRERA SERVICES PERSONNEL ARE NOT PRESENT IN ANY AREA WHERE CONTAMINATION CONTROLS ARE ESTABLISHED.**

**Radioactive Materials**

Radioactive materials generated during the effort will be placed in intermodal containers (20 cubic yard boxes or equivalent). The full or partially full containers will be visually inspected and surveyed externally to determine integrity prior to being moved onto the established lay down work area.

After smear samples have been taken, the container will be properly labeled, stored and placed in a posted radioactive materials area prior to being labeled, manifested, and shipped.

The contents of the container will be inspected and surveyed to determine the approximate Curie content to be assigned to this material. The integrity of the container may be verified at that time.

The lay down area will be surveyed for contamination and decontaminated as required after removal of the containers. This area shall be inspected prior to setting another container in place.

A brief survey of the area will be performed after all materials have been removed. This is to identify any DU fragments that may have been left in the area.

All equipment will be surveyed to ensure no radioactive materials are present before its release.

**Energetic Materials**

Trained UXO personnel shall remove energetic and potentially energetic materials from the soil at the bullet catcher area. These materials are recognized by visual observation of the sand/soil and projectile/fragment mix at the site. The materials are picked from the material and stored in a temporary holding area prior to transfer to a more permanent storage site authorized for storage of energetic materials pending their transfer to a proper disposal facility.

The storage site shall be secured each day to prevent unauthorized access. Cabrera Services personnel and other personnel with access to the storage area shall not handle the potentially energetic materials stored there unless UXO personnel are present.

Energetic materials shall not be placed into the waste containers. The purpose of this operation is to ensure that the waste sent to an authorized burial site does not contain energetic materials.

## 5.2 EQUIPMENT AND SURVEY METHODS SELECTED

UXO personnel will used metal detectors to single out large ferrous (20 mm and higher) potentially energetic rounds. These detectors will have discriminators set to identify ferrous materials in the top 6 to 12 inches of soil.

The instruments selected are appropriate for the type and activity of radioactive material at the work site. The Ludlum Model 2221 rate meter/scalar with a 2" by 2" Sodium

Iodide is useful for quantification of gamma emitters for release of the area. Surveys will be performed according to Cabrera Services procedures.

For the final status survey, a 100% survey of the area will be made with the sodium iodide detector and GPS combination. Samples will be taken for gamma analysis to determine the approximate uranium content for comparison to the limiting concentration of 35 pCi/gram.

### 5.3 RADIATION DETECTION INSTRUMENTS AND EQUIPMENT

*Beta detection and component release surveys*
Ludlum Model 3 with Model 44-9 pancake GM probe

*Smear analysis for alpha and beta emissions*
Ludlum 2929 dual scalar with 43-10 dual phosphor scintillation detector

*Gamma detection*
Ludlum Model 44-10 gamma scintillation detector

All instruments are calibrated within the last twelve months by the instrument vendor, a certified calibration laboratory. The calibration of these instruments is via sources with activity traceable to the National Institute of Standards and Technology (NIST).

## 6.0 FINAL STATUS SURVEYS

Final status surveys of facilities in this work plan will be conducted in accordance with the guidance given for these surveys in the decommissioning plan.

## 7.0 DOCUMENTATION

All survey data collected will be recorded on survey forms. Survey data will be collected and recorded in accordance with Cabrera Services procedures.

# *Cabrera Services, Inc.*

# SUPPLEMENTAL PROJECT HEALTH AND SAFETY PLAN

Decontamination, and
Final Status Surveys

**Lake City Army Ammunition Plant**

Blue Springs, MO - May, 2001

Prepared By: 5/21/01

Thomas J. O'Dou, CHP, Project Manager

# SITE HEALTH AND SAFETY PLAN AND EMERGENCY OPERATIONS PLANS
## TABLE OF CONTENTS

Page

1.0 INTRODUCTION ..... 1
- 1.1 Scope/Applicability of the Site Health and Safety Plan Supplement ..... 1
- 1.2 Visitors ..... 2

2.0 KEY PERSONNEL/IDENTIFICATION OF HEALTH AND SAFETY PERSONNEL ..... 2
- 2.1 Key Personnel ..... 2
- 2.2 Site Specific Health and Safety Personnel ..... 2

3.0 SUPPLEMENTAL TASK/OPERATION SAFETY AND HEALTH RISK ANALYSIS ..... 3
- 3.1 Historical Overview of Site ..... 3
- 3.2 Task by Task Risk Analysis ..... 3

4.0 SUPPLEMENTAL PERSONNEL TRAINING REQUIREMENTS ..... 7
- 4.1 Pre-Assignment and Annual Refresher Training ..... 7
- 4.2 Site Supervisors Training ..... 7
- 4.3 Training and Briefing Topics ..... 8

5.0 SUPPLEMENTAL PERSONAL PROTECTIVE EQUIPMENT TO BE USED ..... 9
- 5.1 Levels of Protection ..... 9
- 5.2 Protective Equipment ..... 11
- 5.3 Specific Levels of Protection Planned for the Project Task Assignments ..... 18

6.0 MEDICAL SURVEILLANCE REQUIREMENTS ..... 18
- 6.1 Baseline or Pre-Assignment Monitoring ..... 19
- 6.3 Site Specific Medical Monitoring ..... 19

7.0 SUPPLEMENTAL FREQUENCY AND TYPES OF PERSONNEL AIR SAMPLING ..... 20

8.0 SITE CONTROL MEASURES ..... 20
- 8.1 Buddy System ..... 20
- 8.2 Site Communications Plan ..... 20
- 8.3 Work Zone Definition ..... 21
- 8.4 Nearest Medical Assistance ..... 21
- 8.5 Safe Work Practices ..... 21
- 8.6 Emergency Alarm Procedures ..... 21

9.0 EMERGENCY RESPONSE/CONTINGENCY PLAN ..... 27
- 9.1 Pre-Emergency Planning ..... 27
- 9.2 Personnel Roles and Lines of Authority ..... 27
- 9.3 Emergency Recognition/Prevention ..... 27

9.4 Evacuation Routes/Procedures ..... 27
9.5 Emergency Contact/Notification System ..... 28
9.6 Emergency Medical Treatment Procedures ..... 28
9.7 Fire and Explosion ..... 29
9.8 Spill or Leaks ..... 29
9.9 Emergency Equipment/Facilities ..... 30

## TABLES AND FIGURES

### TABLES

10.1 Emergency Recognition/Control Measures ..... 30
10.2 Cabrera Internal Call List ..... 31

### FIGURES

8.1 Site Map Depicting Work Zone ..... 22
8.2 Map Depicting Route to Nearest Medical Facilities ..... 23
10.1 Evacuation Routes and Safe Distances ..... 32
10.2 Site Map with Emergency Equipment Located ..... 33

# 1.0 INTRODUCTION

This Site Health and Safety Plan (HASP) supplemental document defines the safety requirements necessary during remedial actions identified at the Lake City Army Ammunition Plant in accordance with and State and Federal Regulations. Primarily these additional actions are associated with the discovery and necessary removal of potentially energetic materials in the soil at the 600-yard bullet catcher area.

A 1961 inspection of the impact areas concluded that very little dispersion had occurred with the type of firing being conducted and the fragments of the projectile were contained within about two feet of the impact point. However, they did state that decontamination of the area was undesirable due to the presence of unexploded rounds. The normal procedure for disposal of any unexploded round is to place an explosive charge next to it and use it to cause the explosives in the round to function. The normal charge of explosives used is either ½ or 1 pound of TNT or equivalent. This would result in a much larger dispersion of the DU from the impact area, (U.S. Army Environmental Hygiene Agency, 1961). As of March 1962, 54 dud munitions were recorded during test firing, (Headquarters, Army Research and Development Command, Picatinny Arsenal 1962). The area of contamination is different from that time period as identified in the 1994 Characterization of the Firing Range for Radioactive Materials.

It is now recognized as a result of initial evaluation of the material at the work site that unexploded ordnance will be encountered during work activities. The sand in the 600-Yard Bullet Catcher and surrounding area will be evaluated for UXO content by metal detectors and radiological surveys of the bullet catcher structure. Unexploded ordinance will be removed from the soil as it is found. Caution is necessary and appropriate. Before digging or excavating any areas on the range, Cabrera Explosive Ordnance Division (UXO) personnel will first clear the area(s). All discovered UXO will be removed from the soil and properly secured to prevent injury to personnel.

## 1.1 Scope/Applicability of the Site Health and Safety Plan

The purpose of this Supplemental Site Health and Safety Plan (HASP) is to define the requirements and designate protocols to be followed at Lake City Army Ammunition Plant during the removal of radioactive materials at the 600-yard bullet catcher and surrounding area. Applicability extends to all Military, Civil Servants, contractors, subcontractors, and visitors.

All Cabrera and contractor personnel working on site at Lake City Army Ammunition Plant in the work area shall be made aware of health and safety hazards associated with the removal of potentially energetic materials from identified radioactive soil. Because of the degree of activity at this site, at or near background in all areas, protective clothing for radioactive materials is not needed. Protective clothing and materials shall be used to prevent injuries associated with discharge of energetic materials. Should other hazards be discovered, the project manager will stop work and take action to control the hazard and protect personnel.

This plan must be reviewed, approved, and an agreement to comply with the requirements must be signed by all personnel prior to entering the work area.

During development of this plan, consideration was given to current safety and health standards, adverse health effects of known contaminants, and procedures designated to account for the potential exposure to unknown substances. Specifically, the following reference sources have been consulted:

10 CFR 20, "Standards for Protection Against Radiation"
10 CFR 71, "Packaging and Transportation of Radioactive Materials"
29 CFR 1910.120, "Labor/National Labor Relations Board"
29 CFR 1910.1000 series, "Labor/OSHA, Department of Labor"
29 CFR 1926, "Labor/OSHA, Department of Labor"
49 CFR, "Transportation"
Occupational Safety and Health Guidelines for Hazardous Waste Site Activities
EPA Publication "Air Surveillance for Hazardous Materials"

### 1.2 Visitors

Visitors to the site will be allowed to observe the equipment setup and an explanation of the operation to remove energetic materials from the soil. Operations must stop upon arrival of visitors within 300 feet of the work area.

## 2.0 KEY PERSONNEL/IDENTIFICATION OF HEALTH AND SAFETY PERSONNEL

### 2.1 Key Personnel

The following personnel and organizations are critical to the planned activities at the Lake City Army Ammunition Plant site. The organizational structure will be reviewed and updated as appropriate by the site supervisor.

| Name/Title | Organization/Branch | Address | Telephone |
|---|---|---|---|
| Garth Anderson | US Army | Lake City Army AP | 816-796-7159 |
| Paul Anthamatten | US Army | Lake City Army AP | 816-796-7156 |
| Mike Styvaert | US Army | RW Executive Agency | 319-570-1455 |

### 2.2 Site Specific Health and Safety Personnel

The Project Manager (PM) in charge of this project is Thomas J. O'Dou. All on-site personnel will report to the Project Manager. Because this work involves only a few people, Mr. O'Dou will also serve as the Site Health and Safety Officer (HSO) while he is on site. At other times a designated HSO shall be appointed. The HSO has total responsibility for ensuring that the radiological and non-radiological provisions of this HASP are adequate and implemented in the field.

The site Cabrera Radiation Protection Supervisor (RPS) will provide on-site radiation protection and report to the Cabrera RSO, as needed for radiation protection instructions. A Radiation Control Technician (RCT) as required will assist the RPS. The RPS will report (on-site) to the Project Manager, with the PM having ultimate responsibility for the site and radiation protection provisions. Changing field conditions may require decisions to be made concerning the adequacy of programs. Therefore, it is vital that the individual assigned as the RPS be experienced and meet the additional training requirements specified by OSHA in 29 CFR 1910.120 (see Section 4.0 of the original HASP). The RPS is also responsible for conducting site inspections on a regular basis in order to ensure the effectiveness of this plan.

The RPS will contact the PM prior to any downgrades in level of protection or monitoring frequency or for items identified in the site-specific work plan. The downgrade will be entered in project records and approved by the RSO or a Cabrera Senior Health Physicist.

## 3.0 TASK/OPERATION SAFETY AND HEALTH RISK ANALYSIS

### 3.1 Historical Overview of Site

During the initial phase of remediation in accordance with the site-decommissioning plan, potentially energetic materials were discovered in the 600-yard bullet catcher area. This material was secured and work at the site was stopped to evaluate the job and actions taken to that point in time.

It was recognized that although there was not a likely possibility to identify potentially energetic rounds, they were indeed present in the soil and the remediation could not progress as planned and the material (soil) could not be disposed of at the planned waste site without removal of the energetic material.

In order to provide evidence to the UXO specialist that the energetic material has been removed from the soil for personnel safety, and to the Cabrera Radioactive Waste Specialist to ensure compliance with DOT requirements and waste site acceptance requirements, a safety survey of the material is required and is described in the work plan supplement.

### 3.2 Task by Task Risk analysis

During ordinance removal operations, risks are anticipated that were not previously discussed in the decommissioning plan. These risks are associated with the discovery of potentially energetic material by Cabrera Services, Inc. UXO personnel. Actions shall be taken to remove the potentially energetic material from the soil in order to minimize exposure of onsite personnel to these hazards, prevent hazards during transportation of the waste, and to meet the waste acceptance criteria of the waste site.

**NOTE**

**All personnel shall be aware that UXO personnel have authority at all times during the UXO removal operations to take 'stop work' actions and properly store and control potentially energetic rounds discovered in the safety survey process. All personnel shall immediately heed the warnings of UXO personnel.**

**TABLE 3.1**
**ADDITIONAL TASK ANALYSIS**
**PHYSICAL HAZARDS OF CONCERN**

Lake City Army Ammunition Plant

| Task | Hazard Description | Prevention/Monitoring Technique |
|---|---|---|
| Safety Survey | Energetic Materials | These materials are to be separated from the soil at the 600-yard bullet catcher. The UXO supervisor shall be in the on site at all times during the UXO removal operation. Discovered materials shall be controlled and handled by UXO qualified personnel. |
| Safety Survey | Heavy Equipment | During safety survey, heavy equipment may be in motion. Personnel shall be cautious to stay out of the areas where movement of heavy equipment may cause a hazard. |
| Safety Survey | Radiation | The accumulation of radioactive materials in the waste containers will cause increased radiation dose rates. Cabrera Services, Inc. radiation protection personnel shall monitor dose rates in the area to ensure that dose rates are maintained As Low As Reasonably Achievable. |

## 4.0 PERSONNEL TRAINING REQUIREMENTS

In addition to the training required in the HASP, all personnel at the site shall be briefed on the additional hazards indicated by removal operations for energetic materials and the associated hazards during these operations.

### 4.1 Pre-Assignment and Annual Refresher Training

Each employee assigned to operations during the safety survey operations shall be trained to prevent exposure to the hazards in the safety survey/remediation areas.

### 4.2 Site Supervisors Training

Consistent with 29 CFR 1910.120 paragraph (e)(8), individuals designated as site supervisors require an additional 8 hours of training. The following individuals are identified as site supervisors:

| Name | Title/Responsibility |
|---|---|
| Thomas J. O'Dou, CHP, RRPT | Project Manager |
| Edward King | UXO Supervisor |
| Todd Eastman | Radioactive Materials Broker |

### 4.3 Training and Briefing Topics

The following additional items will be discussed by a qualified individual at the site pre-entry briefing(s), as well as daily or periodic site briefings.

Site Specific Training:

The location of areas where safety suvey operations present additional hazards.

The type of hazards present at each location.

The areas where increased dose rates are a concern as materials are removed from the soil and are accumulated during material accumulation in waste containers.

The locations where potentially energetic materials are accumulated and stored.

## 5.0 PERSONAL PROTECTIVE EQUIPMENT TO BE USED

This section describes the additional requirements of the personnel protection required for safety survey and soil disposal operations at Lake City Army Ammunition Plant.

### 5.1 Levels of Protection

The level of protective equipment needed will depend on the following hazards:

Potential for radioactive airborne particulates in enclosed spaces, and
Control of potentially energetic materials during UXO removal from soil, and
Control of increased dose rates in accumulation of concentrated DU wastes.

Personnel shall wear protective equipment when response activities involve known or suspected atmospheric contamination, when energetic or potentially energetic materials are present in the work area, or when dose rates are increased due to an increase in the volume of depleted uranium in the waste container.

### 5.2 Protective Equipment for Safety Survey and Remediation Operations

Respiratory protection as indicated by the Radiation Protection Supervisor or a Cabrera Health Physicist.

Long sleeve cotton shirts and pants or Use of coveralls or Tyveks when required by the HSO.

Gloves; cotton and rubber, or leather or cotton work gloves, when required by the HSO.

Boots/shoes, leather or chemical-resistant steel toe shoes if a dropping hazard exists.

Safety Glasses.

Hardhat – not allowed when removing potentially energetic material from soil unless an overhead hazard is present.

### 5.6 Reassessment of Protection Program

When a significant change in hazard potential occurs, the hazards will be reassessed.

### 5.7 Work Mission Duration

This is not anticipated to be a limiting condition at this work site, because the on-site job duration less than 30 work days, the maximum number of days in areas potentially requiring PPE is anticipated to be less than 25 workdays.

### 5.8 Chemical Resistance and Integrity of Protective Material

As described in the original HASP.

### 5.9 Standard Operating Procedures for Respiratory Protection Devices

As described in the original HASP.

## 5.10 Standard Operating Procedures for Personal Protective Clothing

### **5.10.1** Inspection

Regarding evaluation of UXO protective clothing (if required), visually inspect for:

- imperfect seams
- non-uniform materials
- tears
- malfunctioning closures

Visually inspect for:

- imperfect seams
- tears, abrasions
- non-uniform coating
- pressurize rubber or latex gloves with air; listen for pin-hole leaks.

## 5.11 Specific Levels of Protection Planned for the Project Task Assignments

The following levels of protection will be utilized during UXO safety survey activities at Lake City Army Ammunition Plant.

X Level D  X Modified Level D

Table 5.2 presents the level of protection planned for the completion of individual task assignments and the specific components of each protective ensemble.

**TABLE 5.2**
**SPECIFIC LEVELS OF PROTECTION PLANNED FOR THE TASK ASSIGNMENTS**

Modified Level D Tasks:

Sampling and surveys of 600-yard bullet catcher site areas.
Picking UXO materials from the soil
– Additional protection as indicated by the UXO supervisor

## 6.0 MEDICAL SURVEILLANCE REQUIREMENTS

There are no additional requirements for medical surveillance. UXO contractor personnel shall provide evidence of a current physical and physicians letter as described in the original HASP.

## 7.0 FREQUENCY AND TYPES OF PERSONNEL AIR MONITORING/SAMPLING

Personnel air monitoring/sampling will be in accordance with Cabrera procedures. Cabrera procedures shall be kept on-site, during all work operations.

## 8.0 SITE CONTROL MEASURES

The following section defines additional measures and procedures for maintaining site control. Site control is an essential component in the implementation of the Site Health and Safety Program.

### 8.1 Buddy System

During all activities when working in areas where explosives are present or when some conditions present a risk to personnel, the implementation of a buddy system is mandatory. A buddy system requires at least two people who work as a team; each looking out for the other.

### 8.2 Site Communications Plan

Successful communication between field teams and contact with personnel in the support zone is essential. The following communications systems will be available during all work activities:

__ Radios: Two way

_X_ Intrinsically safe - normal voice, visual contact, or yelling

_X_ Hand Signals:

| Signal | Definition |
|---|---|
| Hands clutching throat | Out of air/can't breath |
| Hands on top of head | Need assistance |
| Thumbs up | OK/I'm alright/I understand |
| Thumbs down | No/Negative |
| Arms waving upright | Send backup support |
| Grip partner's wrist | Exit area immediately |

## 8.3 Work Zone Definition

The three general work zones established at the work site are the Restricted Zone, Contamination Reduction Zone, and Support Zone. Figure 8.1 provides a site map of the work zones.

The Restricted Zone is defined as the area where contamination is either known or likely to be present, or because of activity, will provide a potential to cause harm to personnel. Entry into the Restricted Zone requires training and the use of personal protective equipment.

The Contamination Reduction Zone is the area where personnel conduct personal and equipment decontamination. It is essentially a buffer zone between contaminated areas and clean areas. Activities to be conducted in this zone will require personal protection as defined in the detailed work plan.

## 8.4 Nearest Medical Assistance

See Figure 8.2. The route to the medical facility shall be verified by the HSO, and should be familiar to all site personnel. The route is posted in the work trailer.

# ***** EMERGENCY PHONE NUMBER: 7911 *****

## 8.5 Safe Work Practices

Table 8.1 provides a list of standing orders for the Restricted Zone.

Table 8.2 provides a list of standing orders for the Contamination Reduction Zone.

## 8.6 Emergency Alarm Procedures

The warning signals described in Section 10.4 "Evacuation Routes and Procedures", will be deployed in the event of an emergency. Communication signals will also be used according to Section 8.2.

**FIGURE 8.1**
**SITE MAP DEPICTING WORK ZONE**

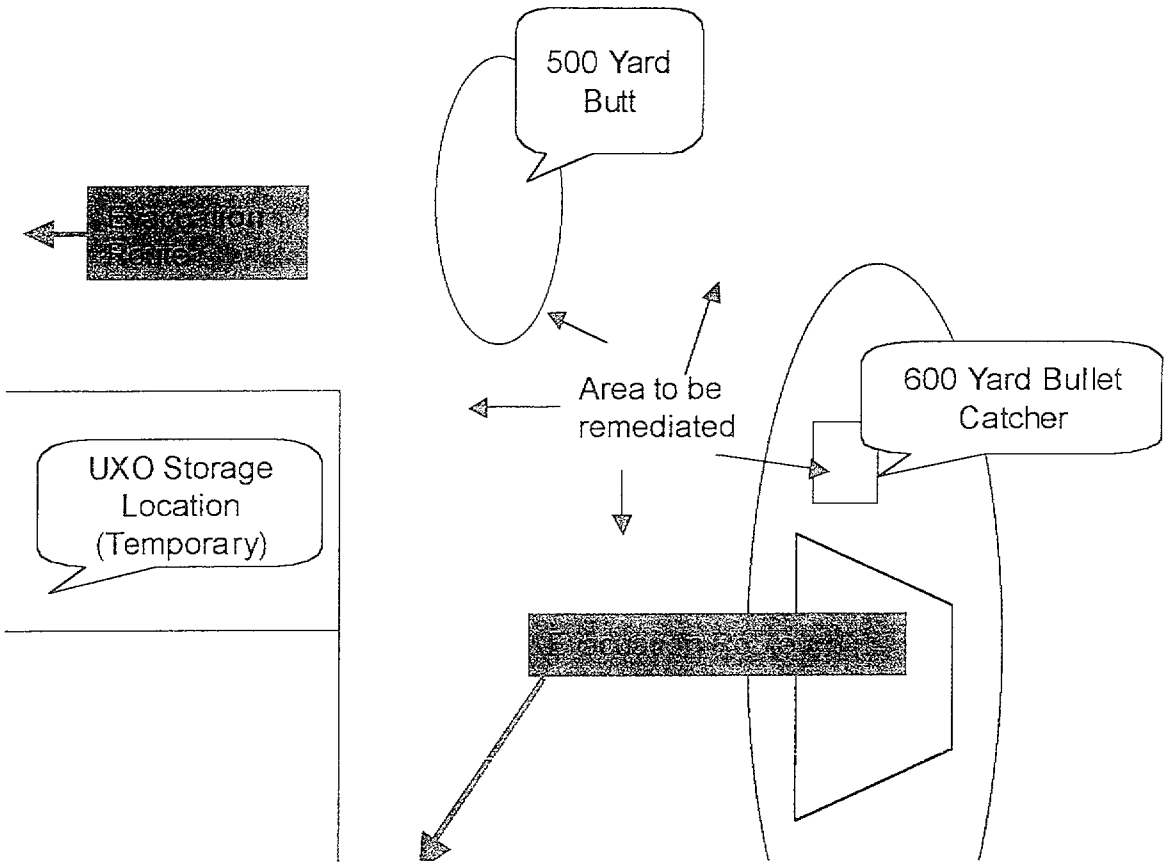


**FIGURE 8.2**
**MAP DEPICTING ROUTE TO NEAREST MEDICAL FACILITIES**

See original HASP

**TABLE 8.1**
**STANDING ORDERS FOR ANY RESTRICTED ZONE INCLUDING THE SAFETY SURVEY AREA**

No smoking, eating, drinking or application of cosmetics in this zone.

No horseplay.

No matches, lighters or tobacco products in this zone.

Check-in on entrance to this zone (sign the APPROPRIATE RWP).

Checkout on exit from this zone.

Implement the communications system.

Line of sight must be in position.

Wear the appropriate level of protection as defined in the RWP.

**TABLE 8.2**
**STANDING ORDERS FOR ANY CONTAMINATION REDUCTION ZONE INCLUDING THE SAFETY SURVEY AREAS**

No smoking, eating, drinking or application of cosmetics in this zone.

No horseplay.

No matches, lighters or tobacco products in this zone.

Wear the appropriate level of protection as defined in the RWP.

Perform whole body frisk prior to exiting area.

## 9.0 DECONTAMINATION PLAN

No changes from the original HASP.

## 10.0 EMERGENCY RESPONSE/CONTINGENCY PLAN

This section describes contingencies and emergency planning procedures to be implemented at the site. This plan is compatible with local, state and federal disaster and emergency management plans as appropriate.

In case of required evacuation by order of UXO personnel, all personnel in the crew shall assemble at the Cabrera Services, Inc. trailer. The project manager and UXO supervisor shall take actions as follows:

1. Secure the situation to minimize the potential effects of an emergency.
2. Ensure safe evacuation of personnel to a safe area.
3. Isolate the area to prevent personnel re-entry.
4. Notify the Cabrera Services, Inc. Project Manager
5. Notify base personnel (security and Army contacts)

### 10.1 Pre-Emergency Planning

During the site briefings, all employees will be trained in and reminded of provisions of the emergency response plan, communication plan, and evacuation routes. Table 10.1 identifies the hazardous conditions associated with specific site activities.

### 10.2 Personnel Roles and Lines of Authority

The Project Manager has primary responsibility for responding to and correcting emergency situations. This includes taking appropriate measures to ensure the safety of site personnel and the public. Possible actions may involve evacuation of personnel from the site area. He/she is additionally responsible for ensuring that corrective measures have been implemented, appropriate authorities notified, and follow-up reports completed. The HSO/RPS may be called upon to act on behalf of the Project Manager, and will direct responses to any medical emergency.

The Project Manager will notify Cabrera management personnel of accidents/incidents involving general safety, chemical exposure or radioactive material/radiation exposure. Table 10.2 identifies the Cabrera personnel that should be contacted in case of an emergency.

### 10.3 Emergency Recognition/Prevention

Table 3.1 provides a listing of physical hazards onsite. Potential additional hazards as a direct result of site activities are listed in Table 10.1. Personnel will be familiar with

techniques of hazard recognition from pre-assignment training and site-specific briefings. The HSO/RPS is responsible for ensuring that prevention devices or equipment is available to personnel.

### 10.4 Evacuation Routes/Procedures

In the event of an emergency that necessitates an evacuation of the site, the following alarm procedures will be implemented:

**Three Horn Blasts.**

**Personnel will be expected to proceed to the closest range exit with their buddy, and mobilize to the posted, pre-designated meeting area. Personnel will remain at that area until an authorized individual provides further instructions.**

Figure 10.1 provides a map depicting evacuation routes for the site and immediate area.

### 10.5 Emergency Contact/Notification System

The following list provides names and telephone numbers for emergency contact personnel. In the event of a medical emergency, personnel will take direction from the HSO and notify the appropriate emergency organization. In the event of a fire or spill, the Site Supervisor will notify the appropriate local, state, and federal agencies. **When using a base phone, dial 7 - then dial the last three digits of the number to connect to another base phone. To dial to an off-base phone, dial 9 and the regular phone number for local calls.**

| Organization | Contact | Telephone |
|---|---|---|
| All Emergency Services | | 7911 |
| Ambulance | | 7911 |
| Police (Base) | Security | 796-7470 |
| Fire | Fire Dept& EMT | 796-7283 |
| | | 796-7121 (mobile) |

### 10.6 Emergency Medical Treatment Procedures

**CAUTION**

**DO NOT DELAY MEDICAL TREATMENT FOR RADIOLOGICAL MONITORING**

Any person who becomes ill or injured in the Restricted Zone must be "frisked" to the maximum extent practical without delaying or affecting medical support or care. If the

injury or illness is minor, full decontamination should be completed and first aid administered prior to transport. If the patient's condition is serious, decontamination may be delayed, but emergency response personnel must be apprised of the situation. First aid should be administered while awaiting an ambulance or paramedics. All injuries must be immediately reported to the Project Manager.

Any person being transported to a clinic or hospital for treatment should take with them information on the materials they may have been exposed to at the site. The HSO/RPS or a RCT will accompany an injured person to the clinic or hospital. Any vehicle used to transport contaminated personnel will be monitored and cleaned as necessary.

### 10.7 Fire or Explosion

In the event of a fire or explosion, the base fire department should be summoned immediately. Upon their arrival, the Project Manager or designated alternate will advise the Fire Marshall of the location, nature, and identification of the hazardous materials on site.

If it is safe to do so, qualified site personnel may:

Use fire fighting equipment available on site to extinguish incipient stage fires; and,

Remove or isolate flammable or other hazardous materials that may contribute to the fire.

**NOTE**: Extinguishing media available on site: Class A, B, C extinguisher for all fires.

### 10.8 Spill or Leaks

In the event of a spill or a leak, site personnel will:

Inform their supervisor immediately;

Locate the source of the spillage and stop the flow if it can be done safely; and,

Begin decontamination and recovery of the spilled materials.

## 10.9 Emergency Equipment/Facilities

Figure 10.2 provides a map of the site and identifies the emergency staging area and the location of the following emergency equipment:

| | | | |
|---|---|---|---|
| X | First Aid Kit | X | Staging Area. |
| X | Fire Extinguisher | X | Site Telephone |
| __ | Mercury Spill Kit | X | Eye Wash |

The project manager has the responsibility to ensure emergency equipment is available for situations which may make emergency response easier for events with reasonable probability for occurrence.

**TABLE 10.1**
**EMERGENCY RECOGNITION/CONTROL MEASURES**

| Hazard | Specific Condition/Location | Prevention/Control |
|---|---|---|
| Fire/Explosion | Site | ~~A, B, C, D extinguishers~~ leave the area |
| Spill | All areas | Absorbent Materials |
| Air Release | Site | ** |

** Assess extent of contamination, from the site, notify the project manager immediately.

**TABLE 10.2**
**Cabrera INTERNAL CALL LIST**

In the event of an injury, accident, fire, explosion, spill, release, or other non-routine event, after obtaining emergency services, immediately contact one of the people starting with:

| Name | Business Phone No. | Home Phone No. | Pager/Cell Phone |
|---|---|---|---|
| Thomas J. O'Dou | (702) 395-9238 | (702) 395-2814 | (702) 528-0563 |
| David Watters | (860) 289-1885 | | (860) 306-0606 |
| Steve Mascuilli, | (860) 289-1885 | | |

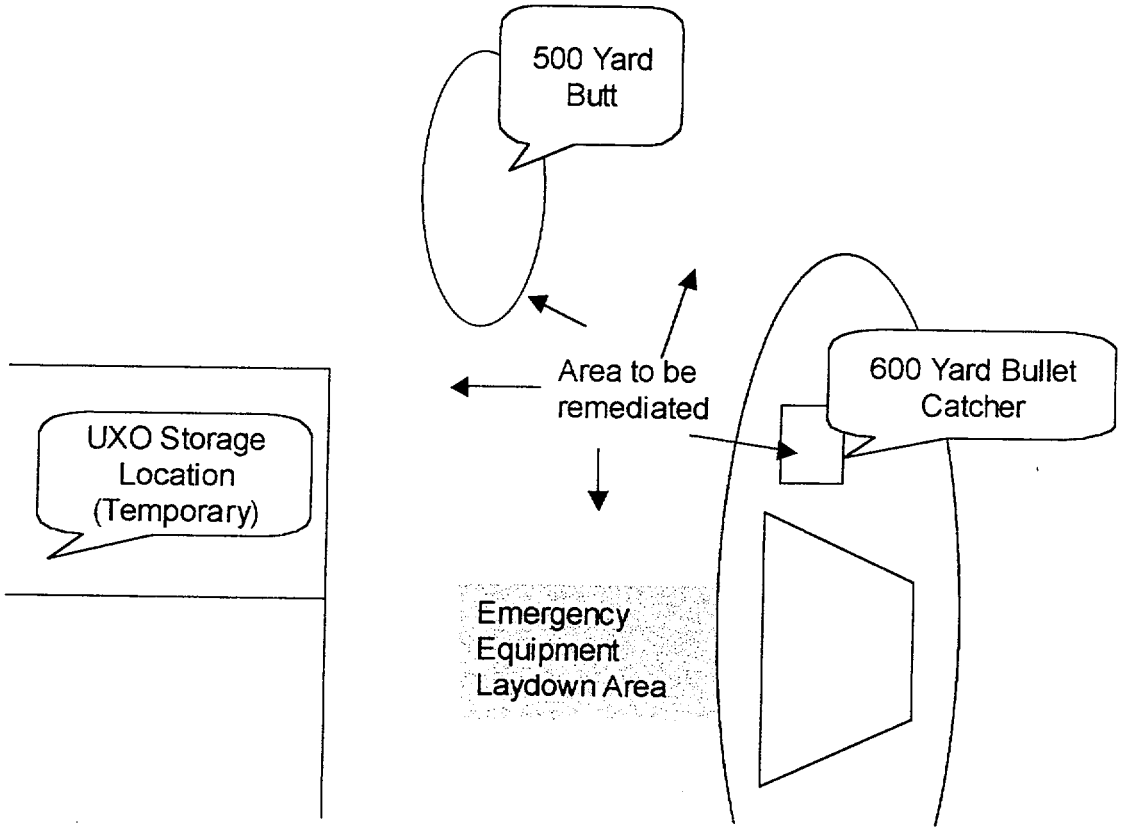
**FIGURE 10.1**
**EVACUATION ROUTES AND SAFE DISTANCES**

In case of an emergency involving explosive materials, follow the directions of ~~base security~~ UXO Personnel to leave the area to the Cabrera Services, Inc. trailer or at least 300 feet from the work area. There are no radioactive sources that would require distances greater than 50 feet from the work area. In case of abnormal situations, where actions are no obvious, follow the directions of the Project Manager or HSO on site.

**FIGURE 10.2**
**SITE MAP WITH EMERGENCY STAGING AREA & EQUIPMENT LOCATED**

| | | | |
|---|---|---|---|
| 1 | First Aid Kit | 3 | Fire Extinguisher |
| 2 | Site Telephone (mobile) | 4 | Eye Wash |

The cell phone will be moved to each site work area and will be kept in the work area - readily accessible.



## 11.0 SPILL CONTAINMENT PROGRAM

The procedures defined in this section comprise the spill containment program in place for project activities.

