New World Environmental, Inc., d.b.a.
**New World Technology** *Bringing you the Technology of the New World*

# FINAL DECOMMISSIONING PLAN
## BUILDING 200, BAY 4
## DAHLGREN LABORATORY
## DAHLGREN, VA

For the:

U.S. ARMY JOINT MUNITIONS COMMAND

ROCK ISLAND, IL

January 10, 2008

Revision 0

*Prepared by:*

**New World Technology**
448 Commerce Way
Livermore, California 94551

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# FINAL DECOMMISSIONING PLAN

Approvals

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# ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ALARA | as low as reasonably achievable |
| ANS | American Nuclear Society |
| ANSI | American National Standards Institute |
| AOC | Areas of Concern |
| BLDG | Building |
| CFR | Code of Federal Regulations |
| cpm | counts per minute |
| DAC | Derived Air Concentration |
| DCGLs | Derived Concentration Guideline Limits |
| D&D | Decontamination and Decommissioning |
| DOD | Department of Defense |
| DP | Decommissioning Plan |
| dpm/100 $cm^2$ | disintegrations per 100 square centimeters |
| DQO | Data Quality Objectives |
| DU | depleted uranium |
| $\varepsilon_i$ | Instrument Efficiency |
| $\varepsilon_s$ | Surface Efficiency Factor |
| EPA | Environmental Protection Agency |
| ft | feet |
| $ft^2$ | square feet |
| FOP | field operating procedure |
| FSSI | Field Support Services Inc. |
| GET | General Employee Training |
| HASP | Health and Safety Plan |
| ISO | International Organization for Standardization |
| LLRW | Low Level Radioactive Waste |

| | |
|---|---|
| m | meter |
| $m^2$ | square meter |
| MARSSIM | Multi Agency Radiation Survey & Site Investigation Manual |
| MDC | Minimum Detectable Concentration |
| MDCR | Minimal Detectable Count Rate |
| MOU | Memorandum of Understanding |
| MSDS | Material Safety Data Sheets |
| mrem/y | millirem per year |
| N/A | not applicable |
| NaI | sodium iodide |
| NIST | National Institute of Standards and Technology |
| NRC | Nuclear Regulatory Commission |
| NRMP | Naval Radioactive Materials Permit |
| NSFD | Naval Support Facility Dahlgren |
| NSWCDD | Naval Surface Warfare Center Dahlgren Division |
| NWT | New World Technology |
| OSHA | Occupational Safety and Health Administration |
| Pa-234m | protactinium-234m |
| PM | Project Manager |
| PPE | personal protective equipment |
| QA | Quality Assurance |
| QC | Quality Control |
| RAMSA | Radioactive Material Storage Area |
| RASO | Naval Sea Systems Command Detachment, Radiological Affairs Support Office |
| RWP | Radiation Work Permit |
| SOPs | Standard Operating Procedures |
| TEDE | Total Effective Dose Equivalent |
| Th-234 | thorium-234 |
| TLD | thermoluminescent dosimeter |
| Tm | Tidal marsh |

| | |
|---|---|
| U-234 | uranium-234 |
| U-235 | uranium-235 |
| U-238 | uranium-238 |
| μR/h | micro roentgens per hour |
| UXO | unexploded ordnance |
| WRS | Wilcoxon Rank Sum Test |
| y | year |

# RECORD OF REVISIONS

| Revision Number | Description | Date |
|---|---|---|
| 0 | Final Decommissioning Plan, Bay 4, Building 200, Dahlgren Laboratory | 1/10/2008 |

# 1.0 EXECUTIVE SUMMARY

New World Environmental, Inc. doing business as New World Technology (NWT) has been contracted by the U.S. Joint Munitions Command (JMC) to conduct decommissioning activities and perform final status surveys in Bldg. 200, Bay 4 and adjacent outdoor areas, located at the Naval Surface Warfare Center Dahlgren Division (NSWCDD), Dahlgren Laboratory, in Dahlgren, VA. The Dahlgren Laboratory is owned by the U.S. Department of the Navy. The address for the Dahlgren Laboratory is 6149 Welsh Road Suite 204 Dahlgren Virginia 22448-5130.

This Decommissioning Plan (DP) describes the decommissioning of Bay 4 in Building 200 and the adjacent outdoor areas. NSWCDD tested depleted uranium munitions from late 1972 through 1993 in Bay 4 and two other outdoor areas at the laboratory. The two other test areas and a storage area for contaminated targets and debris were decommissioned between 1992 and 2000. The earlier decommissioning activities are summarized in the facility operating history.

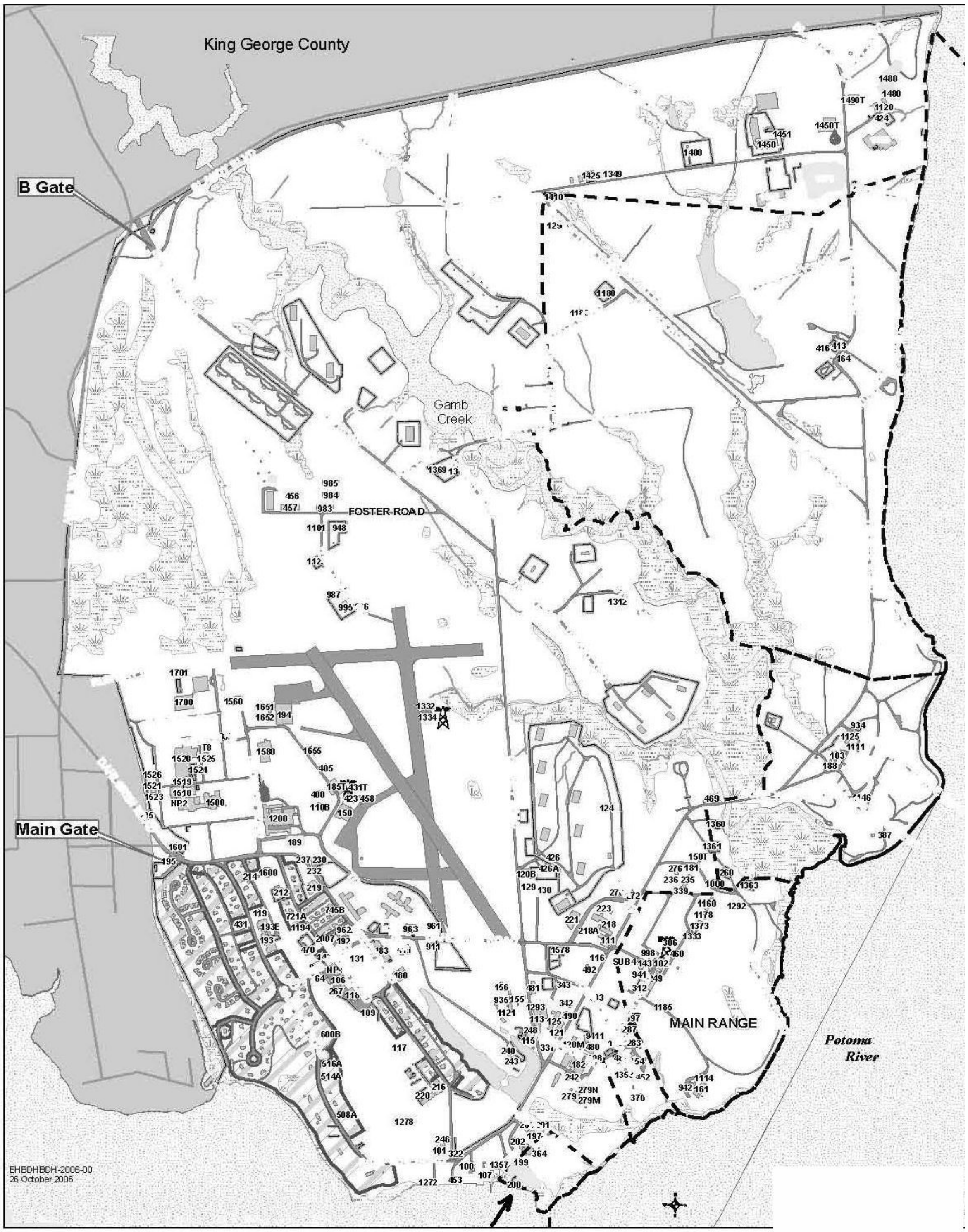
The DP was developed using guidance from NUREG-1757, Consolidated NMSS Decommissioning Guidance, NUREG-1575, Multi-Agency Radiological Survey and Site Investigation Manual (MARSSIM) and the regulations of 10 CFR 20, subpart E.

In accordance with NUREG 1757, for planned decommissioning actions, the Navy has determined that Bay 4 in Building 200 at the NSWCDD falls under decommissioning Group 3, meaning that the use of licensed radioactive material may have resulted in persistent levels of contamination of work areas, building surfaces, and limited surface soil contamination exist and in this specific instance, require clean up techniques different from normal use. For Group 3 decommissioning, licensees will also have to demonstrate that the site meets the screening criteria that results in a calculated dose of the residual radioactivity, distinguishable from background, from all pathways to the average member of the critical group that is not in excess of 0.25 mSv/y (25 mrem/y).

The radionuclide of concern is depleted uranium (DU). The building surface DCGL was calculated using DandD Version 2.1 with default values and adjusted for the resuspension factor recommended by NUREG 1720 (NRC 2002). A gross beta DCGL for building surfaces was developed as a more reliable surrogate for surveying than gross alpha measurement. The soil release limit used a published screening value.

A map showing NSWCDD Dahlgren is presented in Figure 1. The arrow at the bottom of the map points to Bldg. 200.

**Figure 1 NSWCDD on Naval Support Facility Dahlgren Map**



## 1.1 Decommissioning Objective

The objective of this decommissioning effort is to decontaminate/remediate the Building 200 Bay 4 area and adjacent outdoor areas such that the site will meet the criteria for unrestricted use as specified by 10 CFR 20.1402 (NRC 1997a), thus permitting the termination of the NRMP for possession of DU residue from testing of DU munitions. Building 200, Bay 4 will continue in use as an indoor firing range.

## 1.2 Post-Remediation Activities

No post-remediation activities have been identified and none are anticipated.

## 1.3 Amendment to License to Incorporate DP

The Navy Master Materials License will incorporate the DP via license amendment.

# 2.0 FACILITY OPERATING HISTORY

NSWCDD started testing DU munitions in the early 70s and continued through the early 1990s. Testing was conducted at three sites, an indoor range at Building 200 (Bay 4), and two outdoor ranges: the Building 200 Gun Butt (adjacent to Building 200) and the Harris DU Mound at the Explosives Experimental Area.

DU munitions were stored in various bunkers prior to use in testing. Contaminated targets and waste material were stored in a fenced exclusion area outside Building 1180.

## 2.1 License Number/Status/Authorized Activities

NSWCDD is currently operating under NRMP No. 45-00178-Y1NP to reflect the status of the facility as storage of residual radioactive contamination awaiting decommissioning.

## 2.2 License History

NSWCDD conducted testing of depleted uranium (DU) munitions (20 mm-40 mm) under the authority of Atomic Energy Commission (AEC) and subsequently the Nuclear Regulatory Commission (NRC) License No. SMB-1145 issued September 28, 1972 that continued through periodic renewals until 1987 when the license was converted to an NRMP. The Navy received an NRC Master Materials License in 1987 and then converted all NRC licenses, issued to Navy and Marine Corps commands, to Naval Radioactive Materials Permits (NRMP). NSWCDD’s license was converted to NRMP No. 45-00178-S1NP. NRMP No. 45-00178-S1NP was converted to 45-00178-Y1NP to reflect the status of the facility as storage of residual radioactive contamination awaiting decommissioning. Table 1 below provides a summary of the license/NRMP history.

**Table 1 License/NRMP Summary**

| Date Issued | License Number | Amendment Number | Source Material | Chemical Form | Maximum Quantity Of Source Material | Permitted Activities |
|---|---|---|---|---|---|---|
| 28 September 1972 | SMB-1145 | Initial Issue | Depleted Uranium Thorium | Solid | 2280 kilograms | Ordnance Testing in outdoor areas- Explosive Experimental area Pumpkin Neck, Storage at Bldgs 1120 and 497 |
| 14 Jul 1978 | SMB-1145 | #1 Renewal | Depleted Uranium Thorium | Solid | 4500 lbs<br>500 lbs | Ordnance Testing – Bay 4 and outdoor areas, storage of contaminated material adjacent to Bldg 1180 , recovered penetrators stored in Bldg 1180 |
| 20 Nov 1984 | SMB-1145 | #2 Renewal | unchanged | unchanged | 4500 lbs<br>500 lbs | unchanged |
| 18 May 1987 | NRMP No. 45-60921-L1NP | Conversion to NRMP | unchanged | unchanged | unchanged | unchanged |
| 28 September 1987 | NRMP No. 45-60921-S1NP | #0 | Depleted Uranium Thorium | unchanged | 6000 lbs<br>500 lbs | Bldg 1104, room # 2 added for storage of recovered penetrators |

| | | | | | | |
|---|---|---|---|---|---|---|
| 28 Sept 1990 | unchanged | #1 | Depleted Uranium<br>Thorium | unchanged | 6000 lbs<br>500 lbs<br>plus WO material | Added materials and uses for White Oak MD site |
| 9 Aug 1993 | Unchanged | #2 | Unchanged | Unchanged | 6000 lbs<br>500 lbs<br>plus WO material | Removed outdoor testing as authorized use |
| 4 December 1996 | NRMP No. 45-00178-S1NP | #0<br>Reissued due to reorganization of command | Unchanged | Unchanged | 6000 lbs<br>500 lbs | Removed authorized uses and material related to White Oak laboratory closure |
| 4 January 2002 | NRMP No. 45-00178-Y1NP | Reissued to reflect status – storage waiting for decommissioning | Unchanged | Unchanged | Unchanged | |

All work detailed in this plan will be performed under NWT's NRC Broad Scope Radioactive Materials License 04-22745-01.

A Memorandum of Understanding (MOU) will be completed between the Navy and NWT prior to the start of the survey activities defining the license responsibilities between the two organizations.

## 2.3 Previous Decommissioning Activities

The Building 1180 outdoor storage area, the Building 200 Gun Butt, and the Harris DU Mound at Pumpkin Neck were all decommissioned between 1992 and 2000. NAVSEADET RASO approved free release of these areas by letters dated 14 Apr 95 and 5 Jun 01. The Navy contracted through the Army Field Support Command for characterization surveys, decontamination and decommissioning work that were performed by Chem-Nuclear, Allied Technology Group, OHM, and IT Corporation. The free release soil concentration limit used in these decommissioning actions was 35 pCi/g of DU.

### *2.3.1 Building 1180*

Building 1180 was built in early 1977 and began use in July 1977. The building is located at the northern end of the main laboratory area shown in Figure 1.

From March of 1992 to August of 1993, the Building 1180 outdoor area was decontaminated by mechanical means. A pneumatic operated jackhammer was used to remove asphalt areas that were contaminated, and a backhoe/front end loader was used to remove contaminated sections of grass and soil (CNSI, 1994).

The release criteria for loose surface contamination were < 1,000 dpm/100cm$^2$ beta-gamma and < 200 dpm/100cm$^2$ alpha.

The release criteria for fixed surface contamination was < 5,000 dpm/100cm$^2$ beta-gamma and < 1,000 dpm/100cm$^2$ alpha averaged for each grid or object.

The soil release criteria was < 35 pCi/g (88 ug/g total uranium) above background averaged over an area of not more than 100 m$^2$.

The radiological free release survey for the asphalt area inside the RAMSA consisted of obtaining five fixed-point, one minute, beta-gamma scaler measurements per grid. Thirty out of one hundred grids which comprise a zone, were randomly selected as to uniformly cover the zone, were surveyed in this fashion. In addition to the fixed-point measurements previously mentioned, samples (swipes) of the asphalt surface were obtained and analyzed for loose surface alpha contamination. Ten randomly selected asphalt and ten soil samples taken from the holes left in the asphalt as a result of the remediation activities were also obtained for analysis.

The radiological free release survey for the grass and soil area inside the RAMSA consisted of performing a walk-over scan survey using beta-gamma count-rate instrument, with a pancake Geiger-Mueller (GM) tube detector held at surface level. In addition to this survey, one ten- point composite soil sample was obtained from each grid in the grass/soil area.

The radiological free release survey for the area outside of the RAMSA consisted of a walkover survey of the surface of the area utilizing a NaI detector (SPA-3) equipped dose-rate instrument. In addition to this survey, one ten-point composite soil sample was obtained from each grid.

The radiological free release survey for the area in which a depleted uranium penetrator was discovered consisted of obtaining five fixed-point, one minute, beta-gamma scaler measurements in each of the nine grids which comprised this zone. In addition to the fixed point measurements previously mentioned, samples (swipes) of the asphalt surface were obtained and analyzed for loose surface alpha contamination for six

of the nine grids that contained asphalt. One ten-point composite soil sample was obtained from three of the nine grids that contained soil.

A total of 220 soil/asphalt samples were collected as part of the final status survey effort. All of the sample results were less than 88 ug/g, with a maximum activity of 12 ug/g, and an average activity of 0.9 ug/g.

A total of four shipments totaling 2,001 cubic feet were made from the project site for processing at the Defense Consolidation Facility located in Barnwell, SC and then to the Barnwell disposal site located in Barnwell, SC.

### *2.3.2 Building 200 Gun Butt/Harris DU Mound*

Beginning in 1997 and ending in October of 1999, the Building 200 Gun Butt and Harris DU Mound were remediated using a backhoe/front end loader (IT, 2000).

The soil release criteria was < 35 pCi/g above background averaged over an area of not more than 100 $m^2$.

Affected areas were marked off in 10 meter by 10 meter grids. Surveyor flags or other markers were temporarily installed to denote the boundaries of each grid.

The Final Status Survey (FSS) of the soil began with a "walkover" gamma scan to locate any areas of elevated direct radiation. This survey was performed using a NaI gamma scintillation detector, or similar instrument, in conjunction with a portable rate meter.

The detector was kept as close to the surface as conditions would allow. Areas of elevated radiation levels were marked with flags, stakes, paint, etc., to indicate locations where soil samples should be collected.

Four final release samples were collected from each grid at a point midway between each corner and the center.

A total of 169 soil samples were collected from the Building 200 Gun Butt area as part of the final status survey effort. Two samples were over the release criteria of 35 pCi/g. One sample result was 67 pCi/g with a weighted average of 24.5 pCi/g in that 100 $m^2$ area. And the other sample result was 52.0 pCi/g with a weighted average of 17.4 pCi/g in that 100 $m^2$ area. The average activity of all of the soil samples was 8.5 pCi/g.

A total of 162 soil samples were collected from the Harris DU Mound Area as part of the final status survey effort. All of the soil sample results were less than 35 pCi/g, with a maximum activity of 26.8 pCi/g, and an average activity of 3.8 pCi/g.

A total of sixty-nine shipments totaling 17,087 cubic feet were made between 1997 and 1998 from the project site for disposal at Envirocare Inc., located in Clive, UT.

The US NRC also collected split samples during this effort.

Figure 2 and Figure 3 present the grid layouts of the two areas.

**Figure 2 Building 200 Gun Butt Grid Diagram**

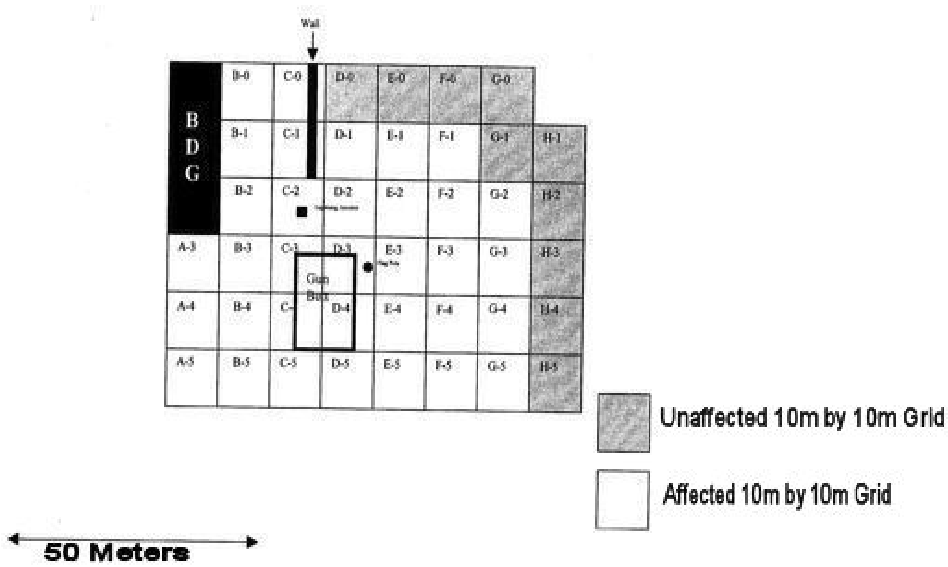
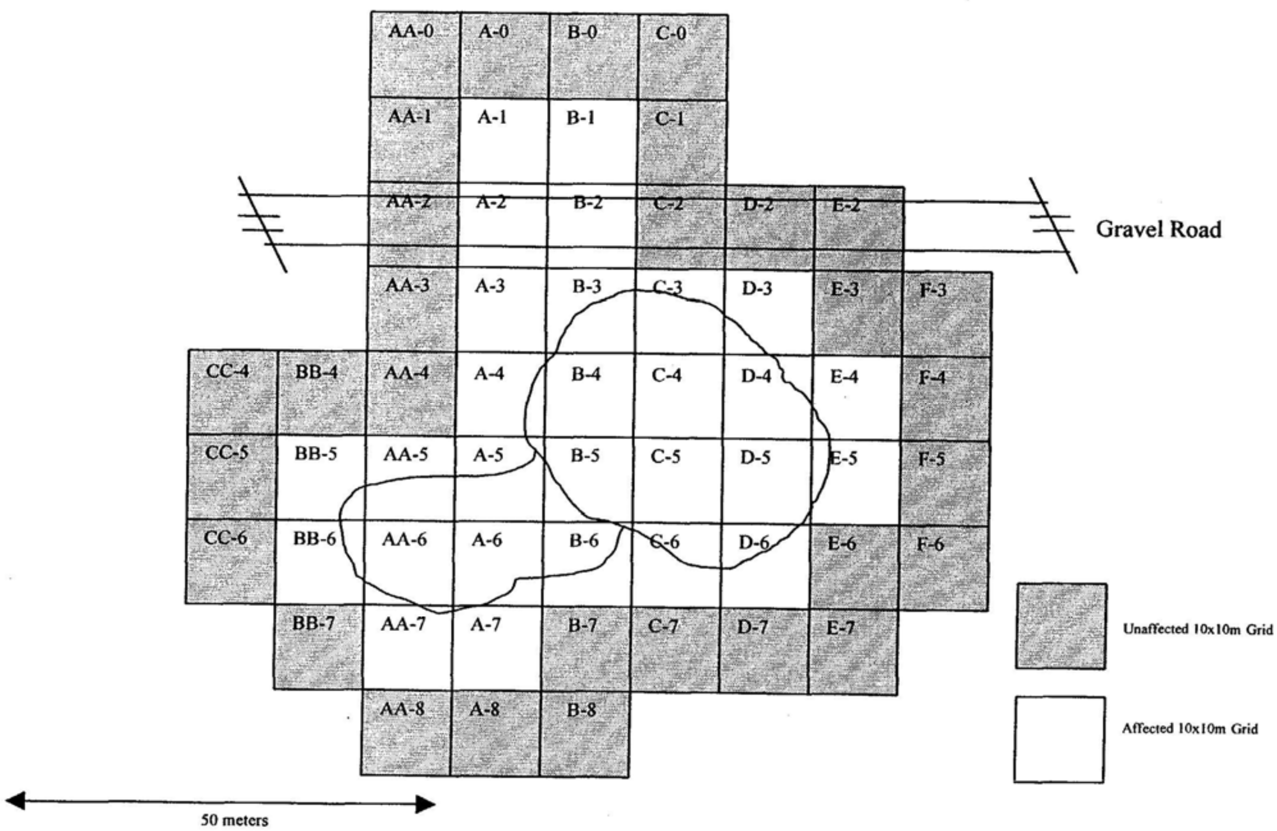


**Figure 3 Harris DU Mound Grid Diagram**




### 2.3.3 *Building 200 Outdoor Areas A and B*

NWT performed remediation activities and conducted a detailed characterization survey in June of 2007 in the Building 200 outdoor Areas A and B.

A final report detailing remediation activities and characterization surveys of the Building 200 two outdoor areas is included in Attachment 2 of this plan.

## 2.4 Spills

No records of any DU spills at NSWCDD were found in the historical documents that were reviewed.

## 2.5 Prior Onsite Burials

No records of any prior onsite burials at NSWCDD were found in the historical documents that were reviewed.

# 3.0 FACILITY DESCRIPTION

## 3.1 Site Location and Description

The Naval Surface Warfare Center Dahlgren Division (NSWCDD) is the largest tenant at Naval Support Facility Dahlgren (NSFD) located in King George County, Virginia, approximately 40 miles south of Washington, D.C. and 25 miles east of Fredericksburg, Virginia (Figure 1). NSFD encompasses approximately 4,300 acres on the western bank of the Potomac River. Dahlgren Site is divided by Upper Machodoc Creek into two areas: the Mainside to the north (see Figure 1) and the Explosive Experimental Area (EEA), also referred to as Pumpkin Neck to the south. NSWCDD is one of the six divisions of the Naval Surface Warfare Center. NSWCDD is one of the U. S. Navy's principal research, development, and test and evaluation, engineering and fleet support activities for surface warfare, surface ship combat systems, ordnance, strategic systems, amphibious warfare, mines and mine countermeasures, and amphibious and special warfare systems. The Division conducts analysis, systems engineering, research, test, evaluation, and integration of important naval and joint warfare systems.

Bay 4 in Building 200 consists of the target bay and gun bay. The target bay is 14.5 ft wide, 9 ft high, and 106 ft in length, and the gun bay is 14.5 ft wide, 9 ft high, and 138 ft in length. The entire Bay 4 interior and roof will be considered impacted areas.

## 3.2 Radiological Status of Facility

Building 200, Bay 4, is an indoor firing range where single shot tests on 20-40 mm DU and tungsten kinetic energy penetrators were evaluated for use in the Phalanx weapons system. Assembled rounds consist of a DU or tungsten penetrator, a sabot that surrounds the penetrator to provide support for the penetrator when in the gun barrel, and a cartridge case filled with propellant. An unofficial estimate is that 2,000 – 3,000 DU rounds were fired in Bay 4 before converting the munitions undergoing testing to tungsten steel alloy.

Bay 4 (indoor firing range) is a long narrow structure that is divided into a gun bay and target bay. The gun bay houses the gun used to fire the penetrators. The two bays are interconnected by a narrow hallway which prevented the pieces of the sabot from entering the target bay, while the penetrator was allowed to continue into the target bay. The target bay housed instrumentation used for penetrator velocity studies, a steel and aluminum plate array used to evaluate penetrability and break-up of penetrators, and a plywood target butt that stopped

the penetrators. Target plates and plywood used to backstop the target plates have mostly been removed and previously disposed of as LLRW. Instrumentation has also been removed. Both bays have exhaust ventilation systems that are used to clear smoke and debris.

A diagram of the firing range is included as Figure 2. The gun bay is 14.5 ft wide, 9 ft high, and 138 ft in length. The roof and walls of the gun bay are concrete. The roof of the gun bay is part of a single roof covering all the bays. The gun bay roof is sealed with an asphaltic material in good condition. It is not known when the sealant was last applied. The ventilation exhaust fan and housing for the gun bay are located approximately over the gun mount. The target bay is 14.5 ft wide, 9 ft high, and 106 ft in length. The walls and ceiling of the target bay are steel plate. The floor is poured concrete. The plywood gun butt is 8 ft high, 14 feet wide, and 15 inches thick and contains up to 50 DU penetrators. Some penetrators may have passed through the plywood and impacted the back wall. A cart holding plywood sheets and a metal support frame about 40 inches high by 2 feet wide by 6 feet long (steel legs and frame) remain and are contaminated with DU. The ventilation exhaust fan and housing for the target bay are located directly at the southwest edge of Bay 4. The fan housing is connected by a duct to an opening approximately over the target area location. The target bay roof is covered by painted foam which is weathered. Rusted steel shows in numerous places. There is a store room adjacent to the target bay with approximate dimensions of 50 feet by 20 feet.