All containers used shall meet the appropriate OSHA and EPA regulations for the waste that they will contain.

Containers shall be inspected and their integrity assured prior to being moved. Containers that cannot be inspected before being moved because of storage conditions shall be positioned in an accessible location and inspected prior to further handling.

Operations on site will be organized so as to minimize the amount of container movement.

Employees involved in the container handling operations shall be warned of the hazards associated with the containers.

Where liquid spills, leaks, or ruptures may occur, adequate quantities of spill containment equipment (absorbent) will be stationed in the immediate area. The spill containment program must be sufficient to contain and isolate the entire volume of hazardous substances being transferred.

Fire extinguishing equipment meeting 29 CFR Part 1910, Subpart 1 shall be on hand and ready for use to control incipient fires. This will consist of Class A, B, C fire extinguisher.

Containers shall have sufficient labels and markings to meet site and DOT requirements.

# Lake City Army Ammunition Plant Radiological Remediation of the 600-Yard Bullet Catcher

## Appendix 4

## Air Sample Analysis Summary

## Alpha / Beta Counting Data

# Lake City Army Ammunition Plant
# Cabrera Services, Inc.
# Air Sample Results

| Sample Number | Area Sampled | Date/Time | Run Time Minutes | Gross Counts Alpha Counts | Gross Counts Beta Counts | MDA uCi/cc Alpha uCi/cc | MDA uCi/cc Beta uCi/cc | Concentration uCi/cc Alpha Result uCi/cc | Concentration uCi/cc Beta Result uCi/cc |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Bullet Catcher | 4/25/2001 8:20 | 194 | 1 | 900 | 4.57747E-14 | 9.89253E-13 | -9.51E-16 | 2.62E-13 |
| 2 | Bldg 45 | 4/25/2001 7:50 | 185 | 2 | 874 | 2.60749E-14 | 6.66886E-13 | 3.99E-15 | 1.42E-13 |
| 3 | 27-4 Sample Well | 4/25/2001 8:10 | 188 | 5 | 844 | 6.38152E-14 | 9.64853E-13 | 2.12E-14 | 1.47E-14 |
| 4 | Bullet Catcher | 4/25/2001 11:41 | 158 | 3 | 840 | 5.62044E-14 | 1.21465E-12 | 1.05E-14 | -3.57E-14 |
| 5 | Bldg 45 | 4/25/2001 11:00 | 201 | 4 | 880 | 5.96879E-14 | 9.02449E-13 | 1.12E-14 | 2.62E-13 |
| 6 | 27-4 Sample Well | 4/25/2001 11:26 | 167 | 0 | 852 | 5.31754E-14 | 1.14919E-12 | -6.63E-15 | 3.38E-14 |
| 7 | Bullet Catcher | 4/26/2001 8:22 | 236 | 5 | 838 | 3.76284E-14 | 8.13199E-13 | 1.48E-14 | -3.19E-14 |
| 8 | Bldg 45 | 4/26/2001 8:10 | 241 | 4 | 880 | 4.97812E-14 | 7.52665E-13 | 9.33E-15 | 2.19E-13 |
| 9 | 27-4 Sample Well | 4/26/2001 8:32 | 237 | 1 | 892 | 3.74696E-14 | 8.09768E-13 | -7.78E-16 | 1.83E-13 |
| 10 | Bullet Catcher | 4/26/2001 12:21 | 129 | 6 | 856 | 9.3002E-14 | 1.40614E-12 | 4.42E-14 | 1.50E-13 |
| 11 | East Perimeter | 4/26/2001 13:06 | 129 | 4 | 852 | 9.3002E-14 | 1.40614E-12 | 1.74E-14 | 1.07E-13 |
| 12 | North Perimeter | 4/26/2001 12:53 | 157 | 0 | 895 | 5.65624E-14 | 1.22239E-12 | -7.05E-15 | 2.94E-13 |
| 13 | Bullet Catcher | 4/27/2001 8:47 | 263 | 1 | 891 | 3.37654E-14 | 7.29715E-13 | -7.01E-16 | 1.61E-13 |
| 14 | East Perimeter | 4/27/2001 9:07 | 222 | 5 | 869 | 5.40417E-14 | 8.17083E-13 | 1.79E-14 | 1.69E-13 |
| 15 | North Perimeter | 4/27/2001 9:45 | 195 | 1 | 863 | 6.15244E-14 | 9.30217E-13 | -1.51E-14 | 1.49E-13 |
| 16 | 600 Yard Bullet Catcher | 4/30/2001 7:25 | 436 | 4 | 999 | 6.24929E-14 | 1.83648E-12 | 1.19E-14 | 4.87E-13 |
| 17 | East Perimeter | 4/30/2001 7:45 | 395 | 5 | 928 | 3.03728E-14 | 4.59221E-13 | 1.01E-14 | 3.02E-13 |
| 18 | North Perimeter | 4/30/2001 8:10 | 385 | 2 | 918 | 3.11617E-14 | 4.71149E-13 | -3.14E-15 | 2.74E-13 |
| 19 | Bullet Catcher | 5/1/2001 8:06 | 454 | 7 | 873 | 2.64257E-14 | 3.99543E-13 | 1.64E-14 | 9.47E-14 |
| 20 | East Perimeter | 5/1/2001 7:42 | 453 | 3 | 864 | 2.6484E-14 | 4.00425E-13 | 1.15E-15 | 6.73E-14 |
| 21 | North Perimeter | 5/1/2001 7:51 | 454 | 7 | 889 | 2.64257E-14 | 3.99543E-13 | 1.64E-14 | 1.44E-13 |
| 22 | Bullet Catcher | 5/1/2001 10:44 | 210 | 5 | 884 | 5.71298E-14 | 8.63773E-13 | 1.89E-14 | 2.77E-13 |
| 23 | East Perimeter | 5/2/2001 10:04 | 251 | 3 | 822 | 4.77979E-14 | 7.22679E-13 | 2.07E-15 | -1.10E-13 |
| 24 | North Perimeter | 5/2/2001 10:20 | 254 | 3 | 871 | 4.72333E-14 | 7.14143E-13 | 2.04E-15 | 1.58E-13 |
| 25 | Lapel - E King | 5/2/2001 14:08 | 70 | 4 | 894 | 1.71389E-13 | 2.59132E-12 | 3.21E-14 | 1.03E-12 |
| 26 | Lapel - E King | 5/3/2001 8:00 | 362 | 10 | 1000 | 2.97323E-14 | 5.51842E-13 | 3.82E-14 | -9.57E-14 |
| 27 | Bullet Catcher | 5/3/2001 8:22 | 101 | 5 | 932 | 8.44579E-14 | 1.95501E-12 | 6.85E-14 | -9.47E-13 |
| 28 | Bullet Catcher | 5/3/2001 10:42 | 288 | 3 | 1020 | 2.96189E-14 | 6.85613E-13 | 1.20E-14 | 9.15E-14 |
| 29 | East Perimeter | 5/3/2001 7:15 | 503 | 5 | 1033 | 1.69587E-14 | 3.92558E-13 | 1.38E-14 | 8.82E-14 |
| 30 | North Perimeter | 5/3/2001 7:28 | 293 | 5 | 976 | 2.91135E-14 | 6.73913E-13 | 2.36E-14 | -1.18E-13 |
| 31 | East Perimeter | 5/21/2001 7:15 | 325 | 1 | 913 | 4.67486E-14 | 5.76347E-13 | -2.13E-14 | 5.97E-14 |
| 32 | North Perimeter | 5/22/2001 8:20 | 310 | 1 | 1002 | 2.75169E-14 | 6.36956E-13 | 0.00E+00 | 4.47E-15 |
| 33 | Bullet Catcher | 5/22/2001 8:00 | 340 | 4 | 1003 | 2.5089E-14 | 5.80754E-13 | 1.53E-14 | 8.16E-15 |
| 34 | Bullet Catcher | 5/21/2001 7:05 | 320 | 5 | 1000 | 4.74791E-14 | 5.85352E-13 | 0.00E+00 | 4.38E-13 |
| 35 | North Perimeter | 5/21/2001 7:30 | 320 | 6 | 871 | 4.74791E-14 | 5.85352E-13 | 5.40E-15 | -1.21E-13 |
| 36 | North Perimeter | 5/23/2001 6:15 | 370 | 1 | 900 | 3.372E-14 | 5.18258E-13 | -9.35E-15 | -1.61E-13 |
| 37 | Bullet Catcher | 5/23/2001 6:05 | 400 | 4 | 886 | 3.1191E-14 | 4.79389E-13 | 4.32E-15 | -1.98E-13 |
| 38 | East Perimeter | 5/23/2001 6:20 | 375 | 3 | 899 | 3.32704E-14 | 5.11348E-13 | 0.00E+00 | -1.63E-13 |
| 39 | Bullet Catcher | 5/24/2001 6:30 | 460 | 2 | 863 | 2.71226E-14 | 4.1686E-13 | -3.76E-15 | -2.41E-13 |
| 40 | North Perimeter | 5/24/2001 6:20 | 460 | 2 | 874 | 2.71226E-14 | 4.1686E-13 | -3.76E-15 | -2.08E-13 |
| 41 | East Perimeter | 5/24/2001 6:10 | 460 | 1 | 897 | 2.71226E-14 | 4.1686E-13 | -7.52E-15 | -1.39E-13 |
| 42 | Lapel - J Cote | 5/23/2001 7:32 | 398 | 3 | 867 | 3.13477E-14 | 4.81798E-13 | 0.00E+00 | -2.65E-13 |
| 43 | Bullet Catcher | 5/25/2001 6:35 | 287 | 4 | 902 | 4.34717E-14 | 6.68138E-13 | 6.03E-15 | -1.98E-13 |
| 44 | North Perimeter | 5/25/2001 6:10 | 335 | 3 | 826 | 3.7243E-14 | 5.72405E-13 | 0.00E+00 | -4.84E-13 |
| 45 | East Perimeter | 5/22/2001 8:10 | 315 | 2 | 993 | 3.41685E-14 | 6.34181E-13 | 0.00E+00 | -1.41E-13 |
| 46 | East Perimeter | 5/25/2001 6:25 | 305 | 3 | 882 | 4.09062E-14 | 6.28707E-13 | 0.00E+00 | -2.77E-13 |
| 47 | Bullet Catcher | 5/7/2001 8:40 | 275 | 5 | 835 | 4.53687E-14 | 6.77411E-13 | 1.26E-14 | -2.72E-13 |
| 48 | East Perimeter | 5/7/2001 8:00 | 294 | 0 | 855 | 4.24367E-14 | 6.33632E-13 | -1.76E-14 | -1.60E-13 |
| 49 | North Perimeter | 5/7/2001 8:15 | 288 | 1 | 832 | 4.33208E-14 | 6.46833E-13 | -1.20E-14 | -2.74E-13 |
| 50 | Bullet Catcher | 5/11/2001 9:35 | 135 | 4 | 869 | 9.24177E-14 | 1.37991E-12 | 1.28E-14 | -2.05E-13 |
| 51 | East Perimeter | 5/11/2001 9:05 | 145 | 3 | 883 | 8.60441E-14 | 1.28474E-12 | 0.00E+00 | -5.74E-14 |
| 52 | North Perimeter | 5/11/2001 9:20 | 140 | 5 | 854 | 8.91171E-14 | 1.33063E-12 | 2.47E-14 | -3.47E-13 |
| 53 | Bullet Catcher | 5/18/2001 8:00 | 340 | 6 | 845 | 3.66953E-14 | 5.47906E-13 | 1.53E-14 | -1.79E-13 |
| 54 | North Perimeter | 5/18/2001 7:40 | 350 | 4 | 914 | 3.56468E-14 | 5.32251E-13 | 4.94E-15 | 9.90E-14 |
| 55 | East Perimeter | 5/29/2001 6:10 | 480 | 1 | 997 | 2.24231E-14 | 4.16181E-13 | -3.60E-15 | -8.09E-14 |
| 56 | North Perimeter | 5/29/2001 6:20 | 480 | 6 | 1004 | 2.24231E-14 | 3.93415E-13 | 1.44E-14 | 2.60E-13 |
| 57 | Bullet Catcher | 5/29/2001 6:00 | 510 | 4 | 1028 | 2.11041E-14 | 3.70273E-13 | 6.78E-15 | 3.10E-13 |
| 58 | Bullet Catcher | 6/1/2001 6:05 | 475 | 1 | 1013 | 2.26591E-14 | 4.20562E-13 | -3.64E-15 | -3.50E-14 |
| 59 | North Perimeter | 6/1/2001 6:20 | 480 | 3 | 1025 | 1.74482E-14 | 4.21026E-13 | 7.21E-15 | 2.46E-13 |
| 60 | East Perimeter | 6/1/2001 6:15 | 475 | 3 | 901 | 1.79584E-14 | 3.96916E-13 | 7.28E-15 | -2.92E-14 |
| 61 | Bullet Catcher | 6/2/2001 6:10 | 660 | 1 | 952 | 1.26896E-14 | 3.06201E-13 | 0.00E+00 | 2.52E-14 |
| 62 | East Perimeter | 6/2/2001 6:25 | 635 | 4 | 887 | 1.34335E-14 | 2.96905E-13 | 8.17E-15 | -5.24E-14 |
| 63 | North Perimeter | 6/2/2001 6:30 | 625 | 4 | 848 | 1.34002E-14 | 3.23348E-13 | 8.30E-15 | -2.04E-13 |
| 64 | North Perimeter | 6/7/2001 6:40 | 425 | 1 | 836 | 2.00712E-14 | 4.43612E-13 | 0.00E+00 | -2.45E-13 |
| 65 | East Perimeter | 6/7/2001 6:40 | 425 | 1 | 885 | 2.00712E-14 | 4.43612E-13 | 0.00E+00 | -8.48E-14 |
| 66 | Bullet Catcher | 6/7/2001 6:25 | 455 | 2 | 908 | 1.87478E-14 | 4.14363E-13 | 3.80E-15 | -9.14E-15 |
| 67 | Bullet Catcher | 6/8/2001 6:25 | 480 | 3 | 860 | 1.74482E-14 | 4.14602E-13 | 7.21E-15 | -1.47E-13 |

# Lake City Army Ammunition Plant
# Cabrera Services, Inc.
# Air Sample Results

| Sample Number | Area Sampled | Date/Time | Run Time Minutes | Gross Counts Alpha Counts | Gross Counts Beta Counts | MDA uCi/cc Alpha uCi/cc | MDA uCi/cc Beta uCi/cc | Concentration uCi/cc Alpha Result uCi/cc | Concentration uCi/cc Beta Result uCi/cc |
|---|---|---|---|---|---|---|---|---|---|
| 68 | North Perimeter | 6/8/2001 7:20 | 370 | 2 | 873 | 2.27389E-14 | 5.09554E-13 | 4.67E-15 | -1.42E-13 |
| 69 | Bullet Catcher | 6/14/2001 6:15 | 465 | 8 | 922 | 2.68309E-14 | 4.0828E-13 | 1.86E-14 | -5.96E-15 |
| 70 | North Perimeter | 6/14/2001 6:15 | 465 | 2 | 930 | 2.68309E-14 | 4.0828E-13 | -3.72E-15 | 1.79E-14 |
| 71 | East Perimeter | 6/14/2001 6:20 | 442 | 3 | 903 | 1.01571E-13 | 1.89285E-12 | 0.00E+00 | -6.59E-14 |
| 72 | Bullet Catcher | 6/9/2001 6:15 | 690 | 5 | 871 | 5.396E-14 | 1.18343E-12 | 7.52E-15 | -1.81E-14 |
| 73 | North Perimeter | 6/9/2001 6:15 | 690 | 3 | 952 | 5.396E-14 | 1.18343E-12 | 2.51E-15 | 1.45E-13 |
| 74 | East Perimeter | 6/9/2001 6:25 | 645 | 1 | 1026 | 5.77247E-14 | 1.26599E-12 | -2.68E-15 | 3.14E-13 |
| 75 | Bullet Catcher | 6/10/2001 6:25 | 950 | 3 | 921 | 3.9192E-14 | 8.59542E-13 | 1.82E-15 | 5.98E-14 |
| 76 | East Perimeter | 6/10/2001 6:30 | 195 | 3 | 975 | 1.90936E-13 | 4.18751E-12 | 8.87E-15 | 6.75E-13 |
| 77 | North Perimeter | 6/10/2001 6:30 | 195 | 2 | 903 | 1.90936E-13 | 4.18751E-12 | 0.00E+00 | 1.64E-13 |
| 78 | East Perimeter | 6/11/2001 6:15 | 480 | 2 | 913 | 7.75676E-14 | 1.70118E-12 | 0.00E+00 | 9.53E-14 |
| 79 | North Perimeter | 6/11/2001 6:30 | 455 | 2 | 869 | 8.18295E-14 | 1.79465E-12 | 0.00E+00 | -3.35E-14 |
| 80 | Bullet Catcher | 6/11/2001 6:15 | 480 | 2 | 908 | 7.75676E-14 | 1.70118E-12 | 0.00E+00 | 8.09E-14 |
| 81 | North Perimeter | 6/12/2001 7:30 | 395 | 3 | 938 | 9.42593E-14 | 2.06725E-12 | 4.30E-15 | 2.15E-13 |
| 82 | East Perimeter | 6/12/2001 7:10 | 420 | 2 | 958 | 8.86487E-14 | 1.9442E-12 | 0.00E+00 | 2.72E-13 |
| 83 | North Perimeter | 6/12/2001 7:10 | 420 | 0 | 873 | 8.70369E-14 | 2.05221E-12 | -8.08E-15 | -2.44E-14 |
| 84 | East Perimeter | 6/13/2001 6:20 | 465 | 2 | 957 | 8.00698E-14 | 1.75605E-12 | 0.00E+00 | 2.30E-13 |
| 85 | Bullet Catcher | 6/13/2001 6:15 | 495 | 3 | 977 | 7.5217E-14 | 1.64963E-12 | 3.49E-15 | 2.72E-13 |
| 86 | Bullet Catcher | 6/14/2001 7:00 | 450 | 4 | 941 | 2.05416E-12 | 3.3303E-11 | 0.00E+00 | 1.44E-12 |
| 87 | Bullet Catcher | 6/14/2001 7:00 | 420 | 4 | 941 | 1.92405E-12 | 3.5193E-11 | 7.41E-14 | 3.03E-12 |
| 88 | Bullet Catcher | 6/13/2001 6:50 | 445 | 3 | 931 | 1.50603E-12 | 3.30296E-11 | 6.99E-14 | 2.86E-12 |
| 89 | Bullet Catcher | 6/13/2001 6:50 | 445 | 2 | 960 | 1.50603E-12 | 3.30296E-11 | 0.00E+00 | 4.49E-12 |
| 90 | Bullet Catcher | 6/13/2001 6:50 | 460 | 1 | 996 | 1.45692E-12 | 3.19525E-11 | -6.77E-14 | 6.29E-12 |
| 91 | Bullet Catcher | 6/22/2001 7:30 | 385 | 3 | 938 | 1.27388E-12 | 3.89891E-11 | 1.62E-13 | 1.30E-12 |
| 92 | Eastern Perimeter | 6/8/2001 7:10 | 385 | 3 | 873 | 1.33387E-13 | 2.32031E-12 | -4.49E-15 | -6.52E-13 |
| 93 | Northern Perimeter | 6/16/2001 6:25 | 640 | 3 | 873 | 8.02408E-14 | 1.39581E-12 | -2.70E-15 | -3.92E-13 |
| 94 | Eastern Perimeter | 6/16/2001 6:20 | 630 | 3 | 861 | 8.15144E-14 | 1.28361E-12 | -2.74E-15 | -4.40E-15 |
| 95 | Bullet Catcher | 6/17/2001 6:15 | 600 | 6 | 874 | 6.20541E-14 | 1.37853E-12 | 1.15E-14 | -6.70E-14 |
| 96 | Bullet Catcher | 6/17/2001 6:15 | 600 | 6 | 874 | 6.20541E-14 | 1.37853E-12 | 1.15E-14 | -6.70E-14 |
| 97 | Eastern Perimeter | 6/17/2001 6:25 | 575 | 3 | 893 | 6.47521E-14 | 1.43847E-12 | 3.01E-15 | -2.41E-14 |
| 98 | Northern Perimeter | 6/17/2001 6:30 | 575 | 2 | 919 | 6.47521E-14 | 1.43847E-12 | 0.00E+00 | 3.86E-14 |
| 99 | Eastern Perimeter | 6/18/2001 6:25 | 450 | 1 | 960 | 8.27387E-14 | 1.83805E-12 | -3.84E-15 | 1.76E-13 |
| 100 | 600 Yard Bullet Catcher | 6/18/2001 6:20 | 460 | 2 | 907 | 8.09401E-14 | 1.79809E-12 | 0.00E+00 | 1.21E-14 |
| 101 | 600 Yard Bullet Catcher | 6/18/2001 6:30 | 435 | 2 | 861 | 8.55918E-14 | 1.90143E-12 | 0.00E+00 | -1.34E-13 |
| 102 | Northern Perimeter | 6/22/2001 6:35 | 455 | 3 | 955 | 8.18295E-14 | 1.81685E-12 | 3.80E-15 | 1.61E-13 |
| 103 | Eastern Perimeter | 6/22/2001 6:25 | 455 | 1 | 833 | 8.18295E-14 | 1.81685E-12 | -3.80E-15 | -2.10E-13 |
| 104 | 600 Yard Bullet Catcher | 6/23/2001 7:00 | 665 | 1 | 892 | 5.59886E-14 | 1.2431E-12 | -2.60E-15 | -2.08E-14 |
| 105 | 600 Yard Bullet Catcher | 6/27/2001 6:35 | 440 | 1 | 850 | 1.02033E-13 | 1.93195E-12 | -7.86E-15 | -3.28E-13 |
| 106 | Northern Perimeter | 6/27/2001 6:55 | 440 | 2 | 967 | 1.02033E-13 | 1.93195E-12 | -3.93E-15 | 4.10E-14 |
| 107 | Northern Perimeter | 6/23/2001 6:45 | 670 | 2 | 891 | 5.55708E-14 | 1.23383E-12 | 0.00E+00 | -2.28E-14 |
| 108 | Eastern Perimeter | 6/23/2001 6:40 | 665 | 4 | 908 | 5.59886E-14 | 1.2431E-12 | 5.20E-15 | 1.25E-14 |
| 109 | 600 Yard Bullet Catcher | 6/22/2001 6:50 | 425 | 2 | 892 | 8.76057E-14 | 1.94509E-12 | 0.00E+00 | -3.26E-14 |
| 110 | 600 Yard Bullet Catcher | 6/24/2001 6:35 | 495 | 3 | 950 | 7.5217E-14 | 1.67003E-12 | 3.49E-15 | 1.34E-13 |
| 111 | Eastern Perimeter | 6/24/2001 6:25 | 515 | 1 | 920 | 7.2296E-14 | 1.60517E-12 | -3.36E-15 | 4.85E-14 |
| 112 | 600 Yard Bullet Catcher | 6/24/2001 6:20 | 530 | 4 | 900 | 7.02499E-14 | 1.55974E-12 | 6.53E-15 | -5.23E-15 |
| 113 | Eastern Perimeter | 6/25/2001 6:25 | 437 | 6 | 900 | 8.52001E-14 | 1.89168E-12 | 1.58E-14 | -6.35E-15 |
| 114 | 600 Yard Bullet Catcher | 6/25/2001 6:15 | 440 | 2 | 947 | 8.46192E-14 | 1.87878E-12 | 0.00E+00 | 1.42E-13 |
| 115 | Northern Perimeter | 6/26/2001 6:30 | 560 | 4 | 897 | 6.64865E-14 | 1.47619E-12 | 6.18E-15 | -1.24E-14 |
| 116 | Northern Perimeter | 6/26/2001 6:40 | 505 | 1 | 890 | 7.37276E-14 | 1.63696E-12 | -3.42E-15 | -3.29E-14 |
| 117 | Eastern Perimeter | 6/26/2001 6:30 | 525 | 4 | 889 | 7.09189E-14 | 1.5746E-12 | 6.59E-15 | -3.43E-14 |
| 118 | 600 Yard Bullet Catcher | 6/26/2001 6:25 | 515 | 2 | 831 | 7.2296E-14 | 1.5648E-12 | 0.00E+00 | -7.00E-14 |
| 119 | Eastern Perimeter | 6/27/2001 6:45 | 440 | 1 | 987 | 1.02033E-13 | 1.93195E-12 | -7.86E-15 | 1.04E-13 |
| 120 | Eastern Perimeter | 6/28/2001 6:30 | 450 | 4 | 941 | 9.97658E-14 | 1.88902E-12 | 3.84E-15 | -4.01E-14 |
| 121 | 600 Yard Bullet Catcher | 6/28/2001 6:25 | 465 | 0 | 960 | 9.65475E-14 | 1.82808E-12 | -1.12E-14 | 1.79E-14 |
| 122 | Northern Perimeter | 6/28/2001 6:40 | 430 | 2 | 916 | 1.04406E-13 | 1.97688E-12 | -4.02E-15 | -1.23E-13 |
| 123 | 600 Yard Bullet Catcher | 6/30/2001 6:10 | 525 | 2 | 898 | 9.78173E-14 | 1.70156E-12 | -6.59E-15 | -4.12E-13 |
| 124 | Northern Perimeter | 6/30/2001 6:20 | 400 | 2 | 1056 | 1.28385E-13 | 2.23329E-12 | -8.65E-15 | 6.93E-15 |
| 125 | Eastern Perimeter | 6/30/2001 6:15 | 405 | 2 | 1029 | 1.268E-13 | 2.20572E-12 | -8.54E-15 | -8.56E-14 |
| 126 | Northern Perimeter | 7/2/2001 6:25 | 470 | 2 | 1102 | 1.09264E-13 | 1.90068E-12 | -7.36E-15 | 1.42E-13 |
| 127 | 600 Yard Bullet Catcher | 7/2/2001 6:20 | 465 | 4 | 1060 | 1.10439E-13 | 1.92111E-12 | 0.00E+00 | 1.79E-14 |
| 128 | Eastern Perimeter | 7/2/2001 6:30 | 450 | 5 | 1088 | 1.1412E-13 | 1.98515E-12 | 3.84E-15 | 1.05E-13 |
| 129 | Eastern Perimeter | 7/5/2001 7:55 | 380 | 4 | 1045 | 1.35142E-13 | 2.35084E-12 | 0.00E+00 | -3.28E-14 |
| 130 | 600 Yard Bullet Catcher | 7/5/2001 7:45 | 375 | 4 | 1122 | 1.36944E-13 | 2.38218E-12 | 0.00E+00 | 2.51E-13 |
| 131 | Northern Perimeter | 7/5/2001 8:00 | 390 | 1 | 1057 | 1.31677E-13 | 2.29056E-12 | -1.33E-14 | 1.07E-14 |
| 132 | Eastern Perimeter | 7/6/2001 6:15 | 475 | 2 | 1097 | 1.08114E-13 | 1.88067E-12 | -7.28E-15 | 1.26E-13 |
| 133 | Northern Perimeter | 7/6/2001 6:25 | 470 | 0 | 981 | 1.09264E-13 | 1.90068E-12 | -1.47E-14 | -2.15E-13 |
| 134 | 600 Yard Bullet Catcher | 7/6/2001 6:10 | 475 | 3 | 1012 | 1.08114E-13 | 1.88067E-12 | -3.64E-15 | -1.23E-13 |

# Lake City Army Ammunition Plant Radiological Final Status Survey of the 600-Yard Bullet Catcher

## Appendix 5
## Waste Information

# CABRERA SERVICES, INC.

**May 6, 2001**

Mr. John Lash
Waste Control Specialists
Oak Ridge, TN

**RE MODIFICAITON OF WASTE PROFILE FOR LAKE CITY ARMY AMMUNITION PLANT TO INCLUDE ADDITIONAL MATERIALS**

Mr. Lash:

I am writing to you in order to follow up on our discussion last Friday concerning modifying a mixed waste profile for Lake City Army Ammunition Plant.

It is Cabrera's desire to modify the existing to include additional construction materials from the 600 Yard Bullet Catcher, which we will dismantle soon.

Presently the materials for the used in the construction of the bullet catcher consist of plate steel with a thickness up to one (1) inch and treated wood telephone poles and timbers (up to 16"x16") used in the sides and roof.

The volume estimates for each of the construction materials is twenty (20) cubic yards of wood with up to five (5) cubic yards of steel plate. The wood construction materials contain projectiles and projectile fragments from small arms testing. All materials will be free of energetic and explosive properties. All materials will be packaged in intermodal containers.

I am seeking your input and concurrence on including these materials.

Please feel free to contact me at any time with questions or concerns. I can be reached at Lake City Army Ammunition Plant via my cellular phone at (860) 508-0455.

Thank you for your time today.

Sincerely,

Todd Eastman
Senior Materials Broker,
Project Supervisor
(860) 508-0455
TEASTMAN@cabreraservices.com

# CABRERA SERVICES, INC.

July 16, 2001

Cindy Kemper, Director
Hazardous Waste Program
Missouri Department of Natural Resources
205 Jefferson Street
Jefferson City, MO 65101-2901

Subject: 30-Day Extension for Storage of Explosive Hazardous Waste

Dear Ms. Kemper:

Cabrera Services, Inc. (CABRERA) on behalf of the Department of Army Lake City Army Ammunition Plant, requests regulatory discretion for a 30-day extension on the time limit to accumulate and store explosive hazardous waste scheduled for processing and disposal.

During recent remediation of lead and Exempt Source (depleted uranium) material contaminated soil, unexploded ordnance (UXO) was discovered. Upon this discovery, the remediation process was changed to identify and separate the UXO from the rest of the waste stream as it was generated. Cabrera and the Department of Army worked with the Missouri Department of Natural Resources (MDNR) to insure that the subsequent separation process would not need any MDNR permits. Unfortunately, prior to the discovery of UXO, two intermodal containers had already been filled. It was understood that separating the UXO in these two intermodal containers would require a permit, so off-site treatment/disposal was pursued. Appropriately licensed and permitted facilities to treat this resultant hazardous waste have been located. Allied Technology Group's Richland Facility is considering CABRERA's request for hosting treatment of this waste stream at this time. The time required to profile this waste, gain necessary Washington State approval and transport this waste could surpass storage limits.

The waste is currently stored on Building 65 parking lot storage pad marked in the attached map. It is assumed that these intermodals contain Exempt Source material, lead and UXO and exhibit the characteristics of D008. The two containers, PLRU 053567 and PLRU 025696, are labeled and the entire area is posted per 40 CFR 264.14.

Please direct any questions or comments to Phil Shuster at 816 796-7168.

Sincerely,

Robin E Beasley
Broker

809 MAIN STREET • HARTFORD, CT • 06108
PHONE: 860 289-1885 • FAX: 860 289-2261

# CABRERA SERVICES, INC.

May 14, 2001

Mr. John Lash
Waste Control Specialist
Oak Ridge, TN

**RE: ADDITIONAL WCS WASTE ACCEPTANCE CRITERIA CLARIFICATION**

Mr. Lash:

This letter is to follow up on our telephone conversation concerning potentially Unexploded Ordnance (UXO) in the waste stream at the U.S. Army's Lake City Army Ammunition Plant.

I am seeking additional guidance on condition 3.1, paragraph 6 of the WCS Waste Acceptance Criteria concerning 'Explosives'.

As you know we have encountered some suspect 20mm projectiles that were used on range in testing and demilitarization of munitions. Due to the physical condition of the projectiles we are unable to specifically identify the specific type of projectiles. After looking over the history of the range, the projectiles could potentially contain energetic properties, to include high explosives, incendiary mixtures and pyrophoric tracer elements.

Pending regulatory approval, it is our intent to sift out and remove the projectiles and large fragments from the waste stream, then package the sifted soils and debris for shipment to your TSDF in Andrews, Texas.

It is widely understood that the suspect rounds are not acceptable. My present concern centers on the small fragments, fines, contaminated debris, soils. It is conceivable that these materials contain trace residues of the energetic materials.

I am now seeking your assistance in determining the regulatory requirements concerning WCS/Texas acceptance of the soils and debris contaminated with residues. Specifically how Texas/WCS defines 'Explosives' and any regulatory guidance/limits on 'Explosives' and residues.

Please feel free to contact me with any comments or concerns. I can be reached in the field at Lake City via my cellular phone (860) 508-0455.

Thank you for you time today.

Sincerely,

Todd Eastman
Senior Materials Broker,
Project Supervisor

# CABRERA SERVICES, INC.

**May 6, 2001**

Mr. John Lash
Waste Control Specialists
Oak Ridge, TN

**RE MODIFICAITON OF WASTE PROFILE FOR LAKE CITY ARMY AMMUNITION PLANT TO INCLUDE ADDITIONAL MATERIALS**

Mr. Lash:

I am writing to you in order to follow up on our discussion last Friday concerning modifying a mixed waste profile for Lake City Army Ammunition Plant.

It is Cabrera's desire to modify the existing to include additional construction materials from the 600 Yard Bullet Catcher, which we will dismantle soon.

Presently the materials for the used in the construction of the bullet catcher consist of plate steel with a thickness up to one (1) inch and treated wood telephone poles and timbers (up to 16"x16") used in the sides and roof.

The volume estimates for each of the construction materials is twenty (20) cubic yards of wood with up to five (5) cubic yards of steel plate. The wood construction materials contain projectiles and projectile fragments from small arms testing. All materials will be free of energetic and explosive properties. All materials will be packaged in intermodal containers.

I am seeking your input and concurrence on including these materials.

Please feel free to contact me at any time with questions or concerns. I can be reached at Lake City Army Ammunition Plant via my cellular phone at (860) 508-0455.

Thank you for your time today.

Sincerely,

Todd Eastman
Senior Materials Broker,
Project Supervisor
(860) 508-0455
TEASTMAN@cabreraservices.com

Lake City Army Ammunition Plant
Cabrera Services, Inc.