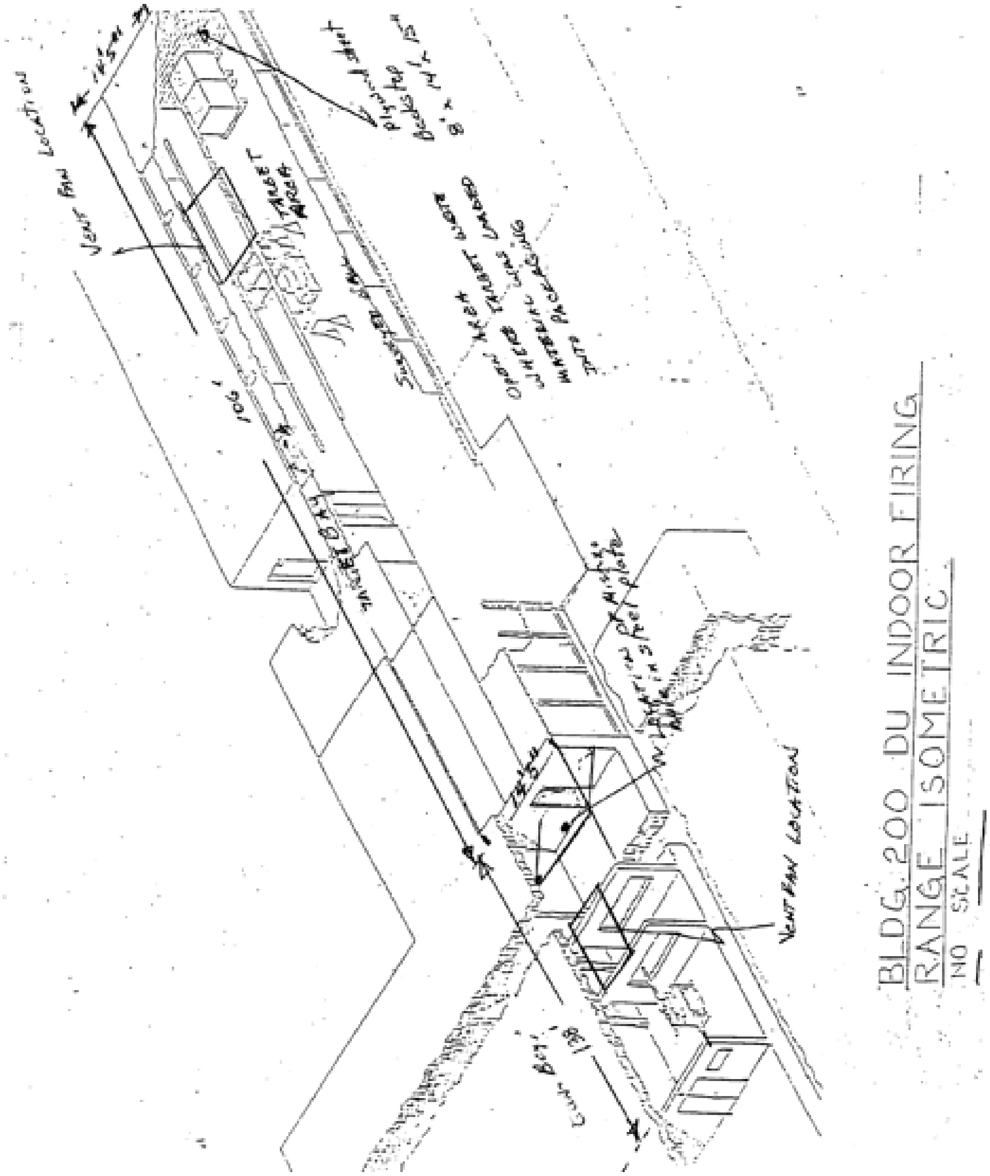
### *3.2.1 Characterization/Scoping Surveys*

During March of 2007 NWT conducted scoping surveys inside of the Bay 4 gun bay and target bay. The survey consisted of fixed 2-minute gross alpha-beta measurements with large area scintillation detectors at systematic locations on the floor, wall, and ceiling surfaces of the bays. Readings were also collected on the roof of the target bay in the vicinity of the exhaust fan. The majority of residual contamination was found along the floor/wall seam along the south wall in the target bay, the south wall and ceiling surfaces of the target bay, and on the vicinity of the exhaust fan on the roof of the target bay. Table 2 below presents a summary of the scoping survey findings.

**Table 2 Bay 4 Scoping Survey Summary Table**

| Area | Average Gross Beta Results in Net dpm/100cm$^2$ | Maximum Gross Beta Results in Net dpm/100cm$^2$ | Average Gross Alpha Results in Net dpm/100cm$^2$ | Maximum Gross Alpha Results in Net dpm/100cm$^2$ |
|---|---|---|---|---|
| Bay 4 Floor | 22847 | 99655 | 28 | 164 |
| Bay Floor North Wall | 4646 | 51792 | 26 | 220 |
| Bay Floor South Wall | 18284 | 226400 | 33 | 233 |
| Bay 4 Ceiling | 54923 | 428624 | 151 | 1047 |
| Bay 4 Roof Near Target Bay Exhaust Fan | 25504 | 92992 | 565 | 3727 |

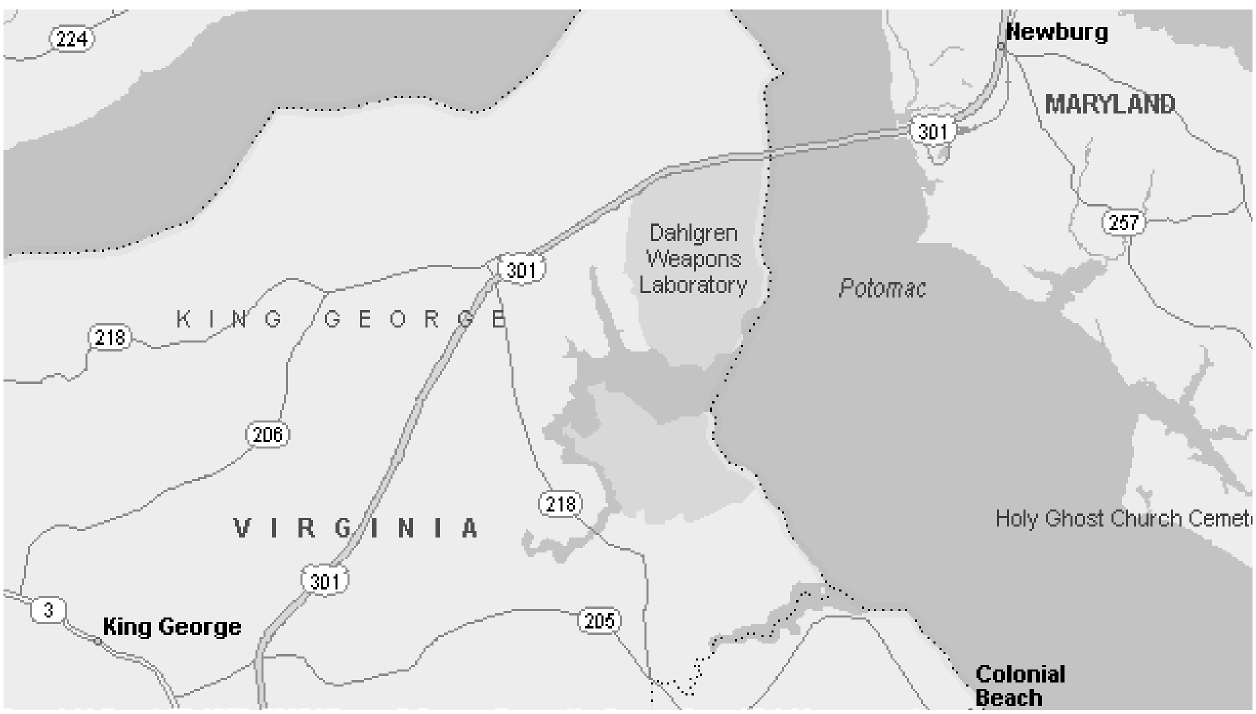
**Figure 4 Building 200 Bay 4 Layout Diagram**



## 3.3 Population Distribution

The region surrounding NSWCDD is sparsely populated. The communities in closest proximity to NSWCDD, King George and Colonial Beach had populations of 16,803 and 3,228 respectively (2000 census). King George is approximately 6 miles southwest of NSWCDD and Colonial Beach is approximately 4 miles to the southeast of NSWCDD. Figure 3 presents a map of NSWCDD and the surrounding areas.

**Figure 5 NSWCDD Area Map**



## 3.4 Current/Future Land Use

It is currently planned that following decommissioning activities in Bay 4 of Building 200, the area will be used for weapons testing and storage not involving radioactive materials.

## 3.5 Meteorology and Climatology

NSWCDD is located in the northern part of Virginia on a peninsula surrounded by the Potomac River. The air is clear most of the year. Normal precipitation varies from two to nine inches annually, with a daily average of 0.10 inches. Precipitation is usually in the form of rain, except for the winter months where it occasionally snows. Visibility is generally greater than 6.5 miles. The mean annual temperature is 57.2˚F, and the temperature ranges from 0 to 118˚F. The mean daily minimum and maximum temperatures are 48.8˚F and 67.7˚F, respectively.

Summer is characterized by warm days with mild nights. Afternoon temperatures rise to 70˚F or higher about 60 days a year and drop into the 60s at night.

Winters are cool with nighttime temperatures dropping to 32˚F or less for about 30 days a year with warming into the 30s during the day. Precipitation is at its maximum from June through September with September being the wettest month. The snowfall average is 3.21 inches, mostly occurring in the months of January and February.

Prevailing winds are from the south at an average wind speed of 7.6 mph. The strongest winds occur in the late winter and early spring. During February and October, the prevailing wind direction is from slightly east of north. Wind speeds in excess of 30 mph occur throughout the year mostly between January and March. Charts 1 and 2 below present summaries of the temperature and precipitation for the area.

**Chart 1 Average Daily Temperature**

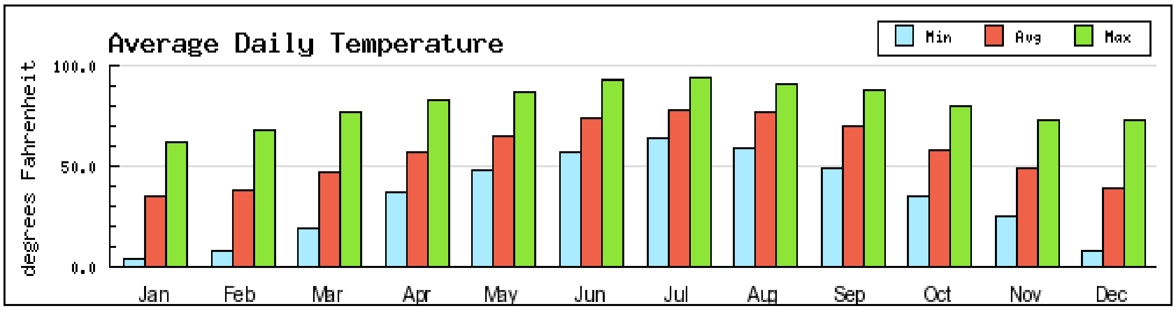
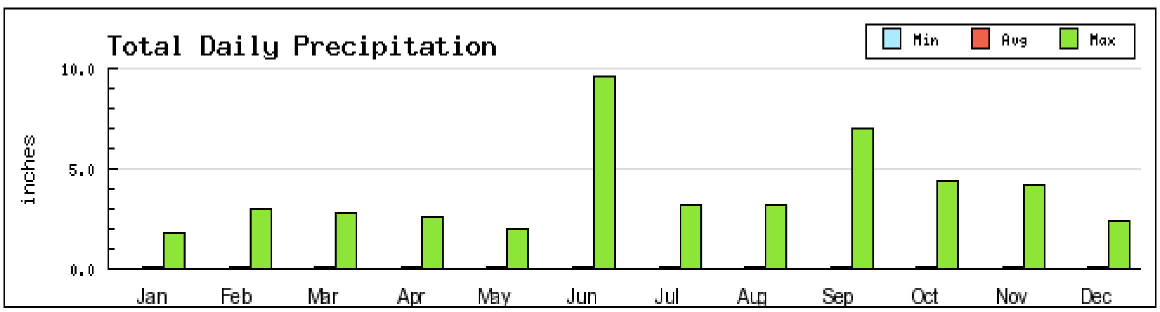



**Chart 2 Average Daily Precipitation**




## 3.6 Ambient Air Quality

The ambient air quality of the entire Commonwealth of Virginia is in attainment for each of the five "criteria" pollutants as described by the National Ambient Air Quality Standards (NAAQS) (MDEQ 2000). In addition to the ambient air quality standards for so called criteria pollutants, the federal government has categorically designated 156 national parks and wilderness areas as Class 1 areas (Figure 4) subject to enhanced air quality protection guidelines. The NSWCDD Site is not located in a Class 1 Area as designated by the Federal government. The closest Class 1 Area to the site is the Shenandoah National Park, located approximately 78 miles to the slight northwest in Virginia. The first downwind Class 1 Area is Shenandoah National Park located approximately 78 miles to the slight northwest in Virginia.

**Figure 6 Federally Designated Class 1 Areas**


## 3.7 Topography and Surface Hydrology

The topography exhibits gentle southward slopes over most of the area with steep slope/bluff on the southern side of the site (i.e., adjacent to Upper Machodoc Creek). A low area

near the center of the peninsula is a wetland with plant cover characteristic of a low tidal marsh. Precipitation either infiltrates the surface soils or becomes surface water runoff. All surface water runoff is directed southward toward Upper Machodoc Creek, a tidally influenced water body which occasionally inundates portions of the site. Upper Machodoc Creek flows in an easterly direction and discharges to the Potomac River (TtNUS, 2004).

## 3.8 Soil Characteristics

Surficial soil outside of Building 200 at Site 37 is fill material, and in the general area of Building 200 native soil materials is classified in the King George County Soil Survey as Tidal marsh (Tm) (USDA, 1974). Tm soil consists of broad, low areas of mixed alluvium that are covered periodically by tidal waters. Tm soil is often moderately coarse textured to medium textured and is composed of various combinations and layers of sandy, loamy, clayey, and mucky materials, which are consistently saturated. The surface layer is commonly gray or dark-gray muck with subsurface layers. The subsurface layers are strongly gleyed (blue-gray and sticky) and gray, greenish-gray, or bluish-gray. Layers of black or dark-gray mucky materials occur at varying depths (TtNUS, 2004).

## 3.9 Geology

Information collected during a previous Remedial Investigation indicates that the site is primarily underlain by fill material (reportedly dredge spoils and gun butt sand adjacent to Building 200), sandy clay, silt, sand, and some debris. The northern portion of the site has a surficial layer of silty clay that grades to a sandy clay to silty clay with a sand lens in between to a depth of 11 feet below ground surface (bgs). This clay is underlain by a 2.5-foot sand layer and an undetermined thickness of clay with trace sand. The area is underlain with a silty and sandy clay unit to a maximum depth of 9 feet, a fine sand unit to a maximum depth of 13 feet, and another clay unit with trace fine sand (TtNUS, 2004).

## 3.10 Hydrology

Hydrogeologic information obtained from area monitoring wells indicates that the uppermost water-bearing zone is under water table conditions. This zone consists primarily of a 4-foot-thick sand layer from 7 to 11 feet bgs that occurs at shallower depths in the northeastern portion of the site. The aquifer is underlain by clay of undetermined thickness and is thought to be the upper confining unit present throughout Dahlgren Site. Groundwater elevation contours indicate that groundwater in the surficial aquifer appears to flow in a southerly direction discharging in a radial pattern into Upper Machodoc Creek (TtNUS, 2004).

## 3.11 Seismology

Virginia is located in the tectonically less active Atlantic Coast area of the United States continent. The site is classified as a seismic Zone 1 in the unified building code, indicating the second to lowest design criteria necessary for new construction. The seismicity of the site and region should be considered very low. Seismic activity is very infrequent due to the stability of the regional geology. Seismic activity is uncommon in this area. Earthquakes within 200 miles of the site with a Maximum Intensity of V (3.5 on the Richter Magnitude Scale) or greater, within the last 100 years, are listed in Table 3 below.

**Table 3 Virginia Earthquake History**

| Date (Year-Mo-Day) | Maximum Intensity | Felt Area (Sq Miles) | Locality |
|---|---|---|---|
| 1907-02-11 | VI | 5,600 | Arvonia |
| 1918-04-10 | VI | 65,000 | Luray |
| 1919-09-06 | VI | - | Warren County |
| 1929-12-26 | VI | 1,000 | Albemarle County |
| 1954-01-02 | VI | - | Bell County, KY/Lee County, Va |
| 1959-04-23 | VI | 2,050 | Giles County |
| 1969-11-20 | VI | 100,000 | Elgood, WV/Rich Creek, Va |
| 1975-11-11 | VI | - | Giles County |
| 1976-09-13 | VI | 9,000 | Carroll County |

## 3.12 Natural Resources

There are no known natural resources that will be affected by decommissioning activities detailed in this DP.

## 3.13 Contaminated Systems and Equipment

The ventilation fan and associated roof duct work in the target bay is contaminated with residual DU up to levels of 3,726 dpm/100cm$^2$ fixed alpha and 92,992 dpm/100cm$^2$ fixed beta-gamma. The system will be removed, downsized, and packaged for disposal.

## 3.14 Surface Soil Contamination

Scoping surveys were conducted in the Building 200 outdoor Areas A and B by NWT in March of 2007.

The surveys consisted of gamma scan walkover surveys with 2” by 2” NaI detectors and biased soil sampling.

Table 4 presents a summary of the soil samples collected during the scoping survey effort.

**Table 4 Scoping Survey Soil Sample Summary Table**

| | | | Alpha Spectroscopy | | | | | | | | | Gamma Spectroscopy | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID# | Sample Matrix | Location/Description | U-234 Results in pCi/g | 2 σ Uncertainty +/- pCi/g | U-234 Detection Limit in pCi/g | U-235 Results in pCi/g | 2 σ Uncertainty +/- pCi/g | U-235 Detection Limit in pCi/g | U-238 Results in pCi/g | 2 σ Uncertainty +/- pCi/g | U-238 Detection Limit in pCi/g | U-238 Results in pCi/g | 2 σ Uncertainty +/- pCi/g | U-238 Detection Limit in pCi/g | Notes |
| B200AA-1 | Soil | Area A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 26.20 | 2.60 | 2.50 | |
| B200AA-2 | Soil | Area A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 547.00 | 42.00 | 12.00 | |
| B200AA-3 | Soil | Area A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 243.00 | 19.00 | 7.00 | |
| B200AA-4 | Soil | Area A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 2.37 | 0.65 | 1.30 | |
| B200AA-5 | Soil | Area A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 4.55 | 0.90 | 1.50 | |
| B200AA-6 | Soil | Area A | 190.00 | 37.00 | 4.00 | 32.00 | 13.00 | 5.00 | 1190.00 | 170.00 | 5.00 | 2010.00 | 150.00 | 30.00 | |
| B200AB-1 | Soil | Area B | 567.00 | 97.00 | 9.00 | 80.00 | 27.00 | 9.00 | 3520.00 | 500.00 | 6.00 | 1550.00 | 120.00 | 20.00 | |
| B200AB-2 | Soil | Area B | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 0.95 | 0.50 | 1.10 | |
| B200AB-3 | Soil | Area B | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 0.31 | 0.65 | 0.89 | |
| B200AB-4 | Soil | Area B | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 0.48 | 0.32 | 0.69 | |
| B200AB-5 | Soil | Area B | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 1.96 | 0.42 | 0.84 | |
| B200AB-6 | Soil | Area B | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 5.58 | 0.90 | 0.89 | |
| | | Maximum: | 567.000 | | | 80.000 | | | 3520.000 | | | 2010.000 | | | |
| | | Average: | 378.500 | | | 56.000 | | | 2355.000 | | | 366.033 | | | |
| | | Standard Deviation: | 266.579 | | | 33.941 | | | 1647.559 | | | 687.144 | | | |

NWT performed remediation activities and conducted a detailed characterization survey in June of 2007 in the Building 200 outdoor Areas A and B.

A final report detailing remediation activities and characterization surveys of the Building 200 two outdoor areas is included in Attachment 2 of this plan.

## 3.15 Surface Water

There is no surface water that contains residual radioactivity in excess of site background levels, and remediation activities are not planned.

## 3.16 Ground Water

There is no ground water that contains residual radioactivity in excess of site background levels, and remediation activities are not planned.

# 4.0 UNRESTRICTED RELEASE CRITERIA

## 4.1 Building Surfaces

### *4.1.1 Gross Alpha DCGL*

The site specific DU gross alpha DCGL for building surfaces shall be 1150 dpm/100 $cm^2$. The DU DCGL was calculated using DandD Version 2.1 and NUREG 1720 "Re-evaluation of the Indoor Resuspension Factor for the Screening Analysis of the Building Occupancy Scenario for NRC's License Termination Rule". DU for purposes of this calculation consisted of 99.7% U-238, 0.250% U-235, and 0.005% U-234 by weight. Using the formula for gross activity DCGL found in MARSSIM Equation 4-4, and DandD Version 2.1 results in a DCGL of 81 dpm/100 $cm^2$ (42 dpm/100$cm^2$ U-238 + 39 dpm/100$cm^2$ U-234). Adjusting for a revised resuspension factor resulted in 81 dpm/100 $cm^2$ x (1 x $10^{-6}$)/1.42 x $10^{-5}$) which equals 1150 dpm/100 $cm^2$ for building surfaces. The adjustment uses the ratio of the default resuspension factor at the 90$^{th}$ percentile from DandD 2.1 compared to the resuspension factor recommended by NUREG 1720 for the 90$^{th}$ percentile. This is the only adjustment to the default screening values used by DandD2.1. The use of a revised suspension factor is appropriate since surveys demonstrate that the contamination is not easily removed from building surfaces.

### *4.1.2 Gross Beta DCGL*

During performance of the scoping surveys in March of 2007 it was discovered that measurement of beta radiation was much more efficient than measurement of alpha radiation as shown in Table 2. Shielding effects of building surface materials are suspected which are caused by fragments and residual radioactivity embedded in the building surface by high velocity impacts of DU rounds. Therefore a gross beta DCGL was developed below as a surrogate for measurement of alpha radiation.

In the case of U-238, the decay product is thorium-234 (Th-234), which is also radioactive and which has a very short half-life (24.1 days) compared to the half-life of U-238 (4.51 billion years). Thorium-234 decays by emitting a beta particle and a gamma ray, producing protactinium-234 (Pa-234). Protactinium-234 is radioactive (half life 6.75

hours) and it also decays by beta particle and gamma ray emission, producing uranium-234, which has a half life of 247,000 years. In fact, there are 14 steps between U-238 and lead-206 which is a stable, non-radioactive substance. Because the uranium enrichment process removes uranium 235 and 234 as well as progeny to neglible amounts, uranium 234 and subsequent progeny are neglected in the calculation. These first three steps of the radioactive decay sequence can be depicted with the following equation:

U-238 -(alpha)--> Th-234 -(beta & gamma)--> Pa-234 -(beta & gamma)--> U-234

Therefore for every single atom of U-238 that disintegrates-one alpha particle, two beta particles and two gamma rays are emitted.

A Gross Beta DCGL of 1,192 dpm/100cm$^2$ can then be applied for the final status surveys.

## 4.2 Surface Soil

The screening value for DU ($^{238}$U) in soil is 14 pCi/g which can be found in the Federal Register: December 7, 1999 (Volume 64, Number 234, Pages 68395-68396.

## 4.3 Planned Decommissioning Activities

### *4.3.1 Contaminated Structures*

It is planned that the metal wall surfaces and roof surfaces will be decontaminated by a sandblasting or similar technique. It is planned that the concrete floor surfaces will be decontaminated by removal of the contaminated concrete surface (scabbling).

Containment systems, HEPA filtered ventilation, and respiratory protection will be utilized during the above decontamination efforts.

### *4.3.2 Contaminated Systems and Equipment*

All contaminated systems and equipment will be dismantled, downsized, and packaged for transportation and disposal.

### *4.3.3 Soil*

A final report detailing remediation activities and characterization surveys of outdoor surface soils outside Building 200 conducted by NWT in June of 2007 is included in Attachment 2 of this plan.

## 4.4 Schedule

Table 5 below is a summary of the schedule of planned decommissioning activities:

**Table 5 Decommissioning Schedule**

| Task | Duration in Weeks |
|---|---|
| Remove Bay 4 Roof Vents, Decontaminate Roof Surfaces, Perform Final Status Surveys [1] | 3 |
| Remove, Downsize and Package Contaminated Targets/Debris Located in Bay 4 | 2 |
| Decontaminate Bay 4 Floor, Wall, and Ceiling Surfaces, Perform Final Status Surveys [1] | 6 |
| Total Project Duration | 8 |

[1] Tasks to be performed concurrently

The following should be noted concerning the schedule of decommissioning activities:

- The dates in the schedule are contingent on NRC approval of the decommissioning plan;

- Circumstances can change during decommissioning, and, if the licensee determines that the decommissioning cannot be completed as outlined in the schedule, the licensee or responsible party will provide an updated schedule to NRC; and,
- If the decommissioning is not expected to be completed within the timeframes as outlined in NRC regulations, a request for an alternative schedule for completing the decommissioning will be made to the NRC schedule.

# 5.0 PROJECT MANAGEMENT AND ORGANIZATION

## 5.1 Project Manager

The Project Manager (PM) will have overall responsibility for ensuring the work associated with this DP is done safely, efficiently and within budget. His primary duties will include, but not be limited to:

- Establish and execute program administrative matters and controls, program-related policy matters, and program levels of authority, responsibility and communication
- Establish and maintain a records management system to verify that project documents are controlled. Project documents include, but are not limited to: correspondence, procedures, drawings, specifications, contract documents, document changes, inspection records, corrective action documents, and personnel records
- Ensure appropriate personnel have been assigned to the project team and that they are qualified to perform the tasks to which they are assigned
- Review and approve project procedures
- Overall management of site personnel, including implementing necessary disciplinary actions
- The Project Manager will have a minimum of 5-years experience in conducting environmental remediation/restoration efforts, primarily with radioactive material
- Act as point of contact with the Navy with regard to contract matters

## 5.2 Radiation Safety Officer

The NSWCDD Radiation Safety Officer will be responsible for organizing, administering, and directing the radiation protection program at the NSWCDD during the decommissioning activities, including radiation safety and environmental health. The Radiation Safety Officer's responsibilities will include:

- Initiating or approving the radiation safety and health aspects of NSWCDD procedures, standards, and rules and ensuring the program is adequately operated
- Participating in design and decommissioning plan reviews where potential radiation exposure and safety could be affected
- Developing methods for keeping radiation exposures ALARA for workers and all facility personnel

- Conducting surveillance programs and investigations to ensure that occupational radiation exposures are below specified limits and ALARA
- Identifying locations, operations, and conditions that have the potential for causing significant exposures to radiation and initiating actions to minimize or eliminate unnecessary exposures.
- Assisting the Decommissioning Project Manager in ensuring that the QA program is effectively implemented.

The Radiation Safety Officer will have the authority to enforce safe performance of NSWCDD decommissioning activities and to shut down operations or activities because of either safety or environmental issues, if immediate corrective action is not taken, until a technical review has been conducted. Resumption of work will require DON Decommissioning Project Manager or DON Construction Manager approval following completion of reviews and implementation of any required corrective actions.

The Radiation Safety Officer will have specific training in the radiation health sciences and will have experience in applying this knowledge to managing a radiation protection program. Minimum qualifications for the Radiation Safety Officer are a bachelor's degree in physical science or biological science or the equivalent, with a minimum of two years of applied health physics experience in a program with radiation safety considerations similar to those for the NSWCDD decommissioning project.

## 5.3 Personnel Assigned to Project

Each person assigned to this project is responsible for his/her health and safety, including radiological safety. Accepting accountability for his/her individual safety as well as the safety of all others on the project is the paramount responsibility of each project employee. Personnel will be hired on the basis of their qualification to perform their assigned tasks. Each member of the project team is responsible to:

- Read and become familiar with the project HASP and DP
- Participate and cooperate in all assigned training activities
- Perform only tasks they can do safely and competently and for which they have been trained
- Notify the project HSM of any special medical conditions or any prescription and/or non-prescription medication they may be taking that could impair their judgment or work performance or create an unsafe working condition
- Prevent the spread of contamination
- Maintain their individual exposure to radiation ALARA
- Report any unsafe act or working condition to project management as soon as possible

- Stop work if conditions are immediately dangerous to human health
- Not disturb or remove any archaeological or historic artifacts
- Practice good housekeeping everywhere on this project
- Immediately report any injury to project management
- Comply with the requirements of the HASP and properly use any PPE required for the work being performed
- Obey instructions of NSWCDD range and safety personnel in regard to the presence of unexploded ordnance in the work areas
- Must have the training mandated by 29 CFR 1910.120 (40 hours plus 3 days on-site experience). Supervisors shall have 8 hours of additional supervisory training. The contractor shall provide written evidence of current Occupational Safety and Health Administration training for each person performing work and a corporate certification that each person is medically capable of working on a hazardous waste site.