# Intermodal Weight/Volume Log

| | | Intermodal ID. No. | | Fill Date | Net Weights IM | Net Weights Contents | |
|---|---|---|---|---|---|---|---|
| 1 | 1 | MHFU | 001035 | 6/27/2001 | 54160 | 46760 | Soil, Steel, <1% PPE |
| 1 | 2 | BKRU | 025595 | 6/10/2001 | 48180 | 40980 | Soil, Wood, <1% PPE |
| 1 | 3 | MHFU | 001401 | 6/16/2001 | 39340 | 32140 | Soil, Steel, <1% PPE |
| 1 | 4 | MHFU | 001794 | 6/1/2001 | 48,880 | 41,380 | Soil, <1% PPE |
| 1 | 5 | BKRU | 026059 | 6/28/2001 | 54000 | 46800 | Soil, Steel, <1% PPE with SP400 |
| 1 | 6 | BKRU | 026413 | 5/25/2001 | 47,760 | 40,560 | Soil, Wood, <1% PPE |
| | | | | | 292,320 | 248,620 | |
| 2 | 1 | MHFU | 010046 | 6/14/2001 | 57240 | 50790 | Soil, <1%PPE |
| 2 | 2 | MHFU | 001693 | 7/5/2001 | 54620 | 47220 | Soil, Steel, <1% PPE |
| 2 | 3 | BKRU | 025963 | 7/2/2001 | 54160 | 46960 | Soil, Steel, <1% PPE |
| 2 | 4 | MHFU | 001607 | 6/25/2001 | 54660 | 47460 | Soil, Steel, <1% PPE with SP400 |
| 2 | 5 | MHFU | 001201 | 5/29/2001 | 54,720 | 48,270 | Soil, Wood, Metal, <1% PPE |
| 2 | 6 | MHFU | 001661 | 6/24/2001 | 54180 | 46680 | Soil, Steel, <1% PPE with SP400 |
| | | | | | 329,580 | 287,380 | |
| 3 | 1 | MHFU | 001678 | 6/26/2001 | 59300 | 51800 | Soil, Steel, <1% PPE |
| 3 | 2 | MHFU | 001681 | 6/30/2001 | 58460 | 50960 | Soil, Steel, <1% PPE |
| 3 | 3 | BKRU | 025613 | 6/27/2001 | 57380 | 50180 | Soil, Steel, <1% PPE |
| 3 | 4 | BKRU | 025517 | 6/26/2001 | 58500 | 51300 | Soil, Steel, <1% PPE |
| 3 | 5 | MHFU | 001690 | 6/22/2001 | 58740 | 51240 | Soil, Steel, <1% PPE |
| 3 | 6 | MHFU | 001701 | 6/24/2001 | 57440 | 49940 | Soil, Steel, <1% PPE with SP400 |
| | | | | | 349,820 | 305,420 | |
| 4 | 1 | BKRU | 025573 | 6/18/2001 | 63800 | 56600 | Soil, Steel, <1% PPE |
| 4 | 2 | MHFU | 001765 | 6/23/2001 | 59800 | 52300 | Soil, Steel, <1% PPE with SP400 |
| 4 | 3 | MHFU | 001029 | 6/17/2001 | 53,660 | 46,260 | Soil, Steel, <1% PPE |
| 4 | 4 | MHFU | 001210 | 6/10/2001 | 60,080 | 53,630 | Soil, Wood, <1% PPE |
| 4 | 5 | MHFU | 001787 | 5/23/2001 | 60840 | 53440 | Soil, Wood, <1% PPE |
| 4 | 6 | BKRU | 026392 | 6/17/2001 | 55720 | 48520 | Soil, Steel, <1% PPE * |
| | | | | | 353,900 | 310,750 | |
| 5 | 1 | MHFU | 001485 | 6/26/2001 | 65620 | 58420 | Soil, Steel, <1% PPE |
| 5 | 2 | BKRU | 025985 | 6/9/2001 | 52,960 | 45,760 | Soil, Wood, <1% PPE |
| 5 | 3 | MHFU | 001795 | 6/12/2001 | 51220 | 43720 | Telephone Poles & Soil |
| 5 | 4 | MHFU | 001373 | 5/24/2001 | 55,780 | 48,380 | Telephone Poles & Soil |
| 5 | 5 | MHFU | 001770 | 6/23/2001 | 59000 | 51500 | Soil, Steel, <1% PPE with SP400 |
| 5 | 6 | MHFU | 001057 | 6/17/2001 | 36,720 | 29,320 | Telephone Poles & Soil |
| 5 | 7 | BKRU | 026460 | 6/26/2001 | 50040 | 42840 | Soil, Steel, <1% PPE |
| | | | | | 371,340 | 319,940 | |
| 6 | 1 | BKRU | 026328 | 6/18/2001 | 61260 | 54060 | Soil, Steel, <1% PPE |
| 6 | 2 | BKRU | 026165 | 6/10/2001 | 49240 | 42040 | Soil, Wood, <1% PPE |
| 6 | 3 | BKRU | 025575 | 6/16/2001 | 48320 | 41120 | Soil, Steel, <1% PPE |
| 6 | 4 | MHFU | 010015 | 6/23/2001 | 52140 | 45690 | Soil, Steel, <1% PPE with SP400 |
| 6 | 5 | MHFU | 001422 | 6/13/2001 | 55840 | 48640 | Soil, <1%PPE |
| 6 | 6 | BKRU | 025609 | 6/11/2001 | 47800 | 40600 | Soil, Wood, <1% PPE |
| 6 | 7 | BKRU | 026185 | 7/9/2001 | 37440 | 30240 | Soil, Steel, <1% PPE |
| | | | | | 352,040 | 302,390 | |
| | | PLRU | 053567 | 5/2/2001 | 53,180 | 44,410 | UXO |
| | | PLRU | 025696 | 5/2/2001 | 57,400 | 49,080 | UXO |

Lake City Army Ammunition Plant
Cabrera Services, Inc.

# Intermodal Activity Log

| Intermodal ID Number | | | Estimated Activity Concentration (pCi/g) | | | |
|---|---|---|---|---|---|---|
| | | | U-234 | U-235 | U-238 | U-Total |
| 3 | MHFU | 001029 | 2.6 | 0.3 | 14.5 | 17.5 |
| 4 | MHFU | 001057 | not sampled | | | |
| 5 | MHFU | 001787 | 0.1 | 0.0 | 0.5 | 0.6 |
| 6 | MHFU | 001373 | 2.9 | 0.4 | 15.8 | 19.0 |
| 7 | BKRU | 026413 | 24.7 | 3.1 | 136.6 | 164.4 |
| 8 | MHFU | 001201 | 1.4 | 0.2 | 7.7 | 9.3 |
| 9 | MHFU | 001794 | 0.8 | 0.1 | 4.7 | 5.6 |
| 10 | BKRU | 025985 | 1.4 | 0.2 | 7.8 | 9.4 |
| 11 | MHFU | 001210 | not sampled | | | |
| 12 | BKRU | 026165 | 2.6 | 0.3 | 14.4 | 17.3 |
| 13 | BKRU | 025595 | 2.5 | 0.3 | 13.6 | 16.4 |
| 14 | BKRU | 025609 | 1.8 | 0.2 | 10.0 | 12.0 |
| 15 | MHFU | 001795 | 1.1 | 0.1 | 5.9 | 7.1 |
| 16 | MHFU | 001422 | 2.9 | 0.4 | 16.0 | 19.2 |
| 17 | MHFU | 010046 | 2.1 | 0.3 | 11.7 | 14.1 |
| 18 | MHFU | 001401 | -0.5 | -0.1 | -2.9 | -3.5 |
| 19 | BKRU | 025575 | 1.7 | 0.2 | 9.4 | 11.4 |
| 20 | BKRU | 026392 | 8.4 | 1.1 | 46.3 | 55.7 |
| 21 | BKRU | 026328 | 1.7 | 0.2 | 9.7 | 11.6 |
| 22 | BKRU | 025573 | 2.8 | 0.3 | 15.3 | 18.4 |
| 23 | MHFU | 001690 | 1.9 | 0.2 | 10.7 | 12.8 |
| 24 | MHFU | 001770 | 34.1 | 4.3 | 188.7 | 227.1 |
| 25 | MHFU | 010015 | 43.7 | 5.5 | 242.1 | 291.4 |
| 26 | MHFU | 001765 | 1.7 | 0.2 | 9.4 | 11.3 |
| 27 | MHFU | 001661 | 0.2 | 0.0 | 1.1 | 1.3 |
| 28 | MHFU | 001701 | 1.2 | 0.2 | 6.7 | 8.1 |
| 29 | MHFU | 001607 | 8.0 | 1.0 | 44.3 | 53.3 |
| 30 | BKRU | 026460 | 2.2 | 0.3 | 12.1 | 14.5 |
| 31 | MHFU | 001485 | 0.4 | 0.0 | 2.1 | 2.5 |
| 32 | MHFU | 001678 | 0.5 | 0.1 | 2.9 | 3.4 |
| 33 | BKRU | 025517 | 2.3 | 0.3 | 13.0 | 15.7 |
| 34 | BKRU | 025613 | 1.7 | 0.2 | 9.3 | 11.2 |
| 35 | MHFU | 001035 | 0.4 | 0.0 | 2.0 | 2.5 |
| 36 | BKRU | 026059 | -0.5 | -0.1 | -2.5 | -3.0 |
| 37 | MHFU | 001681 | 0.9 | 0.1 | 5.2 | 6.2 |
| 38 | BKRU | 025963 | 0.9 | 0.1 | 5.1 | 6.1 |
| 39 | MHFU | 001693 | 1.2 | 0.2 | 6.7 | 8.0 |
| 40 | BKRU | 026185 | not sampled | | | |
| | | | | | **Average:** | **35.9** |
| | | | | | **Maximum:** | **291.4** |

Assumed Activity Fractions (based on site specific data)

| | |
|---|---|
| U-234 | 0.15 |
| U-235 | 0.019 |
| U-238 | 0.831 |
| U-Total | 1.0 |

Estimated activity fractions based on gamma spectroscopy analyses of composite samples
Uranium-238 quantified by measureing its secular equillibrium progeny, Pa-234m
Uranium-234 and -235 qauntified using the activity fracations above

Lake City Army Ammunition Plant
Cabrera Services, Inc.

# Intermodal Weight/Volume Log

| | Intermodal ID. No. | | Fill Date | Volume Capacity | Volume Fill | Tare Weights IM | Tare Weights Truck | Loaded Truck | Net Weights IM | Net Weights Contents | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PLRU | 053567 | 5/2/2001 | 25 | 13 | 8,770 | N/A | N/A | 40,000 | 31,230 | UXO, Steel, <1% PPE |
| 2 | PLRU | 025696 | 5/2/2001 | 25 | 14 | 8,320 | N/A | N/A | 42,900 | 34,580 | UXO, Steel, <1% PPE |
| 3 | MHFU | 001489 | 5/2/2001 | 30 | 12 | 7,400 | N/A | N/A | 36,960 | 29,560 | UXO, Steel, <1% PPE |

Intermodals remaining on-site as of 7/26/01 REBeasley

## ISOTOPIC WASTE CONCENTRATIONS AND TOTAL ACTIVITY

| | | | | Waste Uranium Activity Fractions[c] | | | Activity Concentration in Waste, pCi/g | | | | Waste Activity Total, mCi | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area of Concern | Volume[a] of Waste, $ft^3$ | Fraction of total waste volume | Waste (Soil) Density[b], $g/cm^3$ | U-238 | U-235 | U-234 | U-238 | U-235 | U-234 | Th-234[d] | U-238 | U-235 | U-234 | Th-234[d] |
| 600 - Yard Bullet Catcher | 6000 | 0.17 | 1.431 | 0.831 | 0.019 | 0.15 | 802.0 | 18.3 | 144.8 | 802.0 | 1.95E+02 | 4.46E+00 | 3.52E+01 | 1.95E+02 |
| 600 - Yard Impact Area | 30000 | 0.83 | 1.431 | 0.831 | 0.019 | 0.15 | 22.6 | 0.5 | 4.1 | 22.6 | 2.75E+01 | 6.29E-01 | 4.96E+00 | 2.75E+01 |
| Combined Totals: | 36000 | 1.00 | 1.431 | 0.831 | 0.019 | 0.15 | 153 | 3.5 | 28 | 153 | 2.23E+02 | 5.09E+00 | 4.02E+01 | 2.23E+02 |

Notes:

a) Volume of waste based unpon Lake City Army Ammunition Plant "Characterization of the Firing Range for Hazardous Materials" Allied Technology Group Inc. 6/14/94

b) NRC default density for soil

c) Lake City DU has the following activity fractions - U-238 83.1%, U-234 15.0%, U-235 1.9%

d) The-234 concentration and activity are based upon equilibrium value with parent U-238

LAKE CITY ARMY AMMUNITION PLANT - 600 YARD IMPACT AREA

| Sample Description | Matrix | Activity, U-238 | Error Est | MDA | Units |
|---|---|---|---|---|---|
| 600 A4 01 | SOIL | 0.00E+00[1] | 7.27E+00 | 12 | pCi/g |
| 600 A4 02 | SOIL | 0.00E+00[1] | 1.06E+01 | 18 | pCi/g |
| 600 A6 01 | SOIL | 0.00E+00 | 9.21E+00 | 15 | pCi/g |
| 600 A6 02 | SOIL | 2.58E+01 | 9.51E+00 | 16 | pCi/g |
| 600 B13 01 | SOIL | 0.00E+00[1] | 8.32E+00 | 14 | pCi/g |
| 600 C2 01 | SOIL | 1.03E+02 | 1.19E+01 | 19 | pCi/g |
| 600 C2 02 | SOIL | 0.00E+00[1] | 9.59E+00 | 16 | pCi/g |
| 600 C13 02 (1) | SOIL | 0.00E+00[1] | 8.93E+00 | 15 | pCi/g |
| 600 C13 02 (2) | SOIL | 0.00E+00[1] | 8.74E+00 | 15 | pCi/g |
| 600 CB 01 | SOIL | 0.00E+00 | 1.19E+01 | 20 | pCi/g |
| 600 CB 02 | SOIL | 0.00E+00 | 1.23E+01 | 21 | pCi/g |
| 600 D4 01 | SOIL | 5.34E+01 | 1.58E+01 | 26 | pCi/g |
| 600 D4 02 | SOIL | 0.00E+00[1] | 1.20E+01 | 20 | pCi/g |
| 600 D6 01 | SOIL | 6.02E+02 | 5.30E+01 | 81 | pCi/g |
| 600 D6 02 | SOIL | 0.00E+00[1] | 8.58E+00 | 14 | pCi/g |
| 600 D10 01 | SOIL | 4.65E+01 | 8.12E+00 | 13 | pCi/g |
| 600 D10 02 | SOIL | 2.73E+01 | 1.01E+01 | 17 | pCi/g |
| 600 E8 01 | SOIL | 0.00E+00 | 7.85E+00 | 13 | pCi/g |
| 600 E8 02 | SOIL | 0.00E+00[1] | 9.42E+00 | 16 | pCi/g |
| 600 EP1 01 | SOIL | 0.00E+00 | 8.01E+00 | 14 | pCi/g |
| 600 EP1 02 | SOIL | 1.65E+01 | 5.44E+00 | 9 | pCi/g |
| 600 EP2 01 | SOIL | 0.00E+00 | 6.83E+00 | 12 | pCi/g |
| 600 EP2 02 | SOIL | 0.00E+00 | 8.43E+00 | 14 | pCi/g |
| 600 EP3 01 | SOIL | 0.00E+00 | 5.90E+00 | 10 | pCi/g |
| 600 EP3 02 | SOIL | 0.00E+00[1] | 5.12E+00 | 9 | pCi/g |
| 600 G3 01 | SOIL | 1.88E+01 | 7.55E+00 | 12 | pCi/g |
| 600 G3 02 | SOIL | 0.00E+00[1] | 6.48E+00 | 11 | pCi/g |
| 600 G8 01 | SOIL | 1.76E+02 | 9.52E+00 | 14 | pCi/g |
| 600 G8 02 | SOIL | 0.00E+00[1] | 9.33E+00 | 16 | pCi/g |
| 600 G10 01 | SOIL | 0.00E+00[1] | 5.68E+00 | 10 | pCi/g |
| 600 G10 02 | SOIL | 0.00E+00[1] | 6.83E+00 | 11 | pCi/g |
| 600 H2 01 | SOIL | 0.00E+00[1] | 1.02E+01 | 17 | pCi/g |
| 600 H2 02 | SOIL | 0.00E+00[1] | 1.13E+01 | 19 | pCi/g |
| 600 H10 01 | SOIL | 0.00E+00[1] | 7.56E+00 | 13 | pCi/g |
| 600 H10 02 | SOIL | 0.00E+00[1] | 1.03E+01 | 17 | pCi/g |
| 600 HP1 02 | SOIL | 0.00E+00[1] | 6.64E+00 | 11 | pCi/g |
| 600 I8 01 | SOIL | 0.00E+00[1] | 8.24E+00 | 14 | pCi/g |
| 600 I8 02 | SOIL | 0.00E+00[1] | 9.53E+00 | 16 | pCi/g |
| 600 I14 01 | SOIL | 0.00E+00 | 1.05E+01 | 19 | pCi/g |
| 600 I14 02 | SOIL | 0.00E+00[1] | 1.09E+01 | 18 | pCi/g |
| 600 J10 01 | SOIL | 2.14E+02 | 1.17E+01 | 18 | pCi/g |
| 600 J10 02 | SOIL | 0.00E+00[1] | 1.43E+01 | 24 | pCi/g |
| 600 L4 01 | SOIL | 0.00E+00[1] | 9.55E+00 | 16 | pCi/g |
| 600 L4 02 | SOIL | 0.00E+00[1] | 9.19E+00 | 15 | pCi/g |
| 600 L8 01 | SOIL | 7.90E+01 | 1.00E+01 | 16 | pCi/g |
| 600 L8 02 | SOIL | 0.00E+00[1] | 1.34E+01 | 22 | pCi/g |
| 600 L10 01 | SOIL | 2.71E+02 | 4.33E+01 | 67 | pCi/g |
| 600 L10 02 | SOIL | 0.00E+00 | 9.35E+00 | 16 | pCi/g |
| 600 L13 01 | SOIL | 0.00E+00 | 6.91E+00 | 12 | pCi/g |
| 600 L13 02 | SOIL | 0.00E+00[1] | 8.64E+00 | 14 | pCi/g |

# LAKE CITY ARMY AMMUNITION PLANT - 600 YARD IMPACT AREA

| | | | | | |
|---|---|---|---|---|---|
| 600 LDC 01 | SOIL | 0.00E+00[1] | 7.76E+00 | 13 | pCi/g |
| 600 LDC 02 | SOIL | 0.00E+00[1] | 1.12E+01 | 19 | pCi/g |
| 600 M7 01 | SOIL | 4.94E+01 | 1.67E+01 | 27 | pCi/g |
| 600 M7 02 | SOIL | 1.68E+01 | 9.80E+00 | 16 | pCi/g |
| 600 N2 01 | SOIL | 3.75E+01 | 1.06E+01 | 17 | pCi/g |
| 600 N2 02 | SOIL | 0.00E+00[1] | 9.84E+00 | 16 | pCi/g |
| 600 N8 01 | SOIL | 0.00E+00 | 8.16E+00 | 14 | pCi/g |
| 600 N8 02 | SOIL | 0.00E+00[1] | 8.23E+00 | 14 | pCi/g |
| 600 NP1 01 | SOIL | 0.00E+00 | 7.73E+00 | 13 | pCi/g |
| 600 NP2 01 | SOIL | 3.17E+01 | 8.08E+00 | 13 | pCi/g |
| 600 NP2 02 | SOIL | 0.00E+00 | 7.12E+00 | 12 | pCi/g |
| 600 NP3 01 | SOIL | 0.00E+00[1] | 8.67E+00 | 15 | pCi/g |
| 600 NP3 02 | SOIL | 1.58E+01 | 5.58E+00 | 9 | pCi/g |
| 600 O6 01 | SOIL | 2.60E+01 | 1.08E+01 | 18 | pCi/g |
| 600 O6 02 | SOIL | 0.00E+00[1] | 1.02E+01 | 17 | pCi/g |
| 600 O9 01 | SOIL | 0.00E+00[1] | 1.15E+01 | 19 | pCi/g |
| 600 O9 02 | SOIL | 0.00E+00[1] | 9.89E+00 | 17 | pCi/g |
| 600 RDC 01 | SOIL | 0.00E+00 | 1.12E+01 | 19 | pCi/g |
| 600 RDC 02 | SOIL | 0.00E+00 | 9.33E+00 | 16 | pCi/g |
| 600 RSBC 01 | SOIL | 1.93E+01 | 7.65E+00 | 13 | pCi/g |
| 600 SP1 01 | SOIL | 0.00E+00 | 6.29E+00 | 11 | pCi/g |
| 600 SP1 02 | SOIL | 0.00E+00 | 7.59E+00 | 13 | pCi/g |
| 600 SP2 01 | SOIL | 0.00E+00 | 6.85E+00 | 12 | pCi/g |
| 600 SP2 02 | SOIL | 1.33E+01 | 6.98E+00 | 12 | pCi/g |
| 600 SP3 01 | SOIL | 0.00E+00[1] | 6.07E+00 | 10 | pCi/g |
| 600 SP3 02 | SOIL | 0.00E+00 | 8.29E+00 | 14 | pCi/g |
| 600 WP1 01 | SOIL | 1.30E+01 | 6.11E+00 | 10 | pCi/g |
| 600 WP1 02 | SOIL | 0.00E+00 | 6.74E+00 | 12 | pCi/g |
| 600 WP2 01 | SOIL | 0.00E+00 | 7.34E+00 | 12 | pCi/g |
| 600 WP2 02 | SOIL | 0.00E+00[1] | 7.58E+00 | 13 | pCi/g |
| 600 WP3 01 | SOIL | 0.00E+00 | 6.02E+00 | 10 | pCi/g |
| 600 WP3 02 | SOIL | 0.00E+00[1] | 6.12E+00 | 10 | pCi/g |

1 - Activity listed by analysis is less than MDA; set to zero

| | |
|---|---|
| Average Activity, pCi/g: | 22.6 |
| Activity Range, pCi/g: | 0 - 602 |

## LAKE CITY ARMY AMMUNITION PLANT - 600 YARD BULLET CATCHER

| Sample Description | Matrix | Activity, U238 | Error Est | MDA | Units |
|---|---|---|---|---|---|
| 600 BC C3 01 | SOIL | 9.45E+02 | 1.55E+01 | 21 | pCi/g |
| 600 BC C3 02 | SOIL | 0.00E+00 | 6.34E+00 | 11 | pCi/g |
| 600 BC C9 01 | SOIL | 0.00E+00[1] | 6.55E+00 | 11 | pCi/g |
| 600 BC C9 02 | SOIL | 0.00E+00 | 5.42E+00 | 9 | pCi/g |
| 600 BC F3 01 | SOIL | 0.00E+00 | 6.45E+00 | 11 | pCi/g |
| 600 BC F3 02 | SOIL | 0.00E+00 | 6.23E+00 | 11 | pCi/g |
| 600 BC F9 01 | SOIL | 0.00E+00 | 6.28E+00 | 11 | pCi/g |
| 600 BC F9 02 | SOIL | 0.00E+00 | 5.08E+00 | 9 | pCi/g |
| 600 BC I3 01 | SOIL | 0.00E+00 | 6.23E+00 | 11 | pCi/g |
| 600 BC I3 02 | SOIL | 0.00E+00 | 5.69E+00 | 10 | pCi/g |
| 600 BC I9 01 | SOIL | 0.00E+00 | 6.03E+00 | 10 | pCi/g |
| 600 BC I9 02 | SOIL | 2.79E+01 | 5.74E+00 | 9 | pCi/g |
| 600 BCRS 001 | SOIL | 9.27E+01 | 6.17E+00 | 9 | pCi/g |
| 600 BCRS 002 | SOIL | 1.89E+02 | 8.28E+00 | 12 | pCi/g |
| 600 BCRS 003 | SOIL | 4.22E+02 | 1.14E+01 | 16 | pCi/g |
| 600 BCRS 004 | SOIL | 1.76E+01 | 4.28E+00 | 7 | pCi/g |
| 600 BCRS 005 | SOIL | 3.75E+01 | 5.28E+00 | 8 | pCi/g |
| 600 BCRS 006 | SOIL | 8.04E+02 | 1.61E+01 | 22 | pCi/g |
| 600 BCRS 007 | SOIL | 4.68E+03 | 5.63E+01 | 76 | pCi/g |
| 600 BCRS 008 | SOIL | 1.32E+03 | 1.87E+01 | 25 | pCi/g |
| 600 BCRS 009 | SOIL | 2.26E+03 | 3.56E+01 | 45 | pCi/g |
| 600 BCRS 010 | SOIL | 3.10E+03 | 4.71E+01 | 63 | pCi/g |
| 600 BCRS 011 | SOIL | 2.92E+03 | 4.79E+01 | 64 | pCi/g |
| 600 BCRS 012 | SOIL | 1.41E+03 | 2.90E+01 | 37 | pCi/g |
| 600 BCRS 013 | SOIL | 2.79E+03 | 4.15E+01 | 54 | pCi/g |
| 600 BCRS 014 | SOIL | 1.13E+03 | 2.62E+01 | 35 | pCi/g |
| 600 BCRS 015 | SOIL | 7.78E+02 | 1.24E+01 | 16 | pCi/g |
| 600 BCRS 016 | SOIL | 6.97E+02 | 4.62E+01 | 64 | pCi/g |
| 600 BCRS 017 | SOIL | 1.09E+01 | 4.95E+00 | 8 | pCi/g |
| 600 BCRS 018 | SOIL | 0.00E+00[1] | 5.21E+00 | 9 | pCi/g |
| 600 BCRS 019 | SOIL | 8.62E+02 | 1.26E+01 | 16 | pCi/g |
| 600 BCRS 020 | SOIL | 7.76E+02 | 2.39E+01 | 33 | pCi/g |
| 600 BCRS 021 | SOIL | 4.41E+02 | 1.10E+01 | 15 | pCi/g |
| 600 BCRS 022 | SOIL | 4.54E+02 | 1.03E+01 | 14 | pCi/g |
| 600 BCRS 023 | SOIL | 1.67E+03 | 6.38E+01 | 82 | pCi/g |
| 600 BCRS 024 | SOIL | 7.12E+02 | 4.35E+01 | 60 | pCi/g |
| 600 BCRS 025 | SOIL | 1.01E+02 | 8.05E+00 | 12 | pCi/g |
| 600 BCRS 026 | SOIL | 2.06E+03 | 4.04E+01 | 55 | pCi/g |
| 600 BCRS 027 | SOIL | 8.54E+02 | 2.72E+01 | 36 | pCi/g |
| 600 BCRS 028 | SOIL | 2.24E+03 | 7.20E+01 | 92 | pCi/g |
| 600 BCRS 029 | SOIL | 1.62E+02 | 7.90E+00 | 12 | pCi/g |
| 600 BCRS 030 | SOIL | 0.00E+00 | 5.13E+00 | 9 | pCi/g |
| 600 BCRS 031 | SOIL | 5.01E+01 | 6.82E+00 | 11 | pCi/g |
| 600 BCRS 032 | SOIL | 2.93E+02 | 1.02E+01 | 15 | pCi/g |
| 600 BCRS 033 | SOIL | 9.46E+02 | 1.65E+01 | 23 | pCi/g |
| 600 BCRS 035 | SOIL | 1.60E+01 | 7.83E+00 | 13 | pCi/g |

1 - Activity listed by analysis is less than MDA; set to zero

Average Activity, pCi/g: 802
Activity Range, pCi/g: 0 - 4680

To: Robin E Beasley
From: Ken Michaels
Date: June 26, 2001

It has been determined that the following items are free of radiological contamination.

| LCAAP NO. | Quantity | Type of Ordnance |
|---|---|---|
| 07 | 2 ea. | 30mm |
| 12 | 45 ea. | 20mm M56 Series |
| 15 | 48 ea. | 20mm M56 Series |
| 22 | 39 ea. | 20mm M56 Series |
| 28 | 109 ea. | 20mm M56 Series |
| 38 | 59 ea. | 20mm M56 Series |
| 39 | 51 ea. | 20mm M56 Series |
| 45 | 44 ea. | 20mm M56 Series |
| 46 | 3 ea. | 20mm M53 Series |
| | 400 ea. | |

To: File
From: Robin Beasley
Date: June 26, 2001

The following have been surveyed and contain contamination above background.

| LCAAP NO. | Quantity | Type of Ordnance |
|---|---|---|
| 14 | 7 ea. | 20mm M56 Series |
| 17 | 1 ea. | 30mm Unknown Series |
| 20 | 23 ea. | 20mm M56 Series |
| 21 | 36 ea. | 20mm M56 Series |
| 23 | 2 ea. | M101 Capsule Assembly (incendiary) |
| 25 | 4 ea. | 20mm M53 Series |
| 26 | 24 ea. | 20mm M56 Series |
| 27 | 39 ea. | 20mm M56 Series |
| 30 | 1 ea. | M101 Capsule Assembly (incendiary) |
| 32 | 5 ea. | 20mm M53 Series |
| 34 | 63 ea. | 20mm M56 Series |
| 36 | 1 ea. | 30mm Unknown Series |
| 42 | 12 ea. | 20mm M56 Series |
| 47 | 73 ea. | 20mm M56 Series |
| 01 | 68 ea. | 20mm M56 Series |
| 05 | 49 ea. | 20mm M56 Series |
| 13 | 56 ea. | 20mm M56 Series |
| 31 | 3 ea. | M101 Capsule Assembly |
| | 467 ea. | |

**WCS**

*WASTE CONTROL SPECIALISTS LLC*

# Attachment to Waste Profile Sheet

For Radioactive Material

**PROFILE #:**

Check Appropriate Box: ☐ Storage Only ☒ Treatment/Disposal ☐ Treatment/3rd Party Disposal ☐ Direct Disposal ☐ Treatment/Return to Generator

Radioactive Characteristics: ☐ Mixed ☒ Radioactive

Chemical Form: DU Oxides on debris (metal, rubber, plastic)

Is material waste (Check one): ☒ Yes ☐ No

Is material exempt (Check one): ☐ Yes ☒ No (WAC Section 3.2.1)

If Waste, what waste class (Check one): ☒ A ☐ B ☐ C or ☐ >C
(see Title 10 CFR 61.55 and 25 TAC 289.202 (ggg)(4))

Is material NORM (Check one): ☐ Yes ☒ No

Does material contain technologically enhanced radium (Check one): ☐ Yes ☒ No

Is material source material (Check one): ☒ Yes ☐ No

If yes, Radon emanation rate is: _____ $pCi/m^2/sec$

Grams of special nuclear material (Total for Profile): Pu_____ U-233_____ U-235_____

Highest dose rate in mR/hr: On contact .08 At 1 ft. .08

Are the containers overpacked? (Check one): ☐ Yes ☒ No

Describe the packaging: Intermodal

**Radioactive Constituents:**
List all radionuclides present in the waste, the concentration pCi/gm and the total activity in millicuries. (Attach additional sheets if necessary-please use the same table format as below.)

| Nuclide | Concentration Range (pCi/gm) Min. | Max. | Avg. | Total Activity (mCi) |
|---|---|---|---|---|
| Th-232 | .47 | 2.0 | .898 | |
| Bi-214 | .19 | .53 | .42 | |
| Pb-214 | .37 | .66 | .542 | |
| Th-232 | .47 | 2 | .898 | |
| U-235 | .42 | 2.5 | 1.02 | |
| U-238 | 1.5 | 47 | 18.8 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**Generator's Certification:**

The information contained herein is based on ☒ generator knowledge and/or ☒ analytical data. I hereby certify that the above and attached description is complete and accurate to the best of my knowledge and ability to determine that no deliberate or willful omissions of composition properties exist and that all known or suspected hazards have been disclosed. I certify that the materials tested are representative of all materials described by this document.

**Authorized Signature:**_____ **Date:**_____

**Printed Name:** Todd Eastman **Title:** Sr. Boker

# WASTE PROFILE METALS - TOTALS

| Sample Description | Concentration, mg/kg (ppm) - EPA Method 6010 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sb | As | Ba | Be | Cd | Cr | Pb | Hg | Ni | Se | Ag | Tl | Zn |
| S001/6B | 7.20 | 2.40 | 83.10 | 0.30 | 0.43 | 2.30 | 487.00 | 0.05 | 6.80 | 0.64 | 0.43 | 0.21 | 58.60 |
| S003/6B | 2.50 | 2.00 | 86.20 | 0.21 | 0.41 | 2.30 | 245.00 | 0.05 | 4.60 | 0.62 | 0.41 | 0.21 | 29.00 |
| S005/6B | 1.10 | 1.70 | 68.20 | 0.85 | 0.43 | 3.80 | 16.30 | 0.05 | 6.40 | 0.43 | 0.43 | 0.21 | 20.80 |
| S007/6B | 1.00 | 1.40 | 84.80 | 0.83 | 0.42 | 2.80 | 130.00 | 0.05 | 8.50 | 0.42 | 0.42 | 0.21 | 29.90 |
| S009/6B | 9.10 | 2.50 | 120.00 | 0.20 | 0.40 | 3.30 | 801.00 | 0.05 | 11.00 | 0.60 | 0.40 | 0.20 | 97.20 |
| S011/6B | 21.20 | 1.20 | 56.40 | 0.82 | 0.41 | 1.00 | 3010.00 | 0.05 | 3.10 | 0.41 | 0.41 | 0.20 | 148.00 |
| S013/6B | 19.20 | 1.30 | 47.40 | 0.82 | 0.54 | 2.70 | 1920.00 | 0.05 | 3.70 | 0.41 | 0.41 | 0.21 | 33.60 |
| S015/6B | 5.80 | 7.80 | 107.00 | 0.55 | 0.59 | 4.50 | 578.00 | 0.05 | 9.40 | 0.65 | 0.43 | 0.22 | 140.00 |
| S017/6B | 1.10 | 0.42 | 112.00 | 6.50 | 0.42 | 5.80 | 9.90 | 0.05 | 8.10 | 0.42 | 0.42 | 0.21 | 42.80 |
| S019/6B | 14.40 | 3.00 | 73.50 | 0.81 | 0.81 | 2.10 | 1170.00 | 0.05 | 5.50 | 0.14 | 0.41 | 0.20 | 42.80 |
| S021/6B | 1.50 | 5.60 | 187.00 | 0.97 | 1.70 | 17.00 | 165.00 | 0.06 | 20.40 | 0.49 | 0.49 | 0.24 | 72.40 |
| S023/6B | 13.70 | 3.80 | 117.00 | 0.87 | 1.50 | 2.20 | 1980.00 | 0.06 | 5.80 | 0.44 | 0.44 | 0.22 | 71.80 |
| S025/6B | 7.40 | 6.30 | 169.00 | 0.36 | 0.58 | 5.90 | 1320.00 | 0.06 | 10.70 | 0.73 | 0.48 | 0.24 | 96.60 |
| S027/6B | 2.10 | 6.00 | 189.00 | 0.80 | 0.78 | 11.3 | 734.00 | 0.08 | 16.70 | 0.82 | 0.55 | 0.27 | 124.00 |
| S029/6B | 3.30 | 9.20 | 201.00 | 0.73 | 0.97 | 12.8 | 420.00 | 0.09 | 20.10 | 0.75 | 0.50 | 0.34 | 83.10 |
| S031/6B | 2.20 | 7.80 | 205.00 | 1.00 | 0.87 | 14.2 | 314.00 | 0.06 | 18.50 | 0.50 | 0.50 | 0.25 | 78.90 |
| S033/6B | 3.80 | 9.30 | 256.00 | 0.88 | 1.60 | 14.4 | 728.00 | 0.06 | 22.80 | 0.75 | 0.50 | 0.36 | 101.00 |
| S035/6B | 3.50 | 5.50 | 130.00 | 0.97 | 0.49 | 10.9 | 569.00 | 0.06 | 18.30 | 0.49 | 0.49 | 0.24 | 73.10 |
| S037/6B | 2.10 | 2.00 | 45.40 | 0.91 | 0.45 | 2.90 | 152.00 | 0.06 | 8.10 | 0.45 | 0.45 | 0.23 | 21.50 |
| S039/6B | 1.50 | 1.90 | 87.30 | 0.89 | 0.44 | 3.80 | 151.00 | 0.06 | 11.50 | 0.44 | 0.44 | 0.22 | 31.80 |
| Max | 21.20 | 9.30 | 256.00 | 6.50 | 1.70 | 17.00 | 3010.00 | 0.09 | 22.80 | 0.82 | 0.55 | 0.36 | 148.00 |
| Ave | 6.19 | 4.06 | 121.27 | 1.01 | 0.71 | 6.30 | 745.01 | 0.06 | 11.00 | 0.53 | 0.45 | 0.23 | 69.85 |
| Min | 1.00 | 0.42 | 45.40 | 0.20 | 0.40 | 1.00 | 9.90 | 0.05 | 3.10 | 0.14 | 0.40 | 0.20 | 20.80 |
| *"Times 20 rule" expected TCLP value* | 1.06 | 0.47 | 12.80 | 0.33 | 0.09 | 0.85 | 150.50 | 0.00 | 1.14 | 0.04 | 0.03 | 0.02 | 7.40 |
| *40CFR261.24 table 1 value* | - | 5.0 | 100.0 | - | 1.0 | 5.0 | 5.0 | 0.2 | - | 1.0 | 5.0 | - | - |
| *EPA HW No.* | | D004 | D005 | - | D006 | D007 | D008 | D009 | - | D010 | D011 | - | - |

# FINAL RADIOLOGICAL STATUS REPORT

# LAKE CITY ARMY AMMUNITION PLANT

# BUILDING 3-A DEPLETED URANIUM WING

**Revision 1**

**Allied Technology Group Inc.**
**671 Emory Valley Road**
**Oak Ridge, TN 37830**

**August 2001**

Final Radiological Status Report
Lake City Army Ammunition Plant
Building 3-A Depleted Uranium Wing
Allied Technology Group Inc.

**Table of Contents**
**Text**


| Section | Subject | Page |
|---|---|---|
| 1.0 | Background Information | 1 |
| 2.0 | Site Information | 2 |
| 2.1 | Site Description | 2 |
| 2.2 | Site Conditions at the Time of the Final Survey | 3 |
| 2.3 | Identity of Contaminants | 3 |
| 3.0 | Final Status Survey Overview | 4 |
| 3.1 | Survey Objectives | 4 |
| 3.2 | Organization and Responsibilities | 4 |
| 3.3 | Instrumentation | 5 |
| 3.4 | Survey Procedures | 5 |
| 3.4.1 | Area Classification | 5 |
| 3.4.2 | Reference Grids | 6 |
| 3.4.3 | Surface Scans | 6 |
| 3.4.4 | Surface Activity Measurements | 8 |
| 3.4.5 | Exposure Rate Measurements | 8 |
| 3.4.6 | Soil/Sediment Sampling | 8 |
| 3.4.7 | Special Measurements and Samples | 9 |
| 3.4.8 | Quality Assurance Samples | 9 |

**Table of Contents**
**Text**
**(continued)**


| Section | | Subject | Page |
|---|---|---|---|
| | 3.5 | Background Level Determinations | 9 |
| | 3.6 | Sample Analysis | 11 |
| | 3.7 | Data Interpretation | 11 |
| | 3.8 | Records | 11 |
| 4.0 | Survey Findings and Results | | 11 |
| | 4.1 | Background Levels | 11 |
| | 4.2 | Building Surveys | 12 |
| | 4.3 | Ground Surveys | 12 |
| | 4.4 | Data Evaluation | 13 |
| | 4.5 | Residual Activity Inventory | 17 |
| 5.0 | Summary | | 17 |
| 6.0 | References | | 17 |

## Table of Contents
## Appendices and Tables


| Appendix | Subject |
|---|---|
| A | Grid Map |
| B | Instrument Calibration and Performance Check Records |
| C | Grid Survey Records |
| D | Background Survey Records |
| E | Soil Sample Analysis Results |
| F | Duplicate Sample Results |
| G | Remaining Drain Pipe Disposition Evaluation |

| Table | Subject | Page |
|---|---|---|
| 3-1 | Grid Status | 7 |
| 3-2 | Duplicate Sample Results for Laboratory QA Verification | 10 |
| 4-1 | $^{238}U(^{234}Th)$ Soil Concentrations | 14 |
| 4-2 | Special Soil Sample $^{238}U(^{234}Th)$ Soil Concentrations | 16 |
| 4-3 | Residual $^{238}U(^{234}Th)$ Activity Inventory | 18 |

## 1.0 Background Information

Lake City Army Ammunition Plant (LCAAP) is located on U.S. Highway 7 and 78 between Independence and Blue Springs, MO. The plant was built by the U.S. Army in 1941 and was operated by Remington Arms from 1941 to 1985. Olin Ordnance operated the plant from 1985 through April of 2000. The current operator is ATK, who manufactures and tests small caliber munitions for the U.S. Army.

LCAAP had a small scale depleted uranium (DU) operation during the 1960's and 1970's. Developmental planning of the XM-101 DU spotting projectile started in 1959 and by 1961 LCAAP was producing approximately 8,000 rounds per month. The XM-101 (later M-101) round consisted of a fused, 20mm projectile with a body constructed from DU. LCAAP also produced an XM-106 round identical to the XM-101, but without the explosive components.

The installation designed, manufacture, and tested, and in later years demilitarized some 75,000 20mm DU spotter rounds. The spotter rounds were approximately 6 inches in length, 20mm in diameter and weighed approximately 1 pound each. The machined DU body made up 0.45% of the round's 1 pound weight and contained a fused white phosphorous charge that would detonate upon impact.

For production, bar stock of depleted uranium was stored in crates outside Building 3-A and protected from weather by plastic sheeting. Procedures stated that packages of DU would be brought just inside the building to support machining operations. Scrap from machining operations was stored in water filled containers. Remington would then store these filled cans in a metal storage shed behind Building 3-A. When preparing materials for shipment off site, the water was replaced with oil. These containers were over-packed into a 55-gallon drum prior to shipment.

The manufacturing activities for the Davy Crockett spotter round was confined to Building 3-A and Building 12. Chem Nuclear Systems Incorporated (CNSI) was contracted in 1987 to decommission Building 3-A and Building 12. Radioactive waste from this activity was disposed at the Barnwell, SC low-level radioactive waste facility. After the decommissioning, the NRC Region III authorized release of these buildings for unrestricted use. A subsequent confirmatory survey by NRC Region III in November of 1995 revealed DU contamination levels above releasable limits in the Building 3-A DU wing.

Allied Technology Group (ATG) Inc. was awarded the contract by the U.S. Army Operations Support Command (OSC) for the remediation of the Building 3-A DU wing. After extensive survey efforts during the second half of 2000, ATG and the OSC concurred that there was indication of wide-spread contamination above the FC 83-23 release limits in inaccessible surfaces (e.g., floor seams, floor-wall interfaces, support equipment, etc.) within the building 3-A DU wing. A segregated building demolition was then developed to allow: the potentially contaminated (i.e., affected) materials to appropriate disposal; unaffected materials to be disposed of as non-radioactive solid waste; and a final status survey of the ground below the building's footprint to be conducted without interference from the subject structure. During May and June of 2001, ATG conducted the subject building demolition, surveying, segregating, packaging, and removing the affected and unaffected materials.

All DU operations (manufacture, testing and demilitarization) from 1960 through 1985 were performed under Remington's Nuclear Regulatory Commission (NRC) license. In 1985 Olin Ordnance Corporation became the LCAAP operating contractor. The depleted uranium (DU) operations was added to the U.S. Army (then HQ, AMCCOM) Headquarters, Industrial Operations Support Command (HQ, OSC) NRC license for storage and possession of source material, SUC-1380.

## 2.0 Site Information

### 2.1 Site Description

The LCAAP Building 3-A DU wing consisted of an approximately 80 $m^2$ single-story facility, with a loading dock adjacent to the east and south-east end of the building. An asphalt driveway serviced the loading dock from the south. As described in Reference 1, the affected site area included the building foot-print and a ten meter (10 m)buffer zone around the building, for a total of approximately 3,630 $m^2$. Specific areas of interest within the affected area include the building drains, trenches which previously contained the excavated drain lines and sumps.

## 2.2 Site Conditions at the Time of the Final Survey

The Final Radiological Status Survey (FRSS) was conducted from June 26 through July 2. As designated in Reference 1, ATG demolished the facility structure and packaged and removed the resultant material prior to commencement of the FRSS. The remaining materials, to be evaluated during the FRSS, consisted of the building footprint, where the Building 3-A DU wing had once stood, and the surrounding grounds that were potentially affected due to past facility operations, as well as demolition activities.

As denoted on the survey record included as Appendix A, the building footprint and surrounding area included a number of noteworthy points, including: the remaining portion of Building 3-A (i.e., not the Depleted Uranium (DU) Wing); the trenches from which the drain lines and drain sumps were excavated; and the footprint of the loading dock wall. As discussed in Section 3.5, these remaining structures, due to their Naturally Occurring Radioactive Material (NORM) content, presented a notable effect on the ambient background of external penetrating radiation levels.

At the time of the FRSS, the only remaining potentially affected surfaces, as described in Reference 1, were the interior of the drain lines, downstream of the drain sumps, which required separate action and evaluation as described in Appendix G.

## 2.3 Identity of Contaminants

The contaminant of concern is DU. DU is the chemical element Uranium (U), which has been depleted in the isotope $^{235}U$. Total uranium activity concentrations were inferred from measured > 238U, using a site-specific activity ratio of $^{238}U$ : Total U of 0.831 : 1. Since the radioactive progeny of Uranium is chemically and physically separated from the Uranium isotopes during the enrichment (or depletion in this case) process, then the only progeny that has had time to "grow-in" to equilibrium activity are the $^{234}Th$, and $^{234m}Pa$ daughters of $^{238}U$.

These progeny isotopes were used in the characterization of the subject DU contamination as described herein. The $^{234}Th$ isotope provides a 92 keV gamma emission that was evaluated in the gamma scans, fixed measurements, and soil sample gamma spectrometry analyses as described herein. The $^{234m}Pa$ isotope provides a high energy (i.e., 2.281 $MeV_{max}$) $\beta$ emission that provides ease of monitoring for surface contamination, for material segregation and classification, as well as package, personnel, and equipment monitoring prior to removal from the site.

Each of the subject progeny isotopes (i.e., $^{234}$Th and $^{234m}$Pa) accurately represent the amount of $^{238}$U present in the media evaluated. To convert from $^{238}$U activity to DU activity, a factor of 1.2 times the measured $^{238}$U concentration (i.e., accounting for the unmeasured $^{234}$U and $^{235}$U isotopes) may be used throughout this document to determine the total DU residual activity remaining.

## 3.0 Final Status Survey Overview

### 3.1 Survey Objectives

The purpose of the FRSS was to demonstrate that the radiological conditions at the area where the LCAAP Building 3-A DU wing once stood satisfy the NRC approved release limits. The area can, therefore, be released from licensing restrictions for future use without radiological controls.

Please note that no building surfaces remained following the demolition activities. Therefore, the specific objectives of the survey were to demonstrate that: volumetric contamination within the soil was less than 35 pCi/g of residual DU activity; and external exposure-rates do not exceed five (5) μR/hour above background at one meter (1 m) above the surface.

### 3.2 Organization and Responsibilities

Site operations were under the oversight of ATK, with project authority and responsibility assigned to ATG. Although additional contractors and subcontractors were utilized to perform demolition and excavation functions during the removal of the Building 3-A DU wing structure, ATG personnel performed the surveys and sampling required to complete the FRSS.

Samples were shipped to ATG laboratory personnel at ATG's radiological materials processing facilities in Richland, WA, and Oak Ridge, TN, for analysis. Duplicate and split samples were sent to independent radiological laboratories in Fort Collins, CO, and Madison, PA (i.e., Paragon Analytics, Inc. and Antech Ltd., respectively). Each of these analytical laboratory facilities were evaluated by ATG and determined to satisfactorily meet the Quality Assurance (QA) requirements of Reference 2.

Site personnel reported to the ATG Project Manager for direction and supervision during performance of the FRSS, and were briefed on the technical requirements of the Decommissioning Plan and FRSS by the ATG Project Engineer/ Health Physicist prior to commencement of FRSS activities. All FRSS data was forwarded to the ATG Project Engineer/ Health Physicist for Quality Assurance (QA) review and FRSS report compilation.

## 3.3 Instrumentation

Reference 1 provides a description, with associated sensitivities, of the survey instruments used during the FRSS. The combination of instrumentation and technique were chosen to provide a detection sensitivity capable of verifying the approved release limits. All instruments were calibrated and performance checked utilizing NIST-traceable sources. Records of these activities are provided in Appendix B.

## 3.4 Survey Procedures

Survey planning and procedures were In Accordance With (IAW) Reference 2. Procedures are briefly described in this section, with further detail provided in Section 7.3 of Reference 1.

### 3.4.1 Area Classification

For the purpose of establishing the sampling and measurement frequency and pattern, the site was divided into affected and unaffected areas. The bases for these classifications are described below.

"Affected Areas," as described in Reference 2, are those areas that have known, or the potential for, radioactive contamination. These normally include areas where radioactive materials were used or stored, or where spill or other unusual occurrences have resulted in the spread of contamination. Areas immediately adjacent to locations where radioactive materials were used or stored are also included due to the potential for the spread of contamination.

"Unaffected Areas" are those areas not classified as "affected." They are not expected to contain residual radioactivity based on knowledge of the site history and survey information.

As designated in Section 7.3 of Reference 1, the building footprint, a ten meter (10 m) buffer, and the contaminated asphalt area were classified as affected areas. The areas adjacent to the affected areas will be classified as unaffected areas, also having ten meter by ten meter (10 m x 10 m) grids established, except those occupied by the remainder of Building 3-A (i.e., non-DU wings). These grids are denoted on the Survey Record presented as Appendix A, with the status of each grid designated on Table 3-1. Please note that Grids 20N-10W and 10N-10W were not included, as well as Grids 40N-10W and 30N-10W were only partial included as survey grids (i.e., ~ 5 m x 10 m), due to the remaining Building 3-A structure. As denoted in Table 3-1, the Affected Area was ~ 3,900 $m^2$ and the Unaffected area was ~ 1,400 $m^2$ of outdoor survey area.

### 3.4.2 Reference Grids

A reference grid system was established, IAW Reference 1, to: facilitate selection of sampling and measurement locations; link sample analytical data to locations; and enable data analysis and averaging to ensure compliance with the release limits. The grid system was a right rectangular system laid out in the north-south and east west directions. Ten meter square (10 $m^2$) grids were used for the subject outside area grid. A survey record, designating the assignment of grid points, is provided as Appendix A.

### 3.4.3 Surface Scans

The building was demolished prior to commencement of the FRSS. The resultant materials were segregated and surveyed as affected or unaffected, and packaged for appropriate disposal IAW the requirements of Reference 1. As described in Section 2.2, at the time of commencement of the FRSS, there were no building surfaces remaining.

**Table 3-1: Grid Status (Affected (A) or Unaffected (U))**

| Grid | 10W[2] | 0E | 10E | 20E | 30E | 40E | 50E | 60E |
|---|---|---|---|---|---|---|---|---|
| 40N | A[1] | A[1] | A[1] | A[1] | A[1] | A[1] | A[1] | U |
| 30N | A[1] | A | A | A | A | A | A | U |
| 20N[3] | | A | A | A | A | A | A | U |
| 10N[3] | | A | A | A | A | A | A | U |
| 0N/0S | A[1] | A | A | A | A | A | A | U |
| 10S | A[1] | A | A | A | A | A | A | U |
| 20S | U | U | U | U | U | U | U | U |

1 These grid sections were actually classified as Unaffected (U) areas, as defined by the technical requirements of Reference 1. The survey and sampling protocol actually performed on these grid sections were performed as if they were affected areas (i.e., they were conservatively surveyed and sampled in excess of the technical requirements). They are, therefore, included herein as Affected (A) areas

2 The darkly shaded areas ( ) represent grid sections within the remaining portion of the Building 3-A structure. These areas, as well as the area north of the 40N grids and the areas west of the 10W grids, are separated from the survey area by physical (i.e., brick) walls.

3 The lightly shaded areas ( ) represent the Building 3-A DU Wing footprint.

Soil scans were performed using NaI 2" x 2" detectors attached to a Ludlum Model 12 count-rate meter. As described in Reference 1, the instruments were held within a few inches of the ground surface, with scans conducted at a probe movement rate of less than 0.5 m/s. Affected areas received a 100% scan. Unaffected areas received a 25% scan. An action level was established at 1.5 times background. The subject instruments were performance checked against NIST-traceable sources daily, when in use. The results of these measurements are discussed in Section 4.3.

During these surveys, particular attention was paid to those areas formally internal to the building where the excavation trenches had been created during the removal of the facility's interior drain lines. The internal surfaces of the exterior trenches were also thoroughly surveyed.

### 3.4.4 Surface Activity Measurements

The building was demolished prior to commencement of the FRSS. The resultant materials were segregated and surveyed as affected or unaffected, and packaged for appropriate disposal IAW the requirements of Reference 1. As described in Section 2.2, at the time of commencement of the FRSS, there were no building surfaces remaining.

### 3.4.5 Exposure Rate Measurements

Exposure-rate measurements were taken using a Ludlum Model 19 μR-meter. Measurements were taken at the location of each sample point, at a distance of one meter (1 m) from the surface. The subject instruments were calibrated using NIST traceable calibration sources with calibration fields that had been verified using pressurized ion chamber instruments. These instruments were also performance checked against NIST-traceable sources daily, when in use. The results of these measurements are discussed in Section 4.3.

### 3.4.6 Soil and Sediment Sampling

As described in Reference 1, a minimum 500 ml soil sample was taken at four (4) points in each affected area grid section and one (1) point in each unaffected area grid section. In grid sections where excavation trenches existed (i.e., due to drain-line or sump removal), applicable samples were taken from the trench floor.

These samples were packaged and shipped to ATG's radiological materials processing facilities in Richland, WA, and Oak Ridge, TN, for analysis using HPGe gamma spectrometry equipment. The results of the associated sample analyses are discussed in Sections 4.3 and 4.4.

### 3.4.7 Special Measurements and Samples

Seven (7) samples were taken at pre-designated biased sample points where the building interior drains had previously existed. These soil samples were packaged and shipped to ATG's radiological materials processing facilities in Oak Ridge, TN, for analysis, using HPGe gamma spectrometry equipment. The results of these samples are discussed in Section 4.3.

### 3.4.8 Quality Assurance Samples

Duplicate samples were taken in the grids specified in Table 3-2. These samples were sent to an independent radiological laboratory in Fort Collins, CO (i.e., Paragon Analytics, Inc.) for analysis, using HPGe gamma spectrometry equipment. The associated analysis results are presented in Appendix F and summarized in Table 3-2, indicating adequate sample analysis performance by the primary (i.e., ATG) laboratories.

## 3.5 Background Level Determinations

For direct radiation monitoring purposes, background radiation levels were initially measured for each survey instrument type, at outlying locations in unaffected areas in the vicinity to Building 3-A, as denoted in Appendix D, Page 1 of 2. Upon the initial data review performed in the field, it was noted that survey grid sections adjacent to the remaining unaffected 3-A structure exhibited radiation levels that were higher than those of the grounds physically removed from the structure (i.e., due to naturally occurring radioactive material in the structural materials). Therefore, a second set of background measurements were performed adjacent to a remaining portion of Building 3-A that was physically remote to the potentially affected areas. These measurements are recorded on Appendix D, Page 2 of 2, and denoted on the survey records that were affected by the elevated background due to proximity to remaining, unaffected structural materials.

**Table 3-2: Duplicate Sample Results for Laboratory QA Verification**

| Grid Region | ATG Result (pCi/g of dry soil)[1,2] | QA Result (pCi/g of dry soil)[3,4] |
|---|---|---|
| 40N-20E-2 | 2.6 | MDC |
| 40N-50E-1 | MDC | MDC |
| 30N-10E-1 | 2.4 | 2.7 |
| 30N-20E-2 | MDC | MDC |
| 30N-40E-4 | MDC | MDC |
| 30N-50E-2 | MDC | MDC |
| 20N-10E-1 | MDC | MDC |
| 20N-20E-2 | MDC | MDC |
| 10N-0E-4 | MDC | MDC |
| 10N-10E-3 | MDC | MDC |
| 0S-10W-3 | MDC | MDC |
| 10S-10W-4 | MDC | MDC |
| 0S-30E-1 | MDC | 1.51 |
| 0S-30E-2 | MDC | 7.0 |
| 0S-30E-3 | MDC | 3.0 |
| 0S-30E-4 | MDC | MDC |
| 10S-10E-1 | MDC | MDC |
| 10S-50E-2 | MDC | MDC |
| 20S-50E-1 | MDC | MDC |

1 The bounding ATG analysis uncertainty for these analyses was ± 2.24 pCi/g of dry sample.
2 The bounding ATG Minimum Detectable Concentration (MDC) for this set of analyses was 4.12 pCi/g of dry sample.
3 The bounding QA analysis uncertainty for these analyses was ± 2.24 pCi/g of dry sample.
4 The bounding QA MDC for this set of analyses was 4.12 pCi/g of dry sample.

No soil samples were credited for background determination purposes. The soil DU concentration results reported herein are gross results, without any credit taken for the potential for naturally occurring Uranium preexisting in the LCAAP area soil.

### 3.6 Sample Analysis

The soil samples described in Sections 3.4.6 and 3.4.7 were packaged and shipped to ATG's radiological materials processing facilities in Richland, WA, and Oak Ridge, TN, for analysis. Duplicate and split samples were sent to independent radiological laboratories in Fort Collins, CO, and Madison, PA (i.e., Paragon Analytics, Inc., and Antech Ltd., respectively). All samples were analyzed by gamma spectrometry equipment which had been calibrated and performance checked using NIST-traceable sources.

### 3.7 Data Interpretation

Data was evaluated as the measurements were taken by the technicians performing the surveys and the field supervisors. The completed final data packages were then evaluated again during the report compilation. The resultant data summary is presented in Section 4.4.

### 3.8 Records

All original survey records and associated documentation, as described herein, will be maintained by ATG, IAW applicable quality record retention requirements, until such time as authorized by the NRC for disposal.

## 4.0 Survey Findings and Results

Data is summarized in Tables 4-1, 4-2, and 4-3, as described herein. Actual survey and sample analysis records are provided in Appendices C and E.

### 4.1 Background Levels

As discussed in Section 3.5 and denoted in Appendix D, average background radiation levels for each instrument type were:

- 8,900 cpm on the NaI 2" x 2" detectors;
- 9.2 μR/hour on the Ludlum Model 19 μR-meters; and
- 45 cpm on the Ludlum 44-9 2" G-M pancake probe.

These background values were used to determine the need for further investigation during ground area scans (i.e., the 1.5 times background action level) as well as demonstration of compliance regarding the external exposure-rate release criteria (i.e., 5 μR/hour > background), as specified in Reference 1.

Separate background values were used, as needed, in areas adjacent to the remaining structure of Building 3-A. In these areas, the background values were:

- 12,000 cpm on the NaI 2" x 2" detectors; and
- eleven (11) μR/hour on the Ludlum Model 19 μR-meters.

Where needed to demonstrate compliance, these higher values are denoted on the individual survey records provided in Appendix C.

## 4.2 Building Surveys

The building was demolished prior to commencement of the FRSS. The resultant materials were segregated and surveyed as affected or unaffected, and packaged for appropriate disposal IAW the requirements of Reference 1. As described in Section 2.2, at the time of commencement of the FRSS, there were no building surfaces remaining.

## 4.3 Ground Surveys

Scans

All scans were below the action level of 1.5 times background as specified in Section 5.0 of the Reference 1. The maximum measurements for each grid section are documented on the survey records presented in Appendix C. These measurements ranged from 8,000 to 14,000 counts per minute (cpm), with a mean value of 11,200 cpm and a standard deviation ($\sigma$) of 1,980 cpm, providing a value at the 95% confidence level of 11,640 cpm.

Exposure Rates

All fixed measurements were below the release limit of 5 μR/hour greater than background, as specified in Section 5.0 of the Reference 1. Rates ranged from below background to ~ 4 μR/hour, with the primary reason for increased exposure-rates being associated with proximity to the Naturally Occurring Radioactive Material (NORM) in the remaining structure (i.e., exposure-rates increase from east to west).

Soil Samples

Soil Sample results are presented in Table 4-1. The maximum soil concentration noted was ~ 9.2 pCi/g $^{238}U(^{234}Th)$. Analysis records are presented in Appendix E.

Special Samples

As denoted in Table 4-2, the results of the special soil sample (i.e., interior drain points) analyses indicate negligible activity concentration at these locations. The results of these sample analyses are presented in the back of Appendix E.

## 4.4 Data Evaluation

All scans and fixed measurements were below the action level of 1.5 times background and release limit of 5 μR/hour greater than background (i.e., as specified in Section 5.0 of the Reference 1), respectively. Therefore, the final data evaluation is based upon the soil concentration results for each grid as indicated in Table 4-1.

For a population of non-negative values, the standard deviation ($\sigma$) of that population can be conservatively bounded at the maximum value times $2^{-0.5}$. Therefore, the 95% confidence interval of the maximum soil sample concentration (i.e., 9.2 pCi/g) is bounded at the subject maximum plus 1.96 $\sigma$, or 21.9 pCi/g. Comparison of the 95% confidence maximum bounding activity, times the correction factor discussed in Section 2.3 (i.e., 1.2 times 21.9 pCi/g of $^{238}U(^{234Th})$ activity equals ~ 26.3 pCi/g of DU activity), with the approved release limit of 35 pCi/g (i.e., as specified in Section 5.0 of the Reference 1) demonstrates that the release limit was satisfied for all measurement points of all survey units, at the 95% confidence interval, without a need for averaging any individual results.

**Table 4-1: $^{238}U(^{234Th})$ Soil Concentrations (pCi/g of Dry Sample)[3,4] / External Penetrating Radiation Levels Greater than Ambient (μR/hr)**

| | Quadrant | | | |
|---|---|---|---|---|
| **Grid** | **1** | **2** | **3** | **4** |
| 40N – 10W | MDC/2.0 | MDC/3.5 | NA[1] | NA[1] |
| 40N – 0E | 2.4/2.0 | 2.5/1.5 | MDC/2.5 | MDC/1.0 |
| 40N – 10E | 2.1/2.8 | MDC/3.3 | MDC/2.3 | MDC/2.3 |
| 40N – 20E | 1.8/2.3 | 2.6/2.8 | MDC/2.8 | MDC/2.8 |
| 40N – 30E | MDC/3.3 | MDC/3.3 | 3.0/2.3 | MDC/1.8 |
| 40N – 40E | 2.7/2.8 | MDC/0.8 | 2.5/0.8 | MDC/0.3 |
| 40N – 50E | MDC/1.8 | MDC/1.3 | 1.9/2.8 | MDC/2.8 |
| 40N – 60E | 2.9/0.3 | NA[2] | NA[2] | NA[2] |
| 30N – 10W | 2.6/4.0 | MDC/2.5 | NA[1] | NA[1] |
| 30N – 0E | MDC/3.8 | MDC/3.3 | 2.8/3.8 | 2.8/2.8 |
| 30N – 10E | 2.4/2.3 | MDC/1.8 | 4.6/1.8 | 4.0/1.8 |
| 30N – 20E | MDC/1.8 | MDC/1.3 | 3.3/2.3 | MDC/1.8 |
| 30N – 30E | MDC/1.8 | MDC/1.3 | MDC/1.8 | MDC/2.3 |
| 30N – 40E | MDC/0.8 | MDC/-0.2 | 3.0/0.3 | MDC/-0.2 |
| 30N – 50E | MDC/1.3 | MDC/1.8 | MDC/2.3 | MDC/1.8 |
| 30N – 60E | MDC/0.8 | NA[2] | NA[2] | NA[2] |
| 20N – 0E | 3.9/3.5 | MDC/1.5 | MDC/2.0 | MDC/1.0 |
| 20N – 10E | MDC/2.3 | 2.8/2.8 | MDC/1.8 | MDC/2.3 |
| 20N – 20E | 5.8/1.8 | MDC/1.8 | MDC/1.8 | MDC/1.3 |
| 20N – 30E | MDC/2.3 | MDC/1.3 | MDC/0.8 | MDC/0.8 |
| 20N – 40E | MDC/1.3 | MDC/0.8 | 1.8/1.8 | MDC/1.8 |
| 20N – 50E | MDC/2.3 | MDC/1.8 | MDC/1.8 | MDC/0.8 |
| 20N – 60E | MDC/-0.2 | NA[2] | NA[2] | NA[2] |
| 10N – 0E | MDC/2.5 | MDC/1.0 | MDC/3.5 | MDC/1.5 |
| 10N – 10E | MDC/3.3 | MDC/2.8 | MDC/2.8 | MDC/2.3 |
| 10N – 20E | MDC/2.3 | MDC/2.8 | MDC/3.3 | MDC/2.8 |
| 10N – 30E | MDC/2.8 | MDC/1.8 | MDC/2.3 | MDC/2.3 |

1 Sample not taken due to obstruction by remainder of Building 3-A, as discussed in Section 3.4.1.
2 Unaffected area, only one (1) sample taken per grid section.
3 The bounding analysis uncertainty for these analyses was ± 2.24 pCi/g of dry sample.
4 The bounding Minimum Detectable Concentration (MDC) for this set of analyses was 4.12 pCi/g of dry sample.

**Table 4-1: $^{238}U(^{234Th})$ Soil Concentrations (pCi/g of Dry Sample)[3,4] / External Penetrating Radiation Levels Greater than Ambient (μR/hr)**

| | Quadrant | | | |
|---|---|---|---|---|
| **Grid** | **1** | **2** | **3** | **4** |
| 10N – 40E | MDC/1.8 | 2.6/0.8 | MDC/0.8 | MDC/0.8 |
| 10N – 50E | MDC/1.8 | MDC/0.8 | MDC/2.3 | MDC/1.3 |
| 10N – 60E | MDC/-0.2 | NA[2] | NA[2] | NA[2] |
| 0S – 10W | MDC/4.0 | MDC/3.5 | MDC/1.5 | MDC/0.5 |
| 0N – 0E | 3.6/3.8 | 4.5/3.3 | MDC/2.3 | MDC/2.3 |
| 0N – 10E | 3.1/1.8 | 2.5/1.8 | MDC/1.8 | 2.9/1.8 |
| 0N – 20E | MDC/0.8 | MDC/1.3 | MDC/0.8 | MDC/0.3 |
| 0S – 30E | MDC/1.3 | MDC/2.8 | MDC/1.8 | MDC/2.8 |
| 0S – 40E | MDC/1.3 | 5.1/2.3 | MDC/1.3 | 4.1/1.8 |
| 0S – 50E | 2.7/1.8 | MDC/2.3 | MDC/1.8 | MDC/2.3 |
| 0S – 60E | MDC/-0.2 | NA[2] | NA[2] | NA[2] |
| 10S – 10W | MDC/2.0 | 2.1/1.0 | MDC/2.5 | MDC/2.0 |
| 10S – 0E | MDC/2.8 | 2.9/2.3 | MDC/2.8 | MDC/3.3 |
| 10S – 10E | MDC/2.8 | MDC/2.3 | MDC/2.8 | MDC/2.3 |
| 10S – 20E | MDC/2.3 | 3.4/2.8 | 3.7/1.8 | 3.0/1.8 |
| 10S – 30E | MDC/2.8 | 5.7/1.3 | 7.7/2.3 | 6.9/1.8 |
| 10S – 40E | 1.7/2.8 | 4.1/1.3 | 4.7/2.8 | 2.5/1.3 |
| 10S – 50E | MDC/1.8 | MDC/2.3 | MDC/1.3 | MDC/1.8 |
| 10S – 60E | MDC/0.8 | NA[2] | NA[2] | NA[2] |
| 20S – 10W | MDC/1.8 | NA[2] | NA[2] | NA[2] |
| 20S – 0E | MDC/0.8 | NA[2] | NA[2] | NA[2] |
| 20S – 10E | MDC/0.8 | NA[2] | NA[2] | NA[2] |
| 20S – 20E | 3.1/0.8 | NA[2] | NA[2] | NA[2] |
| 20S – 30E | 9.2/1.3 | NA[2] | NA[2] | NA[2] |
| 20S – 40E | MDC/0.8 | NA[2] | NA[2] | NA[2] |
| 20S – 50E | MDC/1.8 | NA[2] | NA[2] | NA[2] |
| 20S – 60E | MDC/0.8 | NA[2] | NA[2] | NA[2] |

1 Sample not taken due to obstruction by remainder of Building 3-A, as discussed in Section 3.4.1.
2 Unaffected area, only one (1) sample taken per grid section.
3 The bounding analysis uncertainty for these analyses was ± 2.24 pCi/g of dry sample.
4 The bounding Minimum Detectable Concentration (MDC) for this set of analyses was 4.12 pCi/g of dry sample.

**Table 4-2: Special Soil Sample $^{238}U(^{234Th})$ Soil Concentrations (pCi/g of Dry Sample)**

| Sample | Concentration[1] |
|---|---|
| GPS-1LMK | MDC[2] |
| GPS-4LMK | MDC[2] |
| GPS-7LMK | MDC[2] |
| GPS-10LMK | MDC[2] |
| GPS-13LMK | MDC[2] |
| GPS-16LMK | 1.95 |
| GPS-19LMK | MDC[2] |

1 The bounding analysis uncertainty for these analyses was ± 1.15 pCi/g of dry sample.

2 The bounding Minimum Detectable Concentration (MDC) for this set of analyses was 2.99 pCi/g of dry sample.

### 4.5 Residual Activity Inventory

As denoted in Table 4-3, each grid section's bounding residual activity inventory was determined by multiplying the maximum Uranium soil concentration level detected in each grid times the approximate mass of soil potentially affected in that grid section. A total soil mass of 24,000 kg was used in the subject calculation, based upon the surface area of the grid section (i.e., 10 m x 10 m, or $10^6$ $cm^2$), up to a six inch (6" or ~ 15 cm) affected depth, and a soil density of 1.6 g/cc. Then by adding each of these individual grid section results together, the total residual activity inventory was conservatively bounded at a value of 2.4 mCi of $^{238}U$ or, scaling in the $^{234}U$ and $^{235}U$ constituents (i.e., as discussed in Section 2.3), the total DU residual activity inventory is conservatively bounded at 2.9 mCi.

## 5.0 Summary

The FRSS of the LCAAP Building 3-A DU Wing site was conducted from June 26 through July 2 of 2001, IAW the requirements of Reference 2. Results of the survey demonstrate that the decontamination actions were effective in reducing residual activity at the site to meet the NRC limits for release for unrestricted use. This summary does not include the results of the drain-pipe excavation project, which is addressed separately, in detail, in Appendix G.