## 5.4 Training

Personnel assigned to this project will be trained by NWT in regard to the types and magnitudes of radiological, industrial safety, personal hygiene, and physical hazards they may encounter while working and/or visiting the site. Training will also be provided for the conditions unique to NSWCDD. The following sections describe training for this project.

### *5.4.1 Visitor Training*

Visitors to the work areas will be escorted at all times. They will not normally be permitted to enter radiologically controlled areas. Training will consist of a general site/project orientation that discusses:

- Radiological conditions
- Site-specific safety and health conditions

### *5.4.2 General Employee Training*

General Employee Training (GET) will be administered to all employees working on this project. GET will include the following:

- Discussion of the project’s goals
- Discussion of the working environment at NSWCDD, including environmental hazards, security, and UXO hazards and warning signs

- Description of the forms of DU contamination at NSWCDD and its potential health hazards
- General employee safety
- Quality assurance
- Worker rights and responsibilities
- Location of project HASP
- Identification of radiological postings and barriers
- Protective equipment and procedures
- Emergency procedures
- How to contact project management representatives and radiation safety staff

### *5.4.3 Radiation Worker Training*

In addition to the GET described above, those employees who will be working with radioactive materials or in radiologically controlled areas will be required to have extended Radiation Worker Training (RWT) before being permitted to work at NSWCDD. This training will include:

- Radioactivity and radioactive decay
- Forms and characteristics of ionizing radiation
- Manmade and natural radiation sources
- Biological effects of exposure to radiation
- Risks associated with occupational radiation exposure
- Considerations with respect to exposure of women of reproductive age
- Dose equivalent limits and determinations
- Modes of exposure (external and internal)Basic protective measures (time, distance, shielding)Specific methods of maintaining exposure ALARA
- Radiation survey instruments, including types, calibration, use and limitations
- Radiation monitoring program and procedures
- Contamination control, including administrative controls, PPE, engineering controls and workplace design
- Personnel and equipment decontamination
- Emergency procedures
- UXO awareness
- Warning labels, signs and barriers
- Responsibilities of workers and management vis-à-vis radiation safety

RWT will consist of a classroom lecture and procedure review, a practical demonstration of basic radiological safety principles, question and answer period, a handout and a written test. A passing grade of 76 percent is required. A challenge examination may be administered in lieu of the full RWT for those previously trained or demonstrating sufficient radiological work experience.

Any employee who will need radiation monitoring dosimetry will be required to provide a current NRC Form 4 to project management prior to obtaining the dosimetry.

### *5.4.4 Tailgate Safety Training*

A safety briefing will be conducted prior to the beginning of each daily work shift, whenever significant changes in site working conditions or job scope occur, or whenever new personnel arrive at the job site. All personnel will be required to attend. Health and safety procedures and issues for the day, any unique hazards associated with a work activity, and a review of any significant topic from previous activities will be presented at this meeting. The topics discussed will be recorded and attendees will be required to sign an attendance list to confirm they received the information discussed at the briefing. Tailgate training documentation will be included in the decommissioning records.

### *5.4.5 Training Records*

Training documentation will be included in the decommissioning record. The information included in these records will include:

- Project identification
- Type of training conducted
- Date, time and place of training
- Topics discussed
- Signatures of attendees

In addition to the training and records generated from the training, the project contractor will post copies of pertinent notices to employees required by local, state and Federal law, including, but not limited to, NRC Form 3 Notice to Employees, in a conspicuous location at the work site. A copy of the NSWCDD NRMP will also be made available at the site.

## 5.5 Contractor Support

This section discusses the functions that contractors will perform as part of the decommissioning effort. The contractor will perform and support the actual decommissioning activities. This contractor will be the Decommissioning Contractor. The Navy will select all contractors through established procurement procedures and standards requiring a rigorous source evaluation and review process. The review and evaluation specifications will define scope and method of selection and criteria for contractor qualifications, experience, and reputation. Schedules and specific tasks to be performed by contractors will be planned in advance and detailed work procedures will be developed. Prerequisites, such as safety, health, and environmental precautions and protective clothing requirements, will be defined in writing before work is started. All contractors will adhere to NSWCDD procedures delineating the policies and administrative guidelines applicable to the NSWCDD decommissioning project, and work will be performed in accordance with NSWCDD safety and environmental requirements.

The Navy currently envisions that the Decommissioning Contractor will provide all decontamination and dismantling services and related support activities during the decommissioning. The Decommissioning Contractor will perform the decommissioning operations and supervise and schedule day-to-day decommissioning activities. NSWCDD personnel will ensure that all contractor activities are safely performed and comply with 10 CFR Part 20 and other applicable regulations, license conditions, the decommissioning order issued by NRC, and the decommissioning plan.

The Decommissioning Contractor will be responsible for ensuring that decommissioning contractor staff are trained in performing work in radiation areas; setting up work areas and the equipment and services necessary for safely accomplishing the work; scoping and preparing detailed procedures; providing sequencing and scheduling; and processing, packaging, shipping, and disposing of radioactive materials. The Decommissioning Contractor will have complete responsibility for ensuring the safety and health of their employees and for complying with Occupational Safety and Health Administration (OSHA) and NRC requirements. All these efforts will be subject to the review, approval, and authority of the Decommissioning Project Manager and the Radiation Safety Officer to ensure compliance with NRC requirements, license conditions, and NSWCDD safety and health requirements.

While the decommissioning contractor’s efforts will be focused on surveying and removing materials from the ranges, compliance with applicable regulations, health and safety, and project management, specialty services may be required from a subcontractor with the requisite skills, experience, and/or facilities. Such services could include packaging and shipment of radioactive waste and laboratory analyses.

Each subcontractor will provide a task manager and, if necessary, a health and safety and/or quality control contact who will report to the task manager. At all times, the decommissioning contractor will be responsible for the scope, quality and timeliness of services

provided by all subcontractors. The RSO will verify that subcontractor personnel are adequately informed of the conditions and hazards at the work site, preventive measures in place, and the procedures associated with each work task for which the subcontractor is responsible. The PM and RSO will verify that subcontractor personnel perform their decommissioning work in accordance with all licensing commitments and regulatory requirements.

**NOTE: A Memorandum of Understanding (MOU) will be executed with the facility RSO and decommissioning contractor delineating each organization's responsibilities.**

# 6.0 PHYSICAL SECURITY PLAN IN PLACE DURING DECOMMISSIONING

The existing security system in place at NSWCDD is adequate to handle any contingency that may arise during decommissioning activities. There is no cause in the decommissioning plan, as written, for which the existing security should be modified.

# 7.0 RADIATION SAFETY AND HEALTH PROGRAM

## 7.1 Radiation Work Permit

A Radiation Work Permit (RWP) shall be prepared and will specify the activities to be performed and all radiological safety requirements for the work. All personnel assigned to site work will be required to read and sign the RWP, acknowledging that they understand the requirements of the RWP, prior to beginning work.

The RWP will also be used as an information document for industrial safety. Hazards other than radiological may be included in the RWP so proper protection can be taken for all possible hazards. The RWP will clearly specify the need for a briefing on the radiological conditions present in the work environment.

The RWP shall list tasks and specific levels of protection for each worker covered by the RWP. The RWP shall also detail the dosimetry requirements, the protective clothing requirements, and the expected radiation and contamination levels to be encountered during the field survey activity.

## 7.2 Personal Monitoring and Dosimetry

Even though the work consists of equipment and area surveys and potential minor decontamination efforts, and the likelihood that personnel will receive any external or internal exposure is very minimal, NWT administrative policies require the use of external dosimetry on any field project that has the potential for exposure to radioactive material. The Project Manager (or designee) is responsible for ensuring that all NWT personnel assigned to perform the survey (employees, vendors, contractors, and visitors) are appropriately monitored for exposure to ionizing radiation. Each individual working at the site shall wear the dosimetry devices specified in the RWP. Personnel will be issued appropriate personnel monitoring devices consisting of a thermoluminescent dosimeter (TLD). The issuance of monitoring devices shall be documented on a Badge Issue Log.

## 7.3 Proper Location for Wearing Dosimetry Devices

Unless otherwise directed by the PM (or designee), personnel monitoring dosimetry shall be worn on the front of the body between the neck and the waist. When circumstances are such that other parts of the body could potentially receive significantly greater doses, the PM may instruct the individual to wear the dosimetry in a more representative location, or may specify additional dosimetric devices.

## 7.4 Official Exposure Determination and Project Dose Estimate

NWT will be responsible for distributing and collecting the dosimetric devices. The official and permanent record of accumulated external dose received by individuals is obtained from the interpretation of the TLDs as provided by the selected vendor. Once the interpretation of the personnel monitoring devices has been completed, personnel will be sent a hard copy record (NRC Form 5) of their exposure.

Due to the low exposure rates in the work areas, total survey crew TEDE is expected to be < 5 mrem.

## 7.5 Lost or Damaged Dosimetry Devices

Individuals shall immediately notify the PM (or designee) if they lose or damage their dosimeter. A thorough search shall be made for any dosimeter reported lost. Personnel whose exposures are being investigated shall be excluded from work in radiologically controlled areas until the investigation is completed and documented and dosimetry devices reissued. In the event of a lost or damaged TLD, the PM shall investigate the exposure conditions and assign an external dose for the individual, with concurrence of NWT program management.

## 7.6 Workplace Air Monitoring Program

Concentrations of radioactive material in air will be determined, as needed, by sampling the air. Air sampling shall be conducted in accordance with (or equivalent to) the guidance provided in NRC Regulatory Guide 8.25, “Air Sampling in the Workplace”, July 1992 (NRC 1992a). The samples will be collected under known physical conditions (e.g. filter, sample time, flow rate). The flow meters of air samplers shall be calibrated at least annually. Calibration shall also be performed after repair or modification of the flow meter.

Air samples will be collected from general and localized areas when and/or where there is potential for generation of airborne radioactive material. These samples will be used to verify

that the confinement of radioactive material is effective, and provide warning of elevated concentrations for planning or response actions. In each case, the sampling point will be located in the airflow pathway near the known or suspected release point(s). As necessary, more than one air sample location may be used in order to provide a reasonable estimate of the general concentration of radioactive material in air.

The RSO or his/her designee shall apply professional judgment and experience to identify air sampling appropriate for the specific situation. Such judgment will be based on historical air sampling and characterization results, quantity of contamination of the material being handled, potential for release of contaminants based on physical form and activity, type of confinement or containment, and other factors specific to the activity.

Air sampling of the workplace will also be conducted under the following two conditions:

- Areas with removable contamination greater than 1,000 dpm/100cm$^2$ and the worker is actively working in the area for greater than one hour during that workday; or

- Areas with total contamination greater than 5,000 dpm/100 cm$^2$ and the work involves invasive activities such as drilling, scabbling, digging, or otherwise causing the release of contaminants or contaminated material into the air.

As familiarity with work activities increases, the RSO or his/her designee may modify the aforementioned conditions. Any modification will be explained and justified in writing by the RSO or his/her designee.

An administrative action level shall be established for breathing zone air samples of 10% of the derived air concentration (DAC); air sample results greater than this administrative action level shall be reported to the RSO or his/her designee. An administrative limit shall be established for breathing zone air samples of 12 DAC-hours per week; individual exposure greater than this action level shall require the individual to be restricted from work involving potential exposure to airborne radioactive material unless approved by the RSO or his/her designee.

## 7.7 Respiratory Protection Program

The respiratory protection program provides guidance and instruction regarding protection of workers from occupational injury and illness due to exposure to airborne radioactive material. The program is implemented by written procedures. The program and implementing procedures are the primary means used to administratively

establish safe respiratory protection practices and compliance with requirements of the NRC.

The program covers routine use of respiratory protection equipment. The functional areas of the program include medical evaluation; fit testing, selection, issue, inspection, use, cleaning, maintenance, storage, and training.

- Medical

  Prior to the initial fit test, and at least every 12 months thereafter, an evaluation will be made of each worker required to wear respiratory protection equipment as part of the worker's duties as to whether or not the worker can wear the required respirator without physical risk. A worker will not be allowed to wear a particular type of respirator if, in the opinion of a physician, the worker might suffer physical harm due to wearing the respirator. A worker shall not be allowed to use a respirator without a current medical evaluation.

- Fit Test

  All workers required to wear respiratory protection equipment shall be required to successfully complete a fit test prior to initial use of the equipment. The fit test shall be repeated at least annually. A worker shall not be allowed to wear a respirator without a current successful fit test.

- Selection

  Respirators shall be selected from those approved by the National Institute for Occupational Safety and Health for the contaminant or situation to which the worker may be exposed. Health Physics shall select the respirator type. Selection shall be based on the physical, chemical, and physiological properties of the contaminant, the contaminant concentration likely to be encountered, and the likely physical conditions of the workplace environment in which the respirator will be used.

- Issue

  Respirators, when it is determined to be necessary, shall only be assigned or issued to workers qualified, with respect to the program, to use respiratory protection equipment. The type of respirator selected shall be documented on the Radiation Work Permit.

- Inspection

All respirators shall be inspected with regard to operability before, and routinely after, each use, and after cleaning.

- Cleaning

  Respiratory protection equipment that is used routinely shall be cleaned after each use. Respiratory protection equipment that is used by more than one worker shall be cleaned and disinfected after each use. The need for cleaning shall also be based on contamination surveys of the work area and of the respiratory protection equipment.

- Maintenance

  Respiratory protection equipment shall be maintained to retain its original effectiveness. Replacement or repair shall be done only by experienced persons, with parts designed for the respirator. No attempt shall be made to replace components or to make adjustments or repairs beyond the manufacturer's recommendations. Reducing valves or admission valves on regulators shall be returned to the manufacturer or equivalent for repair.

- Storage

  Respirators shall be stored to protect against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. Respirators shall be stored in dedicated carrying cases or cartons that protect from dirt and damage.

- Training

  All workers required to use respiratory protection equipment shall be instructed in the content and applicability of the program and implementing procedures, and especially in the proper use of the equipment and its limitations. Refresher training shall be conducted annually. A worker shall not be allowed to use a respirator without current successful completion of training.

## 7.8 Internal Exposure Determination

Individual monitoring shall be provided for workers who require monitoring of the intake of radioactive material pursuant to 10 CFR 20.1502(b). Monitoring of intake shall normally be conducted by use of air samples, particularly of the breathing zone. Internal dose shall be

determined by converting airborne concentrations to intakes in accordance with NRC Guidance (NRC 1992c).

When a potential or actual condition exists where the worker(s) could have received an unmonitored intake of radioactive material, and cannot otherwise be estimated, the intake shall be determined by measurements of quantities of radionuclides excreted from or retained in the body. These measurements shall be made consistent with the guidance provided in NRC Regulatory Guide 8.9 “Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program”, July 1993 (NRC 1993).

Determination of radiation dose to the embryo/fetus shall be performed in accordance with NRC Regulatory Guide 8.36 “Radiation Dose to the Embryo/Fetus”, July 1992 (NRC 1992d).

## 7.9 Contamination Control Program

Contamination control shall be managed for exposure control and monitored by radiation surveys in accordance with approved procedures.

## 7.10 Exposure Control

Personnel exposure to radioactive material will be controlled by application of engineering, administrative, and personnel protection provisions. The priority of application will be descending with respect to their order of description below.

- Engineering

  Engineering controls will be used, as practicable, to minimize or prevent the presence of uncontained radioactive material. Engineering controls will predominantly be comprised of containment, isolation, ventilation, and decontamination.

- Administrative

  Administrative controls will be used to control work conditions and work practices. Administrative controls will predominantly be comprised of the following:

  1) Access Control

     Routine access to work areas will be limited to personnel necessary to accomplish tasks or activities. Access will also be controlled

with respect to training and use of specified personnel protection equipment.

2) Postings and Barriers

Postings will be used to inform personnel of relevant hazards or conditions and associated access requirements. Barriers may be used to prevent unauthorized access.

3) Procedures

Written procedures may be used to describe specific radiation protection requirements necessary for tasks that involve radioactive material.

4) Radiation Work Permits

RWPs will be used to describe specific or special worker protection requirements for activities involving radioactive material and not covered by a procedure. RWPs may also be used in conjunction with a procedure.

5) Contamination Control

Action levels and limits for radiation surveys, described later in this plan, will be used to control the levels of radioactivity on equipment and in areas.

- Personal Protective Equipment

  Personal protective equipment will be used to control personnel exposure to radioactive material when administrative controls are not sufficient and engineering controls are not practicable. Personal protective equipment may include head covering, eye protection, respiratory protection, impervious outerwear, gloves, and/or protective shoes or shoe covers.

## 7.11 Instrumentation Program

Instrumentation that is capable of performing the radiation surveys and measurements of radioactive material required by regulation, license, and procedures shall be maintained. The types and management of radiation detection instrumentation is described in the following sections.

Calibration, maintenance, repair, and efficiency determination shall be performed according to written procedures, instructions, or other guidance documents reviewed and approved by the RSO, or by a commercial calibration service.

- Frequency

  Instruments shall be calibrated at least annually or following maintenance, repair, or adjustment likely to affect the primary calibration.

- Radiation Energy

  Calibration shall be performed using a source (s) providing radiation fields similar to those in which the instrument will be used.

- Label

  Each instrument shall be labeled or marked with the following information as applicable:

  - Unique identification (e.g. serial number),
  - Initials or specific identifying mark of individual completing the calibration,
  - Energy correction factors, if applicable,
  - Instrument response to an identified check source,
  - Unusual or special use conditions or limitations, and
  - Date by which calibration is again required.

- Standards

  Calibration shall be performed using standard sources traceable to NIST. Gamma spectrometry system(s) measurements may be performed using high purity germanium radiation detectors that have been specifically characterized by the vendor to enable a sourceless efficiency calibration methodology. When this method is selected, the vendor's computer software performs a mathematical efficiency calibration without the use of sources.

- Verification

  Instruments in use shall be verified (checked) daily to ensure that the instrument is in proper working condition. An instrument shall be removed from service if the source check is not within ±20 percent of the initial post-calibration value. Laboratory instruments used for radioactivity measurements are evaluated daily before use via check

sources and efficiency checks. Maintenance or repair shall be performed if the daily source or background checks are not within prescribed ranges.

- Sensitivity

  Radiation detection systems shall be capable of detecting emissions of radioactivity less than the respective limits. Measurement sensitivity will be determined using industry standard guidance (e.g., NUREG-1507 "Minimum Detectable Concentrations with Typical Radiation Safety Instruments for Various Contaminants and Field Conditions",1997 (NRC 1997b)).

# 8.0 SITE PREPARATION, EQUIPMENT AND PERSONNEL

## 8.1 Accessibility

Access to the active work areas will be barricaded using the appropriate postings and boundary rope, and limited to only those personnel performing work in the areas.

## 8.2 Office Space and Restroom Facilities

Existing facility space and restroom facilities located at the NSWCDD Dahlgren will be utilized during the task.

## 8.3 Electrical Power

There is existing electrical power available in the work areas where it is needed. Portable generators will be used where necessary. If a portable generator is used, the NSWCDD Environmental Office must be notified of type and duration of use.

## 8.4 Personnel

**Task personnel and their responsibilities will consist of the following:**

Project Manager - Responsible for the overall operations and safety of the project team.

NWT Corporate RSO (Offsite) – Will communicate directly with the Project Manager on a weekly basis, or as needed, to provide guidance to ensure work is being performed in accordance with authorized license activities.

Health Physics Supervisor – Will act as Task Leader, responsible for the guidance and supervision of Health Physics Technicians performing the survey and sampling operations in accordance with this plan.

Health Physics Technicians - Perform surveys, sampling operations and supervise any decontamination efforts if required.

All NWT personnel will be trained and experienced at the tasks to be performed.

# 9.0 ENVIRONMENTAL MONITORING PROGRAM

## 9.1 Environmental ALARA Evaluation Program

There is no Environmental ALARA Evaluation Program for the NSWCDD Site.

## 9.2 Effluent Monitoring Program

There is no Effluent Monitoring Program for the NSWCDD Site.

## 9.3 Effluent Control Program

There is no Effluent Control Program for the NSWCDD Site.

# 10.0 RADIOACTIVE WASTE MANAGEMENT PROGRAM

## 10.1 Solid Radioactive Waste

It is anticipated that approximately 78 cubic yards (six 20-25 cubic yard intermodal roll-off bins) of solid radioactive waste will be generated during D & D activities.

## 10.2 Management of LLRW

LLRW currently being stored on site will be packaged in appropriate waste containers and segregated from uncontaminated wastes. If LLRW is required to be handled outside of it's packaging, a staging area will be set up for this work. The staging area will have boundary markings and signs will be posted identifying the area.

## 10.3 Waste Packaging

To the extent practical, the number of waste packages and the number of waste shipments will be minimized. Waste will be packaged in a manner that provides containment and protection for the duration of the anticipated storage period and until disposal is achieved, or until the waste is removed from the packaging. Waste packages will be marked such that their contents can be identified.

It is planned that the packaging for the waste will be 20-25 cubic yard intermodal roll-off bins with hard tops. All packaging will be inspected prior to use to ensure suitability for intended use.

## 10.4 Disposal Facility

Radioactive waste will be transferred to a recipient who is properly licensed to receive such waste.

## 10.5 Licensed Material Inventory and Accountability

Inventory and accountability of licensed material is accomplished by keeping track of receipts and outgoing shipments of material in logs. Records will be maintained of licensed material content for waste material accumulated and shipped.

## 10.6 Liquid Radioactive Waste

It is anticipated that no liquid radioactive waste will be generated.

## 10.7 Mixed Waste

It is anticipated that no mixed waste will be generated.

# 11.0 PLANNING PHASE OF RADIOLOGICAL SURVEYS

## 11.1 Radionuclide of Concern

Based on historical information, the radionuclide of concern is depleted uranium . See Table 8 below for the composition of depleted uranium. Therefore, the residual surface activity release limits were determined for this radionuclide constituent of potential concern.

## 11.2 Tools/Equipment Surface Activity Derived Concentration Guideline Limits (DCGLs) for Radionuclides of Concern

The surface activity DCGLs are stated in the "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Materials, (April 1993) Office of Nuclear Material Safety and Safeguards (NMSS)" for the free release of tools, equipment, personnel protective equipment, etc.

Table 6 presents the DCGLs for tools and equipment.

**Table 6 Surface Activity DCGLs for Tools/Equipment**

| Radionuclide | Removable in dpm/100cm$^2$ | Average [2] in dpm/100cm$^2$ | Maximum [3] in dpm/100cm$^2$ | Radiations Emitted |
|---|---|---|---|---|
| U-238 | 1,000 | 5,000 | 15,000 | αβ |

1. Measurements of average contaminant should not be over more than 1 m$^2$
2. The maximum contamination level applies to an area of not more than 100 cm$^2$

## 11.3 Alpha Emitter DCGL Calculation Approach

The specified DCGL for the Building 200, Bay 4 areas which are to remain is 1,150 dpm/100 cm$^2$, alpha, based on the potential presence of DU. The following discussion explains how the limit was derived.

Using DandD Version 2.1 and inputting a concentration of 81 dpm/100cm$^2$ (42 dpm/100cm$^2$ of U-238 + 39 dpm/100cm$^2$ of U-234) produces a dose of 24.4 mrem. This procedure is recommended in NUREG 1757.

NUREG 1720 "Re-evaluation of the Indoor Resuspension Factor for the Screening Analysis of the Building Occupancy Scenario for NRC's License Termination Rule" recommends a resuspension factor of 1 x $10^{-6}$ vice 1.42 x $10^{-5}$ that is used in DandD Version 2.1. Consequently (1 x $10^{-6}$)/(1.42 x $10^{-5}$)= 14.2 which is the factor of adjustment for the resuspension factor.

Since the exposure for depleted uranium results almost entirely from inhalation, the adjusted DCGL is 81 dpm/100 cm$^2$ x 14.2. The adjusted DCGL is 1,150 dpm/100 cm$^2$ of DU.

The DandD Version 2.1 detailed reports are included in this plan in Attachment #1.

## 11.4 Beta Emitter DCGL Calculation Approach

During performance of the scoping surveys in March of 2007 it was discovered that performing measurements for beta radiation was much more efficient than performing

measurements for alpha radiation. Shielding effects of building surface material is suspected that are caused by fragments and residual radioactivity embedded in the building surface by high velocity impacts of DU rounds. Therefore a gross beta DCGL must be developed as a surrogate for direct measurement of alpha.

In the case of U-238, the decay product is thorium-234 (Th-234), which is also radioactive and which has a very short half-life (24.1 days) compared to the half-life of U-238 (4.51 billion years). Thorium-234 decays by emitting a beta particle and a gamma ray, producing protactinium-234 (Pa-234). Protactinium-234 is radioactive (half life 6.75 hours) and it also decays by beta particle and gamma ray emission, producing uranium-234, which has a half life of 247,000 years. In fact, there are 14 steps between U-238 and lead-206 which is a stable, non-radioactive substance. Because the uranium enrichment process removes uranium 235 and 234 as well as progeny, uranium 234 and subsequent progeny are neglected in the calculation. The first three steps of the radioactive decay sequence can be depicted with the following equation:

U-238 -(alpha)--> Th-234 -(beta & gamma)--> Pa-234 -(beta & gamma)--> U-234

Therefore for every single atom of U-238 that disintegrates-one alpha particle, two beta particles and two gamma rays are emitted.

A Gross Beta DCGL of 1,192 dpm/100cm$^2$ (42 dpm/100cm$^2$ of U-238 x 14.2.x 2) can then be applied for the final status surveys.

The gross alpha, and gross beta release limits are presented in Table 7 below.

**Table 7 Gross Alpha-Gross Beta Release Limits**

| **Measurement**<br><br>**Bldg 200 Bay 4 Surfaces** | **Removable [1] dpm/100cm$^2$** | **Activity in dpm/100cm$^2$** |
|---|---|---|
| Gross Alpha | 20 | 1,150 |
| Gross Beta | 1,000 | 1,192 |
| [1] Removable limits used for an estimate of the removable fraction | | |

Table 8 below presents ratio data for depleted uranium.

**Table 8 Depleted Uranium Composition**

| DU | Fraction by Weight | Spec. Activity Ci/g | Activity Ci | Fraction Total Activity |
|---|---|---|---|---|
| U-238 | 99.7% | $3.33 \times 10^{-07}$ | $3.32 \times 10^{-07}$ | 51.35% |
| U-235 | 0.250% | $2.10 \times 10^{-06}$ | $5.25 \times 10^{-09}$ | 0.81% |
| U-234 | 0.005% | $6.19 \times 10^{-03}$ | $3.10 \times 10^{-07}$ | 47.84% |
| | | Total: | $6.47 \times 10^{-07}$ | |

## 11.5 Data Quality Objectives

The surveys of the Building 200, Bay 4 surfaces will require sufficient detail to determine if the release criteria are met. The data from the Final Status Surveys that will be performed as defined in MARSSIM will meet the data quality objectives stated below.

The final status survey design process for the surface areas of Bay 4 in Building 200 begins with development of data quality objectives (DQOs) in accordance with the guidelines outlined in Appendix D of MARSSIM and EPA QA/G4 "Guidance for the Data Quality Objectives Process" (EPA, 2000). The DQOs are then used in conjunction with the radiological conditions at the site to calculate the number and locations of measurement and sampling points to demonstrate compliance with the release criterion. Survey techniques and analytical methodologies were selected to generate the required analytical data. Once the data is received from the surveys and laboratory and is validated, it will be evaluated using statistical techniques to test against the hypothesis stated in Section 12.8.2 of this document. Sampling, as discussed in this and subsequent sections, refers to the collection of measurement data. “Sampling” includes alpha-beta direct measurements (static), alpha-beta scan surveys, as well as the physical collection of swipes for measurement of loose surface contamination for on-site analysis.