## 6.0 References

1. "Lake City Army Ammunition Plant Building 3-A Depleted Uranium Wing Decommissioning Plan," Revision 2; ATG Inc., Oak Ridge, TN; March 2001

2. NUREG/CR-5849, "Manual for Conducting Radiological Surveys for License Termination," U.S. NRC.

**Table 4-3: Residual $^{238}U(^{234}Th)$ Activity Inventory (μCi)**

| Grid | Maximum Activity Concentration (pCi/g) | Residual Activity Inventory (μCi) |
|---|---|---|
| 40N – 10W | MDC | NA |
| 40N – 0E | 2.5 | 60 |
| 40N – 10E | 2.1 | 50.4 |
| 40N – 20E | 2.6 | 62.4 |
| 40N – 30E | 3.0 | 72 |
| 40N – 40E | 2.7 | 64.8 |
| 40N – 50E | 1.9 | 45.6 |
| 40N – 60E | 2.9 | 69.6 |
| 30N – 10W | 2.6 | 62.4 |
| 30N – 0E | 2.8 | 67.2 |
| 30N – 10E | 4.6 | 110.4 |
| 30N – 20E | 3.3 | 79.2 |
| 30N – 30E | MDC | NA |
| 30N – 40E | 3.0 | 72 |
| 30N – 50E | MDC | NA |
| 30N – 60E | MDC | NA |
| 20N – 0E | 3.9 | 93.6 |
| 20N – 10E | 2.8 | 67.2 |
| 20N – 20E | 5.8 | 139.2 |
| 20N – 30E | MDC | NA |
| 20N – 40E | 1.8 | 43.2 |
| 20N – 50E | MDC | NA |
| 20N – 60E | MDC | NA |
| 10N – 0E | MDC | NA |
| 10N – 10E | MDC | NA |
| 10N – 20E | MDC | NA |
| 10N – 30E | MDC | NA |
| 10N – 40E | 2.6 | 62.4 |

**Table 4-3: Residual $^{238}U(^{234}Th)$ Activity Inventory (μCi)**

| Grid | Maximum Activity Concentration (pCi/g) | Residual Activity Inventory (μCi) |
|---|---|---|
| 10N – 50E | MDC | NA |
| 10N – 60E | MDC | NA |
| 0S – 10W | MDC | NA |
| 0N – 0E | 4.5 | 108 |
| 0N – 10E | 3.1 | 74.4 |
| 0N – 20E | MDC | NA |
| 0S – 30E | MDC | NA |
| 0S – 40E | 5.1 | 122.4 |
| 0S – 50E | 2.7 | 64.8 |
| 0S – 60E | MDC | NA |
| 10S – 10W | 2.1 | 50.4 |
| 10S – 0E | 2.9 | 69.6 |
| 10S – 10E | MDC | NA |
| 10S – 20E | 3.7 | 88.8 |
| 10S – 30E | 7.7 | 184.8 |
| 10S – 40E | 4.7 | 112.8 |
| 10S – 50E | MDC | NA |
| 10S – 60E | MDC | NA |
| 20S – 10W | MDC | NA |
| 20S – 0E | MDC | NA |
| 20S – 10E | MDC | NA |
| 20S – 20E | 3.1 | 74.4 |
| 20S – 30E | 9.2 | 220.8 |
| 20S – 40E | MDC | NA |
| 20S – 50E | MDC | NA |
| 20S – 60E | MDC | NA |
| Total | NA | 2,392.8 |

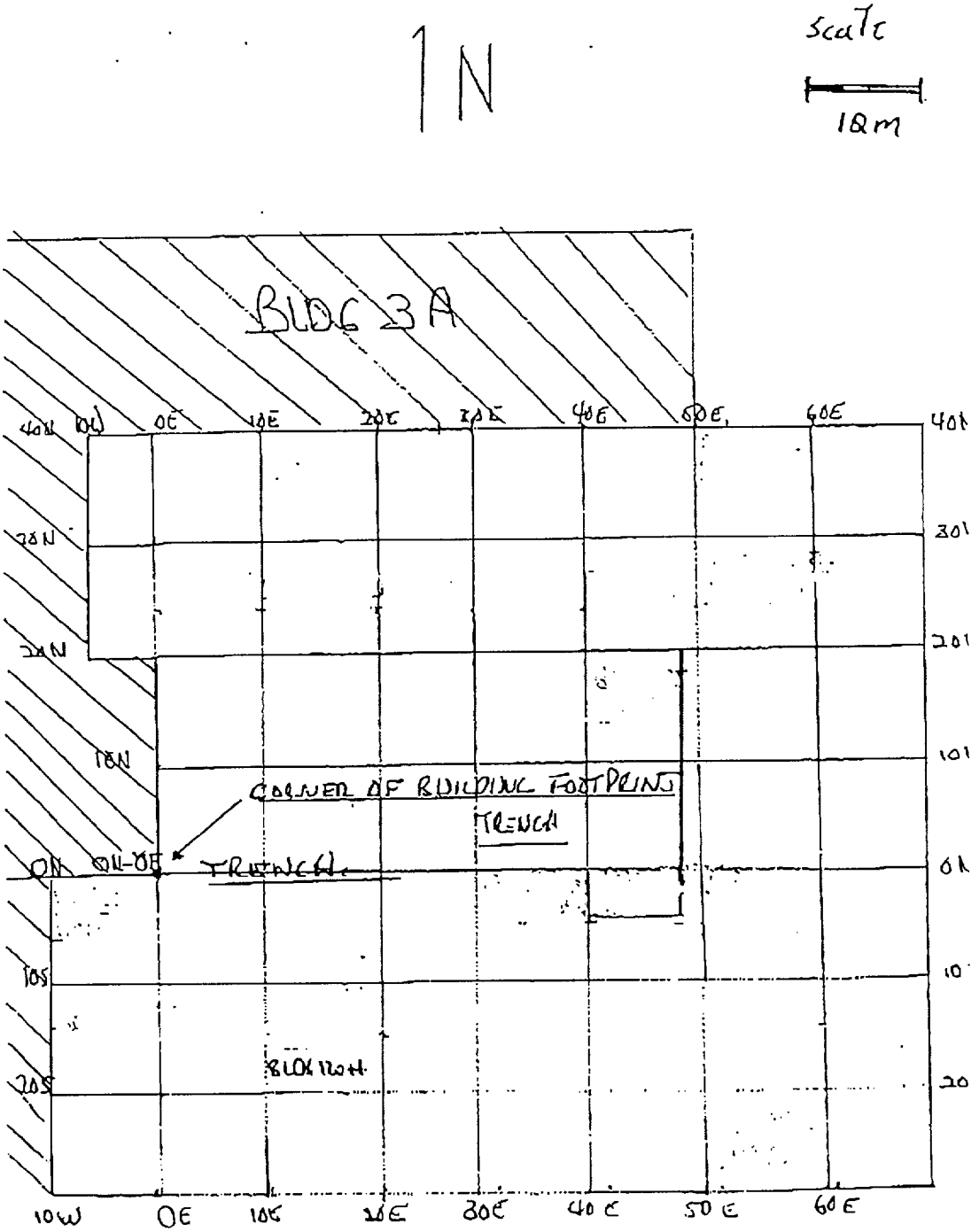
# APPENDIX A

# GRID MAP

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 06

| DATE: 7/2/01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1600 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | | | | | |
| LOCATION: LCAAP | | | N | | |
| REVIEWED BY: | | | N | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |



# Count Rate/Scaler Calibration Record

**Instrument Number:** 121291 **Model:** LM-12 **Cal. Date:** 4/12/01

**Calibration Instruments**

| Type | Number | Cal. Due Date | Type | Number | Cal. Due Date |
|---|---|---|---|---|---|
| Pulser | 134715 | 10/10/01 | Temp. | 2666 | 9/18/01 |
| Voltmeter | 134715 | 10/10/01 | Pressure | 2666 | 9/18/01 |
| O-Scope | N/A | N/A | | | |
| | | | | | |

**Count Rate/Scaler Calibration**

**Temp.:** 78.1 F **Pressure:** 29.3 in Hg

| Scale | Target Value | Tolerances | | Measurements | | Percent Error | |
|---|---|---|---|---|---|---|---|
| | | Min. | Max. | As Found | As Left | As Found | As Left |
| X1 | 100 | 80 | 120 | 100 | 100 | 0.0% | 0.0% |
| | 250 | 200 | 300 | 250 | 250 | 0.0% | 0.0% |
| | 400 | 320 | 480 | 400 | 400 | 0.0% | 0.0% |
| X10 | 1,000 | 800 | 1,200 | 1,000 | 1,000 | 0.0% | 0.0% |
| | 2,500 | 2,000 | 3,000 | 2,500 | 2,500 | 0.0% | 0.0% |
| | 4,000 | 3,200 | 4,800 | 4,000 | 4,000 | 0.0% | 0.0% |
| X100 | 10,000 | 8,000 | 12,000 | 10,000 | 10,000 | 0.0% | 0.0% |
| | 25,000 | 20,000 | 30,000 | 25,000 | 25,000 | 0.0% | 0.0% |
| | 40,000 | 32,000 | 48,000 | 40,000 | 40,000 | 0.0% | 0.0% |
| X1000 | 100,000 | 80,000 | 120,000 | 100,000 | 100,000 | 0.0% | 0.0% |
| | 250,000 | 200,000 | 300,000 | 250,000 | 250,000 | 0.0% | 0.0% |
| | 400,000 | 320,000 | 480,000 | 400,000 | 400,000 | 0.0% | 0.0% |
| N/A | | 0 | 0 | | | N/A | N/A |
| | | 0 | 0 | | | N/A | N/A |
| | | 0 | 0 | | | N/A | N/A |

Comments: None

**Other Calibration Parameters**

| | | | |
|---|---|---|---|
| Threshold* Units: mV | N/A: ____ | As Found: 3 | As Left: 11 |
| Audio Check | N/A: ____ | As Found:SAT | As Left: SAT |
| Battery Charge | N/A: ✓ | As Found:_____ | As Left:_____ |
| HV Indication* | N/A: ____ | As Found:1250 | As Left:1250 |
| Zero | N/A: ____ | As Found:0 | As Left: 0 |
| High Voltage | N/A: ____ | As Found: 1250 | As Left: 850 |

Detector Compatibility:*
GM (SCINT) Proport.
( Circle One)

** Use Specific Detector:
Type: 44-10
Number: 135860

* Indicate the default detector settings only if the instrument is NOT calibrated to a specific detector. Attach a limited use sticker that identifies: Threshold, Voltage, and detector that can be used with the calibration settings, as appropriate.

** A limited use sticker is required specifying the detector.

Calibrator (Print): Kevin Wright Calibrator (Signature): _____

Reviewed By: _____ Next Calibration Due: 10/12/01

ICAL, INC.
CALIBRATION DATA SHEET

FORM 99-1
REV. 4

| | | | |
|---|---|---|---|
| CUSTOMER NAME | : ALLIED TECHNOLOGY | INST. MANUFACTURER | : LUDLUM INST CORP |
| PLANT NAME | : KINGSTON | TYPE | : SCINTILLATION |
| ADDRESS | : 1556 BEAR CREEK ROAD | MODEL NO. | : 19 |
| | KINGSTON, TN | SERIAL NO. | : 131294 |
| | 37763 | | |
| CONTACT PERSON | : KEVIN WRIGHT | DETECTOR MODEL NO. | : INTERNAL |
| | (865) 425 1169 | SERIAL NO. | : NONE |

**SOURCES USED**

| | | | | | |
|---|---|---|---|---|---|
| CAL. SOURCE USED : | CESIUM -137 | 400 CURIE/130 MILLICURIE | SERIAL NO. | : | 9115 |
| CAL. SOURCE USED : | CESIUM -137 | 120 MILLICURIE | SERIAL NO. | : | 10253 |
| CAL. SOURCE USED : | CESIUM -137 | 100 MILLICURIE | SERIAL NO. | : | 11042 |

CALIBRATED IN MOBILE UNIT NUMBER : 2

**CALIBRATION DATA**

| | | AS FOUND | AS LEFT | |
|---|---|---|---|---|
| HIGH VOLTAGE | : | 526.0 | 526.0 | |
| INPUT SENSITIVITY | : | 40.0 | 40.0 | |
| OTHER REQUIRED (LIST) | : | | | |
| CAL. FACILITY TEMPERATURE | : | NA | | DEGREES C |
| BAROMETRIC PRESSURE | : | NA | | in. Hg |

| SCALE | EXPOSURE RATE uR/HR | INSTRUMENT READING AS FOUND | INSTRUMENT READING AS LEFT | PER CENT ERROR AS FOUND | PER CENT ERROR AS LEFT |
|---|---|---|---|---|---|
| X25 | PULSED = 5 uR/HR | 4.50 | 4.50 | -10.00 | -10.00 |
| | PULSED = 20 uR/HR | 19.00 | 19.00 | -5.00 | -5.00 |
| X50 | PULSED = 10 uR/HR | 9.0 | 9.0 | -10.00 | -10.00 |
| | PULSED = 40 uR/HR | 40.0 | 40.0 | 0.00 | 0.00 |
| X250 | PULSED = 50 uR/HR | 45.0 | 45.0 | -10.00 | -10.00 |
| | 200 | 190.0 | 190.0 | -5.00 | -5.00 |
| X500 | 100 | 110.00 | 110.00 | 10.00 | 10.00 |
| | 400 | 380.00 | 380.00 | -5.00 | -5.00 |
| X5000 | 1000 | 1000.00 | 1000.00 | 0.00 | 0.00 |
| | 4000 | 3700.00 | 3700.00 | -7.50 | -7.50 |

**PRECISION**

| SCALE | EXPOSURE RATE | AS FOUND | MEAN VALUE | % DEV. |
|---|---|---|---|---|
| X5000 | 2000 | 1900.00 | | 0.00 |
| | | 1900.00 | 1900.00 | 0.00 |
| | | 1900.00 | | 0.00 |

COMMENTS/REMARKS:

ALL CALIBRATION DONE WITH N.I.S.T. TRACEABLE SOURCES.
CALIBRATION POINTS ACCEPTANCE CRITERIA +/-10% OF ACTUAL EXPOSURE RATE.
OUT OF TOLERANCE VALUES ARE CIRCLED AND CUSTOMER CONTACT NOTIFIED VERBALLY OF CONDITION.
CALIBRATION PERFORMED PER ICAL PROCEDURE NUMBER 99.

CALIBRATED BY : [signature]

DATE CALIBRATED : 4-21-01

CALIBRATION DUE DATE : 10-21-01

SOURCES

## DAILY INVENTORY OF RADIOACTIVE DISC SOURCES OWNED BY ATG ON LCAAP

| IDENTITY | ISOTOPE | TYPE | Serial Number | ACTIVITY | Assay Date | HALF LIFE | Manufacture | DISCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | Tc-99 | BETA | 94TC4700599 | 40200 dpm | 22-Mar-94 | 212000 y | the SOURCE | 1 7/8" Gold Disc |
| Q72 | Th-230 | ALPHA | 95TH4704311 | 30300 dpm | 6-Sep-95 | 80000 y | the SOURCE | 1 7/8" Gold Disc |
| Q99-ST 11 | Cs-137 | GAMMA | ST 11 | 5.0 uCi | | 30.2 y | OXFORD | 1" Orange Disc |
| ST 22 | Cs-137 | GAMMA | ST 22 | 1.0 uCi | | 30.2 y | OXFORD | 1" Red Disc |
| ST 1 | Sr-90 | BETA | ST 1 | 0.1 uCi | | 28.6 y | OXFORD | 1" Green Disc |
| ST 2 | Cs-137 | GAMMA | ST 2 | 5.0 uCi | | 30.2 y | OXFORD | 1" Orange Disc |
| ST 3 | Ba-133 | GAMMA | ST 3 | 1.0 uCi | | 10.5 y | OXFORD | 1" Orange Disc |

| DATE OF INVENTORY | | REMARKS | INITIALS |
|---|---|---|---|
| 1-Jun-01 | Friday | USED - ACCOUNTED FOR | RD |
| 2-Jun-01 | SATURDAY | USED - ALL ACCOUNTED | RD |
| 3-Jun-01 | SUNDAY | USED - ALL ACCOUNTED | SET |
| 4-Jun-01 | Monday | USED - ALL ACCOUNTED | RD |
| 5-Jun-01 | Tuesday | USED - ALL ACCOUNTED | RD |
| 6-Jun-01 | Wednesday | USED - ALL ACCOUNTED | RD |
| 7-Jun-01 | Thursday | USED - ALL ACCOUNTED | RD |
| 8-Jun-01 | Friday | USED - ALL ACCOUNTED | RD |
| 9-Jun-01 | SATURDAY | USED - ALL ACCOUNTED | RD |
| 10-Jun-01 | SUNDAY | USED - ALL ACCOUNTED | RD |
| 11-Jun-01 | Monday | USED - ALL ACCOUNTED | RD |
| 12-Jun-01 | Tuesday | USED - ALL ACCOUNTED | RD |
| 13-Jun-01 | Wednesday | USED - ALL ACCOUNTED | RD |
| 14-Jun-01 | Thursday | USED - ALL ACCOUNTED | RD |
| 15-Jun-01 | Friday | USED - ALL ACCOUNTED | RD |
| 16-Jun-01 | SATURDAY | NO WORK - ALL SECURE | RD |
| 17-Jun-01 | SUNDAY | NO WORK - ALL SECURE | RD |
| 18-Jun-01 | Monday | USED - ALL ACCOUNTED | RD |
| 19-Jun-01 | Tuesday | USED - ALL ACCOUNTED | RD |
| 20-Jun-01 | Wednesday | NO WORK | RD |
| 21-Jun-01 | Thursday | USED - ACCOUNTED FOR | RD |
| 22-Jun-01 | Friday | USED - ACCOUNTED FOR | RD |
| 23-Jun-01 | SATURDAY | USED - ACCOUNTED FOR | RD |
| 24-Jun-01 | SUNDAY | NO WORK | RD |
| 25-Jun-01 | Monday | USED - ALL ACCOUNTED | RD |
| 26-Jun-01 | Tuesday | USED - ALL ACCOUNTED | RD |
| 27-Jun-01 | Wednesday | USED - ALL ACCOUNTED | RD |
| 28-Jun-01 | Thursday | USED - ALL ACCOUNTED | RD |
| 29-Jun-01 | Friday | USED - ALL ACCOUNTED | RD |
| 30-Jun-01 | SATURDAY | USED - ALL ACCOUNTED | RD |
| 1-Jul-01 | SUNDAY | USED - ALL ACCOUNTED | RD |
| 2-Jul-01 | Monday | USED - ALL ACCOUNTED | RD |
| 3-Jul-01 | Tuesday | USED - ALL ACCOUNTED | RD |
| 4-Jul-01 | Wednesday | NO WORK - ~~ALL~~ | RD |
| 5-Jul-01 | Thursday | NO WORK | RD |
| 6-JUL01 | FRIDAY | USED - ALL ACCOUNTED | RD |

NOTES:
ST 22 Cs 137 Source

PERFORMED BY: Ronald DeGumbia RD Steve Thompson SET

REVIEWED BY:

DAILY LOG

.OJECT: LCAAP DATE: 26 JUNE TIME: 0800

| MODEL TYPE | SERIAL NUMBER | MODEL NUMBER | PROBE TYPE | SERIAL NUMBER | CALIBR REPORT | CAL DUE DATE | SOURCE ID USED | ACTIVITY (DPM) | BATTERY CHECK | PHYSICAL DAMAGE | BKGD (CPM) | RESULTS READING | PASS or FAIL | TECH INITIALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ludlum 12 | 121349 | 44-9 | GM | PR025061 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 80 | AR | PASS | DD |
| Ludlum 12 | 125304 | 44-9 | GM | PR133259 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 40 | AR | PASS | DD |
| Ludlum 12 | 125308 | 44-9 | GM | PR128041 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 80 | AR | PASS | DD |
| Ludlum 12 | 130326 | 44-9 | GM | PR100925 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 70 | AR | PASS | DD |
| Ludlum 12 | 121291 | 44-10 | SCINT | PR135860 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 17000 | AR | PASS | DD |
| Ludlum 12 | 121356 | 44-10-5 | SCINT | PR125857 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 16000 | AR | PASS | DD |
| Ludlum 12 | 121370 | 44-10 | SCINT | PR010890 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 17000 | AR | PASS | DD |
| Ludlum 12 | 125241 | 44-10 | SCINT | PR132949 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 17000 | AR | PASS | DD |
| Ludlum 12 | 128227 | 44-08 | SCINT | PR134444 | YES | 10-Oct-01 | Q99 | 5.0 uCi | YES | NO | 1000 | AR | PASS | DD |
| Ludlum 3 | 100357 | 43-5 | ALPHA | PR098034 | YES | 9-Oct-01 | Q-72 | see report | YES | NO | 0 | AR | PASS | DD |
| Ludlum 3 | 102192 | 43-5 | ALPHA | PR100604 | YES | 9-Oct-01 | Q-72 | see report | YES | NO | 0 | AR | PASS | DD |
| BICRON | B500Z | INTERNAL | SCINT | NA | YES | 7-Jun-01 | Q99 | 2 uR/hr | NA | NA | OUT | OF CALIB | | DD |
| LUDLUM 19 | 111280 | INTERNAL | SCINT | NA | YES | 21-Oct-01 | Q99 | 2 uR/hr | YES | NO | 17 uR/hr | AR | PASS | DD |
| LUDLUM 19 | 131294 | INTERNAL | SCINT | NA | YES | 21-Oct-01 | Q99 | 2 uR/hr | YES | NO | 17 uR/hr | AR | PASS | DD |
| Lud. 2929 | 99041 | 43-10-1 | SCINT | PR096923 | YES | 12-Feb-02 | Q71, Q72 | see report | NA | NOT | USED | ~~AR~~ | PASS | DD |
| Lud. 2929 | 126128 | 43-10-1 | SCINT | PR092163 | YES | 13-Apr-02 | Q71, Q72 | see report | NA | NO | AR | AR | PASS | DD |

PROJECT: LCAAP DATE: 27 JUNE 01 TIME: 0700

| MODEL TYPE | SERIAL NUMBER | MODEL NUMBER | PROBE TYPE | SERIAL NUMBER | CALIBR REPORT | CAL DUE DATE | SOURCE ID USED | ACTIVITY (DPM) | BATTERY CHECK | PHYSICAL DAMAGE | BKGD (CPM) | RESULTS READING | PASS or FAIL | TECH INITIALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ludlum 12 | 121349 | 44-9 | GM | PR025061 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 60 | AR | PASS | DD |
| Ludlum 12 | 125304 | 44-9 | GM | PR133259 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 60 | AR | PASS | DD |
| Ludlum 12 | 125308 | 44-9 | GM | PR128041 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 60 | AR | PASS | DD |
| Ludlum 12 | 130326 | 44-9 | GM | PR100925 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 60 | AR | PASS | DD |
| Ludlum 12 | 121291 | 44-10 | SCINT | PR135860 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 15000 | AR | PASS | DD |
| Ludlum 12 | 121356 | 44-10-5 | SCINT | PR125857 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 12000 | AR | PASS | DD |
| Ludlum 12 | 121370 | 44-10 | SCINT | PR010890 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 14000 | AR | PASS | DD |
| Ludlum 12 | 125241 | 44-10 | SCINT | PR132949 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 14000 | AR | PASS | DD |
| Ludlum 12 | 128227 | 44-08 | SCINT | PR134444 | YES | 10-Oct-01 | Q99 | 5.0 uCi | YES | NO | 2200 | AR | PASS | DD |
| Ludlum 3 | 100357 | 43-5 | ALPHA | PR098034 | YES | 9-Oct-01 | Q-72 | see report | YES | NO | 0 | AR | PASS | DD |
| Ludlum 3 | 102192 | 43-5 | ALPHA | PR100604 | YES | 9-Oct-01 | Q-72 | see report | YES | NO | 0 | AR | PASS | DD |
| BICRON | B500Z | INTERNAL | SCINT | NA | YES | 7-Jun-01 | Q99 | 2 uR/hr | NA | NA | OUT | OF | CALIB | DD |
| LUDLUM 19 | 111280 | INTERNAL | SCINT | NA | YES | 21-Oct-01 | Q99 | 2 uR/hr | YES | NO | 17 uR/hr | AR | PASS | DD |
| LUDLUM 19 | 131294 | INTERNAL | SCINT | NA | YES | 21-Oct-01 | Q99 | 2 uR/hr | YES | NO | 18 uR/hr | AR | PASS | DD |
| Lud. 2929 | 99041 | 43-10-1 | SCINT | PR096923 | YES | 12-Feb-02 | Q71, Q72 | see report | NA | NA | NOT | USED | — | DD |
| Lud. 2929 | 126128 | 43-10-1 | SCINT | PR092163 | YES | 13-Apr-02 | Q71, Q72 | see report | NA | NO | AR | AR | PASS | DD |

NOTE:

AR = ACCEPTABLE RANGE

Ronald DeGumbia

DAILY LOG

.OJECT: LCAAP DATE: 28 JUNE 01 TIME: 0730

| MODEL TYPE | SERIAL NUMBER | MODEL NUMBER | PROBE TYPE | SERIAL NUMBER | CALIBR REPORT | CAL DUE DATE | SOURCE ID USED | ACTIVITY (DPM) | BATTERY CHECK | PHYSICAL DAMAGE | BKGD (CPM) | RESULTS READING | PASS or FAIL | TECH INITIALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ludlum 12 | 121349 | 44-9 | GM | PR025061 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 60 | AR | PASS | DD |
| Ludlum 12 | 125304 | 44-9 | GM | PR133259 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 40 | AR | PASS | DD |
| Ludlum 12 | 125308 | 44-9 | GM | PR128041 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 60 | AR | PASS | DD |
| Ludlum 12 | 130326 | 44-9 | GM | PR100925 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 60 | AR | PASS | DD |
| Ludlum 12 | 121291 | 44-10 | SCINT | PR135860 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 15000 | AR | PASS | DD |
| Ludlum 12 | 121356 | 44-10-5 | SCINT | PR125857 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 13000 | AR | PASS | DD |
| Ludlum 12 | 121370 | 44-10 | SCINT | PR010890 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 15,000 | AR | PASS | DD |
| Ludlum 12 | 125241 | 44-10 | SCINT | PR132949 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 17,000 | AR | PASS | DD |
| Ludlum 12 | 128227 | 44-08 | SCINT | PR134444 | YES | 10-Oct-01 | Q99 | 5.0 uCi | YES | NO | 186 | AR | PASS | DD |
| Ludlum 3 | 100357 | 43-5 | ALPHA | PR098034 | YES | 9-Oct-01 | Q-72 | see report | YES | NO | 0 | AR | PASS | DD |
| Ludlum 3 | 102192 | 43-5 | ALPHA | PR100604 | YES | 9-Oct-01 | Q-72 | see report | YES | NO | 0 | AR | PASS | DD |
| BICRON | B500Z | INTERNAL | SCINT | NA | YES | 7-Jun-01 | Q99 | 2 uR/hr | NA | NA | OUT | OF CALIB | — | DD |
| LUDLUM 19 | 111280 | INTERNAL | SCINT | NA | YES | 21-Oct-01 | Q99 | 2 uR/hr | YES | NO | 18uR/hr | AR | PASS | DD |
| LUDLUM 19 | 131294 | INTERNAL | SCINT | NA | YES | 21-Oct-01 | Q99 | 2 uR/hr | YES | NO | 18uR/hr | AR | PASS | DD |
| Lud. 2929 | 99041 | 43-10-1 | SCINT | PR096923 | YES | 12-Feb-02 | Q71, Q72 | see report | NA | NA | NOT | USED | PASS | DD |
| Lud. 2929 | 126128 | 43-10-1 | SCINT | PR092163 | YES | 13-Apr-02 | Q71, Q72 | see report | NA | NO | AR | AR | AR | DD |

PROJECT: LCAAP DATE: 29 JUNE 01 TIME: 0730

| MODEL TYPE | SERIAL NUMBER | MODEL NUMBER | PROBE TYPE | SERIAL NUMBER | CALIBR REPORT | CAL DUE DATE | SOURCE ID USED | ACTIVITY (DPM) | BATTERY CHECK | PHYSICAL DAMAGE | BKGD (CPM) | RESULTS READING | PASS or FAIL | TECH INITIALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ludlum 12 | 121349 | 44-9 | GM | PR025061 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 80 | AR | PASS | DD |
| Ludlum 12 | 125304 | 44-9 | GM | PR133259 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 70 | AR | PASS | DD |
| Ludlum 12 | 125308 | 44-9 | GM | PR128041 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 50 | AR | PASS | DD |
| Ludlum 12 | 130326 | 44-9 | GM | PR100925 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 60 | AR | PASS | DD |
| Ludlum 12 | 121291 | 44-10 | SCINT | PR135860 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 17000 | AR | PASS | DD |
| Ludlum 12 | 121356 | 44-10-5 | SCINT | PR125857 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 10000 | AR | PASS | DD |
| Ludlum 12 | 121370 | 44-10 | SCINT | PR010890 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 15000 | AR | PASS | DD |
| Ludlum 12 | 125241 | 44-10 | SCINT | PR132949 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 16000 | AR | PASS | DD |
| Ludlum 12 | 128227 | 44-08 | SCINT | PR134444 | YES | 10-Oct-01 | Q99 | 5.0 uCi | YES | NO | 900 | AR | PASS | DD |
| Ludlum 3 | 100357 | 43-5 | ALPHA | PR098034 | YES | 9-Oct-01 | Q-72 | see report | YES | NO | 0 | AR | PASS | DD |
| Ludlum 3 | 102192 | 43-5 | ALPHA | PR100604 | YES | 9-Oct-01 | Q-72 | see report | YES | NO | 0 | AR | PASS | DD |
| BICRON | B500Z | INTERNAL | SCINT | NA | YES | 7-Jun-01 | Q99 | 2 uR/hr | NA | NA | OUT | OF | CALIB | DD |
| LUDLUM 19 | 111280 | INTERNAL | SCINT | NA | YES | 21-Oct-01 | Q99 | 2 uR/hr | YES | NO | 16uR/hr | AR | PASS | DD |
| LUDLUM 19 | 131294 | INTERNAL | SCINT | NA | YES | 21-Oct-01 | Q99 | 2 uR/hr | YES | NO | 17uR/hr | AR | PASS | DD |
| Lud. 2929 | 99041 | 43-10-1 | SCINT | PR096923 | YES | 12-Feb-02 | Q71, Q72 | see report | NA | NA | NOT | USED | — | DD |
| Lud. 2929 | 126128 | 43-10-1 | SCINT | PR092163 | YES | 13-Apr-02 | Q71, Q72 | see report | NA | NO | AR | AR | PASS | DD |

NOTE:

AR = ACCEPTABLE RANGE

DD Ronald DeGumbia

DAILY LOG

.OJECT: LCAAP DATE: 30 JUNE 01 TIME: 0800

| MODEL TYPE | SERIAL NUMBER | MODEL NUMBER | PROBE TYPE | SERIAL NUMBER | CALIBR REPORT | CAL DUE DATE | SOURCE ID USED | ACTIVITY (DPM) | BATTERY CHECK | PHYSICAL DAMAGE | BKGD (CPM) | RESULTS READING | PASS or FAIL | TECH INITIALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ludlum 12 | 121349 | 44-9 | GM | PR025061 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 40 | AR | PASS | DD |
| Ludlum 12 | 125304 | 44-9 | GM | PR133259 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NA | OUT | OF SERVICE | PASS | DD |
| Ludlum 12 | 125308 | 44-9 | GM | PR128041 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 60 | AR | PASS | DD |
| Ludlum 12 | 130326 | 44-9 | GM | PR100925 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 70 | AR | PASS | DD |
| Ludlum 12 | 121291 | 44-10 | SCINT | PR135860 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 16000 | AR | PASS | DD |
| Ludlum 12 | 121356 | 44-10-5 | SCINT | PR125857 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 14000 | AR | PASS | DD |
| Ludlum 12 | 121370 | 44-10 | SCINT | PR010890 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 15000 | AR | PASS | DD |
| Ludlum 12 | 125241 | 44-10 | SCINT | PR132949 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 16000 | AR | PASS | DD |
| Ludlum 12 | 128227 | 44-08 | SCINT | PR134444 | YES | 10-Oct-01 | Q99 | 5.0 uCi | YES | NO | 180 | AR | PASS | DD |
| Ludlum 3 | 100357 | 43-5 | ALPHA | PR098034 | YES | 9-Oct-01 | Q-72 | see report | YES | NO | 0 | AR | PASS | DD |
| Ludlum 3 | 102192 | 43-5 | ALPHA | PR100604 | YES | 9-Oct-01 | Q-72 | see report | YES | NO | 0 | AR | PASS | DD |
| BICRON | B500Z | INTERNAL | SCINT | NA | YES | 7-Jun-01 | Q99 | 2 uR/hr | NA | NA | OUT | OF CALIB | — | DD |
| LUDLUM 19 | 111280 | INTERNAL | SCINT | NA | YES | 21-Oct-01 | Q99 | 2 uR/hr | YES | NO | 16uR/hr | AR | PASS | DD |
| LUDLUM 19 | 131294 | INTERNAL | SCINT | NA | YES | 21-Oct-01 | Q99 | 2 uR/hr | YES | NO | 15uR/hr | AR | PASS | DD |
| Lud. 2929 | 99041 | 43-10-1 | SCINT | PR096923 | YES | 12-Feb-02 | Q71, Q72 | see report | NA | NA | NOT | USED | — | DD |
| Lud. 2929 | 126128 | 43-10-1 | SCINT | PR092163 | YES | 13-Apr-02 | Q71, Q72 | see report | NA | NO | AR | AR | PASS | DD |