### *11.5.1 Statement of the Problem*

#### 11.5.1.1 Building 200 Bay 4 Building Surfaces

For the Final Status Surveys of the surface areas of Bay 4 in Building 200 it must be determined if the allowable release limits have been met or if investigation/remediation is warranted. Therefore, the decision to be made can be stated: "Do the Final Status Survey Units meet the allowable fixed residual surface activity release limits of 1,150 dpm/100 $cm^2$ alpha, and 1,192 dpm/100$cm^2$ beta". The null hypothesis ($H_o$) as required by MARSSIM is stated and tested in the negative form: "The median concentration in the survey unit exceeds the surface contamination release limits."

It is anticipated that successful completion of activities described in this decommissioning plan will provide sufficient data for the unrestricted release of the areas undergoing survey. Resources available to provide the necessary data include the following:

Activities outlined in this Decommissioning Plan.

Guidance provided in the Multi Agency Radiation Survey & Site Investigation Manual (MARSSIM) for performing Final Status Surveys (FSS).

Process knowledge, inspections, and various radiological survey reports previously conducted in the areas.

Statistical analysis of survey data collected during survey activities outlined in this Decommissioning Plan.

### *11.5.2 Identification of Decisions*

The need to provide data for unrestricted release of the areas and equipment requires performing radiological surveys as specified in this Decommissioning Plan.

The primary uses of the data expected to result from completion of these surveys is to provide information and data to support the unrestricted release of the equipment and areas.

### *11.5.3 Inputs to the Decision*

Radiological surveys and sampling required to support the unrestricted release of the areas will include:

- Locate and survey a reference area where meaningful background radiation levels can be determined;
- 100 % alpha-beta scan surveys of the floor, wall, roof, and ceiling surface areas in Bay 4 of Building 200 with large area gas proportional detectors will be performed;
- Systematic gross alpha and beta 2-minute direct (static) measurements in the survey areas;
- Gross/alpha beta analysis of swipe samples collected at each of the gross alpha-beta direct measurement locations;
- Laboratory data validation and statistical analysis of collected data.

### *11.5.4 Definition of Study Boundaries*

The spatial boundaries for this survey effort are the entire interior floor, wall, ceiling, and exterior roof and wall surfaces of Bay 4 of Building 200. All areas will be 100% alpha-beta scan surveyed. 2-minute direct measurement alpha-beta surveys will be performed at systematic locations in each of the survey units. Swipe samples for gross alpha/beta and low-energy beta activity will be collected from each of the gross alpha/beta direct measurement locations.

### *11.6.5 Development of a Decision Rule*

#### 11.6.5.1 Surface Contamination Release Limits

The surface contamination release limits for use on this survey effort are provided in Table 8.

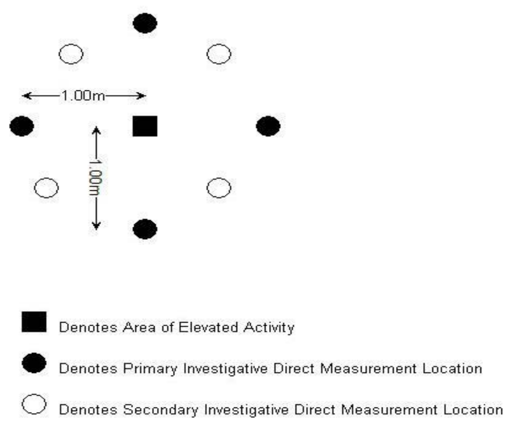
#### 11.6.5.2 Action Levels

For all areas, the action level will be calculated as 90% of the allowable gross alpha/beta release limits for direct measurement (static) readings.

If a survey unit exceeds the Action Level, the survey unit will be further characterized to identify the extent of contamination. The size of the elevated area of activity will be determined first by the performance of scan surveys and direct measurements, at 1-meter increments, in areas immediately adjacent to the elevated area. The determination if the elevated area is due to fixed or removable contamination will be accomplished by obtaining and analyzing swipe samples in the elevated area. Figure 7 provides a sketch of the direct measurement pattern described above.

The surveys will be completed in accordance with the requirements of the survey plan in the survey unit where the elevated area exists. Following completion of the survey in the survey unit any area requiring decontamination will be posted as a "Contaminated Area" with any decontamination activities to be performed in accordance with NWT Standard Operating Procedure (SOP) FM-006-01-20, Decontamination of Equipment, Materials and Tools" and be re-surveyed in accordance with guidelines specified in MARSSIM following decontamination.

## Figure 7 Direct Measurement Pattern for Areas Exceeding Action Level




*11.6.6 Limits on Decision Errors*

Actions to minimize errors need to be implemented during the data collection phase of the radiological survey. Qualified radiation survey personnel will perform the survey and record the data. Additional actions, such as valid instrument calibration, daily instrument source checks, and secondary surveys with separate instruments provide the primary steps to be taken to avoid errors in the data collection phase of the survey process.

In order to minimize errors, the applicable requirements of NWT Standard Operating Procedures (SOPs) for performing surveys and instrumentation calibration and use will be followed.

Data collection and transcribing is the first phase where errors may arise. To avoid data errors for manual surveys, experienced personnel will record and transcribe the data.

The ongoing on-site analyses and evaluation of survey results provides a final check for errors, which if detected, can be corrected.

There are two types of decision errors that can be made when performing the statistical tests described in this plan. The first type of decision error, called a Type I

error, occurs when the null hypothesis is rejected when it is actually true. A Type I error is sometimes called a "false positive." The probability of a Type I error is usually denoted by $\alpha$. The Type I error rate is often referred to as the significance level or size of the test.

The second type of decision error, called a Type II error, occurs when the null hypothesis is not rejected when it is actually false. A Type II error is sometimes called a "false negative." The probability of a Type II error is usually denoted by $\beta$. The *power* of a statistical test is defined as the probability of rejecting the null hypotheses when it is false. It is numerically equal to $1-\beta$, where $\beta$ is the Type II error rate.

This Final Status Survey is designed to limit Type I and Type II errors to 5%. It is important to minimize the chances that survey units exceeding the release limits will be missed (Type I Error) and survey units meeting the release limits will be rejected as too high (Type II Error). The probability of either of these occurring will be set at a maximum of 5%.

### *11.6.7 Optimizing Data Collection*

#### 11.6.7.1 Review Outputs and Existing Data for Consistency

a) Radioactive source readings will be used to check instruments for consistency prior to and after use in each daily shift. The instrument will only be used after readings are compared and agree within +/- 20 %. The on-site project supervisor will review the information each day to verify equipment is operating satisfactorily.

b) The Health Physics Supervisor will review the survey data on a daily basis. This will ensure an ongoing independent review for consistency of all survey data collected.

#### 11.6.7.2 Determination of Scan Percentage

100% of the Building 200 Bay 4 floor, walls, ceiling, exterior wall, and roof areas will be 100% alpha-beta scan surveyed. This is necessary to determine the extent, if any, of residual contamination that is present.

#### 11.6.7.3 Data Collection Decision Alternatives

a) The data collection design alternatives may change slightly based on conditions found in the field being different than

the information furnished based on prior surveys and available information.

b) In the event that a survey unit classification is revised as a result of detecting unexpected contamination, the Navy will be notified and changes to this plan will be required prior to resumption of survey activity.

**11.6.7.4 Select Most Resource Effective Survey Design**

a) As indicated above, the survey design specified for use in this survey plan was developed in accordance with best management practices and MARSSIM guidelines and will provide the necessary data for a radiological final status survey. Coupled with the use of experienced personnel and proper instrumentation, this design is the most efficient and resource effective.

**11.6.7.5 Document Operational Details and Theoretical Assumptions**

a) Operational details for the radiological survey process have been developed for and are included as part of this survey plan. The theoretical assumptions are based on guidelines contained in MARSSIM (MARSSIM, 2000). Specific assumptions regarding types of radiation measurements, instrument detection capabilities, quantities and locations of data to be collected, and action levels are contained in this survey plan.

### *11.6.8 Sampling Process Design*

The sampling process design includes the following elements:

The *types of samples and sampling matrices* for the Final Status Survey of the areas are alpha/beta scans, direct measurements, and swipe samples of surfaces.

The *sampling frequency* at the areas is set at a minimum of 16 direct measurements for each of the survey units.

## 11.7 ALARA Considerations

Based upon the DGCL's and the conservatism that was factored into the survey design, the maximum calculated TEDE, < 25 mrem/y, is considered ALARA. During

performance of the surveys and any potential decontamination activities, the workers exposures are not anticipated to exceed 5 millirem TEDE.

# 12.0 IMPLEMENTATION PHASE OF SURVEYS

## 12.1 Background Reference Radiation Levels

A site background reference area will be chosen that has similar physical, chemical, geological, radiological, and biological characteristics as the survey unit being evaluated. Background reference areas are normally selected from non-impacted areas, but are not limited to natural areas undisturbed by human activities. In some situations, a reference area may be associated with the survey unit being evaluated, but cannot be potentially contaminated by site activities. Generally, reference areas should not be part of the survey unit being evaluated.

The site background count rate levels will be established for the final status surveys by obtaining sixteen, 2-minute static readings (with each instrument to be used), taken on contact with concrete and steel surfaces for alpha-beta surveys from areas unlikely to be affected by the residual radioactive materials that could be present at the different survey areas. The average value for these readings will be used as the area background radiation levels.

The readings will be documented on Form NWT QA003 or equivalent electronic spreadsheet.

## 12.2 Area Classifications

For the purposes of establishing the sampling and measurement frequency and pattern, the Building 200 Bay 4 areas will be divided into impacted areas with one of three following classifications:

*Class 1 Areas*: Areas that have, or had prior to remediation, a potential for radioactive contamination (based on site operational history) or known contamination (based on previous radiation surveys) above the release limits. Examples of Class 1 areas include:

- site areas previously subjected to remedial actions
- locations where leaks or spills are known (or suspected) to have occurred
- radioactive material storage areas

- areas with contaminants in discrete solid pieces of material or high specific activity

*Class 2 Areas*: Areas that have, or had prior to remediation, a potential for radioactive contamination or known contamination but are not expected to exceed the building residual surface activity release limits provided in Tables 1 and 2. To justify changing the classification from Class 1 to Class 2, there should be measurement data that provides a high degree of confidence that no individual measurement would exceed the release limits. Other justifications for reclassifying an area, as Class 2 may be appropriate, based on site-specific considerations. Examples of areas that might be classified as Class 2 include:

- locations where radioactive materials were present in an unsealed form
- areas downwind from the main areas of concern (AOC)
- areas handling radioactive materials
- areas on the perimeter of former contamination control areas

*Class 3 Areas*: Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the release limits, based on site operating history and previous radiation surveys. Examples of areas that might be classified as Class 3 include buffer zones around Class 1 or Class 2 areas and areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification.

Based upon process knowledge, the operational history, and routine surveys and inspections performed the floor, wall, and ceiling areas of the Building 200 Bay 4 will be classified as *Class1* areas. In addition, the exterior roof and exterior wall areas of Building 200 Bay 4 will be classified as *Class 1* areas.

## 12.3 Survey Units

Table 9 below presents the classifications and number of survey units of the areas where radiological surveys are to be performed during this effort.

**Note: This table is for informational purposes only as detailed drawings are not available for the areas and actual dimensions of the survey areas are estimates. Survey units will be adjusted accordingly with actual measurements on site.**

### Table 9 Field Survey Unit Summary Table

| Area/Location | MARSSIM Classification | Total Surface Area (Square meters/Square feet) | Radionuclide(s) of Concern | Number of Survey Units |
|---|---|---|---|---|
| Building 200 Bay 4 Roof | Class 1 | ~ 329/3538 | See Section 11.1 | 4 |
| Building 200 Bay 4 Ceiling | Class 1 | ~329/3538 | See Section 11.1 | 4 |
| Building 200 Bay 4 Walls | Class 1 | ~ 432/4653 | See Section 11.1 | 5 |
| Building 200 Bay 4 Floor | Class 1 | ~ 329/3538 | See Section 11.1 | 4 |

Survey units are limited in size based on classification, exposure pathway modeling assumptions, and site-specific conditions. MARSSIM (Rev. 0, August 2000) recommends areas for survey units according to the following:

| Classification | Suggested Area |
|---|---|
| Class 1 Building Surfaces | up to 100 $m^2$/1076 $ft^2$ floor area |
| Class 2 Building Surfaces | 100 $m^2$/1076 $ft^2$ to 1,000 $m^2$/10,763 $ft^2$ |
| Class 3 Building Surfaces | no limit |

## 12.4 Reference Grids

A reference coordinate system will be laid out for each survey unit. A square grid system will be used for the Final Status Surveys in Building 200 Bay 4. The length, L, of a side of the square grid is determined by the total number of samples or measurements to be taken. The length of the square will determine the distance between direct measurements (MARSSIM, 2000). The length or spacing of the grids will be calculated for the survey unit using the following equation:

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

Where,

L = length of squares grids (ft);

A = surface area of the survey unit ($ft^2$); and

N = statistically calculated number of samples.

The length of the measurement/sampling intervals for each of the survey units is presented in Table 10 below.

**Note: This table is for informational purposes only as drawings are not available for the areas and actual dimensions of the survey areas are estimates. Survey units will be adjusted accordingly with actual measurements on site.**

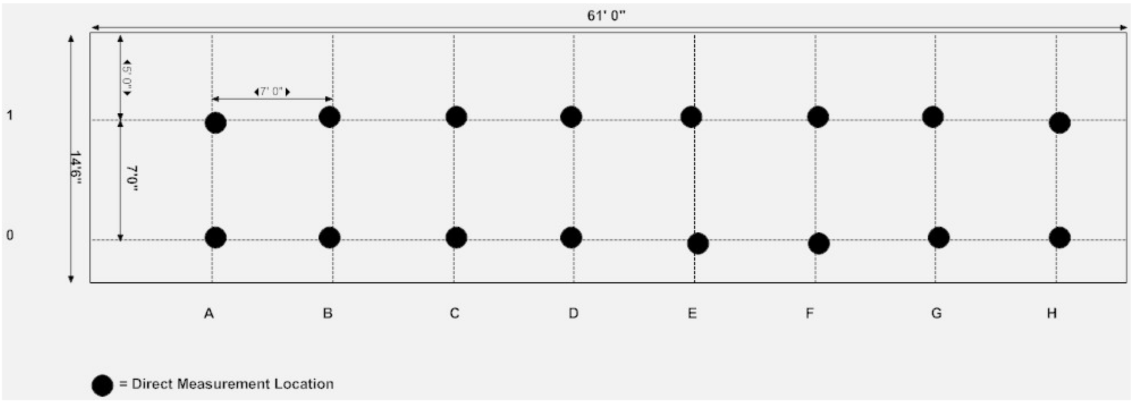
**Table 10 Survey Unit Data Table**

| Survey Unit | Survey Unit Size in $m^2/ft^2$ | MARSSIM Class | Number of Direct Measurements | Length of Grid Pattern in Meters/Feet [1] |
|---|---|---|---|---|
| Building 200 Bay 4 Roof | ~ 82/884.5 | Class 1 | 16 | 2.1/7 |
| Building 200 Bay 4 Ceiling | ~ 82/884.5 | Class 1 | 16 | 2.1/7 |
| Building 200 Bay 4 Walls | ~ 108/1163 | Class 1 | 16 | 2.6/8.5 |
| Building 200 Bay 4 Floor | ~ 82/884.5 | Class 1 | 16 | 2.1/7 |

[1] Actual grid spacing intervals will be calculated in accordance with Sections 12.3 and 12.4 prior to performing the survey.

Figure 8 presents a diagram of the layout of a survey unit for Building 200, Bay 4.

**Figure 8 Building 200 Bay 4 Floor Survey Unit Layout Diagram**




## 12.5 Systematic vs. Biased Sampling

It is important to randomly survey a site, so that each part of the site has an equal chance of being surveyed. This type of survey is called systematic. However, knowledge of the site can identify areas that are more likely to contain contaminants. These should be examined closely. This type of survey is called biased.

Both systematic and biased sampling will be employed in Bay 4 in Building 200. The systematic sampling pattern starting point for the survey unit will be randomly placed. However, in addition to these systematic samples, other samples will be taken where the alpha-beta scan surveys indicates elevated levels of residual contamination, if any are noted. 2-minute alpha-beta direct measurements (throughout the entire survey unit at systematic locations) will also be performed.

Biased measurements and samples will be collected from floor seams, cracks, exhaust ducts, and floor drains if applicable. These measurements and samples will be compared directly to the DCGLs and will not be included as part of the systematic survey unit data sets.

## 12.6 Survey Instrumentation

### *12.6.1 Instrumentation Selection*

Instruments will be selected that are suitable for the physical and environmental conditions at the site. The instruments and measurement methods selected will be able to

detect the radionuclide of concern or radiation types of interest, and are, in relation to the survey or analytical technique, capable of measuring levels that are equal to or less than the release limits.

### *12.6.2 Instruments for the Scan Surveys for Alpha and Beta Surface Activity*

Surface scan surveys for alpha and beta radiation will be conducted with Ludlum Model 43-68 and Model 43-37 alpha-beta gas proportional probes or equivalent and Ludlum Model 2224 alpha/beta rate meter/scaler or equivalent. The probes will have 0.8 $mg/cm^2$ or 0.4 $mg/cm^2$ thick Mylar windows. The detector will be moved over the surface being surveyed at a rate of ½" per second. The detector will be held within ¼" of the surface being surveyed. Audible indicators will be used during the surveys

### *12.6.3 Instruments for the Direct Measurements for Alpha and Beta Surface Activity*

Direct surface contamination surveys for alpha and beta radiation will be conducted with Ludlum Model 43-68 and Model 43-37 alpha-beta gas proportional probes or equivalent and Ludlum Model 2224 alpha/beta rate meters/scalers or equivalent. The probes will have 0.8 $mg/cm^2$ or 0.4 $mg/cm^2$ thick Mylar windows. Direct measurements will be conducted with the detector on contact with the surface for a period of 2 minutes.

### *12.6.4 Gross Beta-Gamma-Alpha Loose Surface Contamination Surveys*

Loose surface contamination surveys of alpha and beta/gamma emitters will be performed using cloth smears.

The swipe survey will be performed by wiping over an area of 100 $cm^2$ (~ 4" by 4") with a cloth smear, applying moderate pressure.

The smears will be analyzed with a Ludlum Model-2929 Dual Channel Scaler phoswich detector or equivalent.

## 12.7 Detection Sensitivity—Static and Scan Minimum Detectable Concentration (MDC), Gross Alpha-Gross Beta Surveys

**NOTE: The calculations in this section are for illustrative purposes only. The instrument efficiencies presented were calculated from experiments conducted by NWT with gas proportional detectors that had a 0.4 $mg/cm^2$ thick window. Actual static and scan MDC calculations will be performed at the time of the survey using the equations below. The counting time for the**

**gross alpha/beta static direct measurement readings will be adjusted accordingly to achieve ≤ 90 % of gross alpha and gross beta residual surface activity release limits.**

### *12.7.1 Determination of Instrument Efficiency ($\varepsilon_I$) for Alpha and Beta Surface Activity Measurements*

The instrument efficiency ($\varepsilon_I$) is determined during calibration and is defined as the ratio between the net count rate (in counts per minute (cpm)) of the instrument and the surface emission rate of the calibration source for a specified geometry. The surface emission rate is the 2π particle fluence that is affected by both the attenuation and backscatter of the radiation emitted from the calibration source. Equation 1 will be used to calculate the instrument efficiency in counts per particle, although efficiency is typically reported as having no units or unitless.

**Equation 1**

$$\varepsilon_i = \frac{R_{S+B} - R_B}{q_{2\Pi}\left({W_A}/{S_A}\right)}$$

Where,

$R_{S+B}$ = the gross count rate of the calibration measurement (cpm)

$R_B$ = the background count rate in cpm

$q_{2\pi}$ = surface emission rate of the calibration source (NIST traceable)

$W_A$ = Active Area of the detector window ($cm^2$)

$S_A$ = Area of the source ($cm^2$)

Note: This equation assumes that the dimensions of the calibration source are sufficient to cover the window of the instrument detector. If the dimensions of the calibration source are smaller than the detector's window, set $W_A$ equal to the dimensions of the calibration source, i.e., set the quotient of $W_A$ and $S_A$ equal to 1.

The instrument efficiency is determined during calibration by obtaining static counts with the detector over a calibration source that has a National Institute of Standards and Technology (NIST) traceable surface emission rate. The 2π particle fluence rate is corrected for decay, attenuation and scatter, then; the surface emission rate

of the source must be corrected for the area subtended by the probe. Factors that can also affect the instruments efficiency are discussed below:

Calibration Sources: The calibration sources selected emit alpha or beta radiation with energies similar to those expected from the contaminant in the field, i.e., similar to the expected radionuclide(s) of concern.

Source Geometry Factors: The instrument efficiency is determined with a calibration source equal to or greater than the area of the probe.

Source-to-Detector Distance: The detector is calibrated at a source-to-detector distance that is the same as the detector-to-surface distance used in the field.

Window Density Thickness: The detector is calibrated with a probe window density thickness that is the same as the probe window density thickness used in the field.

Detector-Related Factors - Ambient Conditions: If ambient conditions such as the temperature, pressure, and humidity vary significantly, during calibration and during field use, corrections to the detector's response will be considered.

### *12.7.2 Static MDC*

The static MDC is the minimum level of radioactivity, on a surface, that can be practically detected by the overall measurement process with a high degree of confidence. The conventional equation, Equation 2, is used to calculate instrument MDCs in dpm per 100 cm$^2$ when the background and sample are counted for the same time intervals.

**Equation 2**

$$MDC = \frac{3 + 4.65\sqrt{C_B * \mathrm{T_B}}}{\varepsilon_i \varepsilon_s \frac{W_A}{100\ cm^2} \mathrm{T_B}}$$

where;

$C_B$ = background count rate (cpm)

$T_B$ = background counting time (min)

$\varepsilon_\iota$ = instrument efficiency (count per particle)

$\varepsilon_s$ = contaminated surface efficiency (particle per disintegration)

$W_A$= area of the detector window ($cm^2$)

If the background and sample are counted for different time intervals, Equation 3 is used to calculate the MDC in dpm per 100 $cm^2$.

**Equation 3**

$$MDC = \frac{3 + 3.29\sqrt{R_B T_{S+B}\left(1 + \frac{T_{S+B}}{T_B}\right)}}{\varepsilon_i \varepsilon_s \frac{W_A}{100\ cm^2} T_{S+B}}$$

where;

$R_B$ = background count rate (cpm)

$T_B$ = background counting time (min)

$T_{S+B}$ = sample counting time (min)

$\varepsilon_\iota$ = the instrument efficiency (count per particle)

$\varepsilon_s$ = the contaminated surface efficiency (particle per disintegration)

$W_A$ = the area of the detector window ($cm^2$)

### *12.7.3 Surface Efficiency ($\varepsilon_s$) for Surface Activity Measurements*

The surface efficiency term in Equation 2 is used to determine the 4π total efficiency for a particular surface and condition. Suitable values are based on the radiation and radiation energy, and are primarily impacted by the backscatter and self-absorption characteristics of the surface on which the contamination exists in the field. Backscatter is most affected by the energy of the radiation and the density of the surface material. Self-absorption characteristics or attenuation are also a function of the radiation’s energy and surface condition. Surfaces typically encountered in the field include concrete, wood, dry wall, plaster, carpet, and metal. Surface conditions include both physical effects, such as scabbled concrete, and the effect of surface coatings, i.e., dust, paint, rust, water, and oil.

In the absence of experimentally determined surface efficiencies, ISO-7503-1 and NUREG 1507, provide conservative recommendations for surface efficiencies. ISO-7503-1, recommends a surface efficiency of 0.5 for maximum beta energies exceeding 0.5 MeV, and to use a surface efficiency of 0.25 for beta energies between 0.15 and 0.4 MeV and for alpha emitters (ISO, 1998), (NRC, 1997). NUREG-1507 provides surface efficiencies based on studies performed primarily at ORISE. In general, NUREG-1507 indicates that the ISO rule-of-thumb for surface efficiencies is conservative, particularly for beta-emitting radionuclides with end-point energies between 0.25 MeV and 0.4 MeV.

The surface conditions at Building 200 Bay 4 are concrete floors and metal walls that may be slightly covered with dust. The surface efficiency for alpha emitters (U-238) used in accordance with ISO-7503-1 is 0.25 and for beta emitters is 0.25.

### *12.7.4 Probe Area Correction Factor for Surface Activity Measurements*

In Equation 2, $W_A$ is the size of the "active" area of the detector window. If the area of the detector window does not equal 100 $cm^2$, it is necessary to convert the detector response to units of dpm per 100 $cm^2$.

### *12.7.5 Calculation of Static MDC for Alpha Surveys (582$cm^2$ probe)*

The following example illustrates the calculation of the MDC in dpm/100$cm^2$ $\beta\gamma$ for the large area gas proportional instrument with a 582 $cm^2$ probe area that will be used for the direct measurement surveys that will be performed during the Final Status Survey. The measurement and background counting times are each two minutes:

Where:

Instrument Efficiency: 20%

Surface Efficiency Factor: 25%

Background Count Rate: 10 CPM

Sample Count Time: 2 minutes

Probe Area Size: 582 $cm^2$

The MDC is calculated using equation 2 as follows:

$$MDC = \frac{3 \ + \ 4.65 \ \sqrt{10 * 2}}{0.25 * 0.20 * 2 * \frac{582}{100}} = \ 41 \text{ dpm/100cm}^2 \ a$$

## *12.7.6 Calculation of Static MDC for Beta Surveys (582cm² probe)*

The following example illustrates the calculation of the MDC in dpm/100cm$^2$ βγ for the large area gas proportional instrument with a 582 cm$^2$ probe area that will be used for the direct measurement surveys that will be performed during the Final Status Survey. The measurement and background counting times are each two minutes:

Where:

Instrument Efficiency: 20%

Surface Efficiency Factor: 25%

Background Count Rate: 1000 CPM

Sample Count Time: 2 minutes

Probe Area Size: 582 cm$^2$

The MDC is calculated using equation 2 as follows:

$$MDC = \frac{3 \ + \ 4.65 \ \sqrt{1000 * 2}}{0.25 * 0.20 * 2 * \frac{582}{100}} = \ 362 \text{ dpm/100cm}^2 \ \beta\gamma$$

### *12.7.7 Calculation of Static MDC for Alpha Surveys (126cm$^2$ probe)*

The following example illustrates the calculation of the MDC in dpm/100 cm$^2$ $\alpha$ for the large area gas proportional instrument with a 126 cm$^2$ probe area that will be used for the direct measurement surveys that will be performed during the Final Status Survey. The measurement and background counting times are each two minutes:

Where:

Instrument Efficiency: 20%

Surface Efficiency Factor: 25%

Background Count Rate: 2 CPM

Sample Count Time: 2 minutes

Probe Area Size: 126 cm$^2$

The MDC is calculated using equation 2 as follows.

$$MDC = \frac{3 + 4.65\sqrt{2 * 2}}{0.25 * 0.20 * 2 * \frac{126}{100}} = 98 \text{ dpm/100cm}^2 \; a$$

### *12.7.8 Calculation of Static MDC for Beta Surveys (126cm$^2$ probe)*

The following example illustrates the calculation of the MDC in dpm/100 cm$^2$ $\beta$ for the large area gas proportional instrument with a 126 cm$^2$ probe area that will be used for the direct measurement surveys that will be performed during the Final Status Survey. The measurement and background counting times are each two minutes:

Where:

Instrument Efficiency: 20%

Surface Efficiency Factor: 25%

Background Count Rate: 200 CPM

Sample Count Time: 2 minutes

Probe Area Size: 126 $cm^2$

The MDC is calculated using equation 2 as follows.

$$MDC = \frac{3 \ + \ 4.65 \ \sqrt{200 * 2}}{0.25 * 0.20 * 2 * \dfrac{126}{100}} = \ 762 \text{ dpm/100cm}^2 \ \beta\gamma$$

*12.7.9 Scanning Minimal Detectable Count Rate, (MDCR)*

The minimum detectable number of net source counts in the scan interval, for an ideal observer, can be arrived at by multiplying the square root of the number of background counts (in the scan interval) by the detectability value associated with the desired performance (as reflected in *d'*) as shown in Equation 4.

**Equation 4**

$$MDCR = d' \sqrt{b_i} \times {}^{60}\!/_{i}$$

where,

d' = index of sensitivity (α and β error) – MARSSIM Table 6.5

$b_i$ = number of background counts in scan time interval (count)

i = scan or observation interval (s) (time that a typical source remains under the probe during the scan)

*12.7.10 Determination of MDCR and Use of Surveyor Efficiency (Beta, 582 $cm^2$ probe)*

The minimum detectable number of net source counts in the interval is given by $S_i$. Therefore, for an ideal observer, the number of source counts required for a specified

level of performance can be arrived at by multiplying the square root of the number of background counts by the detectability value associated with the desired performance (as reflected in *d'*) as shown in the equation below.

$$S_i = d'\sqrt{b_i}$$

The following example illustrates the calculation of the MDCR in dpm/100 $cm^2$ βγ for the large area gas proportional instrument with a 582 $cm^2$ probe area that will be used for the scan surveys that will be performed during the Final Status Survey. The background count rate for these detectors is typically 1000-1200 CPM βγ. For this calculation a background count rate of 1000 CPM will be used. It will be assumed that a typical source remains under the probe for 10 seconds during the scan, therefore the average number of background counts in the observation interval is 166.7 ($b_i$ = 1000 × (10/60)). The required rate of true positives will be 95%, and the false positives will be 5%.

From Table 6.5 of MARSSIM, the value of *d'*, representing this performance goal, is 3.28.

The minimum detectable number of net source counts, $S_i$, needed will be estimated by multiplying 12.9 (the square root of 166.7) by 3.28 (the *d'* value); so $S_i$ equals 42.3.

The minimum detectable source count rate (MDCR), in cpm, may be calculated by:

$$MDCR = S_i(60/i)$$

$$MDCR = 42.3(60/10) = 254cpm$$

The $MDCR_{Surveyor}$ is calculated assuming a surveyor efficiency (p) of 0.5 and

$$MDCR_{Surveyor} = \frac{MDCR}{\sqrt{p}} = \frac{254}{\sqrt{0.5}} = 360cpm$$

### 12.7.11 Determination of MDCR and Use of Surveyor Efficiency (Beta, 126 $cm^2$ probe)

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

$$S_i = d'\sqrt{b_i}$$

The following example illustrates the calculation of the MDCR in dpm/100$cm^2$ βγ for the large area gas proportional instrument with a 126 $cm^2$ probe area that will be used for the scan surveys that will be performed during the Final Status Survey. The background count rate for these detectors is typically 150-200 CPM βγ. For this calculation a background count rate of 200 CPM will be used. It will be assumed that a typical source remains under the probe for 7 seconds during the scan, therefore the average number of background counts in the observation interval is 23 ($b_i = 200 \times (7/60)$). The required rate of true positives will be 95%, and the false positives will be 5%.

From Table 6.5 of MARSSIM, the value of *d'*, representing this performance goal, is 3.28.

The minimum detectable number of net source counts, $S_i$, needed will be estimated by multiplying 4.8 (the square root of 23) by 3.28 (the *d'* value); so $S_i$ equals 15.7.

The minimum detectable source count rate (MDCR), in cpm, may be calculated by:

$$MDCR = S_i(60/i)$$

$$MDCR = 15.7(60/7) = 135cpm$$

The $MDCR_{Surveyor}$ is calculated assuming a surveyor efficiency (p) of 0.5 and a background count rate of 200 cpm as follows:

$$MDCR_{Surveyor} = \frac{MDCR}{\sqrt{p}} = \frac{135}{\sqrt{0.5}} = 190cpm$$

### *12.7.12 Determination of MDCR and Use of Surveyor Efficiency (Alpha, 582 cm² probe)*

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

$$S_i = d'\sqrt{b_i}$$

The following example illustrates the calculation of the MDCR in dpm/100cm² $\alpha$ for the large area gas proportional instrument with a 582 cm² probe area that will be used for the scan surveys that will be performed during the Final Status Survey. The background count rate for these detectors is typically 2-10 CPM $\alpha$. For this calculation a background count rate of 10 CPM will be used. It will be assumed that a typical source remains under the probe for 10 seconds during the scan therefore, the average number of background counts in the observation interval is 1.7 ($b_i = 10 \times (10/60)$). The required rate of true positives will be 95%, and the false positives will be 5%.

From Table 6.5 of MARSSIM, the value of *d'*, representing this performance goal, is 3.28.

The minimum detectable number of net source counts, $S_i$ , needed will be estimated by multiplying 1.3 (the square root of 1.7) by 3.28 (the *d'* value); so $S_i$ equals 4.2.

The minimum detectable source count rate (MDCR), in cpm, may be calculated by:

$$MDCR = S_i(60/i)$$

$$MDCR = 4.2(60/10) = 25.2cpm$$

The $MDCR_{Surveyor}$ is calculated assuming a surveyor efficiency (p) of 0.5 and a background count rate of 10 cpm as follows:

$$MDCR_{Surveyor} = \frac{MDCR}{\sqrt{p}} = \frac{25.2}{\sqrt{0.5}} = 36cpm$$

### *12.7.13 Determination of MDCR and Use of Surveyor Efficiency (Alpha, 126 cm² probe)*

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

The following example illustrates the calculation of the MDCR in dpm/100cm$^2$ $\alpha$ for the large area gas proportional instrument with a 126 cm$^2$ probe area that will be used for the scan surveys that will be performed during the Final Status Survey. The background count rate for these detectors is typically 0-2 CPM $\alpha$. For this calculation a background count rate of 2 CPM will be used. It will be assumed that a typical source remains under the probe for 7 seconds during the scan therefore, the average number of background counts in the observation interval is 0.23 ($b_i = 2 \times (7/60)$). The required rate of true positives will be 95%, and the false positives will be 5%.

From Table 6.5 of MARSSIM, the value of *d'*, representing this performance goal, is 3.28.

The minimum detectable number of net source counts, $S_i$ , needed will be estimated by multiplying 0.48 (the square root of 0.2) by 3.28 (the *d'* value); so $S_i$ equals 1.6.

The minimum detectable source count rate (MDCR), in cpm, may be calculated by:

$$MDCR = S_i(60 / i)$$

$$MDCR = 1.6(60 / 7) = 14 cpm$$

The $MDCR_{Surveyor}$ is calculated assuming a surveyor efficiency (p) of 0.5 and a background count rate of 2 cpm as follows:

$$MDCR_{Surveyor} = \frac{MDCR}{\sqrt{p}} = \frac{15}{\sqrt{0.5}} = 21 cpm$$

### *12.7.14 Scan MDC*

The scan MDC is determined from the minimum detectable count rate (MDCR) by applying conversion factors that account for detector and surface characteristics and surveyor efficiency. As discussed below, the MDCR accounts for the background level, performance criteria (d'), and observation interval. The observation interval during scanning is the actual time that the detector can respond to the contamination source. This interval depends on the scan speed, detector size in the direction of the scan, and area of elevated activity.

The scan MDC for structure surfaces is calculated using Equation 5.

**Equation 5**

$$\text{Scan MDC} = \frac{\text{MDCR}}{\sqrt{p}\ \varepsilon_i \varepsilon_s \frac{\text{W}_A}{100\ \text{cm}^2}}$$

Where;

MDCR = discussed in Section 12.7.9

$p$ = surveyor efficiency factor

$\varepsilon_\iota$ = instrument efficiency (count per particle)

$\varepsilon_s$ = contaminated surface efficiency (particles per disintegration)

$W_A$ = area of the detector window ($cm^2$)

### *12.7.15 Scan MDCs for Building and Structure Surfaces (Beta-Gamma, 126cm² probe)*

The scan MDC for structure surfaces may be calculated:

$$ScanMDC = \frac{MDCR}{\sqrt{p}\ \varepsilon_i \varepsilon_s \frac{probe\ area\ in\ cm^2}{100cm^2}}$$

Where;

MDCR = minimum detectable count rate

$\varepsilon_I$ = instrument efficiency

$\varepsilon_s$ = surface efficiency

p = surveyor efficiency

The scan MDC (in dpm/100 $cm^2$) on the wall surfaces may be determined for a background level of 200 cpm and a 7-second observation interval using a hand-held gas proportional detector (126 $cm^2$ probe area). For the specified level of performance a 95% true positive rate and 5% false positive rate will be required.

$d'$ equals 3.28 (Table 6.5 of MARSSIM) and the MDCR is 135 cpm. Using a surveyor efficiency of 0.5, and assuming instrument and surface efficiencies of 0.20 and 0.25 respectively, the scan MDC is calculated using the equation below:

$$Scan\ MDC = \frac{135}{\sqrt{0.5}\ (0.25)(0.20)(1.26)} = 3049 dpm/100cm^2 \beta\gamma$$

Using the above equations found in Chapter 6 of MARSSIM (Rev. 0, August 2000) the detection sensitivity for such surveys for using the above survey parameters and a large area gas proportional detector is approximately 3,049 dpm/100cm$^2$ beta-gamma.

### *12.7.16 Scan MDCs for Building and Structure Surfaces (Beta-Gamma, 582cm$^2$ probe)*

The scan MDC for structure surfaces may be calculated as;

$$ScanMDC = \frac{MDCR}{\sqrt{p}\ \varepsilon_I \varepsilon_s \frac{probe\ area\ in\ cm^2}{100cm^2}}$$

Where;

MDCR = minimum detectable count rate

$\varepsilon_I$ = instrument efficiency

$\varepsilon_s$ = surface efficiency

p = surveyor efficiency

The scan MDC (in dpm/100 cm$^2$) on the concrete floor surfaces may be determined for a background level of 1000 cpm and a 10-second observation interval using a hand-held gas proportional detector (582 cm$^2$ probe area). For the specified level of performance a 95% true positive rate and 5% false positive rate will be required.

$d'$ equals 3.28 (Table 6.5 of MARSSIM) and the MDCR is 254 cpm. Using a surveyor efficiency of 0.5, and assuming instrument and surface efficiencies of 0.20 and 0.25 respectively, the scan MDC is calculated using the equations below:

$$Scan\ MDC = \frac{254}{\sqrt{0.5}\ (0.25)(0.20)(5.82)} = 1235 dpm/100cm^2 \beta\gamma$$

Using the above equations found in Chapter 6 of MARSSIM (Rev. 0, August 2000) the detection sensitivity for such surveys using the above survey parameters and a large area gas proportional detector is approximately 1235 dpm/100 $cm^2$ beta-gamma.

### *12.7.17 Scan MDCs for Building and Structure Surfaces (Alpha, 126$cm^2$ probe)*

Scanning for alpha emitters differs significantly from scanning for beta and gamma emitters in that the expected background response of most alpha detectors is very close to zero. The following sections cover scanning for alpha emitters and assumes that the surface being surveyed is similar in nature to the material on which the detector was calibrated. In this respect, the approach is purely theoretical. Surveying surfaces that are dirty, non-planar, or weathered can significantly affect the detection efficiency and therefore bias the expected MDC for the scan. The use of reasonable detection efficiency values instead of optimistic values is highly recommended.

Since the time a contaminated area is under the probe varies and the background count rate of some alpha instruments is less than 1 cpm, it is not reasonable to determine a fixed MDC for scanning. Instead, it is more practical to determine the probability of detecting an area of contamination at a predetermined DCGL for given scan rates.

For alpha survey instrumentation with backgrounds ranging from <1 to 3 cpm, a single count provides a surveyor sufficient cause to stop and investigate further. Assuming this to be true, the probability of detecting given levels of alpha surface contamination can be calculated by use of Poisson summation statistics.

Given a known scan rate and a surface contamination release limit, the probability of detecting a single count while passing over the contaminated area is

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

Where

$P(n\geq 1)$ = probability of observing a single count

G = contamination activity (dpm)

E = detector efficiency ($4\pi$)

d = width of detector in direction of scan (cm)

v = scan speed (cm/s)

The following example illustrates the calculation of the calculation of the probability for the large area gas proportional instrument with a 126 $cm^2$ probe area that will be used for the scan surveys of Building 200 Bay 4 that will be performed during the Final Status Survey:

$$1.00 = 1 - e^{\frac{-1150*0.05*8.75}{60(1.25)}}$$

Where

G = 1,150 dpm

E = 5 %

d = 8.75 cm

v = 1.25

Once a count is recorded and the guideline level of contamination is present the surveyor should stop and wait until the probability of getting another count is at least 90%. This time interval can be calculated by:

$$t = \frac{13,800}{CAE}$$

Where

t = time period for static count(s)

C = contamination guideline (dpm/100$cm^2$)

A = physical probe area ($cm^2$)

E = detector efficiency ($4\pi$)

Therefore

$$1.9 \text{ seconds} = \frac{13,800}{1,150 * 126 * 0.05}$$

Where

t = time period for static count(s)

C = 1,150 dpm/100cm$^2$

A = 126 cm$^2$

E = 5 %

Using the above equations found in Chapter 6 of MARSSIM (Rev. 0, August 2000) the probability of detecting 1,150 dpm/100cm$^2$ alpha is approximately 100 %.

### *12.7.18 Scan MDCs for Building and Structure Surfaces (Alpha, 582cm$^2$ probe)*

The larger (582cm$^2$) gas proportional detectors have background count rates on the order of 5 to 10 cpm, and a single count will not cause a surveyor to investigate further. A counting period long enough to establish that a single count indicates an elevated contamination level would be prohibitively inefficient. For these types of instruments, the surveyor usually will need to get at least 2 counts while passing over the source area before stopping for further investigation.

Assuming this to be a valid assumption, the probability of getting two or more counts can be calculated by:

$$P(n \geq 2) = 1 - e^{-\frac{(GE+B)t}{60}} \left( 1 + \frac{(GE+B)t}{60} \right)$$

Where

$P(n \geq 2)$ = probability of getting 2 or more counts during the time interval *t*

*t* = d/v, dwell time over source (s)

G = contamination activity (dpm)

E = detector efficiency (4π)

B = background count rate (cpm)

The following example illustrates the calculation of the calculation of the probability for the large area gas proportional instrument with a 582 cm$^2$ probe area that will be used for the scan surveys that will be performed on the Building 200 Bay 4 floor surfaces during the Final Status Survey:

$$01.00 = 1 - e^{-\frac{(1150*0.05+10)10.8}{60}}\left(1 + \frac{(1150*0.05+10)10.8}{60}\right)$$

Where

$P(n \geq 2)$ = probability of getting 2 or more counts during the time interval *t*

*t* = 13.5/1.25

G = 1150 dpm

E = 5 %

B = 10 cpm

Using the above equations found in Chapter 6 of MARSSIM (Rev. 0, August 2000) the probability of detecting 1,150 dpm/100cm$^2$ alpha is approximately 100 %.

Table 11 below presents the instrumentation that will be used for the Final Status Surveys inside of Building 200 Bay 4. The table also includes the type of NIST traceable checks source that will be used for calculating instrument efficiencies.

## Table 11 Typical Instrumentation for NWT Radiological Surveys

Note: Equivalent instrumentation may be used in place of the stated manufacturer or model. Instrumentation listed is anticipated at the time of development of this plan.

| Type of Measurement/Area Surveyed | Meter | Detector | Bkgd. (See Note 1) | Eff. % (See Note 1) | Type of Check Source | Detection Sensitivity (See Note 1) |
|---|---|---|---|---|---|---|
| Surface Scans- Alpha/Beta/Building 200 Bay 4 Floor | Ludlum Model-2224 Scaler/rate meter | Large Area Gas Prop. Ludlum Model 43-37 (582 $cm^2$) | 1000-1200 CPM $\beta\gamma$<br>2-10 CPM $\alpha$ | ~20 $\beta$<br>~20 $\alpha$ | 100 $cm^2$ Tc-99 Plate Source $\beta$<br>100 $cm^2$ Th-230 Plate Source $\alpha$ | ~ 1235 dpm/100$cm^2$ $\beta\gamma$<br>~ 100 % @ 1150 dpm/100$cm^2$ $\alpha$ |
| Surface Scans- Alpha/Beta/Building 200 Bay 4 Walls | Ludlum Model-2224 Scaler/rate meter | Large Area Gas Prop. Ludlum Model 43-68 (126 $cm^2$) | 150-200 CPM $\beta\gamma$<br>0-2 CPM $\alpha$ | ~20 $\beta$<br>~20 $\alpha$ | 100 $cm^2$ Tc-99 Plate Source $\beta$<br>100 $cm^2$ Th-230 Plate Source $\alpha$ | ~ 3049 dpm/100$cm^2$ $\beta\gamma$<br>~ 100 % @ 1150 dpm/100$cm^2$ $\alpha$ |
| Direct Measurements Alpha/Beta/Building 200 Bay 4 Floor (2-minute) | Ludlum Model-2224 Scaler/rate meter | Large Area Gas Prop. Ludlum Model 43-37 (582 $cm^2$) | 1000-1200 CPM $\beta\gamma$<br>2-10 CPM $\alpha$ | ~20 $\beta$<br>~20 $\alpha$ | 100 $cm^2$ Tc–99 Plate Source $\beta$<br>100 $cm^2$ Th-230 Plate Source $\alpha$ | ~ 362 dpm/100$cm^2$ $\beta\gamma$<br>~ 41 dpm/100$cm^2$ $\alpha$ |
| Direct Measurements Alpha/Beta/Building 200 Bay 4 Walls (2-minute) | Ludlum Model-2224 Scaler/rate meter | Large Area Gas Prop. Ludlum Model 43-68 (126 $cm^2$) | 150-200 CPM $\beta\gamma$<br>0-2 CPM $\alpha$ | ~20 $\beta$<br>~20 $\alpha$ | 100 $cm^2$ Tc–99 Plate Source $\beta$<br>100 $cm^2$ Th-230 Plate Source $\alpha$ | ~ 762 dpm/100$cm^2$ $\beta\gamma$<br>~ 98 dpm/100$cm^2$ $\alpha$ |
| Gross alpha/beta/gamma on Swipe Samples | Ludlum Model-2929 Dual Channel Scaler | Ludlum Model 43-10-1 ZnS Scintillation Detector | 50-75 CPM $\beta\gamma$ | ~32 $\alpha$<br>~20 $\beta\gamma$ | 47 mm or equiv. Tc-99 Source $\beta$<br>47 mm or equiv. Th-230 Source $\alpha$ | ~ 15-22 dpm/100$cm^2$ $\alpha$<br>~ 120-180 dpm/100$cm^2$ $\beta\gamma$ |

Note 1: Actual background values, efficiencies and detection sensitivities will be calculated using actual on site conditions in accordance with Section 12.1 of this plan.

## 12.8 Statistical Considerations

### *12.8.1 Demonstration Of Compliance*

When determining compliance with remediation goals, the survey unit is examined. One measurement does not determine compliance. Rather, the site data are examined statistically. The three compliance tests are summarized in Table 12 below. They include:

- Compare the largest site measurement to the smallest background measurement.
- Compare the average site measurement to the average background measurement.
- Use the Wilcoxon Rank Sum test (MARSSIM, 2000) to determine if the site data (less background) exceed the surface contamination release limits.

**Table 12 Statistical Comparisons with Release Limits**

| Survey Result | Conclusion |
|---|---|
| Difference between the largest survey measurement and the smallest background reference area measurement is less than the surface contamination release limits. | Site meets release criterion. |
| Difference of survey unit and background reference area average is greater than the surface contamination release limits. | Site does not meet release criterion. |
| Difference between any survey unit measurement and any background reference area measurement greater than the surface contamination release limits and the difference of survey unit average and background reference area average is less than the surface contamination release limits. | Site meets release criterion if Wilcoxon Rank Sum test rejects the hypothesis that the survey unit exceeds the release criterion. |

### *12.8.2 Null Hypothesis*

Using the MARSSIM methodology, the null hypothesis is stated as "the residual activity in the survey unit exceeds the release criteria" (Rev. 0, August 2000). Thus, in order to pass the survey unit (that is, release the area), the null hypothesis must be rejected. If necessary, the Wilcoxon Rank Sum Test will be used on the survey data to test the statistical null hypothesis.

### *12.8.3 Confidence Levels*

The Final Status Survey is designed to limit Type I and Type II errors to 5%. It is important to minimize the chances that area grids exceeding the release limits will be missed (Type I) and area grids meeting the release limits will be rejected as too high (Type II). The probability of either of these occurring is set at a maximum of 5%. The Critical Value for the Wilcoxon Rank Sum Test is calculated from these probability values and from the number of samples/measurements taken.

### *12.8.4 Wilcoxon Rank Sum Test*

Since gross alpha-beta measurements (and not radionuclide specific) are being performed as part of this Final Status Survey, Chapter 8, Subsection 8.2.3 of MARSSIM suggests use of the Wilcoxon Rank Sum Test to test the statistical null hypothesis instead of the Sign Test.

The WRS test is a two-sample test that compares the distribution of a set of measurements in a survey unit to that of a set of measurements in a reference area. The test is performed by first adding the value of the release limits to each measurement in the reference area. The combined set of survey unit data and adjusted reference area data are listed, or ranked, in increasing numerical order. If the ranks of the adjusted reference site measurements are significantly higher than the ranks of the survey unit measurements, the survey unit demonstrates compliance with the release criterion. The advantage of this nonparametric test is that it does not assume the data are normally or log-normally distributed. The WRS test also allows for "less than" measurements to be present in the reference area and the survey units.

For this case, the release limit value is added to each of background reference area measurement results that were obtained in the background reference area to obtain the adjusted reference area measurement $Z_i$.

The $m$ adjusted reference sample measurements, $Z_i$, from the reference area and the $n$ sample measurements, $Y_i$, from the survey unit are pooled and ranked in order of increasing size from 1 to N, where $N = m + n$. For this case N=64.

If several measurements are tied *(i.e.*, have the same value), they are all assigned the average rank of that group of tied measurements.

If there are $t$ "less than" values, they are all given the average of the ranks from 1 to $t$.

Therefore, they are all assigned the rank t(t+1)/(2t) = (t+1)/2, which is the average of the first *t* integers. If there is more than one detection limit, all observations below the largest detection limit should be treated as "less than" values.

The ranks of the adjusted measurements from the background reference area are then summed, $W_r$.

Since the sum of the first N integers is N(N+1)/2, one can equivalently sum the ranks of the measurements from the survey unit, $W_s$, and compute $W_r = N(N+1)/2 - W_s$.

Compare $W_r$ with the critical value given in Table I.4 found in Appendix I of MARSSIM for the appropriate values of n, m, and $\alpha$. If $W_r$ is greater than the critical value, the hypothesis that the survey unit exceeds the release criterion is rejected.

If the test shows that the first group is larger than the second, then the release criteria is not met.

### *12.8.5 Direct Measurement/Swipe Sampling Frequency*

It is assumed that there will be no radioactive contamination in the background reference area. The MARSSIM guidelines will be used and a 95 percent confidence level for detecting radioactivity above the investigation level will be assumed. Using the Wilcoxon Rank Sum Test, a release limit of 1150 dpm/100cm$^2$ gross alpha, a LBGR value of 575 dpm/100cm$^2$ (one half of the release limit value), and a Standard Deviation value of 345 dpm/100cm$^2$ (conservative estimate of 30% of the release limit value) with a false negative ($\beta$) error rate of 5 percent, and a false positive error ($\alpha$) rate of 5 percent, the number of survey/sampling data points can then be calculated.

The initial step in determining the number of data points is to calculate the relative shift, $\Delta/\sigma$ = (Release Limit Value-LBGR)/$\sigma$, from the release limit value, the lower bound of the gray region (LBGR), and the standard deviation of the contaminant in the survey unit, $\sigma$. Values of the relative shift that are less than one will result in a large number of measurements needed to demonstrate compliance.

The calculated value of the relative shift is 1.67.

The corresponding value of $P_r$ from Table 5.4 in Chapter 5 of MARSSIM is 0.871014.

The number of direct measurement sample data points (N/2) can then be obtained directly from Table 5.3 in Chapter 5 of MARSSIM. For $\alpha = 0.05$, $\beta = 0.05$ and $\Delta/\sigma =$ 1.0, a value of 16 is obtained for N/2. The table value has already been increased by 20% to account for missing or unusable data and uncertainty in the calculated value of N/2.

The Critical Value is 308

## 12.9 Survey Design

### *12.9.1 Class 1 Areas (Building 200 Bay 4 Floor, Ceiling, Walls)*

#### 12.9.1.1 Gross Alpha/Gross Beta Scan Surveys

The survey will consist of 100% direct scan surveys for alpha-beta radiations using a large area proportional detector system (Ludlum Instruments Model 2224 scaler/rate meter or equivalent coupled to a Ludlum Instruments Model 43-37 large area (582 $cm^2$) and Ludlum Instruments Model 43-68 large area (126 $cm^2$) gas proportional detectors or the equivalent).

#### 12.9.1.2 Gross Alpha/Gross Beta Direct Measurements

The survey will consist of 2-minute direct measurement surveys for alpha-beta radiations using a large area proportional detector system (Ludlum Instruments Model 2224 scaler/rate meter or equivalent coupled to a Ludlum Instruments Model 43-37 large area (582 $cm^2$) gas proportional detectors or the equivalent).

The number of direct measurements taken in the survey unit will be in accordance with Table 10 of this plan.

The spacing interval between the direct measurements will be in accordance with Table 10 of this plan.

The results of the direct measurements will be recorded on form NWT-001RCS, Radiation Contamination Survey Cover Sheet or equivalent electronic spreadsheet.

#### 12.9.1.3 Gross Beta-Gamma-Alpha Loose Surface Contamination Surveys

Loose surface contamination surveys of alpha and beta/gamma emitters will be performed using cloth smears.

The swipe survey will be performed by wiping over an area of 100 $cm^2$ (~ 4" by 4") with a cloth smear, and applying moderate pressure.

The smears will be analyzed with a Ludlum Model-2929 Dual Channel Scaler phoswich detector or equivalent in accordance with NWT

Standard Operating Procedure TM-003-01-20, “Operation and Calibration of the Ludlum Model 2929 Dual Channel Scaler”.

One swipe sample will be collected at each gross alpha/beta direct measurement location.

The results of the smears will be recorded on form NWT-006, Smear Counting Analysis Report or equivalent electronic spreadsheet.

# 13.0 HEALTH AND SAFETY CONSIDERATIONS

The remediation and Final Status Surveys for Bay 4 in Building 200 will be conducted in accordance with the applicable sections of the NWT Health and Safety Plan. All on site personnel shall read and understand the contents of the plan prior to beginning work on the project. All on-site workers shall sign a statement that they have read and understand the requirements of the HASP.

## 13.1 Hazard Analysis

The job hazard Analysis identifies potential safety, health and environmental hazards and provides for the protection of personnel, the community, and the environment.

### *13.1.1 Radiological Exposure*

Residual amounts of low-level radioactive material may be present on the surfaces of the equipment and building surfaces in Bay 4 of Building 200. Personnel performing the surveys and equipment removal shall wear dosimetry and modified Level D PPE as described in Section 13.2.2 of this plan.

## 13.2 Hazard Controls

The following control measures will be implemented during the survey activities. The control measures are intended to supplement the HASP.

### *13.2.1 Radiation Work Permit*

A Radiation Work Permit (RWP) shall be prepared and will specify the activities to be performed and all radiological safety requirements for the work. All personnel assigned to site work will be required to read and sign the RWP acknowledging that they understand the requirements prior to beginning work.

The RWP will also be used as an information document for industrial safety. Hazards other than radiological may be included in the RWP so proper protection can be taken for all possible hazards from one controlling document. Implicit in any RWP is the need for a briefing on the radiological conditions present in the work environment.

The RWP shall list tasks and specific levels of protection for each worker covered by the RWP. The RWP shall also detail the dosimetry requirements, the protective

clothing requirements, and the expected radiation and contamination levels to be encountered during the job.

### *13.2.2 PPE*

Personnel performing the work at NSWCDD will wear modified Level D PPE in accordance with the PPE selection matrix in the HASP.

The modified Level D PPE will consist of:

- Steel-toed shoes;
- Latex rubber or equivalent gloves (when obtaining swipe or soil samples).

### *13.2.3 Safety Equipment*

In addition to other equipment specified in this work plan, the following safety equipment will be staged at the NSWCDD provided office space:

- First aid kit.

## 13.3 Training

Personnel performing activities associated with the NSWCDD work activities will receive training covering this work plan.

All on-site project personnel shall have completed at least 40 hours of hazardous waste operations-related training, as required by the Occupational Safety and Health administration (OSHA) Regulation 29 CFR Part 1910.120. Those personnel who have completed the 40-hour training more than 12 months prior to start of field activities shall have completed an 8-hour refresher course within the past twelve months.

The Health Physics Supervisor shall have completed an additional 8 hours of relevant supervisory health and safety training.

Personnel operating the survey detection equipment will be qualified ANSI 3.1 Senior Health Physics Technicians based on training and experience outlined in Section 4.4.6 and 4.5.3.2 of ANSI standard ANSI/ANS-3.1-1993 (ANSI/ANS, 1993).

A formal review and documentation of the key personnel qualifications to perform the required work will be made by management and verified during the Operational Readiness Review that will be conducted prior to start of work.