PROJECT: LCAAP DATE: 1 JULY 01 TIME: 0830

| MODEL TYPE | SERIAL NUMBER | MODEL NUMBER | PROBE TYPE | SERIAL NUMBER | CALIBR REPORT | CAL DUE DATE | SOURCE ID USED | ACTIVITY (DPM) | BATTERY CHECK | PHYSICAL DAMAGE | BKGD (CPM) | RESULTS READING | PASS or FAIL | TECH INITIALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ludlum 12 | 121349 | 44-9 | GM | PR025061 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 60 | AR | PASS | DD |
| Ludlum 12 | 125304 | 44-9 | GM | PR133259 | YES | 4-Oct-01 | Q71 | 40,200 | NA | NA | OUT | OF SERVICE | | DD |
| Ludlum 12 | 125308 | 44-9 | GM | PR128041 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 50 | AR | PASS | DD |
| Ludlum 12 | 130326 | 44-9 | GM | PR100925 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 80 | AR | PASS | DD |
| Ludlum 12 | 121291 | 44-10 | SCINT | PR135860 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 17000 | AR | PASS | DD |
| Ludlum 12 | 121356 | 44-10-5 | SCINT | PR125857 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 17000 | AR | PASS | DD |
| Ludlum 12 | 121370 | 44-10 | SCINT | PR010890 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 15000 | AR | PASS | DD |
| Ludlum 12 | 125241 | 44-10 | SCINT | PR132949 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 15000 | AR | PASS | DD |
| Ludlum 12 | 128227 | 44-08 | SCINT | PR134444 | YES | 10-Oct-01 | Q99 | 5.0 uCi | YES | NO | 180 | AR | PASS | DD |
| Ludlum 3 | 100357 | 43-5 | ALPHA | PR098034 | YES | 9-Oct-01 | Q-72 | see report | YES | NO | 0 | AR | PASS | DD |
| Ludlum 3 | 102192 | 43-5 | ALPHA | PR100604 | YES | 9-Oct-01 | Q-72 | see report | YES | NO | 0 | AR | PASS | DD |
| BICRON | B500Z | INTERNAL | SCINT | NA | YES | 7-Jun-01 | Q99 | 2 uR/hr | NA | NA | OUT | OF CALIB | — | DD |
| LUDLUM 19 | 111280 | INTERNAL | SCINT | NA | YES | 21-Oct-01 | Q99 | 2 uR/hr | YES | NO | 16uR/hr | AR | PASS | DD |
| LUDLUM 19 | 131294 | INTERNAL | SCINT | NA | YES | 21-Oct-01 | Q99 | 2 uR/hr | YES | NO | 16uR/hr | AR | PASS | DD |
| Lud. 2929 | 99041 | 43-10-1 | SCINT | PR096923 | YES | 12-Feb-02 | Q71, Q72 | see report | NA | NA | NOT | USED | — | DD |
| Lud. 2929 | 126128 | 43-10-1 | SCINT | PR092163 | YES | 13-Apr-02 | Q71, Q72 | see report | NA | NO | AR | AR | PASS | DD |

NOTE:

AR = ACCEPTABLE RANGE

RDe = Ronald DeGumbia

DAILY LOG

.OJECT: LCAAP DATE: 2 JULY 01 TIME: 0800

| MODEL TYPE | SERIAL NUMBER | MODEL NUMBER | PROBE TYPE | SERIAL NUMBER | CALIBR REPORT | CAL DUE DATE | SOURCE ID USED | ACTIVITY (DPM) | BATTERY CHECK | PHYSICAL DAMAGE | BKGD (CPM) | RESULTS READING | PASS or FAIL | TECH INITIALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ludlum 12 | 121349 | 44-9 | GM | PR025061 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 50 | AR | PASS | DD |
| Ludlum 12 | 125304 | 44-9 | GM | PR133259 | YES | 4-Oct-01 | Q71 | 40,200 | NA | NA | OUT | OF SERVICE | | DD |
| Ludlum 12 | 125308 | 44-9 | GM | PR128041 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 60 | AR | PASS | DD |
| Ludlum 12 | 130326 | 44-9 | GM | PR100925 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 60 | AR | PASS | DD |
| Ludlum 12 | 121291 | 44-10 | SCINT | PR135860 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 16000 | AR | PASS | DD |
| Ludlum 12 | 121356 | 44-10-5 | SCINT | PR125857 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 9000 | AR | PASS | DD |
| Ludlum 12 | 121370 | 44-10 | SCINT | PR010890 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 15000 | AR | PASS | DD |
| Ludlum 12 | 125241 | 44-10 | SCINT | PR132949 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 16000 | AR | PASS | DD |
| Ludlum 12 | 128227 | 44-08 | SCINT | PR134444 | YES | 10-Oct-01 | Q99 | 5.0 uCi | YES | NO | 1200 | AR | PASS | DD |
| Ludlum 3 | 100357 | 43-5 | ALPHA | PR098034 | YES | 9-Oct-01 | Q-72 | see report | YES | NO | 0 | AR | PASS | DD |
| Ludlum 3 | 102192 | 43-5 | ALPHA | PR100604 | YES | 9-Oct-01 | Q-72 | see report | YES | NO | 0 | AR | PASS | DD |
| BICRON | B500Z | INTERNAL | SCINT | NA | YES | 7-Jun-01 | Q99 | 2 uR/hr | NA | NA | NOT | IN CALIB | | DD |
| LUDLUM 19 | 111280 | INTERNAL | SCINT | NA | YES | 21-Oct-01 | Q99 | 2 uR/hr | YES | NO | 17uR/hr | AR | PASS | DD |
| LUDLUM 19 | 131294 | INTERNAL | SCINT | NA | YES | 21-Oct-01 | Q99 | 2 uR/hr | YES | NO | 16uR/hr | AR | PASS | DD |
| Lud. 2929 | 99041 | 43-10-1 | SCINT | PR096923 | YES | 12-Feb-02 | Q71, Q72 | see report | NA | NA | NOT | USED | PASS | DD |
| Lud. 2929 | 126128 | 43-10-1 | SCINT | PR092163 | YES | 13-Apr-02 | Q71, Q72 | see report | NA | NO | AR | AR | PASS | DD |

PROJECT: LCAAP DATE: 3 JULY 01 TIME:

| MODEL TYPE | SERIAL NUMBER | MODEL NUMBER | PROBE TYPE | SERIAL NUMBER | CALIBR REPORT | CAL DUE DATE | SOURCE ID USED | ACTIVITY (DPM) | BATTERY CHECK | PHYSICAL DAMAGE | BKGD (CPM) | RESULTS READING | PASS or FAIL | TECH INITIALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ludlum 12 | 121349 | 44-9 | GM | PR025061 | YES | 4-Oct-01 | Q71 | 40,200 | NA | SHIPPED | | | | DD |
| Ludlum 12 | 125304 | 44-9 | GM | PR133259 | YES | 4-Oct-01 | Q71 | 40,200 | NA | SHIPPED | | | | DD |
| Ludlum 12 | 125308 | 44-9 | GM | PR128041 | YES | 4-Oct-01 | Q71 | 40,200 | NA | SHIPPED | | | | DD |
| Ludlum 12 | 130326 | 44-9 | GM | PR100925 | YES | 4-Oct-01 | Q71 | 40,200 | YES | NO | 60 | AR | PASS | DD |
| Ludlum 12 | 121291 | 44-10 | SCINT | PR135860 | YES | 12-Oct-01 | Q99 | 5.0 uCi | NA | SHIPPED | | | | DD |
| Ludlum 12 | 121356 | 44-10-5 | SCINT | PR125857 | YES | 12-Oct-01 | Q99 | 5.0 uCi | NA | SHIPPED | | | | DD |
| Ludlum 12 | 121370 | 44-10 | SCINT | PR010890 | YES | 12-Oct-01 | Q99 | 5.0 uCi | NA | SHIPPED | | | | DD |
| Ludlum 12 | 125241 | 44-10 | SCINT | PR132949 | YES | 12-Oct-01 | Q99 | 5.0 uCi | YES | NO | 16000 | AR | PASS | DD |
| Ludlum 12 | 128227 | 44-08 | SCINT | PR134444 | YES | 10-Oct-01 | Q99 | 5.0 uCi | NA | SHIPPED | | | | DD |
| Ludlum 3 | 100357 | 43-5 | ALPHA | PR098034 | YES | 9-Oct-01 | Q-72 | see report | NA | SHIPPED | | | | DD |
| Ludlum 3 | 102192 | 43-5 | ALPHA | PR100604 | YES | 9-Oct-01 | Q-72 | see report | NA | SHIPPED | | | | |
| BICRON | B500Z | INTERNAL | SCINT | NA | YES | 7-Jun-01 | Q99 | 2 uR/hr | NA | SHIPPED | | | | DD |
| LUDLUM 19 | 111280 | INTERNAL | SCINT | NA | YES | 21-Oct-01 | Q99 | 2 uR/hr | YES | NO | 17uR/hr | AR | PASS | |
| LUDLUM 19 | 131294 | INTERNAL | SCINT | NA | YES | 21-Oct-01 | Q99 | 2 uR/hr | NA | SHIPPED | | | | DD |
| Lud. 2929 | 99041 | 43-10-1 | SCINT | PR096923 | YES | 12-Feb-02 | Q71, Q72 | see report | NA | SHIPPED | | | | DD |
| Lud. 2929 | 126128 | 43-10-1 | SCINT | PR092163 | YES | 13-Apr-02 | Q71, Q72 | see report | NA | NO | AR | AR | PASS | DD |

NOTE:

AR = ACCEPTABLE RANGE

DD Ronald DeGumbia

# APPENDIX C

# GRID SURVEY RECORDS

**PLEASE NOTE**

On the attached survey records, there is a small darkened block adjacent to the lower right corner of the grid block with the annotation "TEN SQ METER." This subject annotation refers to the entire grid block (i.e., each grid is a 10 m x 10 m area). It is not intended to represent the size of the smaller darkened area.

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF02

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| ATE: 6-27-01 | | | | | |
| TIME: 1935 | MODEL | SERIAL # | EFF.% | BKGRD (1) | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | N/A | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | N/A | 8900 cpm | 10-12-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates – microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

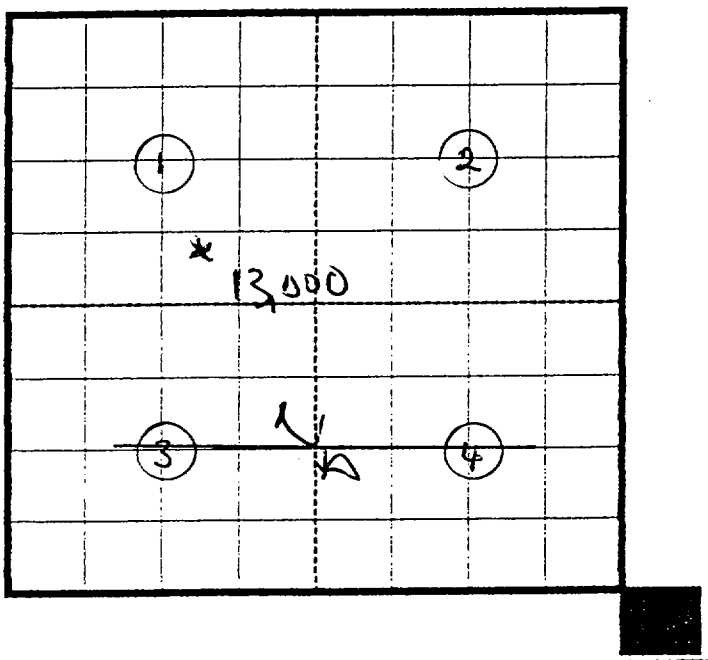
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 40 ~~EAST~~ WEST 10 PARTIAL GRID




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 13.0 |
| 2 | 14.5 |
| 3 | — |
| 4 | — |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks: (1) BKGD Near structures ≅ 11 MR/hr

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF-02

| ATE: 6-27-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1850 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMSON | 19 | B1294 | NA | 9.2 µR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates ~~mR/hr~~ R/hr (µR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

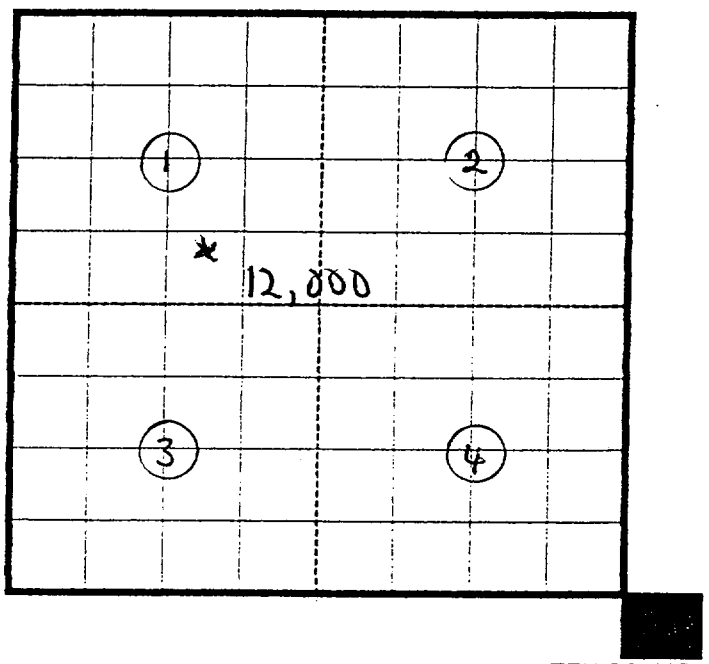
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 40 EAST 0




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 13.0 |
| 2 | 13.5 |
| 3 | 13.5 |
| 4 | 12.0 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks: ① BKgd near structures ≅ 11 µR/hr

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

| ATE: 6-27-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1905 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVE THOMPSON | 19 | 131294 | NA | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

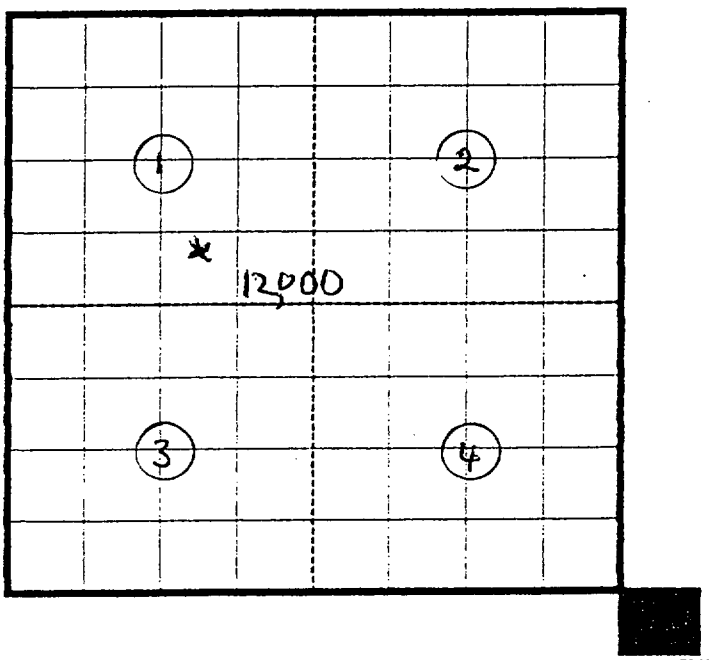
PURPOSE OF SURVEY: FINAL STATUS SURVEY

SMEAR RESULTS
RESULTS = DPM/100cm²
UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 40 EAST 10




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION: *

| | |
|---|---|
| 1 | 12.0 |
| 2 | 12.5 |
| 3 | 11.5 |
| 4 | 11.5 |

HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| ATE: 6-27-01 | | | | | |
| TIME: 1910 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131254 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 112291 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = micro/R/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

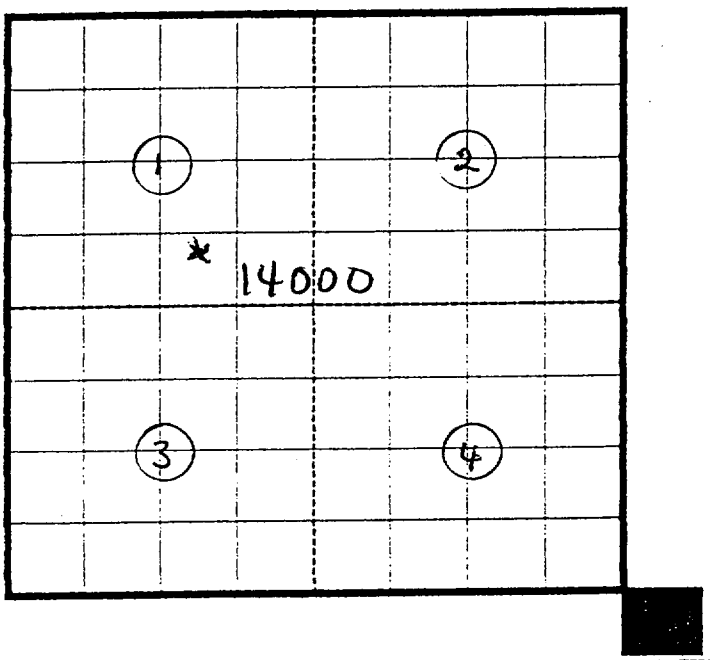
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 40 EAST 20




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 11.5 |
| 2 | 12.0 |
| 3 | 12.0 |
| 4 | 12.0 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF02

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| ATE: 6-27-01 | | | | | |
| TIME: 1815 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = ~~microR/hr~~ (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

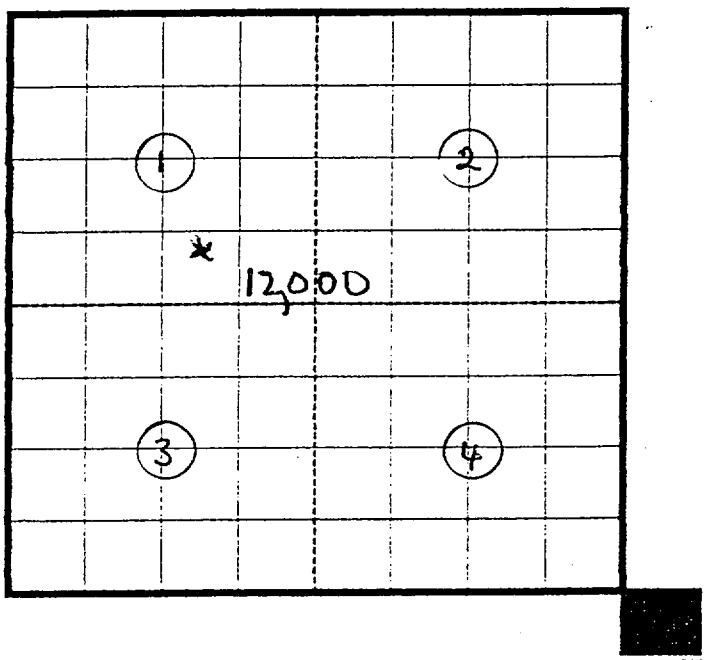
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 40 EAST 30




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 12.5 |
| 2 | 12.5 |
| 3 | 11.5 |
| 4 | 11.0 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

| ATE: 6-27-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1900 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = ~~microR/hr~~ (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

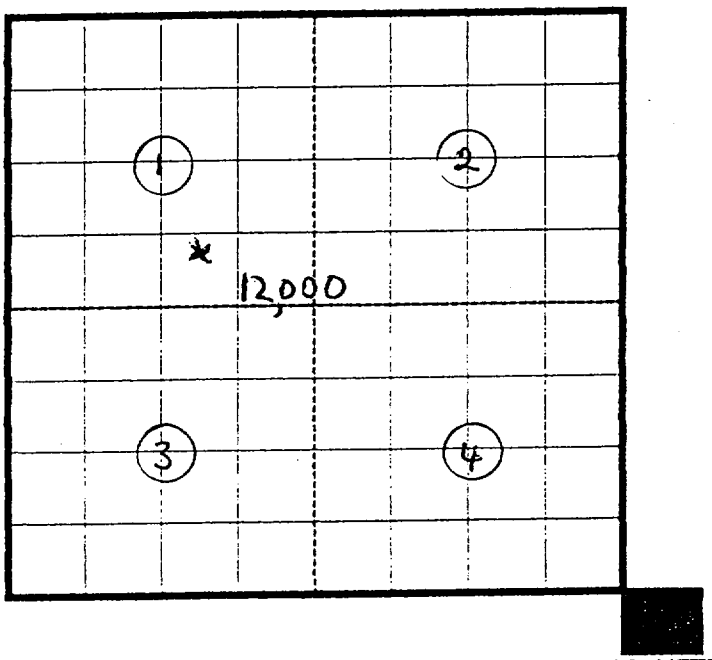
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 40 EAST 40




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 12.0 |
| 2 | 10.0 |
| 3 | 10.0 |
| 4 | 9.5 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LC-02

| DATE: 7-1-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1305 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THIMPSON | 19 | 131294 | N/A | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 37A | 12 | 121294 | N/A | 2900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = ~~microR/hr~~ (μR/hr) | | | | | |

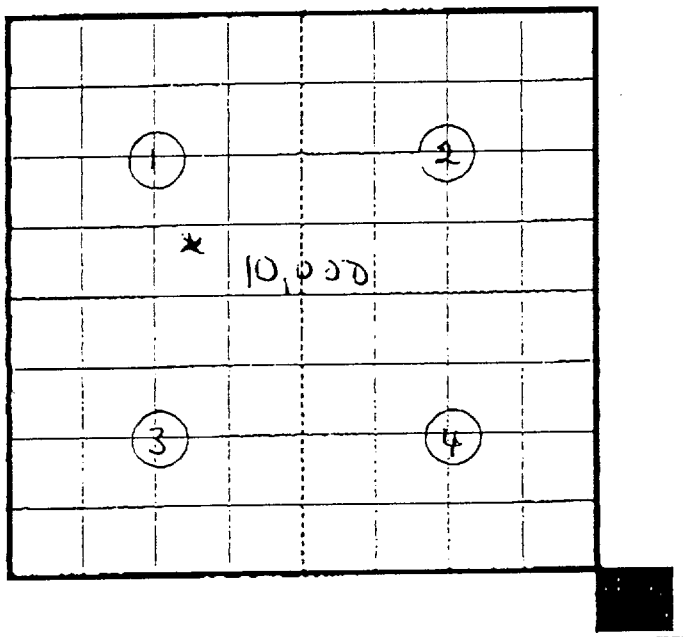
PURPOSE OF SURVEY: FINAL STATUS SURVEY

SMEAR RESULTS
RESULTS - DPM/100cm²
UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| N/A | N/A | N/A |

AFFECTED AREA

NORTH 0 EAST 50




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 11.0 |
| 2 | 11.5 |
| 3 | 11.0 |
| 4 | 11.5 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

ALLIED TECHNOLOGY GROUP, INC. FORM ATGF-001 6/96

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF03

| DATE: 7-1-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1331 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVE THOMPSON | 19 | B1264 | N/A | 9.2 μR/hr | 10-22-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121251 | N/A | 8900 cpm | 12-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

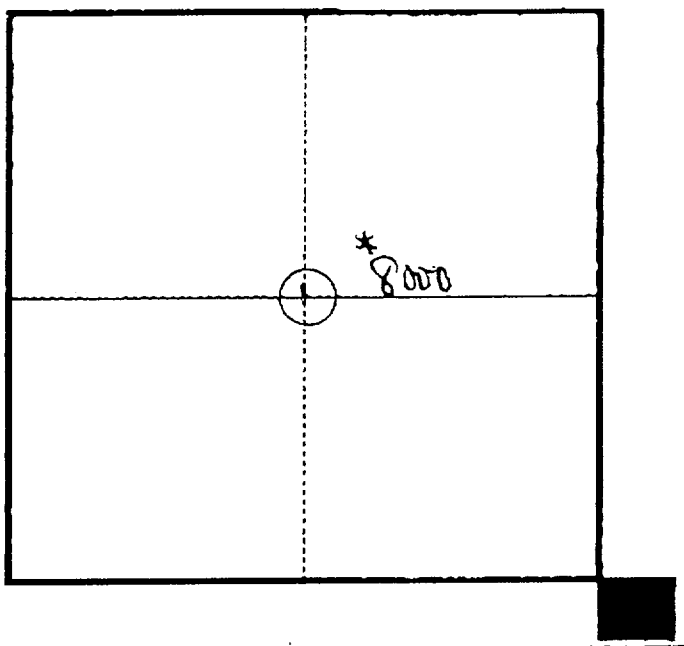
PURPOSE OF SURVEY: FINAL STATUS SURVEY

SMEAR RESULTS
RESULTS = DPM/100cm²
UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | NA | NA |

NON- AFFECTED AREA

NORTH 0 EAST 60




TEN SQ METER

uREM/hr SOIL SAMPLE LOCATION:

1 9.0

HIGHEST READING ON 25% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

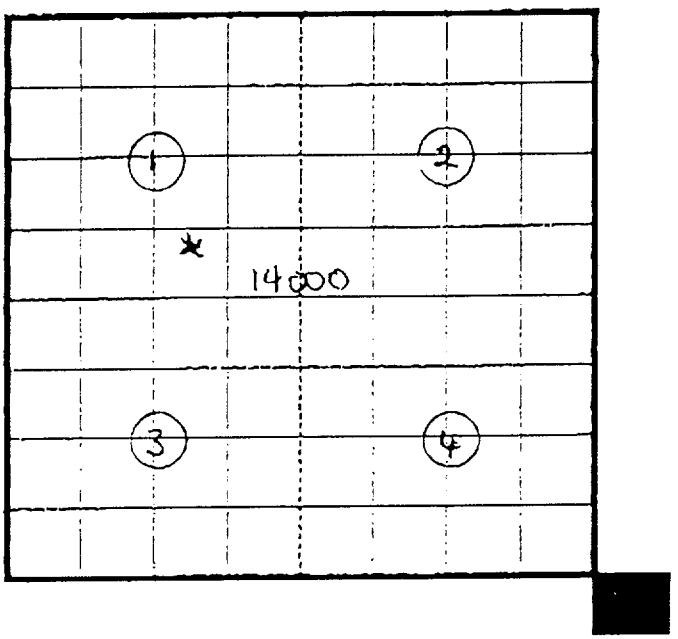
| DATE: 6-27-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1615 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVE THOMPSON | 19 | B1294 | NA | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 cpm | 10-21-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

SMEAR RESULTS
RESULTS = DPM/100cm²
UNLESS OTHERWISE NOTED

AFFECTED AREA

SOUTH ~~NORTH~~ 0 EAST 30




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 10.5 |
| 2 | 12.0 |
| 3 | 11.0 |
| 4 | 12.0 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN CROSS CPM

| # | βγ | α |
|---|---|---|
| N/A | N/A | N/A |

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF02

| DATE: 6-27-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 16:30 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVE THOMPSON | 19 | 131294 | NA | 9.2 uR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 124291 | NA | 8900 cpm | 10-21-01 |
| REVIEWED BY: [illegible] | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (uR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

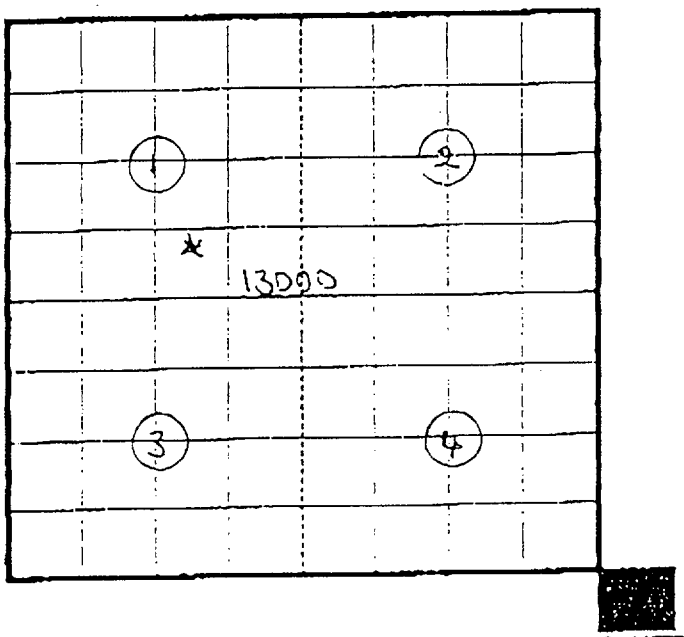
SMEAR RESULTS

RESULTS - DPM/100cm² UNLESS OTHERWISE NOTED

| # | | BY | | α | |
|---|---|---|---|---|---|
| NA | | N/A | | NA | |

AFFECTED AREA

~~NORTH~~ SOUTH 0 EAST 40




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION: *

HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

| | |
|---|---|
| 1 | 10.5 |
| 2 | 11.5 |
| 3 | 10.5 |
| 4 | 11.0 |

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| DATE: 6-27-01 | | | | | |
| TIME: 1710 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVE THOMPSON | 19 | 131294 | NA | 9.2 uR/hr | 10-25-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 142291 | MS | 8900 cpm | 10-25-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates - microR/hr (µR/hr) | | | | | |

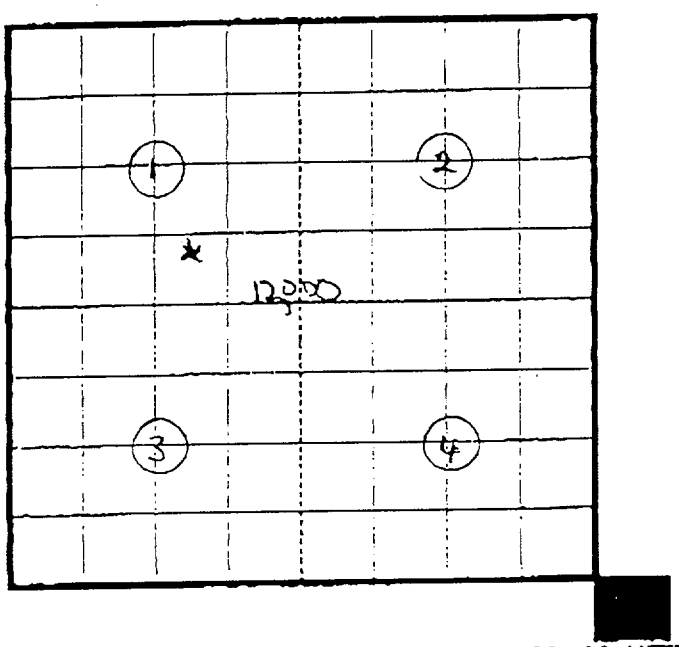
PURPOSE OF SURVEY: FINAL STATUS SURVEY

SMEAR RESULTS
RESULTS – DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | N/A |

AFFECTED AREA

~~NORTH~~ SOUTH 10 EAST 30




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION: *

| | |
|---|---|
| 1 | 12.0 |
| 2 | 10.5 |
| 3 | 11.5 |
| 4 | 11.0 |

HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF02

| DATE: 6-27-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1730 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVE THOMPSON | 19 | 131814 | ND | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | ND | 8900 cpm | 10-21-01 |
| REVIEWED BY: [illegible] | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

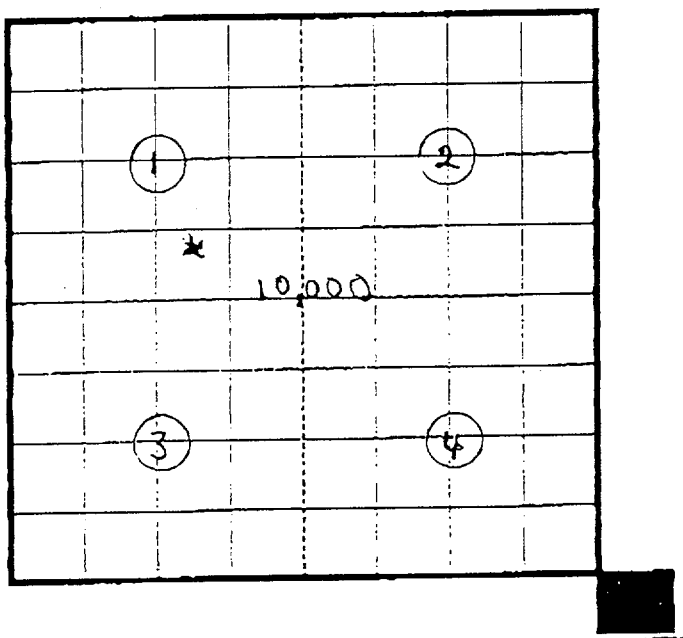
PURPOSE OF SURVEY: FINAL STATUS SURVEY

SMEAR RESULTS
RESULTS = DPM/100 cm²
UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

SOUTH ~~NORTH~~ 10 EAST 10




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 12.0 |
| 2 | 10.5 |
| 3 | 12.0 |
| 4 | 10.5 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

ALLIED TECHNOLOGY GROUP, INC. FORM ATGF-001 6/96

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF02

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| ATE: 6-27-01 | | | | | |
| TIME: 1840 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

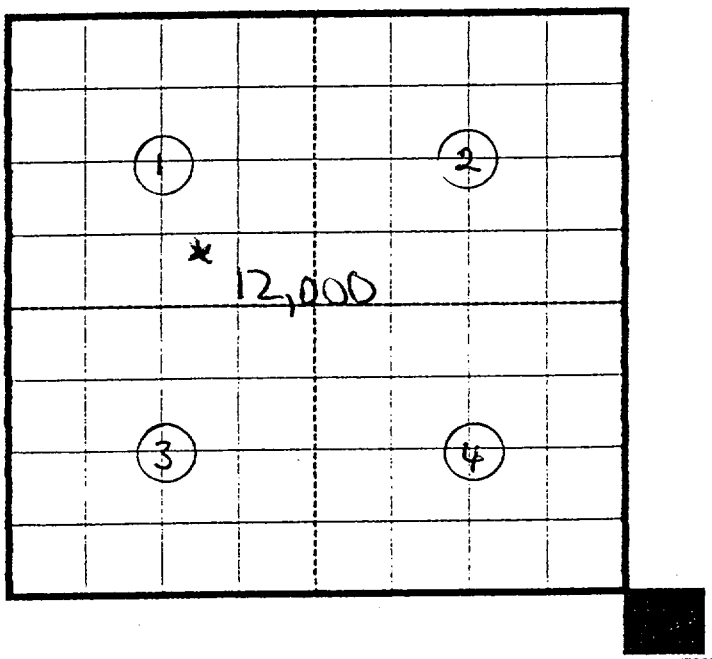
PURPOSE OF SURVEY: FINAL STATUS SURVEY

SMEAR RESULTS
RESULTS = DPM/100cm²
UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 30 EAST 30




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 11.0 |
| 2 | 10.5 |
| 3 | 11.0 |
| 4 | 11.5 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| ATE: 6-27-01 | | | | | |
| TIME: 1845 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | N/A | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | N/A | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

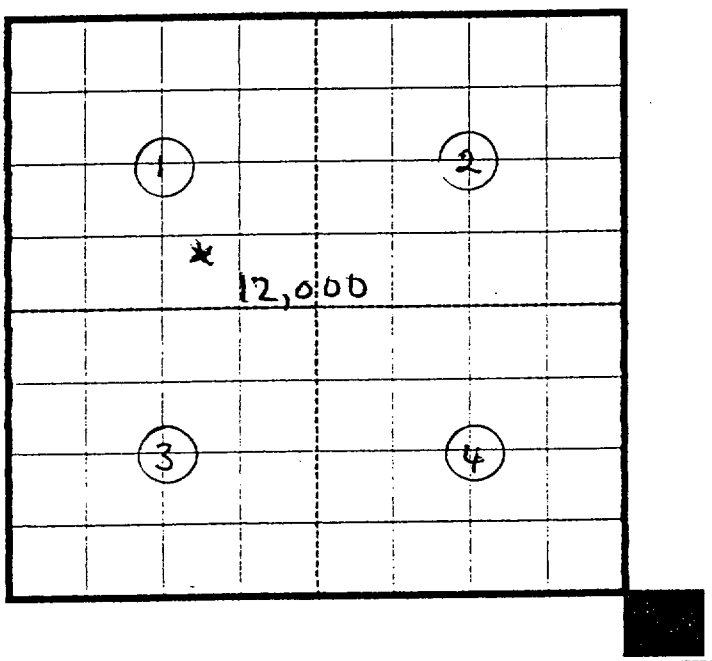
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 30 EAST 40