The personnel will be familiar with the handling and storage of radioactive materials, contamination controls, and the use of radiation survey equipment.

## 13.4 Hazard Communications

The Project Manager or designee shall ensure that crewmembers understand their obligation to safety and ensure that members are familiar with the elements of the safety program. A copy of this plan will be maintained in the on-site project office.

Daily tailgate safety meetings shall be conducted and documented as specified in the Health and Safety Plan.

Material Safety Data Sheets (MSDSs) for all hazardous substances and materials that will be used on site will be maintained in the on-site project office.

# 14.0 QUALITY ASSURANCE

## 14.1 Equipment

The instruments and systems will be calibrated on an annual frequency using the manufacturer's calibration protocol to National Institute of Standards and Technology (NIST) traceable sources.

The survey instruments will be source checked each day prior to the start of the survey activities each day to verify proper operation of detectors and detection systems.

## 14.2 Records and Reports

The Health Physics Supervisor is responsible for reviewing data for accuracy and completeness before on-site activities are concluded. Electronic records may be substituted, provided appropriate access authorization procedures are in place and quality assurance requirements are met.

All data, notes, measurements, calibrations, and other information pertinent to a survey site must be recorded and maintained. Records must conform to the following basic requirements:

- Marked with date of entry.
- Signed or initialed (by hand or electronically) by the author of the entry.
- Written or printed in a legible manner.
- Contain all pertinent information in a concise, accurate entry.

Column headings or requested information on record data forms may be inappropriate or incorrect for specific site situations. If so, appropriate handwritten changes must be made on the forms. When certain information requested on the presented form is not required, the space or columns should be crossed through or marked "NA" (not applicable) as an indication that such information was not required, rather than having possibly been forgotten.

If data corrections are necessary a single line will be drawn through the entry. New data, initials of the surveyor, and date of correction will be recorded. Data will not be obliterated by erasing or with the use of white-out.

All training records and accident investigation documents will be maintained. The training records will include brief biographies (resumes) certifications, or documents that demonstrate the qualifications of the personnel performing the work.

The Final Status Survey Report will contain records and information necessary to document and support the Final Status Survey effort. All generated records for the project shall be maintained in the on-site office. Records that must be controlled and maintained during the project and presented in the Final Status Survey Report, in addition to site activities include but are not limited to:

- Description of survey design;
- ALARA evaluation/discussion;
- Instrument calibration data;
- Description of area to be released and it's radiological use and history;
- Daily instrument performance check data;
- Instrument efficiency determination data;
- Survey records;
- Dates surveys were performed;
- Survey results and data;
- Description of instrumentation used;
- Instrumentation MDC calculations;
- Smear sample location records;
- Identification of release limits used;
- Sample analysis results;
- Survey maps;
- Quality control data;
- Comparison of survey results to release limits;

Listed records will be maintained on site during project activities. All listed records will be transmitted with the final project report and will be maintained at the NWT corporate office in Livermore, CA.

## 14.3 Quality Control Samples

Paired duplicates of 10 % of the swipe samples will be collected and counted on site. The results of the QC duplicate samples will be compared to each other. A maximum deviation of ± 20% is the satisfactory objective of the comparison of the samples.

In addition, two randomly selected duplicate direct measurements with the same instrumentation used for the initial measurement will be collected from each survey unit. The results of the QC duplicate measurement and initial measurement will be compared to each other. A maximum deviation of ± 20% is the satisfactory objective of the comparison of the measurements. The results of the second measurement will be kept separate from the original data set and statistical testing.

## 14.4 Data Management

Data will be maintained in the on-site office. Back up copies of data will be made routinely and maintained on the computer and/or copier provided. Further, back up copies of survey and sample results will routinely be made to CDs or other electronic media.

# 15.0 SURVEY PROCEDURES AND MEASUREMENT DATA INTERPRETATION

## 15.1 Surface Activity Measurements

Measurements to quantify surface activity levels represent the fundamental compliance measurements for buildings and structures. ISO-7503, NUREG-1507, and ASTM were used as technical guidance to ensure the accurate measurement of surface activity.

Equation 6 is used to document and calculate the surface activity in dpm per 100 cm$^2$.

**Equation 6**

$$A_S = \frac{R_{S+B} - R_B}{\varepsilon_i \varepsilon_S \frac{W_A}{100\,cm^2}}$$

Where;

$A_S$ = total surface activity (dpm/100 cm$^2$)

$R_{S+B}$ = the gross count rate of the measurement in cpm,

$R_B$ = the background count rate in cpm

$\varepsilon_\iota$ = the instrument efficiency (counts per particle)

$\varepsilon_s$ = the contaminated surface efficiency (particles per disintegration)

$W_A$ = the area of the detector window (cm$^2$)

This equation has two efficiency terms, which account for differences between the conditions under which the detector is calibrated, and conditions under which the detector is used in the field. The instrument efficiency ($\varepsilon_i$) is discussed in Section 12.7.1, and is determined under ideal conditions in the laboratory. The surface efficiency, is discussed in Section 12.7.3, and is used to determine the 4π total efficiency for a particular surface and condition.

## 15.2 Action Level Calculations

The gross alpha and gross beta action levels in net cpm, discussed in Section 11.5.5.2 can be calculated using Equation 7 (for gross alpha measurements) and Equation 8 (for gross beta measurements) below

**Equation 7**

$$\text{Net CPM } \alpha = 1035*(\varepsilon_i \varepsilon_s \frac{W_A}{100\ cm^2})$$

**Equation 8**

$$\text{Net CPM } \beta\gamma = 1072*(\varepsilon_i \varepsilon_s \frac{W_A}{100\ cm^2})$$

Where;

$\varepsilon_\iota$ = instrument efficiency (counts per particle)

$\varepsilon_s$ = contaminated surface efficiency (particles per disintegration)

$W_A$ = area of the detector window ($cm^2$)

## 15.3 Data Assessment

Basic statistical quantities will be calculated for the data in order to identify patterns, relationships and any type anomaly.

The Health Physics Supervisor will review data at the end of each phase of the survey to determine the validity of the results and adequate coverage of the survey areas.

# 16.0 FINAL REPORT

After all measurements have been made and laboratory results are complete, the data will be analyzed and a report will be prepared no later than fifty working days following completion of the project. The report will include all measurements, laboratory reports (including quality control results) and analysis of the data. A narrative of the work and conclusions drawn from the results will be presented. Any deviations from this DP will be noted and explained.

# 17.0 RESTRICTED USE CRITERIA

Because no restricted use release is planned, and the Navy will maintain control of the areas for the foreseeable future, no discussions on restricted release are applicable for this DP.

# 18.0 FINANCIAL ASSURANCE/COST ESTIMATE

A cost estimate for completion of decommissioning activities is provided in Table 13 below.

The US Army JMC has issued a delivery order to NWT to include the performance of D & D activities and Final Status Surveys at Building 200 at the NSWCDD. The contract value is for the amount of $213,554.00. This funding does not include D & D efforts on the roof of Bay 4 of Building 200, or transportation and disposal of the waste.

Financial assurance and remaining funding of activities supporting the decommissioning and radiological release of the site at NSWCDD are provided through the U. S. Government, specifically the Department of Defense, and are dependent on congressional appropriation.

**Table 13 Decommissioning Cost Estimate**

| COST ELEMENT | Total |
|---|---|
| Direct Labor | $ 136,528 |
| MI&E | $ 73,699 |
| Travel | $ 13,888 |
| Analyticals | $ 4,684 |
| Supplies | $ 19,653 |
| Equipment | $ 54,493 |
| Freight | $ 66,791 |
| Gov't Freight | $ 1,808 |
| Disposal | $ 22,240 |
| **Total Cost** | **$ 393,983** |

# 19.0 REFERENCES

American National Standards Institute/American Nuclear Society (ANSI/ANS), 1993. *Selection, Qualification, and Training of Personnel for Nuclear Power Plants*, ANSI/ANS, 1993.

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U.S. Nuclear Regulatory Commission (NRC), 2002. *Re-evaluation of the Indoor Resuspension Factor for the Screening Analysis of the Building Occupancy Scenario for NRC's License Termination Rule, NUREG-1720*, April, 2002.

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# Attachment 1

# DandD Version 2.1 Modeling Code DCGL Calculations

# DandD Building Occupancy Scenario

**DandD Version:** 2.1.0
**Run Date/Time:** 12/15/2007 12:19:18 PM
**Site Name:** Dahlgren Building 200
**Description:** DCGL
**FileName:**C:\DandD_Docs\Dahlgren.mcd

## Options:

**Implicit progeny doses included with explicit parent doses**
**Nuclide concentrations are distributed among all progeny**
**Number of simulations:** 100
**Seed for Random Generation:** 8718721
**Averages used for behavioral type parameters**

**External Pathway is ON**
**Inhalation Pathway is ON**
**Secondary Ingestion Pathway is ON**

## Initial Activities:

| Nuclide | Area of Contamination ($m^2$) | Distribution |
|---|---|---|
| **234U** | UNLIMITED | CONSTANT(dpm/100 cm**2) |
| Justification for concentration: DCGL | | Value 3.92E+01 |
| **235U** | UNLIMITED | CONSTANT(dpm/100 cm**2) |
| Justification for concentration: DCGL | | Value 6.60E-01 |
| **238U** | UNLIMITED | CONSTANT(dpm/100 cm**2) |
| Justification for concentration: DCGL | | Value 4.21E+01 |

## Chain Data:

Number of chains: **3**

Chain No. 1: **234U**
Nuclides in chain: **7**

| Nuclide | Chain Position | Half Life | First Parent | Fractional Yield | Second Parent | Fractional Yield | Ingestion CEDE Factor (Sv/Bq) | Inhalation CEDE Factor (Sv/Bq) | Surface Dose Rate Factor ((Sv/d)/(Bq/$m^2$)) | 15 cm Dose Rate Factor ((Sv/d)/(Bq/$m^3$)) |
|---|---|---|---|---|---|---|---|---|---|---|
| **234U** | 1 | 8.92E+07 | | | | | 7.66E-08 | 3.58E-05 | 6.46E-14 | 1.85E-16 |
| **230Th** | 2 | 2.81E+07 | 1 | 1 | 0 | 0 | 1.48E-07 | 8.80E-05 | 6.48E-14 | 5.52E-16 |
| **226Ra** | 3 | 5.84E+05 | 2 | 1 | 0 | 0 | 3.58E-07 | 2.32E-06 | 5.56E-13 | 1.42E-14 |
| **222Rn** | 4 | 3.82E+00 | 3 | 1 | 0 | 0 | 0.00E+00 | 0.00E+00 | 3.41E-14 | 9.81E-16 |
| **210Pb** | 5 | 8.15E+03 | 4 | 1 | 0 | 0 | 1.45E-06 | 3.67E-06 | 2.14E-13 | 1.13E-15 |
| **210Bi** | 6 | 5.01E+00 | 5 | 1 | 0 | 0 | 1.73E-09 | 5.29E-08 | 9.06E-14 | 1.61E-15 |
| **210Po** | 7 | 1.38E+02 | 6 | 1 | 0 | 0 | 5.14E-07 | 2.54E-06 | 7.16E-16 | 2.11E-17 |

Chain No. 2: **235U**

Nuclides in chain: **6**

| Nuclide | Chain Position | Half Life | First Parent | Fractional Yield | Second Parent | Fractional Yield | Ingestion CEDE Factor (Sv/Bq) | Inhalation CEDE Factor (Sv/Bq) | Surface Dose Rate Factor ((Sv/d)/(Bq/m$^2$)) | 15 cm Dose Rate Factor ((Sv/d)/(Bq/m$^3$)) |
|---|---|---|---|---|---|---|---|---|---|---|
| **235U** | 1 | 2.57E+11 | | | | | 7.19E-08 | 3.32E-05 | 1.28E-11 | 3.24E-13 |
| **231Th** | 2 | 1.06E+00 | 1 | 1 | 0 | 0 | 3.65E-10 | 2.37E-10 | 1.60E-12 | 1.68E-14 |
| **231Pa** | 3 | 1.20E+07 | 2 | 1 | 0 | 0 | 2.86E-06 | 3.47E-04 | 3.52E-12 | 8.30E-14 |
| **227Ac** | 4 | 7.95E+03 | 3 | 1 | 0 | 0 | 3.80E-06 | 1.81E-03 | 1.36E-14 | 2.26E-16 |
| **227Th** | 5 | 1.87E+01 | 4 | 0.9862 | 0 | 0 | 1.03E-08 | 4.37E-06 | 8.94E-12 | 2.29E-13 |
| **223Ra** | 6 | 1.14E+01 | 5 | 1 | 4 | 0.0138 | 1.78E-07 | 2.12E-06 | 1.11E-11 | 2.67E-13 |

Chain No. 3: **238U**
Nuclides in chain: **9**

| Nuclide | Chain Position | Half Life | First Parent | Fractional Yield | Second Parent | Fractional Yield | Ingestion CEDE Factor (Sv/Bq) | Inhalation CEDE Factor (Sv/Bq) | Surface Dose Rate Factor ((Sv/d)/(Bq/m$^2$)) | 15 cm Dose Rate Factor ((Sv/d)/(Bq/m$^3$)) |
|---|---|---|---|---|---|---|---|---|---|---|
| **238U** | 1 | 1.63E+12 | | | | | 6.88E-08 | 3.20E-05 | 4.76E-14 | 4.76E-17 |
| **234Th** | 2 | 2.41E+01 | 1 | 1 | 0 | 0 | 3.69E-09 | 9.47E-09 | 7.18E-13 | 1.12E-14 |
| **234U** | 3 | 8.93E+07 | 2 | 1 | 0 | 0 | 7.66E-08 | 3.58E-05 | 6.46E-14 | 1.85E-16 |
| **230Th** | 4 | 2.81E+07 | 3 | 1 | 0 | 0 | 1.48E-07 | 8.80E-05 | 6.48E-14 | 5.52E-16 |
| **226Ra** | 5 | 5.84E+05 | 4 | 1 | 0 | 0 | 3.58E-07 | 2.32E-06 | 5.56E-13 | 1.42E-14 |
| **222Rn** | 6 | 3.82E+00 | 5 | 1 | 0 | 0 | 0.00E+00 | 0.00E+00 | 3.41E-14 | 9.81E-16 |
| **210Pb** | 7 | 8.15E+03 | 6 | 1 | 0 | 0 | 1.45E-06 | 3.67E-06 | 2.14E-13 | 1.13E-15 |
| **210Bi** | 8 | 5.01E+00 | 7 | 1 | 0 | 0 | 1.73E-09 | 5.29E-08 | 9.06E-14 | 1.61E-15 |
| **210Po** | 9 | 1.38E+02 | 8 | 1 | 0 | 0 | 5.14E-07 | 2.54E-06 | 7.16E-16 | 2.11E-17 |

## Initial Concentrations:

**Note: All reported values are the upper bound of the symmetric 95% confidence interval for the** 0.9 **quantile value**

| Nuclide | Surface Concentration (dpm/100 cm**2) |
|---|---|
| 234U | 3.92E+01 |
| 230Th | 0.00E+00 |
| 226Ra | 0.00E+00 |
| 222Rn | 0.00E+00 |
| 210Pb | 0.00E+00 |
| 210Bi | 0.00E+00 |
| 210Po | 0.00E+00 |
| 235U | 6.60E-01 |
| 231Th | 0.00E+00 |
| 231Pa | 0.00E+00 |
| 227Ac | 0.00E+00 |
| 227Th | 0.00E+00 |
| 223Ra | 0.00E+00 |
| 238U | 4.21E+01 |
| 234Th | 0.00E+00 |

# Model Parameters:

## General Parameters:

| Parameter Name | Description | Distribution | |
|---|---|---|---|
| **To:Time In Building** | The time in the building during the occupancy period | CONSTANT(hr/week) | |
| Default value used | | Value | 4.50E+01 |
| **Tto:Occupancy Period** | The duration of the occupancy exposure period | CONSTANT(days) | |
| Default value used | | Value | 3.65E+02 |
| **Vo:Breathing Rate** | The average volumetric breathing rate during building occupancy for an 8-hour work day | CONSTANT(m**3/hr) | |
| Default value used | | Value | 1.40E+00 |
| **RFo*:Resuspension Factor** | Effective resuspension factor during the occupancy period = RFo * Fl | DERIVED(1/m) | |
| Default value used | | | |
| **GO*:Ingestion Rate** | Effective secondary ingestion transfer rate of removable surface activity from building surfaces to the mouth during building occupancy = GO * Fl | DERIVED(m**2/hr) | |
| Default value used | | | |
| **Tstart:Start Time** | The start time of the scenario in days | CONSTANT(days) | |
| Default value used | | Value | 0.00E+00 |
| **Tend:End Time** | The ending time of the scenario in days | CONSTANT(days) | |
| Default value used | | Value | 3.65E+02 |
| **dt:Time Step Size** | The time step size | CONSTANT(days) | |
| Default value used | | Value | 3.65E+02 |
| **Pstep:Print Step Size** | The time steps for the history file. Doses will be written to the history file every n time steps | CONSTANT(none) | |
| Default value used | | Value | 1.00E+00 |
| **AOExt:External Exposure Area** | Minimum surface area to which occupant is exposed via external radiation during occupancy period | CONSTANT(m**2) | |
| Default value used | | Value | 1.00E+01 |
| **AOInh:Inhalation Exposure Area** | Minimum surface area to which occupant is exposed via inhalation during occupancy period | CONSTANT(m**2) | |
| Default value used | | Value | 1.00E+01 |
| **AOIng:Secondary Ingestion Exposure Area** | Minimum surface area to which occupant is exposed via secondary ingestion during occupancy period | CONSTANT(m**2) | |
| Default value used | | Value | 1.00E+01 |
| **AO:Exposure Area** | Minimum surface area to which occupant is exposed during the occupancy period | DERIVED(m**2) | |
| Default value used | | | |
| **Fl:Loose Fraction** | Fraction of surface contamination available for resuspension and ingestion | CONSTANT(none) | |
| Default value used | | Value | 1.00E-01 |
| **Rfo:Loose Resuspension Factor** | Resuspension factor for loose contamination | CONTINUOUS LOGARITHMIC(1/m) | |
| Default value used | | Value | Probability |
| | | 9.12E-06 | 0.00E+00 |
| | | 1.10E-04 | 7.67E-01 |
| | | 1.46E-04 | 9.09E-01 |

| | | | |
|---|---|---|---|
| | | 1.62E-04<br>1.85E-04<br>1.90E-04 | 9.50E-01<br>9.90E-01<br>1.00E+00 |
| **GO:Loose Ingestion Rate** | The secondary ingestion transfer rate of loose removable surface activity from building surfaces to the mouth during building occupancy | CONSTANT(m**2/hr) | |
| Default value used | | Value | 1.10E-04 |

### Correlation Coefficients:

None

## Summary Results:

90.00% **of the** 100 **calculated TEDE values are** < 2.15E+01 **mrem/year .**
**The 95 % Confidence Interval for the** 0.9 **quantile value of TEDE is** 1.91E+01 **to** 2.44E+01 **mrem/year**

## Detailed Results:

**Note: All reported values are the upper bound of the symmetric 95% confidence interval for the** 0.9 **quantile value**

### Concentration at Time of Peak Dose:

| Nuclide | Surface Concentration (dpm/100 cm**2) |
|---|---|
| 234U | 3.92E+01 |
| 230Th | 1.77E-04 |
| 226Ra | 2.55E-08 |
| 222Rn | 2.44E-08 |
| 210Pb | 1.86E-10 |
| 210Bi | 1.72E-10 |
| 210Po | 4.66E-11 |
| 235U | 6.60E-01 |
| 231Th | 6.57E-01 |
| 231Pa | 6.90E-06 |
| 227Ac | 7.24E-08 |
| 227Th | 5.77E-08 |
| 223Ra | 5.10E-08 |
| 238U | 4.21E+01 |
| 234Th | 3.81E+01 |

### Pathway Dose from All Nuclides (mrem)

| All Pathways Dose | External | Inhalation | Secondary Ingestion |
|---|---|---|---|
| 2.44E+01 | 1.68E-03 | 2.44E+01 | 2.61E-02 |

### Radionuclide Dose through All Active Pathways (mrem)

| Nuclide | All Pathways Dose |
|---|---|
| 234U | 1.24E+01 |

| | |
|---|---|
| 230Th | 1.37E-04 |
| 226Ra | 5.60E-10 |
| 222Rn | 5.76E-11 |
| 210Pb | 7.15E-12 |
| 210Bi | 8.14E-14 |
| 210Po | 1.15E-12 |
| 235U | 1.93E-01 |
| 231Th | 1.95E-05 |
| 231Pa | 2.12E-05 |
| 227Ac | 1.15E-06 |
| 227Th | 2.23E-09 |
| 223Ra | 1.01E-09 |
| 238U | 1.19E+01 |
| 234Th | 5.24E-03 |
| All Nuclides | 2.44E+01 |

**Dose from Each Nuclide through Each Active Pathway (mrem)**

| Nuclide | External | Inhalation | Secondary Ingestion |
|---|---|---|---|
| 234U | 4.11E-05 | 1.24E+01 | 1.29E-02 |
| 230Th | 1.86E-10 | 1.37E-04 | 1.12E-07 |
| 226Ra | 2.31E-13 | 5.21E-10 | 3.92E-11 |
| 222Rn | 5.67E-11 | 8.35E-13 | 2.57E-14 |
| 210Pb | 6.45E-16 | 5.99E-12 | 1.15E-12 |
| 210Bi | 2.53E-16 | 7.99E-14 | 1.27E-15 |
| 210Po | 5.43E-19 | 1.04E-12 | 1.03E-13 |
| 235U | 1.37E-04 | 1.93E-01 | 2.04E-04 |
| 231Th | 1.71E-05 | 1.37E-06 | 1.03E-06 |
| 231Pa | 3.95E-10 | 2.11E-05 | 8.47E-08 |
| 227Ac | 9.52E-14 | 1.15E-06 | 1.18E-09 |
| 227Th | 8.39E-12 | 2.22E-09 | 2.55E-12 |
| 223Ra | 2.03E-11 | 9.53E-10 | 3.90E-11 |
| 238U | 3.26E-05 | 1.19E+01 | 1.24E-02 |
| 234Th | 1.46E-03 | 3.18E-03 | 6.03E-04 |

# Attachment 2

# Building 200 Outdoor Areas Final Characterization Survey Report

New World Environmental, Inc., d.b.a.
**New World Technology** *Bringing you the Technology of the New World*

# FINAL CHARACTERIZATION SURVEY REPORT

## BUILDING 200 OUTDOOR AREAS
## Naval Surface Warfare Center Dahlgren Division

**Dahlgren Laboratory**

**DAHLGREN, VA**

For the:

U.S. ARMY JOINT MUNITIONS COMMAND

ROCK ISLAND, IL

October 30, 2007

Rev. 1

*Prepared by:*

**New World Technology**
448 Commerce Way
Livermore, California 94551

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Approvals Page

# FINAL CHARACTERIZATION SURVEY REPORT

Written by: *Daniel M. Spicuzza* Date: 10/30/2007
Daniel M. Spicuzza, Project Manager

Approved by: Date: 10/30/2007
William Haney, Director of Operations

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# ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ALARA | As Low As Reasonably Achievable |
| ANS | American Nuclear Society |
| ANSI | American National Standards Institute |
| AOC | Areas of Concern |
| BLDG | Building |
| Ci | Curies |
| CFR | Code of Federal Regulations |
| cpm | Counts per minute |
| DCGLs | Derived Concentration Guideline Limits |
| D&D | Decontamination and Decommissioning |
| DOD | Department of Defense |
| dpm/100 $cm^2$ | disintegrations per 100 square centimeters |
| DQO | Data Quality Objectives |
| DU | Depleted Uranium |
| $\varepsilon_i$ | Instrument Efficiency |
| $\varepsilon_s$ | Surface Efficiency Factor |
| EPA | Environmental Protection Agency |
| ft | Feet |
| $ft^2$ | square feet |
| FOP | Field Operation Procedure |
| FSSI | Field Support Services Inc. |
| HASP | Health and Safety Plan |
| ISO | International Organization for Standardization |
| LLRW | Low Level Radioactive Waste |
| m | meter |
| $m^2$ | square meter |
| MARSSIM | Multi Agency Radiation Survey & Site Investigation Manual |
| MDC | Minimum Detectable Concentration |

| | |
|---|---|
| MDCR | Minimal Detectable Count Rate |
| MML | Master Materials License |
| MOU | Memorandum of Understanding |
| MSDS | Material Safety Data Sheets |
| mrem/y | Millirem per year |
| N/A | Not Applicable |
| NaI | Sodium iodide |
| NIST | National Institute of Standards and Technology |
| NRC | Nuclear Regulatory Commission |
| NRMP | Navy Radioactive Materials Permit |
| NSWCDD | Naval Surface Warfare Center Dahlgren Division |
| NWT | New World Technology |
| OSHA | Occupational Safety and Health Administration |
| Pa-234m | Protactinium-234 |
| pCi/g | Picocuries per gram |
| PM | Project Manager |
| PPE | Personal Protective Equipment |
| QA | Quality Assurance |
| QC | Quality Control |
| RASO | Naval Sea Systems Command Detachment, Radiological Affairs Support Office |
| RWP | Radiation Work Permit |
| SOPs | Standard Operating Procedures |
| TEDE | Total Effective Dose Equivalent |
| Th-234 | Thorium-234 |
| TLD | thermoluminescent dosimeter |
| U-234 | Uranium-234 |
| U-235 | Uranium-235 |
| U-238 | Uranium-238 |
| μR/h | micro roentgens per hour |
| WRS | Wilcoxon Rank Sum Test |
| y | year |

# RECORD OF REVISIONS

| Revision Number | Description | Date |
|---|---|---|
| 0 | Draft Characterization Survey Report | 8/15/2007 |
| 1 | Final Characterization Survey Report | 10/30/2007 |

# 1.0 EXECUTIVE SUMMARY

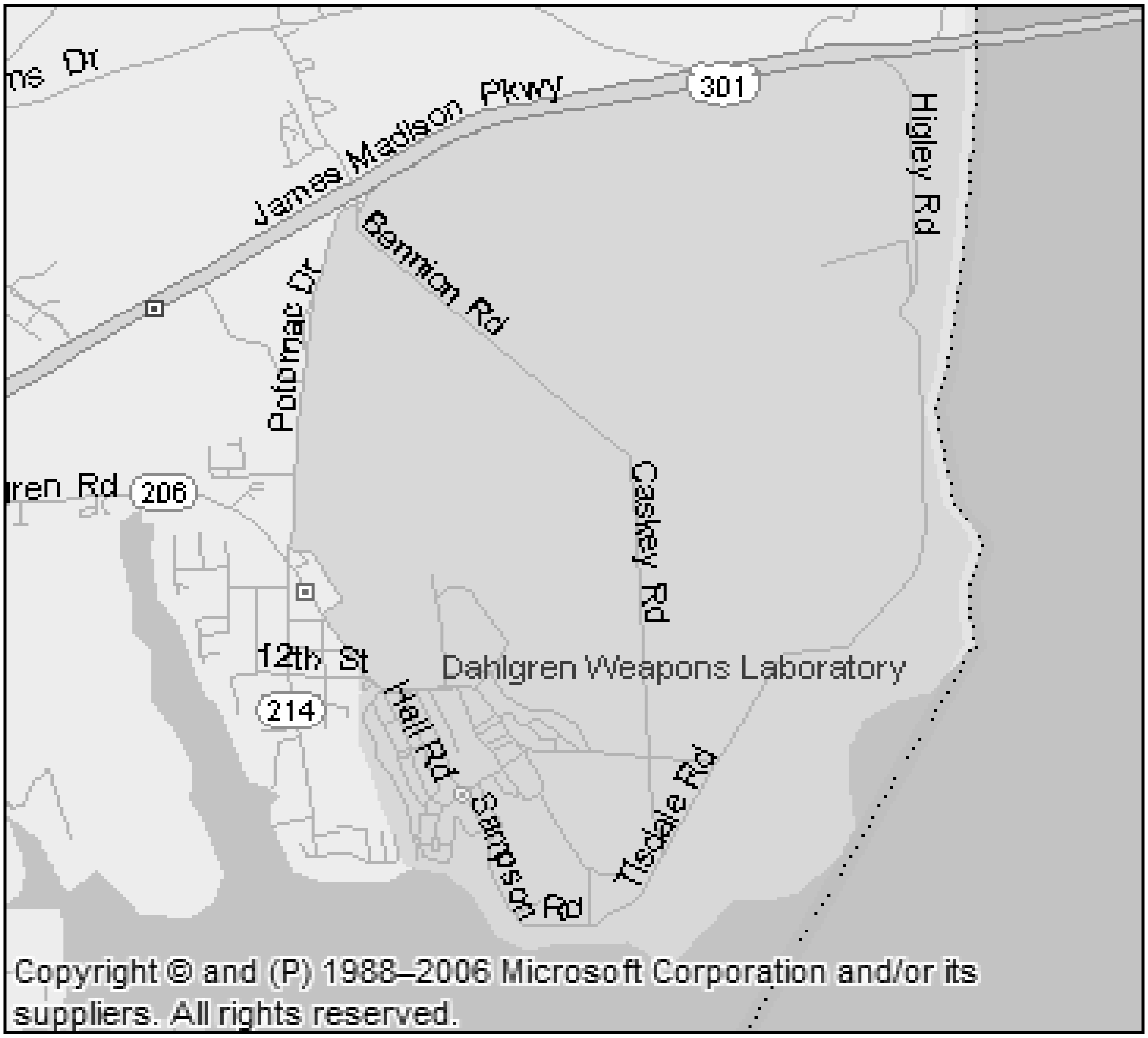
New World Environmental Inc. doing business as New World Technology (NWT) was contracted by the U.S. Army Joint Munitions Command (JMC) to perform remediation activities and characterization surveys in two outdoor areas located outside of Building 200 at the Naval Sea Systems Command, Naval Surface Warfare Center Dahlgren Division (NSWCDD), Dahlgren Laboratory, Dahlgren, VA.

NSWCDD is in the process of terminating their Naval Radioactive Materials Permit (NRMP) originally issued to authorize testing of munitions containing depleted uranium (DU). The testing of DU was performed under the authorization of Atomic Energy Commission/Nuclear Regulatory Commission License No. SMB-1145 issued September 28, 1972 and continuing through 1987 when the license was converted to an NRMP. The termination process will require Building 200, Bay 4 and equipment contained therein, as well as outside areas adjacent to Building 200 referred to as Area "A" and Area "B" to be surveyed, decontaminated, and released for unrestricted use in accordance with the Radiological Affairs Support Office (RASO), the Naval Radiation Safety Committee (NRSC), and the Nuclear Regulatory Commission (NRC) guidance. The criterion for release requires that residual radioactivity, distinguishable from background, results in a calculated dose from all pathways to the average member of the critical group that does not exceed 0.25 mSv/y (25 mrem/y). The areas outside of Building 200 referred to as Area "A" and Area "B" required remediation and performance of characterization surveys. This report only addresses the outdoor areas.

Following remediation of the two areas, a robust characterization survey was performed in the two areas which included a 100% gamma scan survey followed by soil sampling. The results of the characterization surveys indicated that the areas met the criteria for unrestricted use (NRC screening value). The screening value for DU ($^{238}U$) in soil is 14 pCi/g, which can be found in the Federal Register: December 7, 1999 (Volume 64, Number 234, Pages 68395-68396.

A map showing the location of the Dahlgren Laboratory is presented in Figure 1.

**Figure 1 Dahlgren Laboratory Location Map**



## 1.1 Licenses, Permits

NSWCDD conducted testing of depleted uranium (DU) munitions (20 mm-40 mm) under the authority of Atomic Energy Commission (AEC) and subsequently Nuclear Regulatory Commission (NRC) License No. SMB-1145 issued September 28, 1972 and continued through periodic renewals to 1987 when the license was converted to an NRMP. The Navy received an NRC Master Materials License (MML) in 1987. After which, the Navy converted all NRC licenses, issued to Navy and Marine Corps commands, to Naval Radioactive Materials Permits (NRMP). NSWCDD's license was converted to NRMP No. 45-00178-S1NP. NRMP No. 45-00178-S1NP was converted to 45-00178-Y1NP to reflect the status of the facility as storage of residual radioactive contamination awaiting decommissioning.

All work detailed in this report was performed under the Navy's MML.

## 1.2 Facilities and Equipment

The Naval Surface Warfare Center Dahlgren Division (NSWCDD) is located on the western bank of the Potomac River in King George County, Virginia, approximately 25 miles east of Fredericksburg and 40 miles south of Washington, DC. NSWCDD is bounded on the east by the Potomac River (see Figure 1). NSWCDD is one of the six divisions of the Naval Surface Warfare Center. NSWCDD is one of the U. S. Navy's principal research, development, tests and development and engineering centers of fleet support activities for surface warfare, surface ship combat systems, ordnance, strategic systems, amphibious warfare, mines and mine countermeasures, and amphibious and special warfare systems. The Division conducts analysis, systems engineering, research, test, evaluation, and integration of important naval and joint warfare systems.

# 2.0 BACKGROUND INFORMATION

## 2.1 Facility Radiological History

NSWCDD started testing DU munitions in the early 1970s and continued through the early 1990s. Testing was conducted at three sites, an indoor range at Building 200 (Bay 4), and two outdoor ranges: the Building 200 Gun Butt (adjacent to Building 200) and the Harris DU Mound at the Explosives Experimental Area. A map showing the location of Building 200 is presented in Figure 2.

DU munitions were stored in various bunkers prior to use in testing. Contaminated targets and waste material were stored in a fenced exclusion area outside Building 1180.

The Building 1180 outdoor storage area, the Building 200 Gun Butt, and the Harris DU Mound at Pumpkin Neck were all decommissioned between 1992 and 2000. NAVSEADET RASO approved free release of these areas by letters dated 14 Apr 95 and 5 Jun 01. The Navy contracted through the Army Field Support Command for characterization surveys, decontamination and decommissioning work that were performed by Chem-Nuclear, Allied Technology Group, OHM, and IT Corporation. The free release soil concentration limit used in these decommissioning actions was 35 pCi/g of DU.

The Building 200 indoor firing range (Bay 4), areas on the roof of Building 200, and the adjacent grounds of the building are the remaining areas impacted, or potentially impacted by testing of depleted uranium munitions. Building 200 is located approximately 200 feet from the Potomac River and is within the 100 year flood plain. An outside area east and southeast of Building 200 was surveyed and released for unrestricted use during the remediation and final status survey of the Gun Butt located next to Building 200.

Building 200, Bay 4, is the indoor firing range where single shot tests of 20-40 mm DU and tungsten kinetic energy penetrators are evaluated for use in the Phalanx weapons system. Assembled rounds consist of a DU or tungsten penetrator, a sabot that surrounds the penetrators to provide support for the penetrators when in the gun barrel, and a cartridge case filled with propellant. An unofficial estimate is that 2,000 – 3,000 DU rounds were fired in Bay 4 before converting the munitions undergoing testing to tungsten steel alloy.

Bay 4 (indoor firing range) is a long narrow structure that is divided into a gun bay and target bay. The gun bay houses the gun used to fire the penetrators. The two bays are interconnected by a narrow hallway forcing the pieces of the sabot to remain in the gun bay, while the penetrator is allowed to continue into the target bay. The target bay housed instrumentation used for penetrator velocity studies, a steel and aluminum plate array used to evaluate penetrability and break-up of penetrators, and a plywood target butt that stops the penetrators. Target plates and plywood used to backstop the target plates have mostly been removed and previously disposed of as LLRW. Instrumentation has also been removed. Both bays have exhaust ventilation systems that are used to clear smoke and debris.

A diagram of the firing range is included as Figure 3. The gun bay is 14.5 ft wide, 9 ft high, and 138 ft in length. The roof and walls of the gun bay are concrete. The roof of the gun bay is part of single roof covering all the bays. The gun bay roof is sealed with an asphaltic material in good condition. It is not known when the sealant was last applied. The ventilation exhaust fan and housing for the gun bay are located approximately over the gun mount. The target bay is 14.5 ft wide, 9 ft high, and 106 ft in length. The walls and ceiling of the target bay are steel plate. The floor is poured concrete. The plywood gun butt is 8 ft high, 14 feet wide, and 15 inches thick and contains up to 50 DU penetrators. Some penetrators may have passed through the plywood and impacted the back wall. A cart holding plywood sheets and a metal support frame about 40 inches high by 2 feet wide by 6 feet long (steel legs and frame) remain and are contaminated with DU. The ventilation exhaust fan and housing for the target bay are located directly at the southwest edge of Bay 4. The fan housing is connected by a duct to an opening approximately over target area location. The target bay roof is covered by painted foam which is weathered. Rusted steel shows in numerous places. There is a store room adjacent to the target bay with approximate dimensions of 50 feet by 20 feet (The roof of the storeroom may be potentially impacted from ventilation exhaust).

NSWCDD conducted a health physics survey in 1990 to study the ventilation effectiveness on airborne DU concentrations during testing in the target bay. The amount of DU eroded from a penetrator was measured as well as airborne DU concentrations with and without the exhaust ventilation in operation.

The NSWCDD conducted direct surface contamination surveys and swipe surveys of the gun and target bays in 1994 and 1995 that included the exhaust ventilation fans on the roof. The direct surface contamination surveys were conducted with a frisker with an estimated minimum detectable activity of 2000 dpm/100 $cm^2$ alpha activity. In the gun bay, the only contaminated area detected was a hole in a steel deflector plate (that slopes and forms part of the ceiling) caused by a misfire. The ventilation fan and housing and the roof surrounding the housing is contaminated. In the target bay, the floor and one wall were surveyed. Residual contamination was measured on approximately 20-30 square meters of floor, near the target area. Maximum contamination levels on the floor are equivalent to 40,000 to 100,000 dpm/100 $cm^2$. Residual contamination equivalent to 4,000 to 40,000 dpm/100 $cm^2$ was measured on the exhaust fan and housing over the target bay. The roof of the target bay may be potentially contaminated as well as the roof of the adjacent storeroom. Swipe surveys totaled 600 swipes, of which 10 to 20 had removable contamination up to 50 dpm/100$cm^2$. The MDA of the frisker probe used in the direct measurements limits knowledge of DU contamination levels since current DU DCGLs will be much lower than the MDA. There is quite likely more than 20-30 square meters of contaminated floor and walls.

IT Corporation completed a final status survey for the Building 200 Gun Butt that indicated DU contamination of soil adjacent to Building 200 on the northeast side, although the average in the survey grids did not exceed 35 pCi/g or 14 pCi/g. An area (Area A in Figure 4) adjacent to the target bay was not sampled during the characterization survey or the final status survey and could still contain residual contamination exceeding the screening value DCGL that will be used for this project. The screening DCGL for DU is 14 pCi/g, which is less than the 35 pCi/g limit used in the previous decommissioning projects. The soil adjacent to Building 200 immediately below the target bay ventilation fan contained residual contamination levels approaching 35 pCi/g although the average for that grid (14.9 pCi/g) is less than the 35 pCi/g DCGL for the Gun Butt Decommissioning. The soil area southwest of Building 200 (Area B in Figure 4) could likewise be contaminated from the roof ventilation exhaust. Target and waste debris were moved in and out of Building 200 through an equipment access door opening into

this area. The contaminated targets and waste material was packaged and loaded on vehicles for transport to storage outside Building 1180. The area is combinations of grass covered soil and sand or crush and run leading to an asphalt road. This area is identified on Figure 3 as "Open area where target material was loaded for packaging."

The average annual wind speed is 7.6 mph. Strongest winds occur in the late winter and early spring. The mean wind direction is from the south. During February and October, the prevailing wind direction is from slightly east of north.

## 2.2 Scope of Work

Field Support Services Inc. had been contracted to perform environmental restoration services along the shoreline and to the southwest of Building 200. Part of their work included intrusion and excavation into portions of Area B adjacent to Building 200. Their work also included removal and replacement of gravel road along the edge of Area A.

This scope of work included the remediation and performance of characterization surveys of outdoor Area A and Area B.

The areas to be remediated were unexploded ordnance areas. Digging below the asphalt layer in Area B required shielded and remotely operated equipment, this included collecting soil samples. The Navy and FSSI supplied the required equipment and operator for the remote operations and for shielded manned operations.

The installation only allowed for shielded or remote digging on weekends. The work was completed from 14 June 2007 through 16 June 2007.

It was assumed that the volume of radioactively contaminated material could fit in one B-25 box.

## Figure 2 Building 200 Location Map

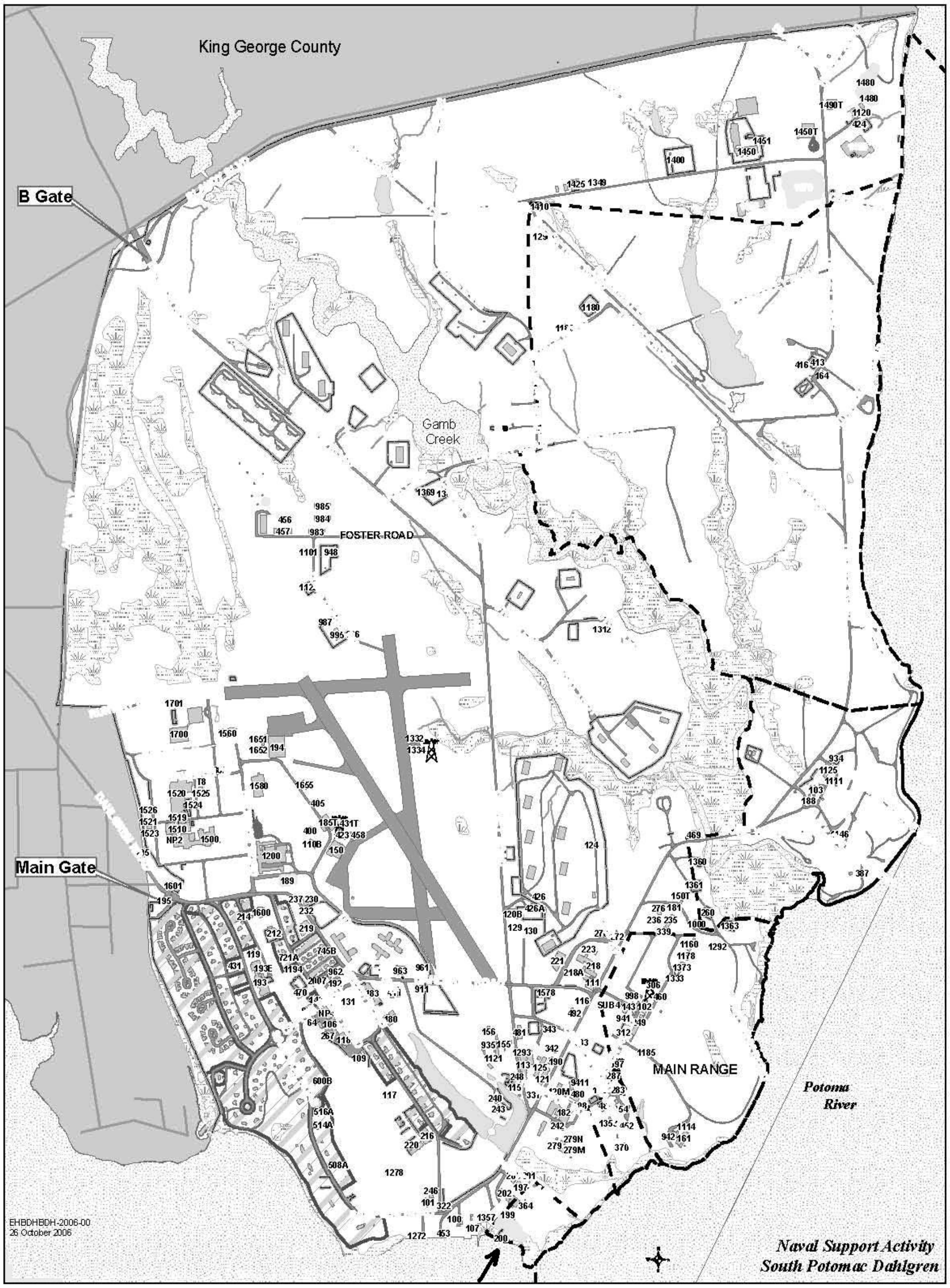


**Figure 3 Building 200 Indoor Range Drawing**

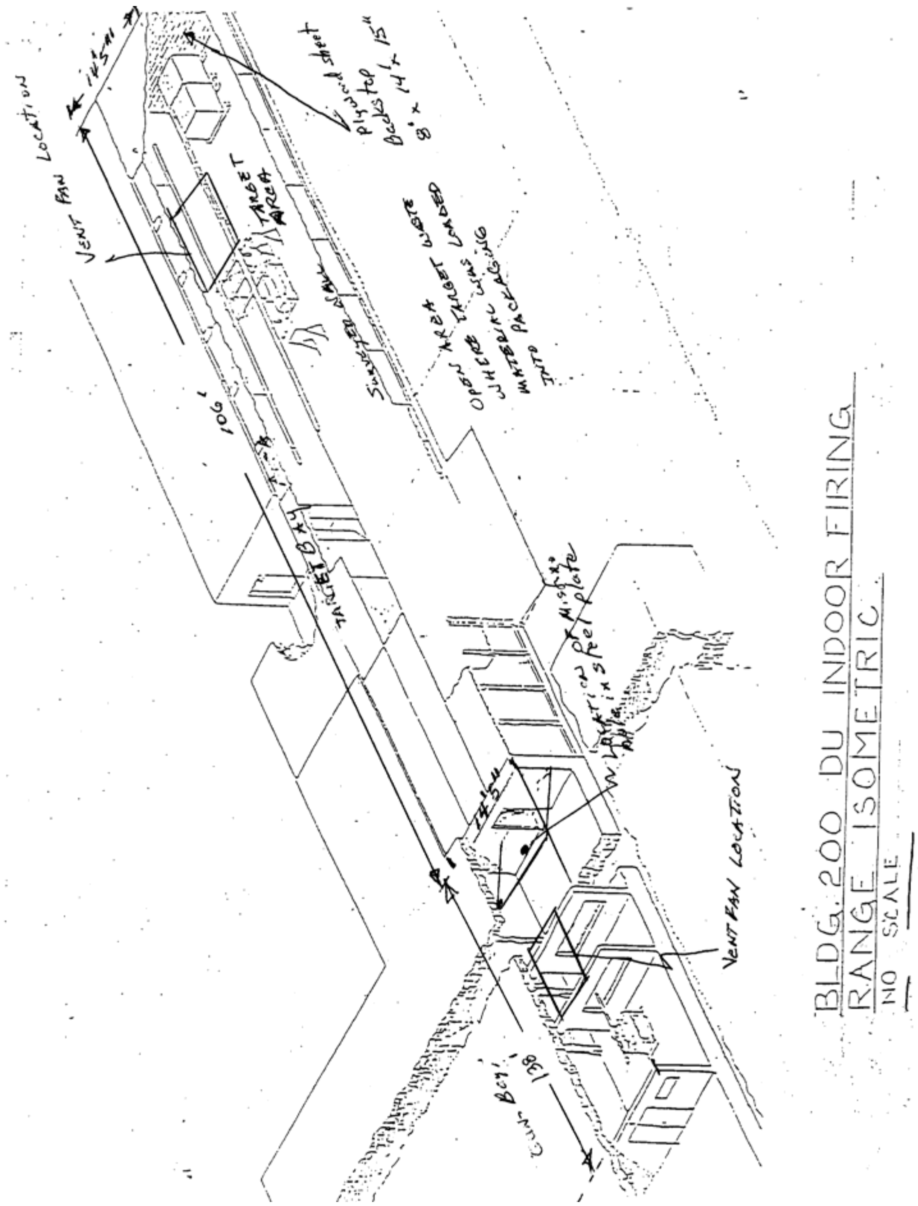
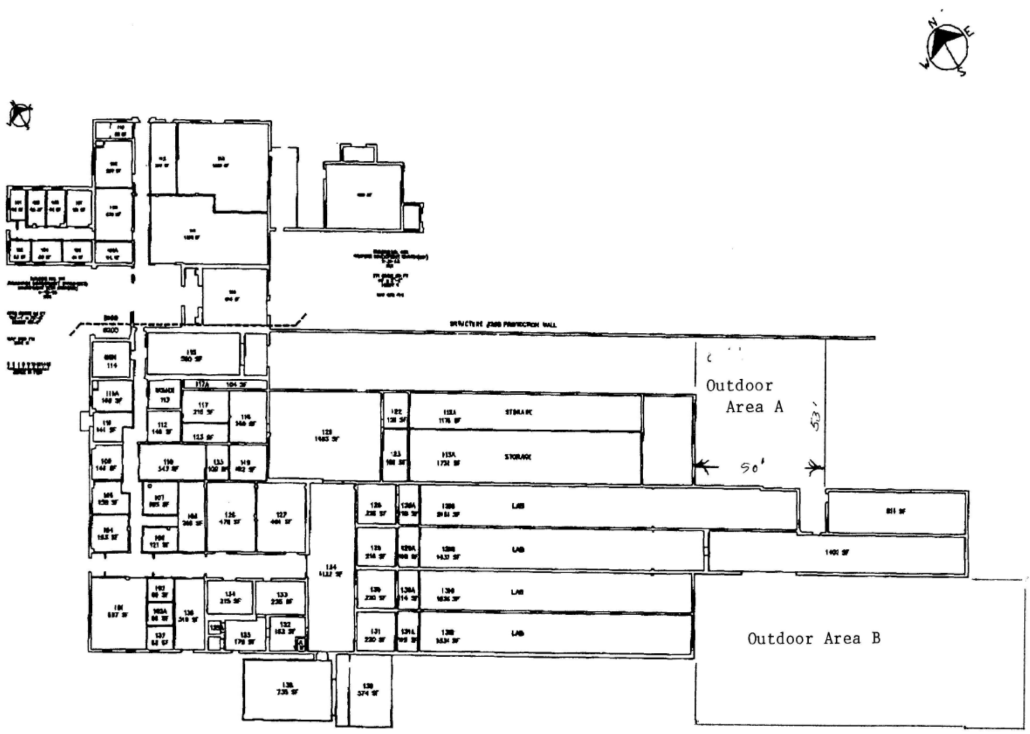


**Figure 4 Building 200 Outdoor Area Drawing**



# 3.0 RADIOLOGICAL CONTROL REQUIREMENTS

## 3.1 Radiation Work Permit

A Radiation Work Permit (RWP) was prepared and specified the activities to be performed and all radiological safety requirements for the work including protective clothing, dosimetry requirements and expected radiation and contamination levels. All personnel assigned to site work were required to read, understand and sign the RWP prior to beginning work.

The RWP was also used as an information document for industrial safety. Hazards other than radiological were included in the RWP so proper protection was taken for all possible hazards.

A copy of the completed RWP is presented in Appendix A of this report.

## 3.2 Personnel Monitoring and Dosimetry

Even though the likelihood that personnel would receive any external or internal exposure was very minimal, NWT administrative policies require the use of external dosimetry on any field project that has the potential for exposure to radioactive material. The Project Manager was responsible for ensuring that all NWT personnel assigned to perform the surveys were appropriately monitored for exposure to ionizing radiation. Each individual working at the site wore the dosimetry devices as specified in the RWP, a thermoluminescent dosimeter (TLD). The issuance of monitoring devices was documented on a Badge Issue Log.

## 3.3 Official Exposure Determination and Project Dose Estimate

The vendor TLD report showed that no personnel received any detectable whole body exposure of < 10 millirem, which is the detection threshold of the TLDs. Personnel were sent a hard copy record (NRC Form 5) of their exposure.

# 4.0 PLANNED CHARACTERIZATION SURVEYS

The surveys consisted of gamma scan surveys with 2" by 2" NaI detectors and the collection of soil samples for gamma spectroscopy analysis. The surveys were performed in accordance with the guidance provided in MARSSIM, while applying the screening value Derived Concentration Guideline Level (DCGL).

# 5.0 SITE PREPARATION, EQUIPMENT AND PERSONNEL

## 5.1 Accessibility

Access to the active work areas was limited to only those personnel performing work in the areas.

## 5.2 Office Space, Restroom Facilities and Electrical Power

Existing facility space and restroom facilities located in Building 200 were utilized by the survey crew during work activities. There was existing electrical power available in the work areas where it was needed.

## 5.3 UXO Briefing

A UXO briefing was conducted with all personnel involved in the remediation/survey activities.

## 5.4 Personnel

Project personnel and their responsibilities consisted of the following:

**Project Manager** – Responsible for the overall operations and safety of the project team.

**Health Physics Technicians** - Performed surveys and sampling operations.

All NWT personnel were trained and experienced at the tasks to be performed.

## 5.5 Training

Initial project training included, but was not limited to:

- UXO Awareness

- Operation of radiological survey instrumentation

# 6.0 REMEDIATION ACTIVITIES

All remediation work using NSWCDD personnel and equipment was done in accordance with CGE-0800-001-04 Procedures for Unexploded Ordnance (UX) Support of Environmental Investigations and Remediation and COE-800-001-04-04 Change Notice B Operation Procedures Supplement (OPS) for GOP No. CGE-0800-001-04, Unexploded Ordnance (UX) Support of Environmental Investigations and Remediation at Site 37. All personnel in the area were required to read and sign the GOP and OPS acknowledging that they understand the requirements prior to beginning work. Coordination of all remediation work with Range Control and with Field Support Services Inc. (FSSI) was essential.

The defined tasks for the remediation effort were:

## 6.1 Area Preparation

Barrier tape or rope was utilized to define the active work areas. 6 mil thick plastic sheeting was used for spreading the soil onto for screening purposes, and to prevent uncontrolled scattering of contamination.

A B-25 box was staged adjacent to the work area to place contaminated soils into.

## 6.2 Removal of Asphalt Surface

Asphalt surface removal was accomplished using a shielded excavator. Removed asphalt surface material was placed on plastic sheeting so the bottom side of the material could be gamma scan surveyed.

## 6.3 Surveys of Removed Asphalt Surface Material

The bottom surface of the removed asphalt surface material was 100 % gamma scan surveyed. None of the survey results of the material exceeded the gamma scan action level described in Section 8.7.3 of this plan.

## 6.4 Removal of Contaminated Soils

Any soil exceeding the gamma scan action level described in Section 8.7.3 was removed and screened for UXO in accordance with GOP/OPS, and placed in the shipping container for storage prior to shipment. Soil removal was accomplished using a remote operated excavator.

## 6.5 Packaging of the Waste Materials

Following screening for UXO the materials were packaged into the B-25 box. The container was covered and had the lid secured to protect the container contents from rain intrusion, and prevent leakage of the container contents. The container met all applicable Department of Transportation requirements. The estimated maximum volume of materials that required removal was approximately 50 cubic feet.

## 6.6 Shipment and Disposal of the Waste Materials

Disposal of the waste materials was not part of this phase of the project. The B-25 box was stored in a secure location inside of the Building 200 firing bay for future disposal.

# 7.0 PLANNING PHASE OF RADIOLOGICAL CHARACTERIZATION SURVEYS

## 7.1 Derived Concentration Guideline Limits (DGGLs)

### *7.1.1 Tools, Equipment, Materials*

The DCGL's for tools, equipment, and material are found in the "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses, By-product, Source, or Special Nuclear Materials, (NRC 1987)" and are summarized in Table 1 below.

**Table 1 Surface Activity DCGL's**

| Radionuclide | Removable in dpm/100cm$^2$ | Average [2] in dpm/100cm$^2$ | Maximum [3] in dpm/100cm$^2$ | Radiations Emitted |
|---|---|---|---|---|
| U-238 | 1,000 | 5,000 | 15,000 | $\alpha$ |

1. Measurements of average contaminant should not be over more than 1 m$^2$
2. The maximum contamination level applies to an area of not more than 100 cm$^2$

### *7.1.2 Soil*

The screening value for DU ($^{238}$U) in soil is 14 pCi/g which can be found in the Federal Register: December 7, 1999 (Volume 64, Number 234, Pages 68395-68396.

# 8.0 IMPLEMENTATION PHASE OF CHARACTERIZATION SURVEYS

## 8.1 Objective of Characterization Surveys

The objective of the characterization surveys was to demonstrate that residual radioactivity levels meet the release criterion. In demonstrating the objective is met, the null hypothesis (Ho) that residual contamination exceeds the release criterion is tested. The alternative hypothesis (Ha) is that residual contamination meets the release criterion.

## 8.2 Background Reference Area Radiation Levels

A site background reference area was chosen that had similar physical, chemical, geological, radiological, and biological characteristics as the survey unit being evaluated. Background reference areas are normally selected from non-impacted areas, but are not limited to natural areas undisturbed by human activities. In some situations, a reference area may be associated with the survey unit being evaluated, but cannot be potentially contaminated by site activities. Generally, reference areas should not be part of the survey unit being evaluated.