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 10.0 |
| 2 | 9.0 |
| 3 | 9.5 |
| 4 | 9.0 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| ATE: 7-1-01 | | | | | |
| TIME: 1315 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 uR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121251 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (µR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

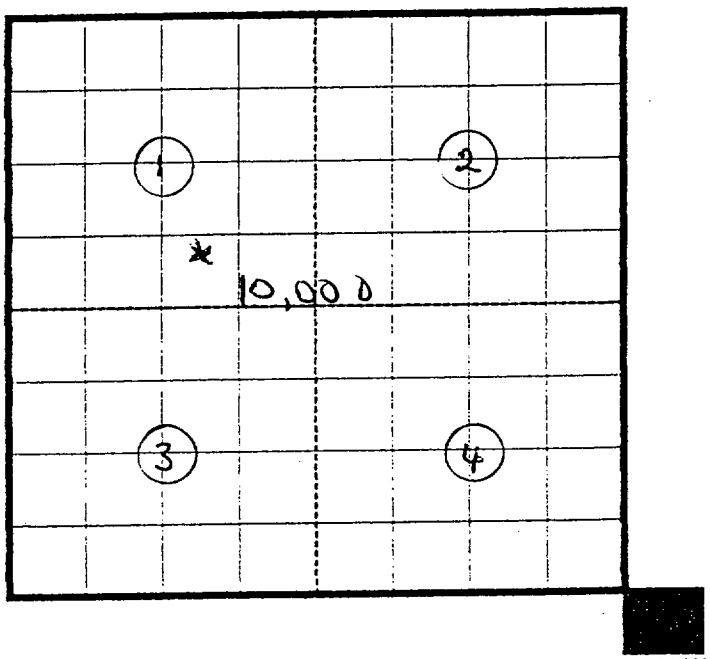
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 30 EAST 50




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 10.5 |
| 2 | 11.0 |
| 3 | 11.5 |
| 4 | 11.0 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 03

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| DATE: 7.1.01 | | | | | |
| TIME: 1335 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 CPM | 10-12-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

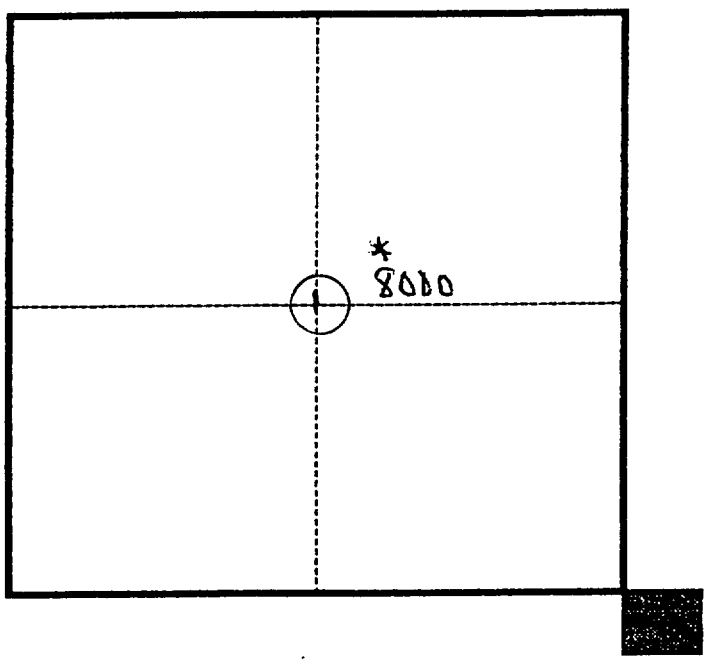
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | NA | NA |

NON- AFFECTED AREA

NORTH 30 EAST 60




TEN SQ METER

uREM/hr SOIL SAMPLE LOCATION:

1 10.0

HIGHEST READING ON 25% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF02

| ATE: 6-27-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1815 | MODEL | SERIAL # | EFF.% | BKGRD ① | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMSON | 19 | 131294 | NA | 9.2 uR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 cpm | 10-2-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates = ~~microR/hr~~ (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

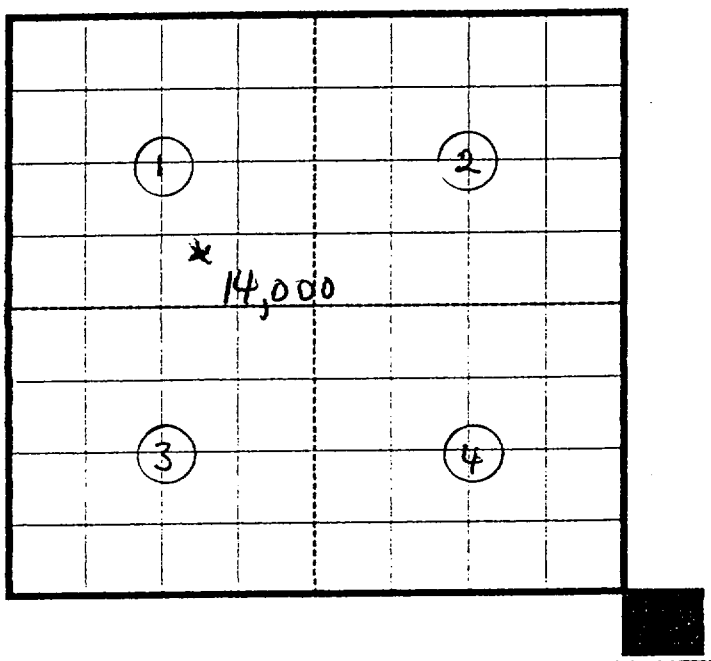
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 20 EAST 0




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION: * HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

| | |
|---|---|
| 1 | 14.5 |
| 2 | 12.5 |
| 3 | 13.0 |
| 4 | 12.0 |

Remarks: ① BKgd near structures ≅ 11 uR/hr

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

| ATE: 6-27-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1820 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | B1294 | NA | 9.2 uR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (µR/hr) | | | | | |

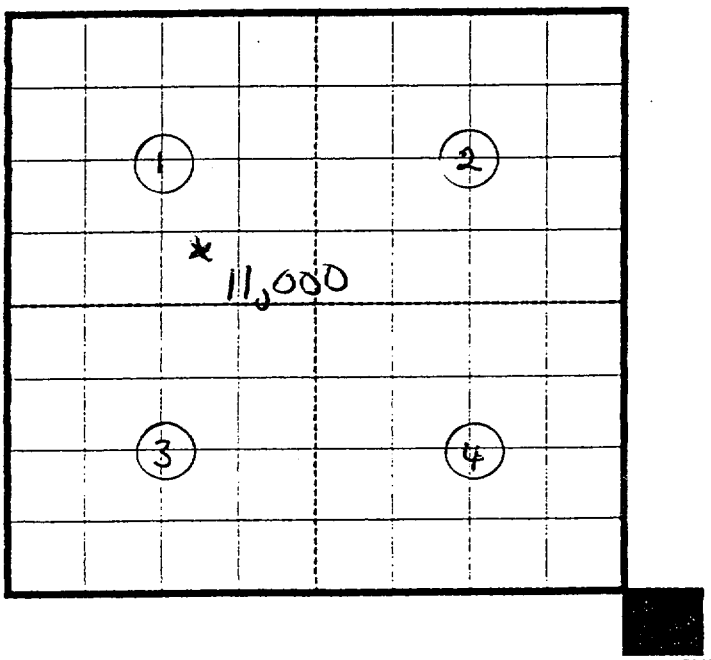
PURPOSE OF SURVEY: FINAL STATUS SURVEY

SMEAR RESULTS
RESULTS = DPM/100cm²
UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 20 EAST 10




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 11.5 |
| 2 | 12.0 |
| 3 | 11.0 |
| 4 | 11.5 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF02

| ATE: 6-27-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1825 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

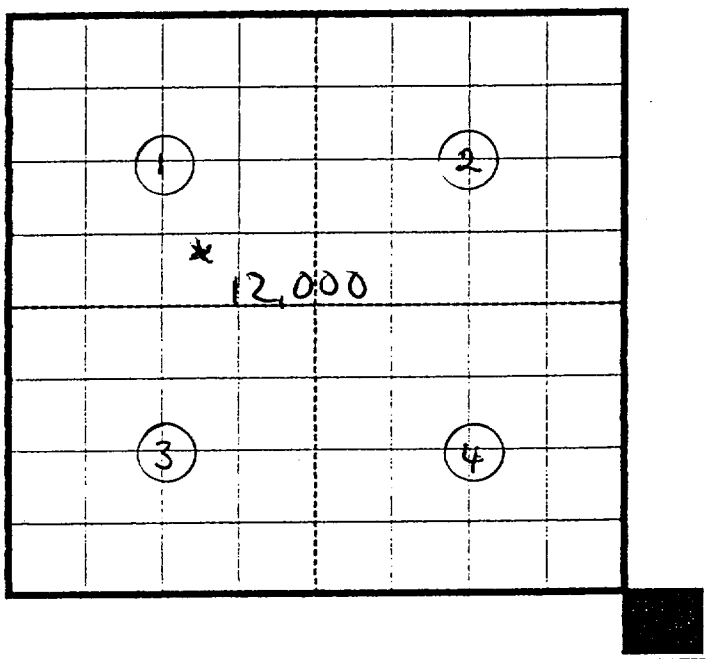
PURPOSE OF SURVEY: FINAL STATUS SURVEY

SMEAR RESULTS
RESULTS = DPM/100cm²
UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 20 EAST 20




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION: *

| | |
|---|---|
| 1 | 11.0 |
| 2 | 11.0 |
| 3 | 11.0 |
| 4 | 10.5 |

HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF02

| ATE: 6-27-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1830 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 124291 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: [illegible] | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

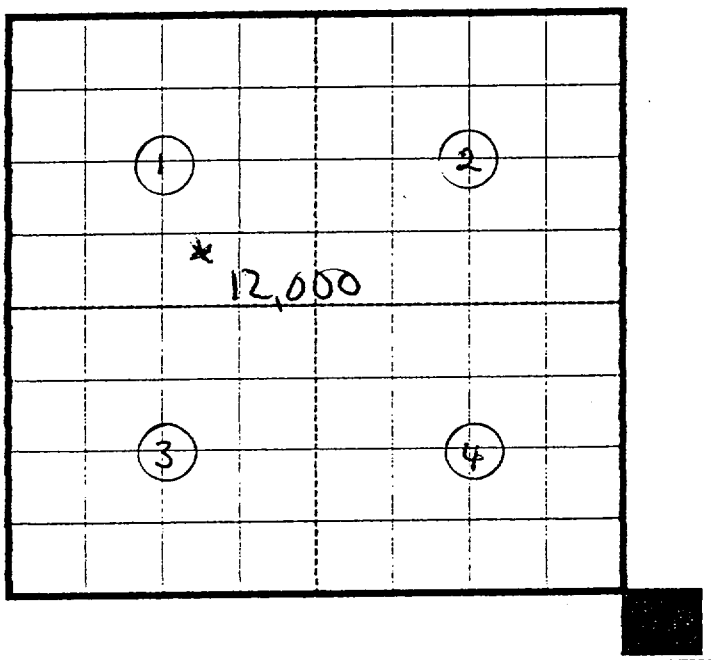
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 20 EAST 30




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 11.5 |
| 2 | 10.5 |
| 3 | 10.0 |
| 4 | 10.0 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| ATE: 7-2-01 | | | | | |
| TIME: 1605 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | MS | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | MS | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

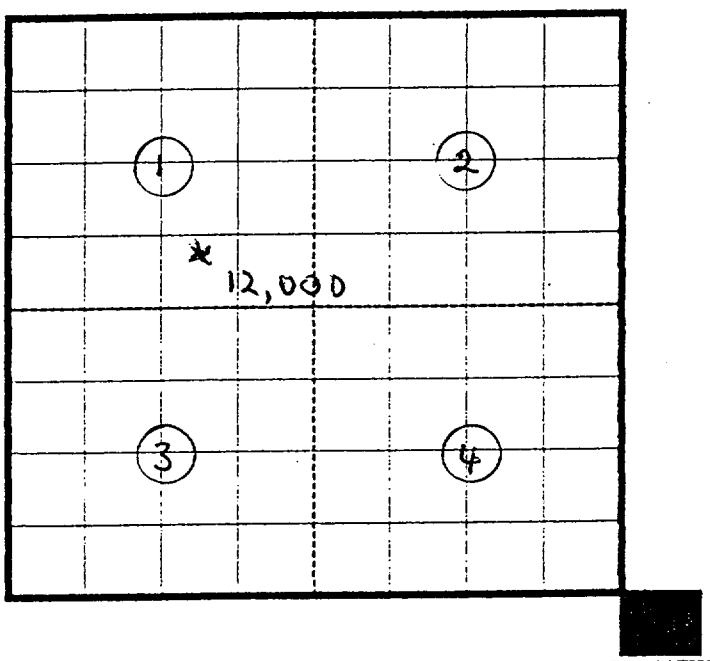
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 20 EAST 40




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 10.5 |
| 2 | 10.0 |
| 3 | 11.0 |
| 4 | 11.0 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

| ATE: 7-1-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1320 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMESON | 19 | 131264 | NA | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: [illegible] | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

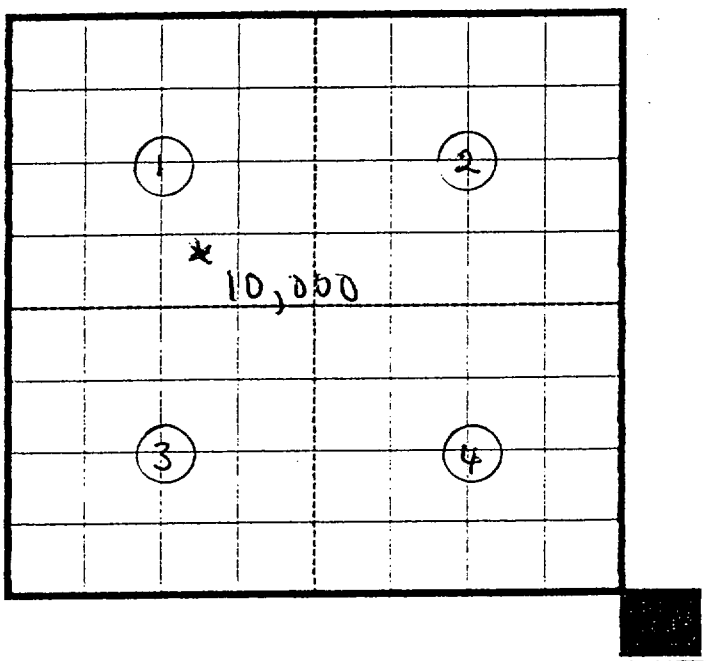
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 20 EAST 50




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 11.5 |
| 2 | 11.0 |
| 3 | 11.0 |
| 4 | 10.0 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 03

| | | | | | |
|---|---|---|---|---|---|
| \TE: 7-1-01 | INSTRUMENTATION USED | | | | |
| TIME: 1335 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: Stevey Thompson | 19 | 131284U | NA | 9.2 uR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 1U291 | NA | 8900 CPM | 10-12-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (µR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

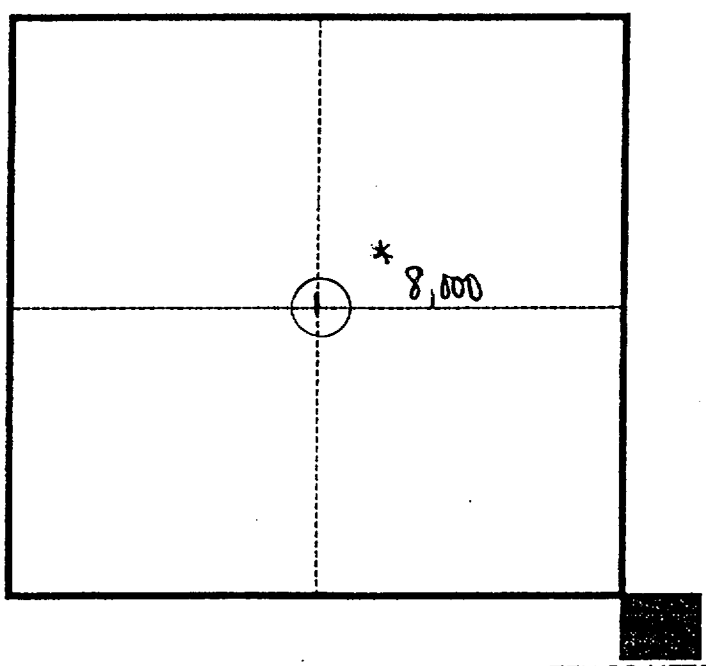
**SMEAR RESULTS**

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | NA | NA |
| ↓ | ↓ | ↓ |

**NON- AFFECTED AREA**

NORTH 20 EAST 60




uREM/hr SOIL SAMPLE LOCATION: HIGHEST READING ON 25% GRID WALKOVER WITH NaI IN GROSS CPM

1 | 9.0 |

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF02

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| DATE: 7-1-01 | | | | | |
| TIME: 1355 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 124294 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

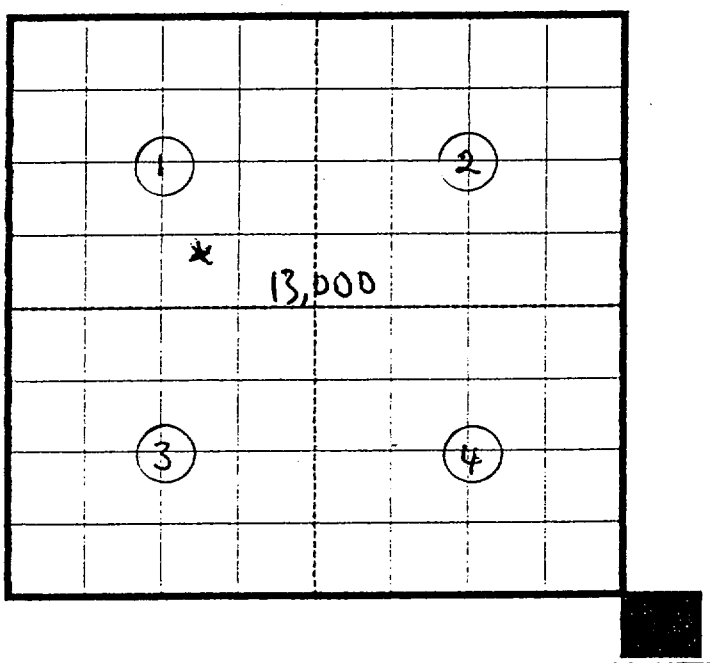
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 10 EAST 0




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 13.5 |
| 2 | 12.0 |
| 3 | 14.5 |
| 4 | 12.5 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks: ① Bkgd near structure ≅ 11 μR/hour

ALLIED TECHNOLOGY GROUP, INC. FORM ATGF-001 6/96

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

| ATE: 7-1-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1400 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | B12590 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 2900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

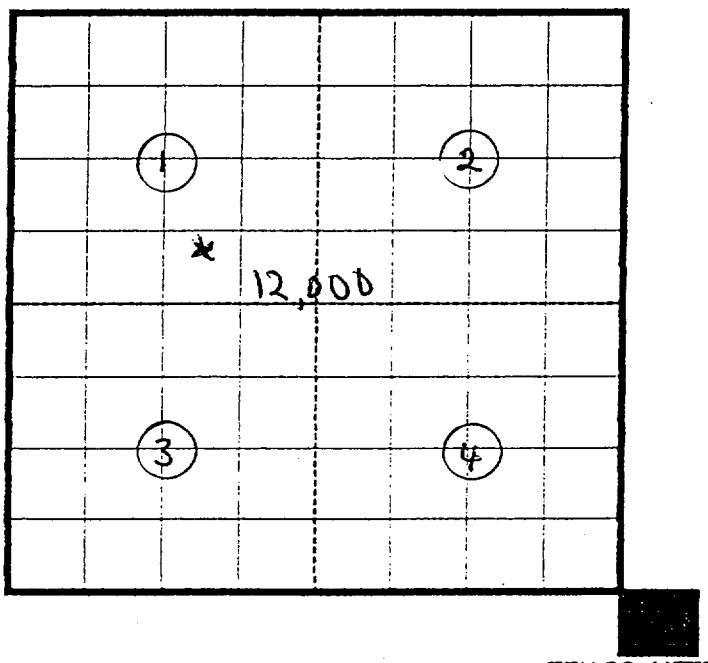
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 10 EAST 10




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION: *

HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

| | |
|---|---|
| 1 | 12.5 |
| 2 | 12.0 |
| 3 | 12.0 |
| 4 | 11.5 |

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| ATE: 7-1-01 | | | | | |
| TIME: 1405 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131291 | NA | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = micro R/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

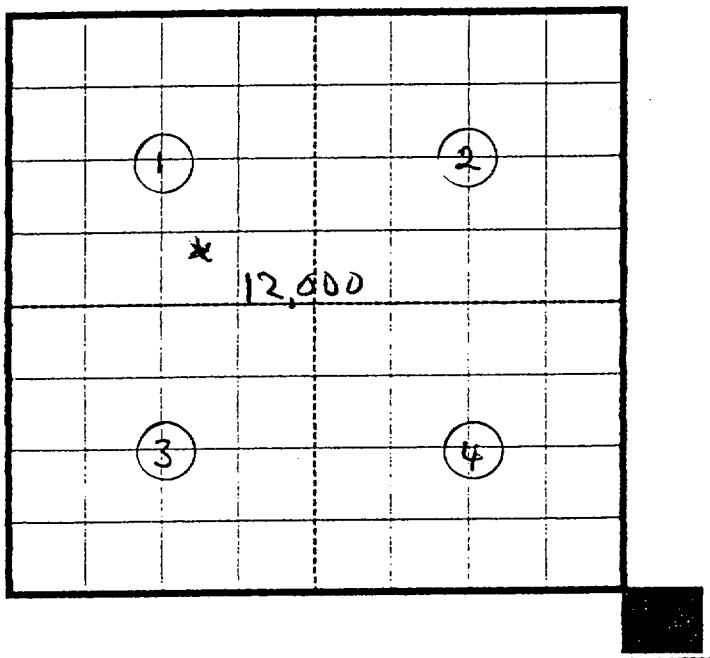
SMEAR RESULTS

RESULTS = DPM/100cm²
UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 10 EAST 20




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 11.5 |
| 2 | 12.0 |
| 3 | 12.5 |
| 4 | 12.0 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF02

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| DATE: 7-1-01 | | | | | |
| TIME: 1350 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 121291 | NA | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates = mrem/R/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

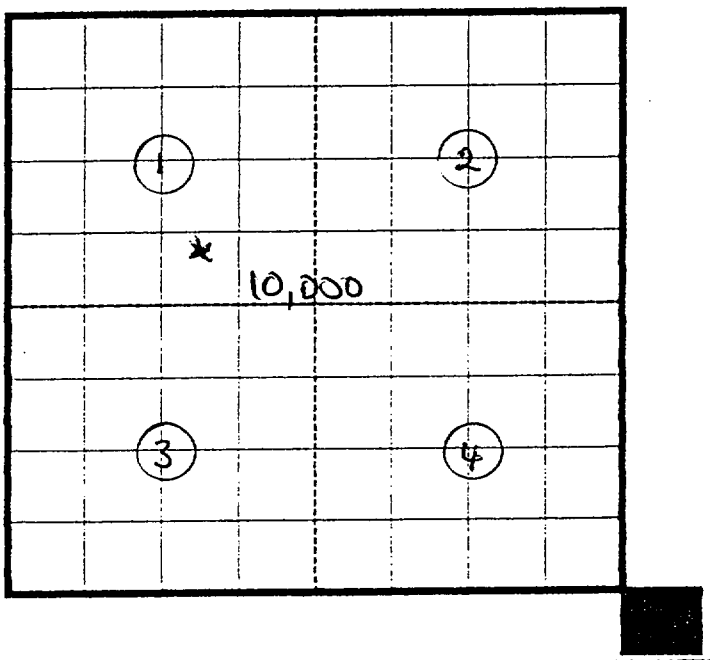
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 10 EAST 30




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 12.0 |
| 2 | 11.0 |
| 3 | 11.5 |
| 4 | 11.5 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 2

| ATE: 7-1-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1410 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 120291 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

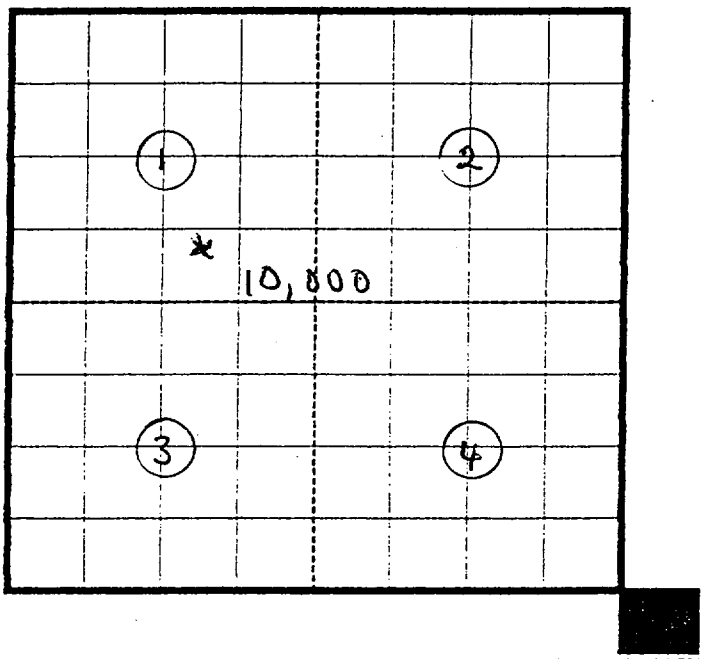
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 10 EAST 40




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 11.0 |
| 2 | 10.0 |
| 3 | 10.0 |
| 4 | 10.0 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF02

| ATE: 7-1-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1330 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN Thompson | 19 | 131294 | NA | 9.2 μR/Hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 cpm | 10-21-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

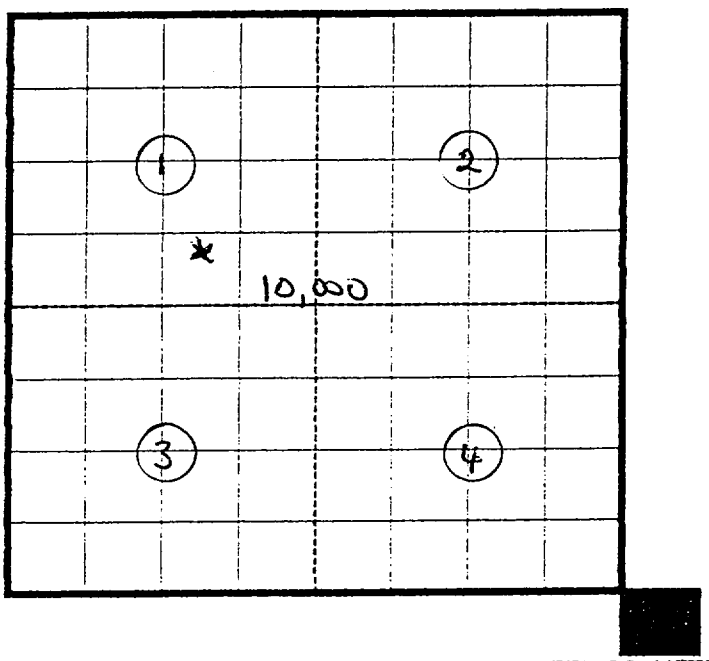
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 10 EAST 50




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION: *

HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

| | |
|---|---|
| 1 | 11.0 |
| 2 | 10.0 |
| 3 | 11.5 |
| 4 | 10.5 |

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 03

| ATE: 7-1-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1335 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 CPM | 10-12-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

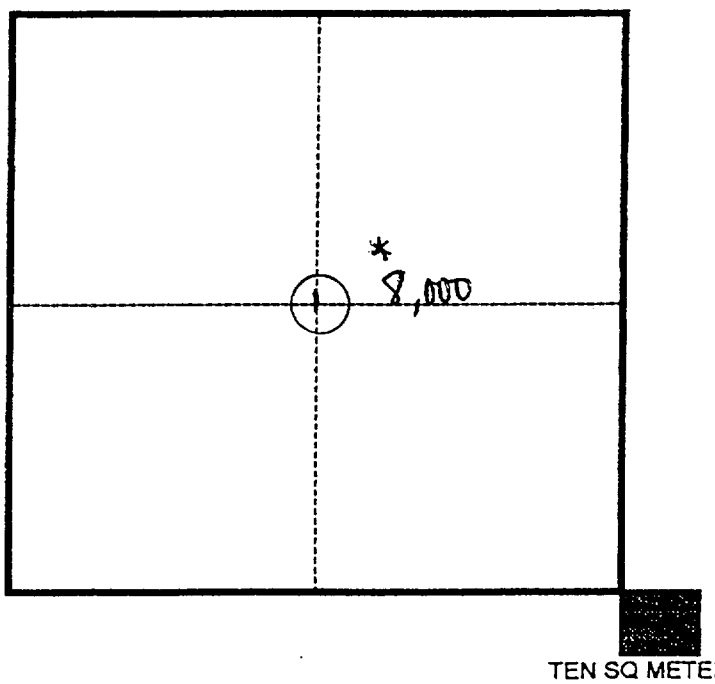
PURPOSE OF SURVEY: FINAL STATUS SURVEY

SMEAR RESULTS
RESULTS = DPM/100cm²
UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | NA | NA |

NON- AFFECTED AREA

NORTH 10 EAST 60




uREM/hr SOIL SAMPLE LOCATION: HIGHEST READING ON 25% GRID WALKOVER WITH NaI IN GROSS CPM

1 9.0

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCP02

| DATE: 7-1-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1425 | MODEL | SERIAL # | EFF.% | BKGRD (1) | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131914 | N/A | 9.2 μR/hr | 10-24-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | N/A | 8900 cpm | 10-12-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

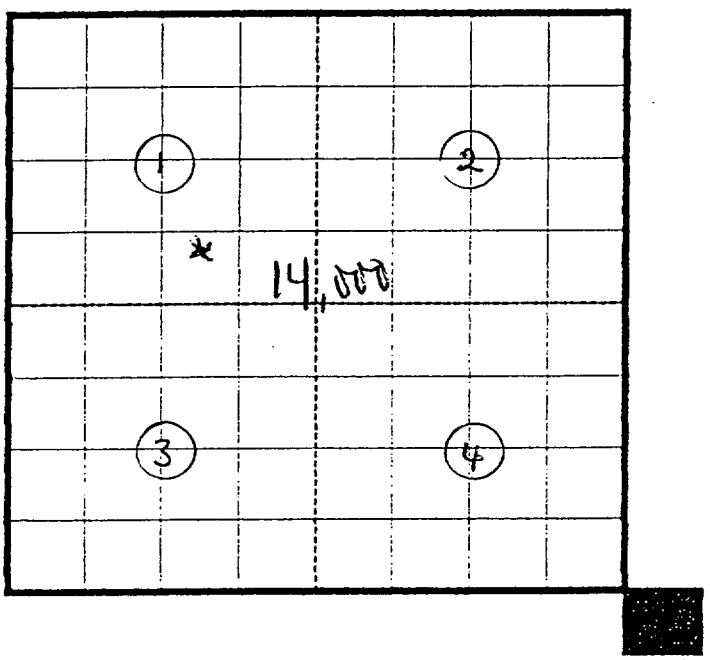
PURPOSE OF SURVEY: FINAL STATUS SURVEY

SMEAR RESULTS
RESULTS = DPM/100cm²
UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 0 WEST 10 EAST 10




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION: *

| | |
|---|---|
| 1 | 15.0 |
| 2 | 14.5 |
| 3 | 12.5 |
| 4 | 11.5 |

HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks: (1) BKGD near structure ≈ 11 μR/hour & 12,000 cpm

ALLIED TECHNOLOGY GROUP, INC. FORM ATGF-001 6/96

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF02

| ATE: 6-27-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1805 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVE THOMPSON | 19 | 131294 | NA | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

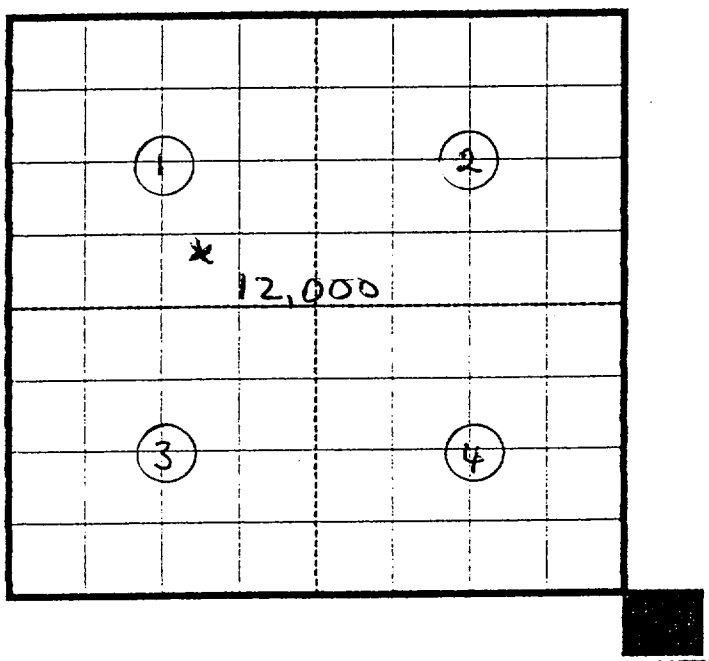
PURPOSE OF SURVEY: FINAL STATUS SURVEY

SMEAR RESULTS
RESULTS = DPM/100cm²
UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 0 EAST 0




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 13.0 |
| 2 | 12.5 |
| 3 | 11.5 |
| 4 | 11.5 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF02

| ATE: 6-27-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1810 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 13244 | NA | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 12291 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = ~~microR~~/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

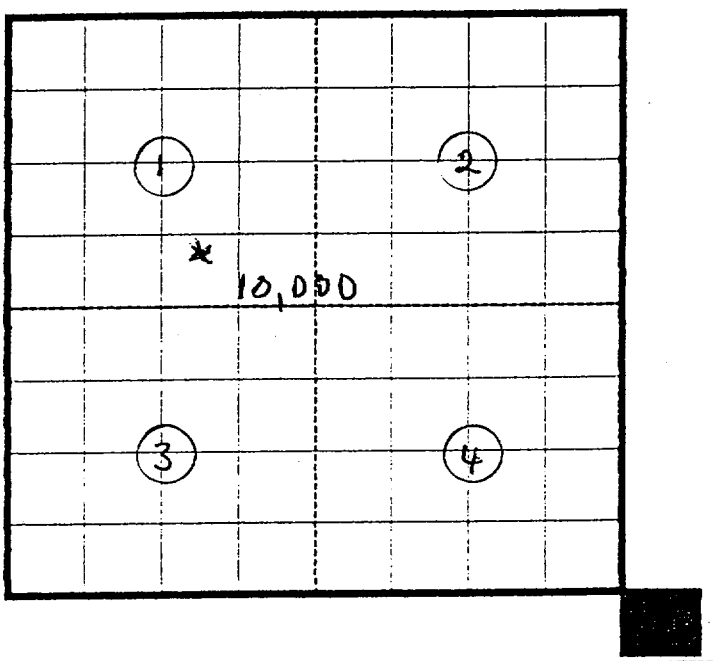
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 0 EAST 10