The site background count rate levels was established for the characterization surveys by collecting thirty readings (with each instrument to be used), taken at approximately 4" from the surface from areas unlikely to be affected by the residual radioactive materials that could be present at the different survey areas. The average value for these readings was used as the area background radiation levels. An area behind Building 161 was be used as the background reference area. A map showing the location of the background reference area is presented in Figure 5 below.

In addition, during NWT's site visit in March of 2007, 8 soil samples were collected from random locations in the background reference area. Surface (0-15 cm below ground surface) samples were collected from each sampling location.

Sampling equipment and tools were wiped down and surveyed after each sample to ensure no cross contamination occurred during the sampling process.

Approximately 300 to 500 grams of soil was collected from each location. Samples were prepared by removing vegetation, rocks, and foreign objects exceeding ¼ inch in diameter. The samples, once prepared, were placed into an appropriate container. Collection methodology, chain of custody, and analysis requirements are detailed in NWT's FOP's.

The laboratory utilized the gamma emissions from the daughter products Th-234 and Pa-234m to determine the total activity of DU.

The samples were counted at the laboratory for the period of time to achieve a Minimum Detectable Activity (MDA) of less than or equal to approximately 2 pCi/gram. The MDA is the *a priori* net activity level above the critical level that the counting system can be expected to detect 95% of the time. This level of activity represents 14% of the specified DCGL of 14.0 pCi/g.

Table 2 presents a summary of the background reference area readings.

Table 3 presents a summary of the background reference area soil sample results.

The survey data is presented in this report in Appendix B.

The soil sample laboratory data is presented in this report in Appendix C.

## Figure 5 Background Reference Area Location Map

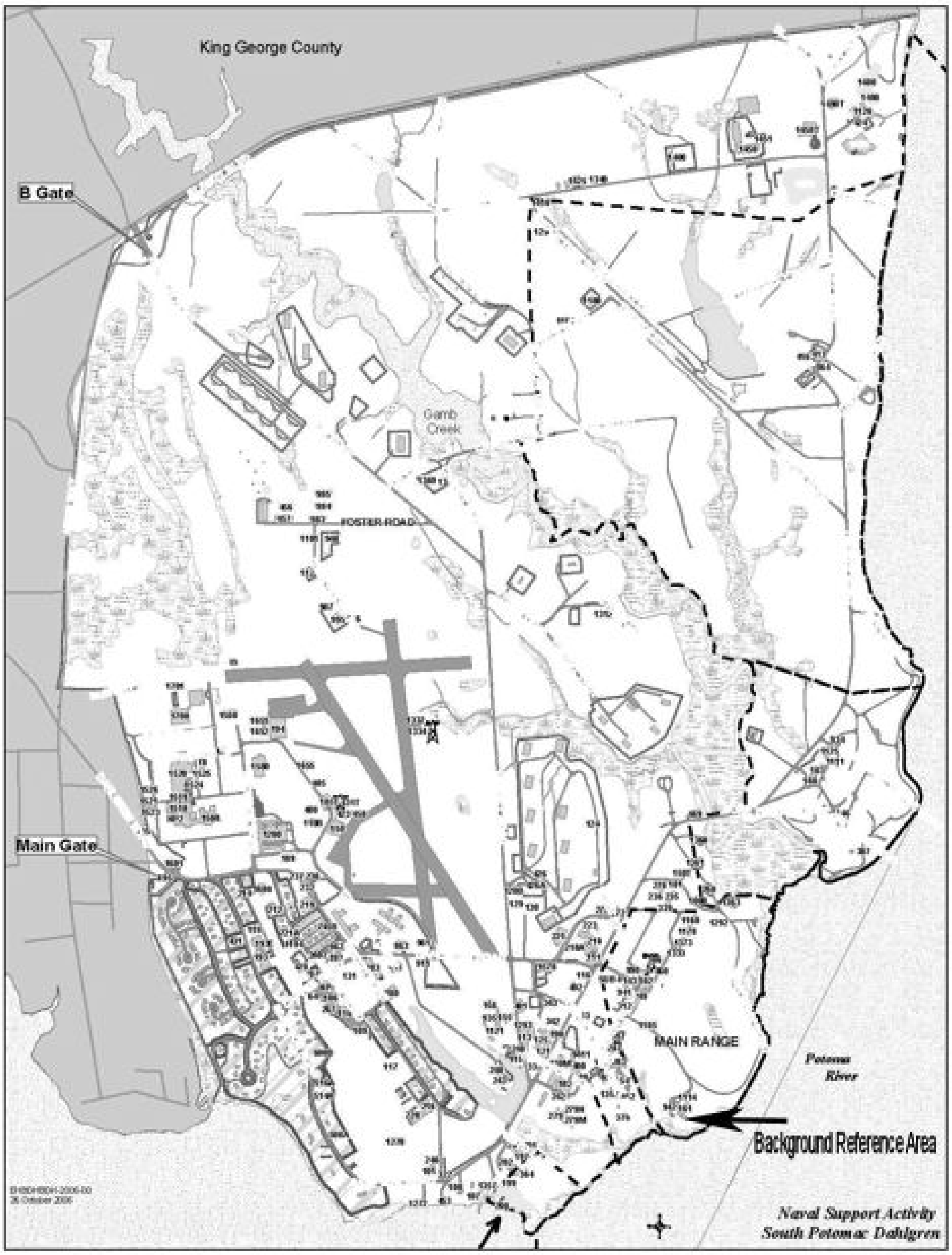


**Table 2 Background Reference Area Summary Table**

| Instrument S/N | Surface Type | Average Background Count Rate in CPM | Action Level In CPM |
|---|---|---|---|
| 228693 | Soil | 6906 | 9017 |
| 228693 | Asphalt | 5890 | 7840 |
| 228710 | Soil | 7197 | 9352 |
| 228710 | Asphalt | 6673 | 8748 |
| 232920 | Soil | 7267 | 9432 |
| 232920 | Asphalt | 6276 | 8289 |

**Table 3 Background Reference Area Soil Sample Summary Table**

| | | | Gamma Spectroscopy | | |
|---|---|---|---|---|---|
| **Sample ID#** | **Sample Matrix** | **Location/Description** | **U-238 Results in pCi/g** | **2 σ Uncertainty +/- pCi/g** | **U-238 Detection Limit in pCi/g** |
| BKG-1 | Soil | Reference Area | 1.310 | 0.670 | 1.700 |
| BKG-2 | Soil | Reference Area | 1.180 | 0.610 | 0.990 |
| BKG-3 | Soil | Reference Area | 0.500 | 1.000 | 1.700 |
| BKG-4 | Soil | Reference Area | 0.310 | 0.960 | 1.700 |
| BKG-5 | Soil | Reference Area | 0.070 | 0.870 | 1.600 |
| BKG-6 | Soil | Reference Area | 0.160 | 0.910 | 1.600 |
| BKG-7 | Soil | Reference Area | 0.390 | 0.790 | 1.400 |
| BKG-8 | Soil | Reference Area | 0.360 | 0.920 | 1.700 |
| | | **Maximum:** | **1.310** | | |
| | | **Average:** | **0.535** | | |
| | | **Standard Deviation:** | **0.459** | | |

## 8.3 Area Classifications

For the purposes of establishing the sampling and measurement frequency and pattern, the Building 200 outdoor areas were divided into impacted areas with one of three following classifications:

*Class 1 Areas*: Areas that have, or had prior to remediation, a potential for radioactive contamination (based on site operational history) or known contamination (based on previous radiation surveys) above the release limits. Examples of Class 1 areas include:

- site areas previously subjected to remedial actions
- locations where leaks or spills are known (or suspected) to have occurred
- radioactive material storage areas
- areas with contaminants in discrete solid pieces of material or high specific activity

*Class 2 Area*s: Areas that have, or had prior to remediation, a potential for radioactive contamination or known contamination but are not expected to exceed the building residual surface activity release limits provided in Tables 1 and 2. To justify changing the classification from Class 1 to Class 2, there should be measurement data that provides a high degree of confidence that no individual measurement would exceed the release limits. Other justifications for reclassifying an area, as Class 2 may be appropriate, based on site-specific considerations. Examples of areas that might be classified as Class 2 include:

- locations where radioactive materials were present in an unsealed form
- areas downwind from the main areas of concern (AOC)
- areas handling radioactive materials
- areas on the perimeter of former contamination control areas

*Class 3 Area*s: Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the release limits, based on site operating history and previous radiation surveys. Examples of areas that might be classified as Class 3 include buffer zones around Class 1 or Class 2 areas and areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification.

Based upon process knowledge, the operational history, past scoping surveys, and routine surveys and inspections performed Area A and Area B were classified as *Class1* areas.

## 8.4 Survey Units

Table 4 below presents the classifications and number of survey units of the areas where the radiological characterization surveys were performed during this effort.

**Table 4 Survey Unit Summary Table**

| Area/Location | MARSSIM Classification | Total Surface Area (Square meters/Square feet) | Radionuclide(s) of Concern | Number of Survey Units |
|---|---|---|---|---|
| Area A | Class 1 | ~ 522/5618 | DU | 1 |
| Area B | Class 1 | ~ 632/6800 | DU | 1 |

Survey units are limited in size based on classification, exposure pathway modeling assumptions, and site-specific conditions. MARSSIM (Rev. 1, August 2000) recommends areas for survey units according to the following:

| Classification | Suggested Area |
|---|---|
| Class 1 Open Land Areas | up to 2,000 $m^2$/21,528 $ft^2$ |
| Class 2 Open Land Areas | 2,000 $m^2$/21,528 $ft^2$ to 10,000 $m^2$/107,639 $ft^2$ |
| Class 3 Open Land Areas | no limit |

## 8.5 Reference Grids

A reference coordinate system was laid out for each survey unit. A square grid system was used for the Building 200 outdoor areas characterization surveys. The length, L, of a side of the square grid is determined by the total number of samples or measurements to be taken. The length of the square determined the distance between direct measurements (MARSSIM, 2000). The length or spacing of the grids was calculated for the survey unit using the following equation:

Where,

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

L = length of squares grids (ft);

A = surface area of the survey unit ($ft^2$); and

N = statistically calculated number of samples.

The length of the measurement/sampling intervals for each of the survey units is presented in Table 5 below.

**Table 5 Survey Unit Data Table**

| Survey Unit | Survey Unit Size in $m^2/ft^2$ | MARSSIM Class | Number of Direct Measurements | Length of Grid Pattern in Meters/Feet |
|---|---|---|---|---|
| Area A | ~ 522/5618 | 1 | 18 | 5.6/18.5 |
| Area B | ~ 632/6800 | 1 | 18 | 5.9/19.5 |

Figure 6 and Figure 7 present diagrams of the layouts of the survey units for Area A and Area B.

**Figure 6 Outdoor Area A Survey Unit Layout Diagram**

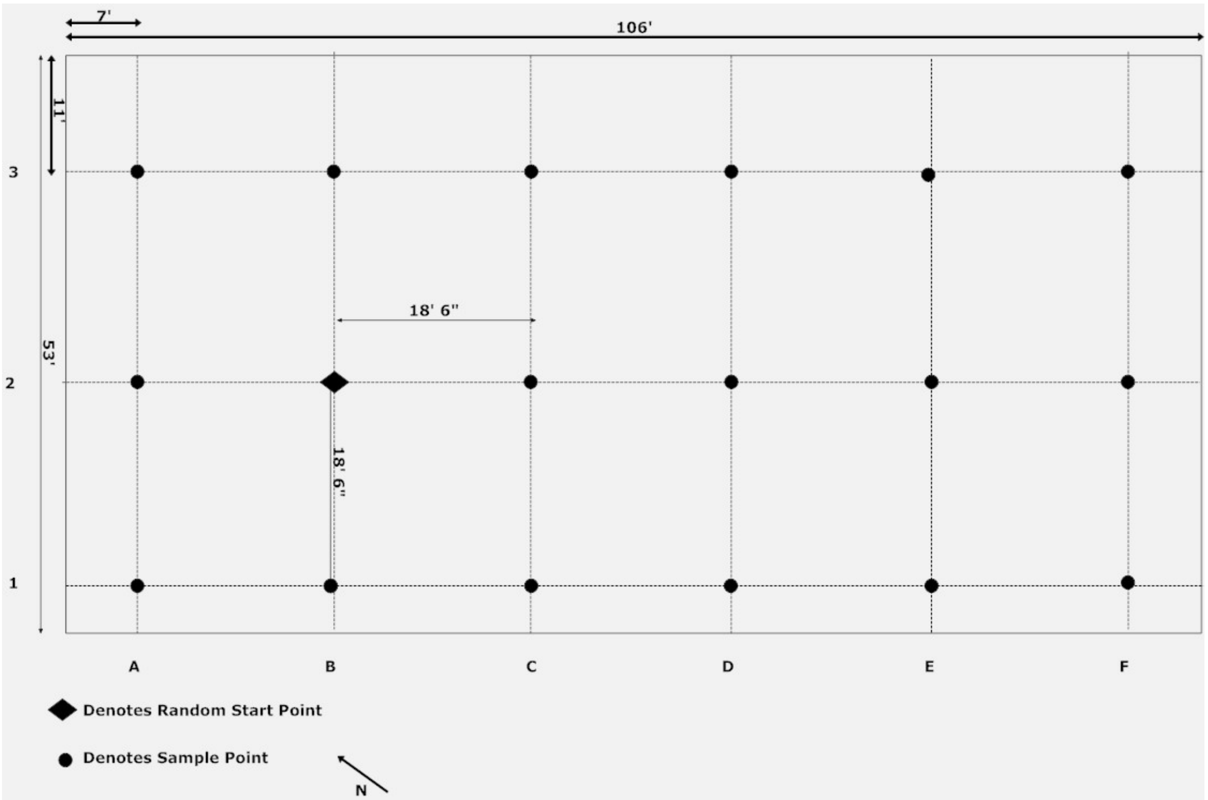
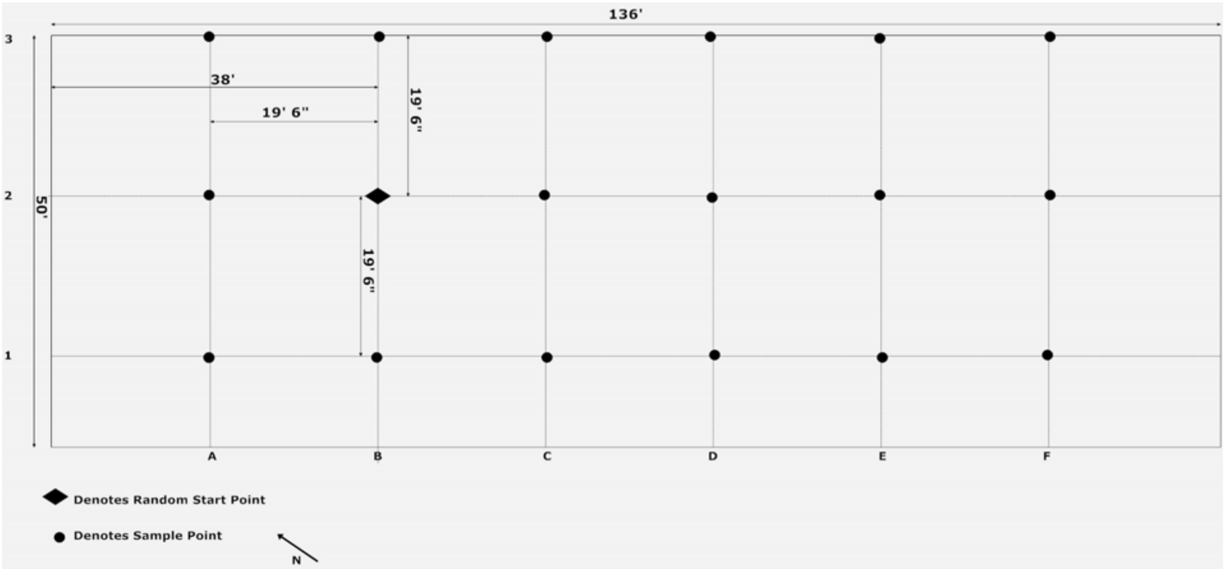


**Figure 7 Outdoor Area B Survey Unit Layout Diagram**




## 8.6 Survey Instrumentation

### *8.6.1 Instrumentation Selection*

Instruments were selected that were suitable for the physical and environmental conditions at the site. The instruments and measurement methods selected were able to detect the radionuclide of concern or radiation types of interest, and are, in relation to the survey or analytical technique, capable of measuring levels that are equal to or less than the release limits.

### *8.6.2 Instruments for the Scan Surveys for Gamma Radiations*

Surface scan surveys for gamma radiation were conducted with Ludlum Model 44-10 2" by 2" NaI scintillation detectors coupled to a Ludlum Model 2350-1 Data Loggers. This radiation detection system measures gamma energies in the range of about 80 to 3,000 kilo electron Volt (keV).

The detector was moved over the surface being surveyed in a serpentine pattern at a rate of 1' per second. The scan rate of 1'per second provides an observation interval of 2-seconds (based on a diameter of about 56 cm for the area of elevated activity). The detectors were held within 4" of the surface being surveyed. Audible indicators were used during the surveys. The data loggers were operated in rate-meter mode with a log frequency (electronic recording of gamma count rate) of six seconds.

### *8.6.3 Instruments for the Scan and Direct Measurement Surveys for Alpha and Beta Surface Activity on Tools/Equipment*

Surface scan surveys for alpha and beta radiation were conducted with Ludlum Model 43-89 large area scintillation detectors coupled to Ludlum Model 2360 data loggers. The probes had 1.2 mg/cm$^2$ thick Mylar windows. The detector was moved over the surface being surveyed at a rate of ½" per second. The detector was held within ¼" of the surface being surveyed. Direct measurements were conducted with the detector on contact with the surface for a period of 2 minutes. Audible indicators were used during the surveys.

### *8.6.4 Gross Beta-Gamma-Alpha Loose Surface Contamination Surveys*

Loose surface contamination surveys of alpha and beta/gamma emitters were performed using cloth smears.

The swipe survey was performed by wiping over an area of 100 cm$^2$ (~ 4" by 4") with a cloth smear, and applying moderate pressure.

The smears were analyzed with a Ludlum Model-2929 Dual Channel Scaler phoswich detector.

## 8.7 Detection Sensitivity-Minimum Detectable Count Rate (MDCR), Gamma Scan Surveys

### *8.7.1 Measurements of Gamma Count Rate*

Ground surfaces were 100 % gamma scanned to identify the presence of elevated direct radiation that might indicate residual gross activity or hot spots. Scanning was performed according to the following Field Operating Procedures (FOP's): NWT OP-001, Radiation and Contamination Survey Techniques, and HSP-010, Gamma Scanning of Site Grounds.

The data loggers were operated in rate-meter mode with a log frequency of six seconds. The calculated minimum detectable count rate (MDCR) was used as an action-level (see Section 8.7.3 below) for investigation. When count rates above this level were observed, the location was marked with marking paint. The marked locations were then subjected to a more detailed survey to evaluate the presence of elevated activity and to delineate the areas.

### *8.7.2 Scanning Minimal Detectable Count Rate, (MDCR)*

The minimum detectable number of net source counts in the interval is given by $S_i$. Therefore, for an ideal observer, the number of source counts required for a specified level of performance can be arrived at by multiplying the square root of the number of

background counts (determined to be ~ 7,000 cpm) by the detectability value associated with the desired performance (as reflected in d') as shown in Equation 1 below:

**Equation 1**

$$S_i = d' \sqrt{b_i}$$

*Where* :

$d'$ = index of sensitivity (α and β error) Table 6.5 of MARSSIM
$b_i$ = number of background counts in scan time interval

$$d' = 3.28$$

$$b_i = 7{,}000\ (2/60)$$

$$b_i = 233$$

*Therefore* :

$$S_i = 3.28\sqrt{233}$$

$$S_i = 50$$

The MDCR is then calculated using Equation 2 below:

**Equation 2**

$$MDCR = S_i \ x(60/i)$$

$$Where:$$
$$i = \text{scan time interval}$$

$$Therefore:$$

$$MDCR = 50 \ x(60/2)$$
$$MDCR = 1500 \ cpm$$

The $MDCR_{surveyor}$ may then be calculated assuming a surveyor efficiency (p) of 0.5 as follows:

$$MDCR_{SURVEYOR} = 1500 / \sqrt{0.5}$$

$$MDCR_{SURVEYOR} = 2121 \ cpm$$

For example, the determined background count rate at Area A and Area B is approximately 7,000 cpm. The instrumentation uses a two second scan interval. Using an index of sensitivity of 3.28 (95% true positive rate and 5% false positive rate); the $MDCR_{surveyor}$ is 2,121 cpm (or 9,121 cpm-gross).

### *8.7.3 Gamma Scan Action Level*

For the purposes of this survey effort, the gamma scan action level was set at the gamma scan MDCR as calculated in Section 8.7.2 above.

Table 5 below presents the instrumentation that was used for the Characterization Surveys at Area A and Area B. The table also includes the type of NIST traceable check sources that was used for calculating instrument efficiencies and performing daily response checks.

## 8.8 Scan MDC

The calculated scan MDC for a 2" by 2" NaI detector is 56 pCi/g as found in Table 6.7 of MARSSIM.

## 8.9 Detection Sensitivity—Static and Scan Minimum Detectable Concentration (MDC), Gross Alpha-Gross Beta Surveys

### *8.9.1 Determination of Instrument Efficiency ($\varepsilon_I$) for Alpha and Beta Surface Activity Measurements*

The instrument efficiency ($\varepsilon_I$) is determined during calibration and is defined as the ratio between the net count rate (in counts per minute (cpm)) of the instrument and the surface emission rate of the calibration source for a specified geometry. The surface emission rate is the 2π particle fluence that is affected by both the attenuation and backscatter of the radiation emitted from the calibration source. Equation 3 was used to calculate the instrument efficiency in counts per particle, although efficiency is typically reported as having no units or unitless.

**Equation 3**

$$\varepsilon_i = \frac{R_{S+B} - R_B}{q_{2\Pi}\left( W_A / S_A \right)}$$

Where,

$R_{S+B}$ = the gross count rate of the calibration measurement (cpm)

$R_B$ = the background count rate in cpm

$q_{2\pi}$ = surface emission rate of the calibration source (NIST traceable)

$W_A$ = Active Area of the detector window ($cm^2$)

$S_A$ = Area of the source ($cm^2$)

Note: This equation assumes that the dimensions of the calibration source are sufficient to cover the window of the instrument detector. If the dimensions of the calibration source are smaller than the detector's window, set $W_A$ equal to the dimensions of the calibration source, i.e., set the quotient of $W_A$ and $S_A$ equal to 1.

The instrument efficiency is determined during calibration by obtaining static counts with the detector over a calibration source that has a National Institute of Standards and Technology (NIST) traceable surface emission rate. The $2\pi$ particle fluence rate is corrected for decay, attenuation and scatter, then; the surface emission rate of the source must be corrected for the area subtended by the probe. Factors that can also affect the instruments efficiency are discussed below:

Calibration Sources: The calibration sources selected emit alpha or beta radiation with energies similar to those expected from the contaminant in the field, i.e., similar to the expected radionuclide(s) of concern.

Source Geometry Factors: The instrument efficiency is determined with a calibration source equal to or greater than the area of the probe.

Source-to-Detector Distance: The detector is calibrated at a source-to-detector distance that is the same as the detector-to-surface distance used in the field.

Window Density Thickness: The detector is calibrated with a probe window density thickness that is the same as the probe window density thickness used in the field.

Detector-Related Factors - Ambient Conditions: If ambient conditions such as the temperature, pressure, and humidity vary significantly, during calibration and during field use, corrections to the detector's response will be considered.

### *8.9.2 Static MDC*

The static MDC is the level of radioactivity, on a surface, that is practically detectable at a confidence level of 95% by the overall measurement process. The conventional equation, Equation 4, was used to calculate instrument MDCs in dpm per 100 $cm^2$ when the background and sample are counted for the same time intervals.

**Equation 4**

$$MDC = \frac{3 + 4.65\sqrt{C_B * T_B}}{\varepsilon_i \varepsilon_s \frac{W_A}{100\ cm^2} T_B}$$

Where,

$C_B$ = background count rate (cpm)

$T_B$ = background counting time (min)

$\varepsilon_\iota$ = instrument efficiency (count per particle)

$\varepsilon_s$ = contaminated surface efficiency (particle per disintegration)

$W_A$= area of the detector window ($cm^2$)

### *8.9.3 Surface Efficiency ($\varepsilon_s$) for Surface Activity Measurements*

The surface efficiency term in Equation 2 is used to determine the 4π total efficiency for a particular surface and condition. Suitable values are based on the radiation and radiation energy, and are primarily impacted by the backscatter and self-absorption characteristics of the surface on which the contamination exists in the field. Backscatter is most affected by the energy of the radiation and the density of the surface material. Self-absorption characteristics or attenuation are also a function of the radiation's energy and surface condition. Surfaces typically encountered in the field include concrete, wood, dry wall, plaster, carpet, and metal. Surface conditions include both physical effects, such as scabbled concrete, and the effect of surface coatings, i.e., dust, paint, rust, water, and oil.

In the absence of experimentally determined surface efficiencies, ISO-7503-1 and NUREG 1507, provide conservative recommendations for surface efficiencies. ISO-7503-1, recommends a surface efficiency of 0.5 for maximum beta energies exceeding 0.5 MeV, and to use a surface efficiency of 0.25 for beta energies between 0.15 and 0.4 MeV and for alpha emitters (ISO, 1998), (NRC, 1997). NUREG-1507 provides surface efficiencies based on studies performed primarily at ORISE. In general, NUREG-1507 indicates that the ISO rule-of-thumb for surface efficiencies is conservative, particularly for beta-emitting radionuclides with end-point energies between 0.25 MeV and 0.4 MeV.

The surface efficiency for alpha emitters (U-238) used in accordance with ISO-7503-1 is 0.25.

### *8.9.4 Probe Area Correction Factor for Surface Activity Measurements*

In Equation 2, $W_A$ is the size of the "active" area of the detector window. If the area of the detector window does not equal 100 $cm^2$, it is necessary to convert the detector response to units of dpm per 100 $cm^2$.

### *8.9.5 Beta Scan MDC*

The beta scan MDC is determined from the minimum detectable count rate (MDCR) by applying conversion factors that account for detector and surface characteristics and surveyor efficiency. As discussed below, the MDCR accounts for the background level, performance criteria (d'), and observation interval. The observation interval during scanning is the actual time that the detector can respond to the contamination source. This interval depends on the scan speed, detector size in the direction of the scan, and area of elevated activity.

The scan MDC for tools/equipment surfaces was calculated using Equation 5 below.

**Equation 5**

$$Scan\ MDC = \frac{MDCR}{\sqrt{p}\ \varepsilon_i \varepsilon_s \frac{W_A}{100\ cm^2}}$$

Where;

MDCR = discussed in Section 7.8.5

$p$ = surveyor efficiency factor

$\varepsilon_i$ = instrument efficiency (count per particle)

$\varepsilon_s$ = contaminated surface efficiency (particles per disintegration)

$W_A$ = area of the detector window ($cm^2$)

### *8.9.6 Alpha Scan MDCs for Tools/Equipment Surfaces (126cm² probe)*

Scanning for alpha emitters differs significantly from scanning for beta and gamma emitters in that the expected background response of most alpha detectors is very close to zero. Surveying surfaces that are dirty, non-planar, or weathered can significantly affect the detection efficiency and therefore bias the expected MDC for the scan. The use

of reasonable detection efficiency values instead of optimistic values has been incorporated.

Since the time a contaminated area is under the probe varies and the background count rate of some alpha instruments is less than 1 cpm, it is not reasonable to determine a fixed MDC for scanning. Instead, it is more practical to determine the probability of detecting an area of contamination at a predetermined DCGL for given scan rates.

For alpha survey instrumentation with backgrounds ranging from <1 to 3 cpm, a single count provides a surveyor sufficient cause to stop and investigate further. Assuming this to be true, the probability of detecting given levels of alpha surface contamination can be calculated by use of Poisson summation statistics.

Given a known scan rate and a surface contamination release limit, the probability of detecting a single count while passing over the contaminated area is calculated using Equation 6 below:

**Equation 6**

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

Where

| | | |
|---|---|---|
| P(n≥1) | = | probability of observing a single count |
| G | = | contamination activity (dpm) |
| E | = | detector efficiency (4π) |
| d | = | width of detector in direction of scan (cm) |
| v | = | scan speed (cm/s) |

Once a count is recorded and the guideline level of contamination is present the surveyor should stop and wait until the probability of getting another count is at least 90%. This time interval