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 11.0 |
| 2 | 11.0 |
| 3 | 11.0 |
| 4 | 11.0 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| ATE: 6-27-01 | | | | | |
| TIME: 1930 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVE THOMPSON | 19 | 121294 | NA | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

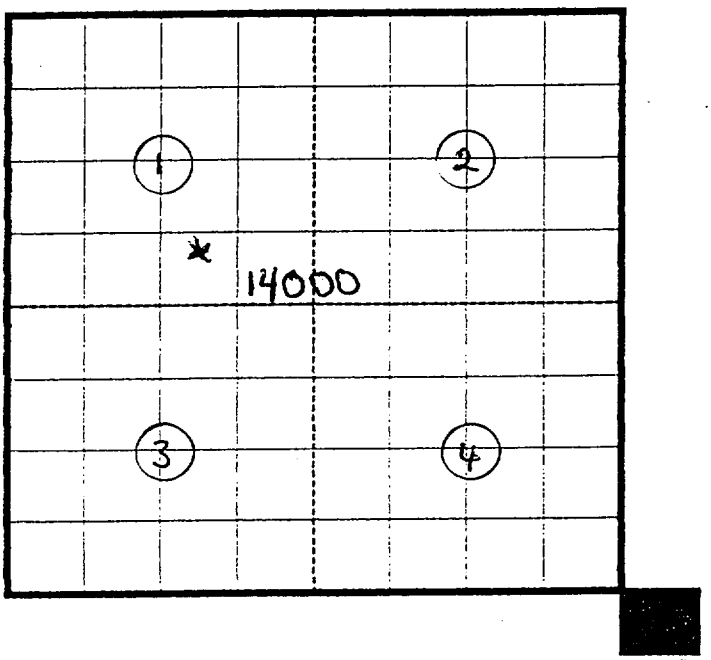
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 0 EAST 20




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 10.0 |
| 2 | 10.5 |
| 3 | 10.0 |
| 4 | 9.5 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF02

| DATE: 7-1-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1305 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | N/A | 9.2 uR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 142544 | N/A | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

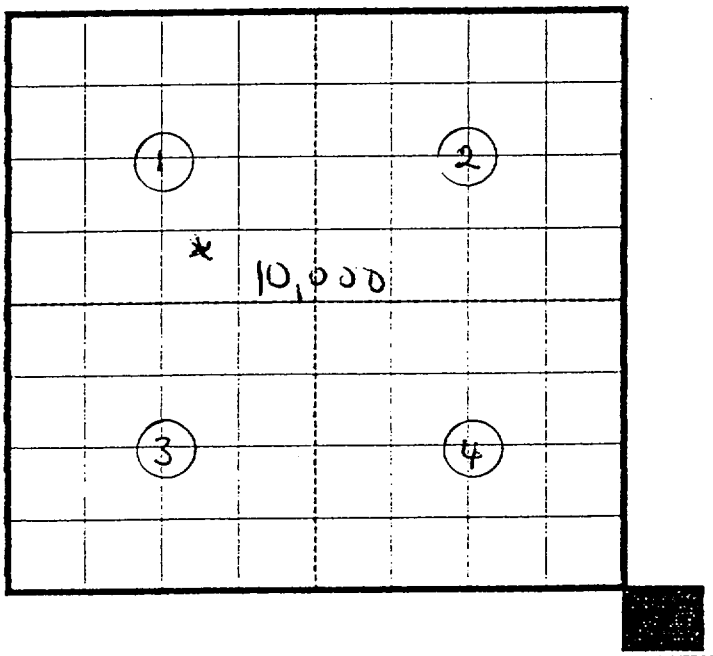
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

NORTH 0 EAST 50




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION: *

HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

| | |
|---|---|
| 1 | 11.0 |
| 2 | 11.5 |
| 3 | 11.0 |
| 4 | 11.5 |

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF03

| DATE: 7-1-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1331 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | B1294 | NA | 9.2 μR/HR | 10-2-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

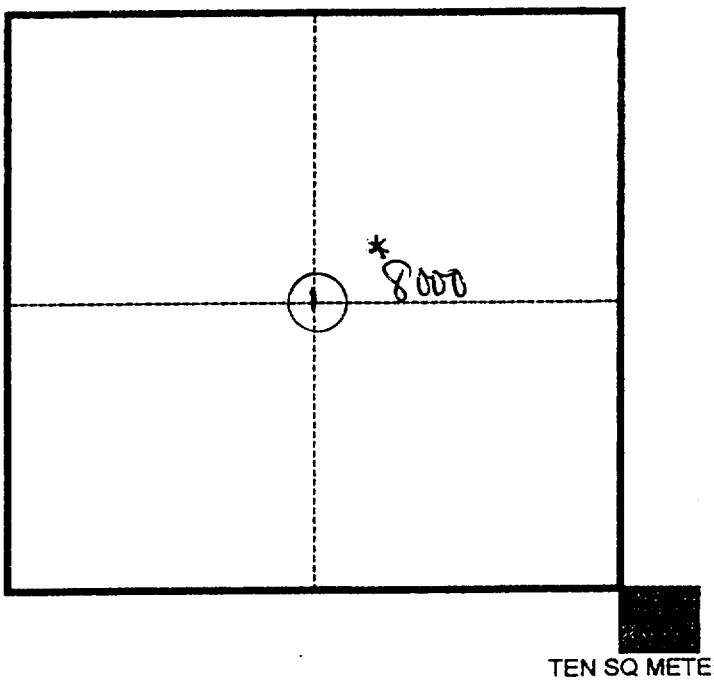
PURPOSE OF SURVEY: FINAL STATUS SURVEY

SMEAR RESULTS
RESULTS = DPM/100cm²
UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | NA | NA |

NON- AFFECTED AREA

NORTH 0 EAST 60




TEN SQ METER

uREM/hr SOIL SAMPLE LOCATION:

1 9.0

HIGHEST READING ON 25% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

| ATE: 7-1-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1345 | MODEL | SERIAL # | EFF.% | BKGRD ① | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMSON | 19 | 131294 | NA | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121281 | NA | 8900 cpm | 12-12-01 |
| REVIEWED BY: [illegible] | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

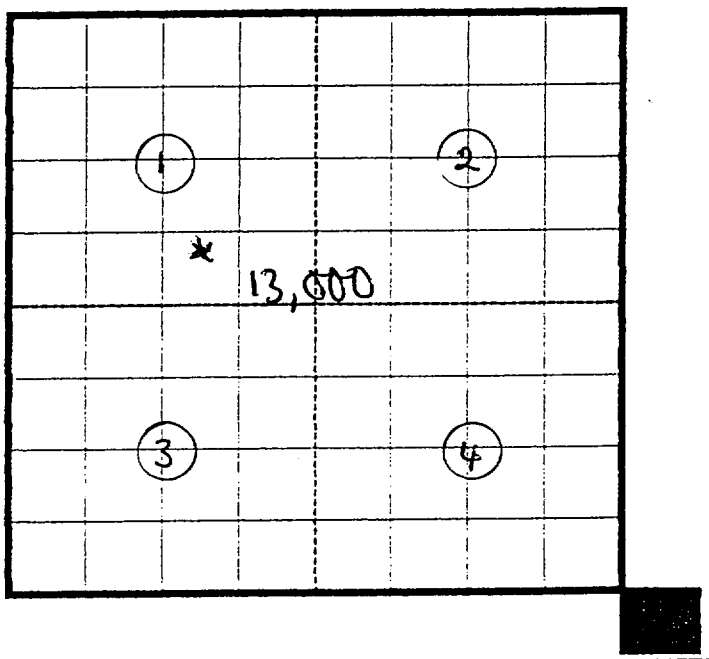
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

SOUTH ~~NORTH~~ 10 WEST ~~EAST~~ 10




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 13.0 |
| 2 | 12.0 |
| 3 | 13.5 |
| 4 | 13.0 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks: ① Bckgrd near structure ≅ 11 μR/hr

ALLIED TECHNOLOGY GROUP, INC. FORM ATGF-001 6/96

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

| ATE: 7-1-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1340 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 ~~121365~~ | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

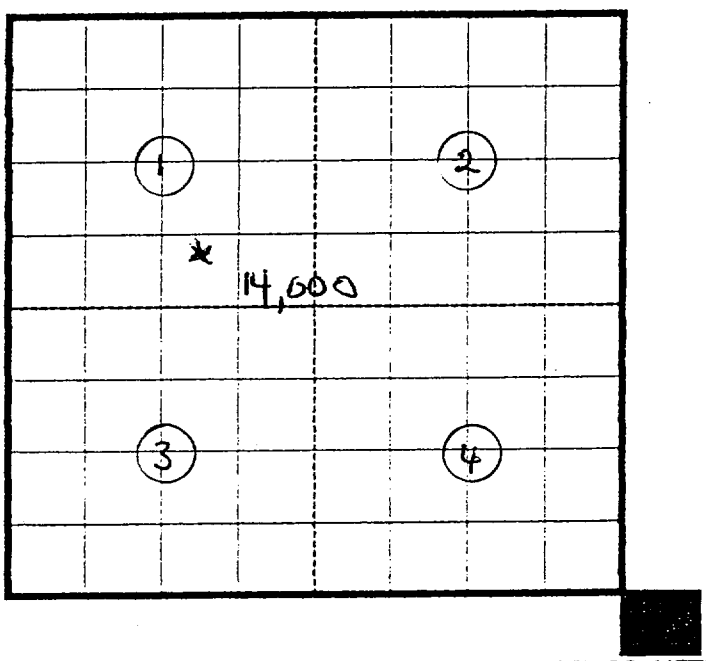
PURPOSE OF SURVEY: FINAL STATUS SURVEY

SMEAR RESULTS
RESULTS = DPM/100cm²
UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

~~NORTH~~ SOUTH 10 EAST 0




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 12.0 |
| 2 | 11.5 |
| 3 | 12.0 |
| 4 | 12.5 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

| ATE: 7-1-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1415 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131290 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121201 | NA | 8900 cpm | 12-12-01 |
| REVIEWED BY: [illegible] | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

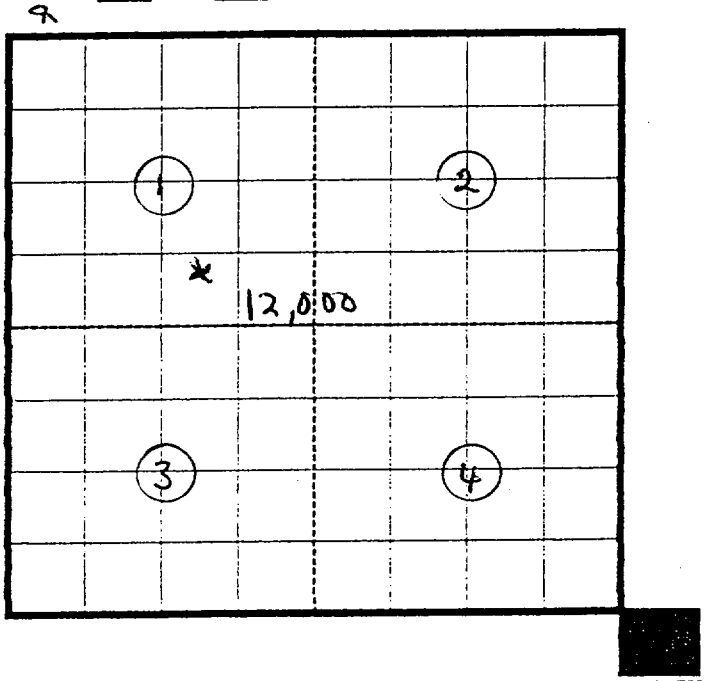
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

SOUTH ~~NORTH~~ 10 EAST 10




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION: *

| | |
|---|---|
| 1 | 12.0 |
| 2 | 11.5 |
| 3 | 12.0 |
| 4 | 11.5 |

HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| DATE: 7-2-01 | | | | | |
| TIME: 1600 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131254 | NA | 9.2 μR/hr | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121294 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates = mrem/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

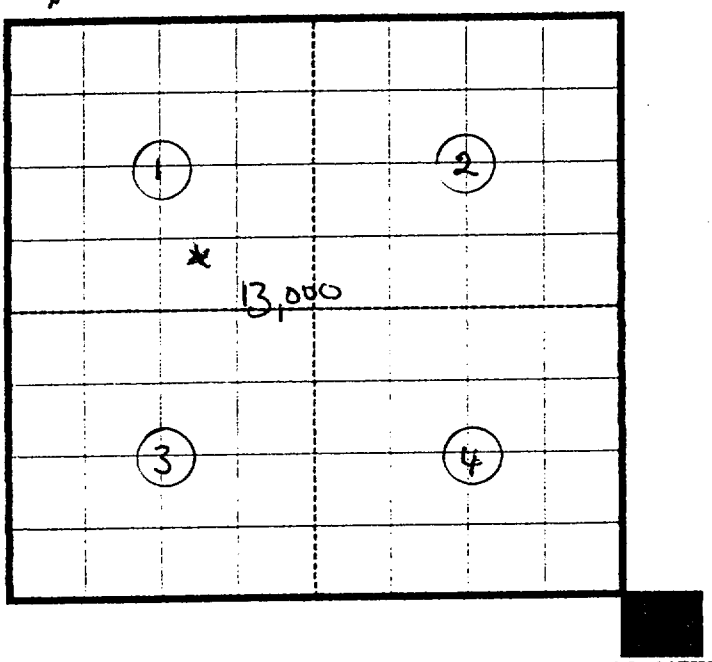
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

~~NORTH~~ SOUTH 10 EAST 20




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION:

| | |
|---|---|
| 1 | 11.5 |
| 2 | 12.0 |
| 3 | 11.0 |
| 4 | 11.0 |

* HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 02

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| ATE: 7-1-01 | | | | | |
| TIME: 1310 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121491 | NA | 8900 cpm | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = ~~mrem~~R/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

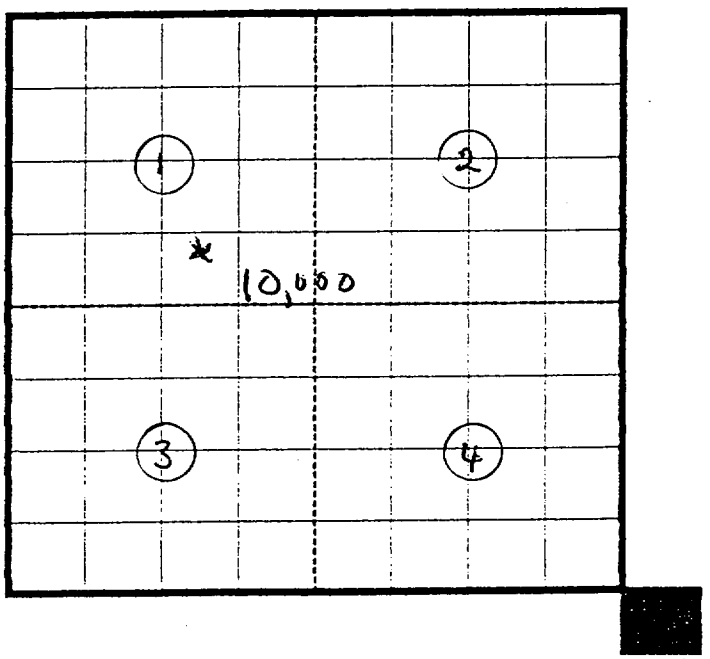
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | N/A | NA |

AFFECTED AREA

SOUTH ~~NORTH~~ 10 EAST 50




TEN SQ. METERS

uREM/hr READINGS SOIL SAMPLE LOCATION: *

HIGHEST READING ON 100% GRID WALKOVER WITH NaI IN GROSS CPM

| | |
|---|---|
| 1 | 11.0 |
| 2 | 11.5 |
| 3 | 10.5 |
| 4 | 11.0 |

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF03

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| DATE: 7-1-01 | | | | | |
| TIME: 1335 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 μR/HR | 10.21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 CPM | 10-12-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates = ~~mrem~~/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

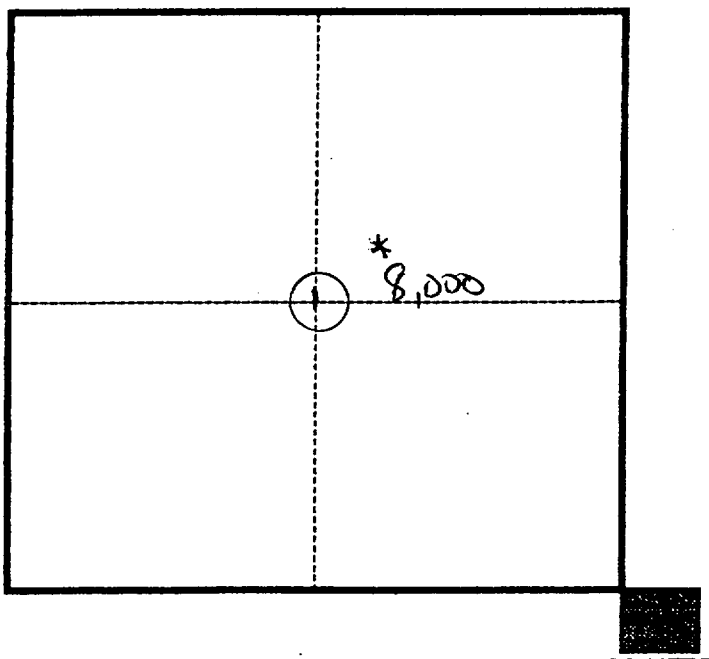
SMEAR RESULTS

RESULTS = DPM/100cm²
UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | NA | NA |

NON- AFFECTED AREA

~~NORTH~~ SOUTH 10 EAST 60




TEN SQ METER

uREM/hr SOIL SAMPLE LOCATION:

1 10.0

HIGHEST READING ON 25% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF02

| .TE: 7-2-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1615 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: S THOMPSON | 19 | 131294 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 CPM | 10-12-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates = ~~micro~~R/hr (μR/hr) | | | | | |

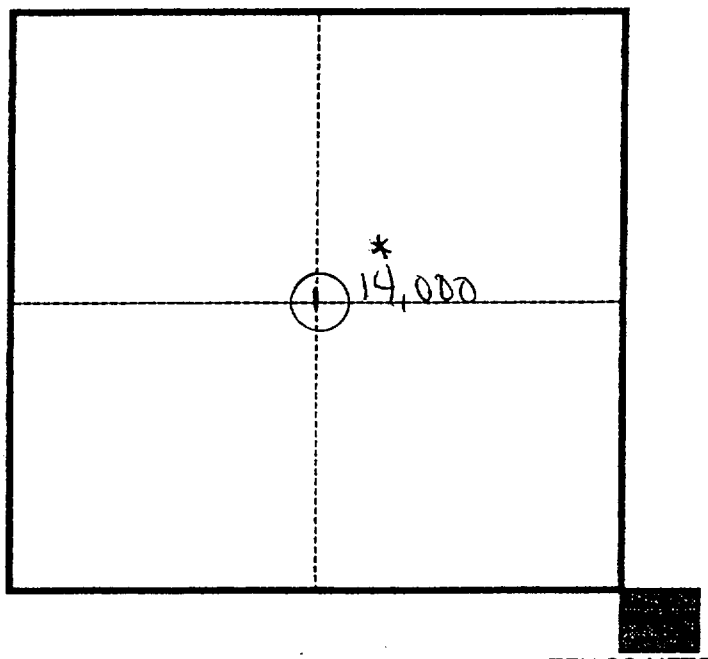
PURPOSE OF SURVEY: FINAL STATUS SURVEY

SMEAR RESULTS
RESULTS = DPM/100cm²
UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | NA | NA |

NON- AFFECTED AREA

SOUTH ~~NORTH~~ 20 WEST ~~EAST~~ 10




TEN SQ METER

uREM/hr SOIL SAMPLE LOCATION: HIGHEST READING ON 25% GRID WALKOVER WITH NaI IN GROSS CPM

1 11.0

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 03

| ATE: 7-1-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1430 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 CPM | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

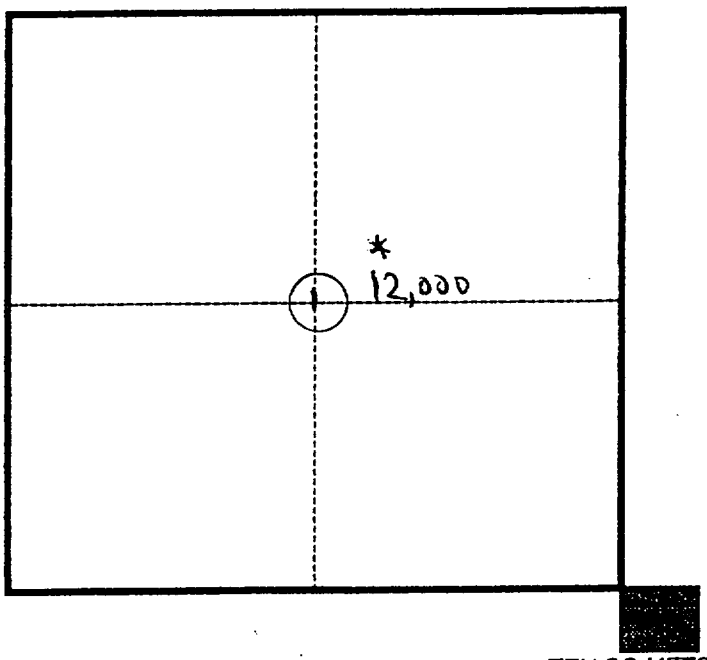
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | NA | NA |

NON- AFFECTED AREA

~~NORTH~~ SOUTH 20 EAST 0




TEN SQ METER

uREM/hr SOIL SAMPLE LOCATION: HIGHEST READING ON 25% GRID WALKOVER WITH NaI IN GROSS CPM

1 10.0

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF03

| ATE: 7-1-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1430 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 CPM | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

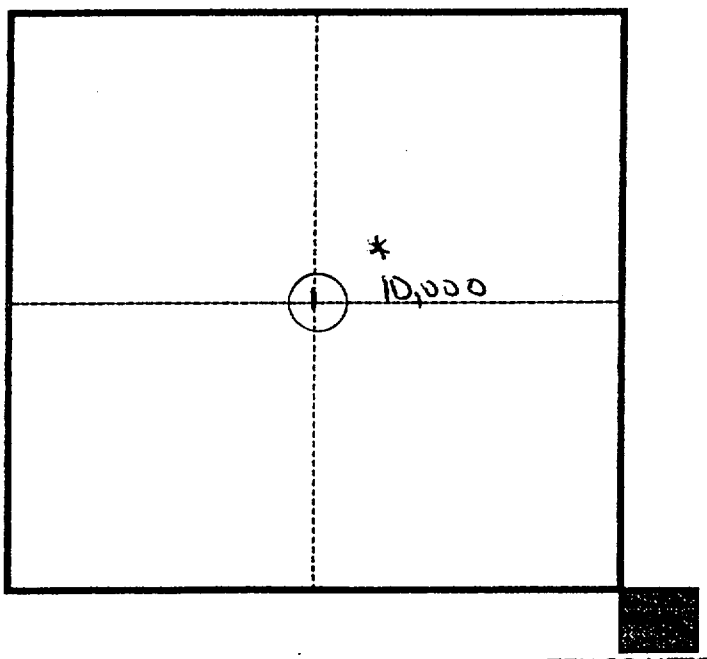
SMEAR RESULTS

RESULTS = DPM/100cm²
UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | NA | NA |

NON- AFFECTED AREA

~~NORTH~~ SOUTH 20 EAST 10




TEN SQ METER

uREM/hr SOIL SAMPLE LOCATION: HIGHEST READING ON 25% GRID WALKOVER WITH NaI IN GROSS CPM

1 10.0

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF03

| ATE: 7-1-01 | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| TIME: 1510 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 CPM | 10-12-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

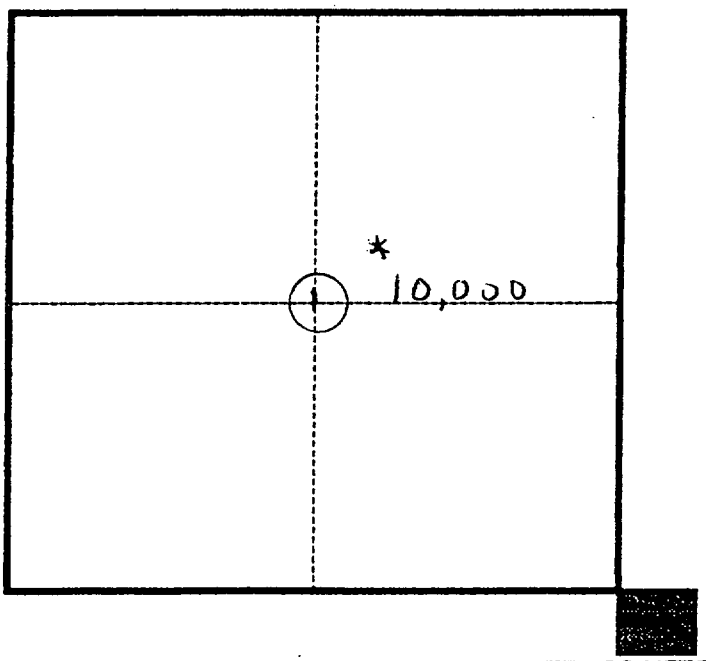
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | NA | NA |

NON- AFFECTED AREA

~~NORTH~~ SOUTH 20 EAST 20




TEN SQ METER

uREM/hr SOIL SAMPLE LOCATION:

1 10.6

HIGHEST READING ON 25% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF-~~02~~ 03

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| DATE: 7-2-01 | | | | | |
| TIME: 1600 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: SHAWN THOMPSON | 19 | B1294 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 16291 | NA | 8900 CPM | 10-12-01 |
| REVIEWED BY: [signature] | | | | | |
| Smear Locations Circled. Dose Rates = ~~microR/hr~~ (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

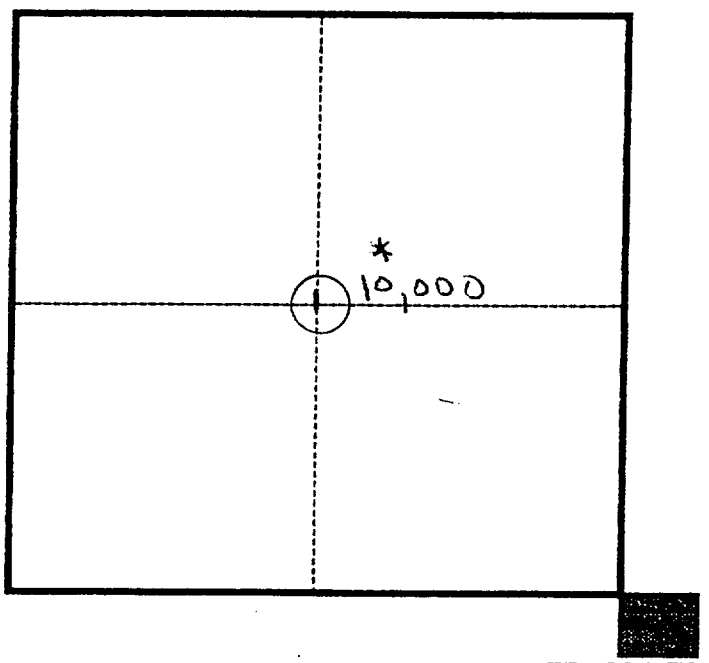
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | NA | NA |

NON- AFFECTED AREA

SOUTH ~~NORTH~~ 20 EAST 30




TEN SQ METER

uREM/hr SOIL SAMPLE LOCATION: HIGHEST READING ON 25% GRID WALKOVER WITH NaI IN GROSS CPM

1 10.5

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF03

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| DATE: 7-1-01 | | | | | |
| TIME: 1335 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 CPM | 10-12-01 |
| REVIEWED BY: [illegible] | | | | | |
| Smear Locations Circled. Dose Rates = ~~microR/hr~~ (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

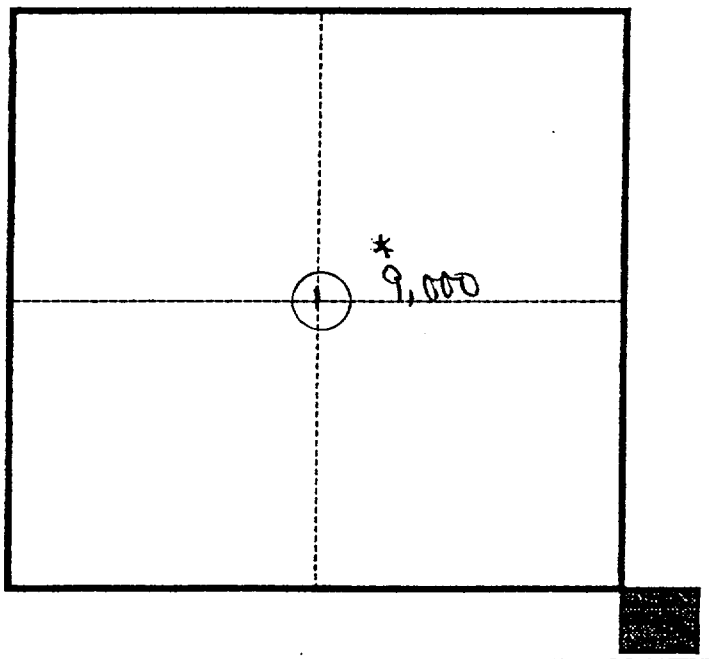
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | NA | NA |

NON- AFFECTED AREA

SOUTH ~~NORTH~~ 20 EAST 40




TEN SQ METER

uREM/hr SOIL SAMPLE LOCATION: HIGHEST READING ON 25% GRID WALKOVER WITH NaI IN GROSS CPM

1 10.0

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 03

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| ATE: 7-1-01 | | | | | |
| TIME: 1335 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131241 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121251 | NA | 8900 CPM | 10-12-01 |
| REVIEWED BY: [illegible] | | | | | |
| Smear Locations Circled. Dose Rates = microR/hr (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

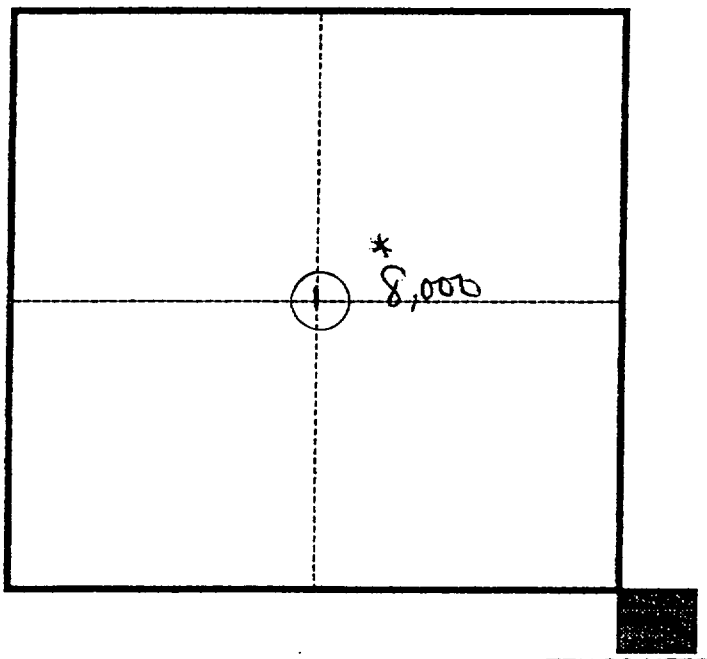
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | NA | NA |

NON- AFFECTED AREA

SOUTH ~~NORTH~~ 20 EAST 50




TEN SQ METER

uREM/hr SOIL SAMPLE LOCATION: HIGHEST READING ON 25% GRID WALKOVER WITH NaI IN GROSS CPM

1 11.0

Remarks:

# RADIOLOGICAL SURVEY REPORT

ATGS #: LCF 03

| | INSTRUMENTATION USED | | | | |
|---|---|---|---|---|---|
| ATE: 7-1-01 | | | | | |
| TIME: 1335 | MODEL | SERIAL # | EFF.% | BKGRD | CAL. DUE DATE |
| SURVEYOR: STEVEN THOMPSON | 19 | 131294 | NA | 9.2 μR/HR | 10-21-01 |
| LOCATION: LCAAP BLDG 3A | 12 | 121291 | NA | 8900 CPM | 10-12-01 |
| REVIEWED BY: | | | | | |
| Smear Locations Circled. Dose Rates = ~~mR/hr~~ (μR/hr) | | | | | |

PURPOSE OF SURVEY: FINAL STATUS SURVEY

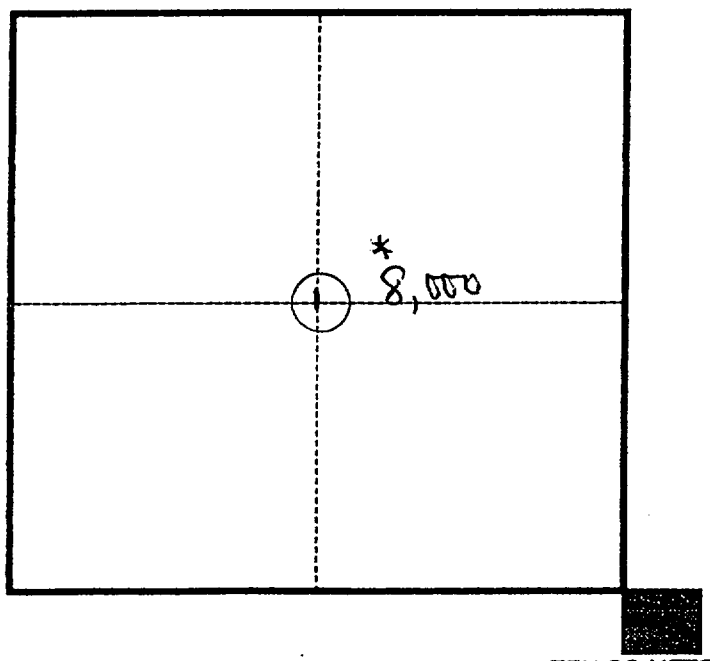
SMEAR RESULTS

RESULTS = DPM/100cm² UNLESS OTHERWISE NOTED

| # | βγ | α |
|---|---|---|
| NA | NA | NA |

NON- AFFECTED AREA

~~NORTH~~ SOUTH 20 EAST 60




TEN SQ METER

uREM/hr SOIL SAMPLE LOCATION:

1 10.0

HIGHEST READING ON 25% GRID WALKOVER WITH NaI IN GROSS CPM

Remarks: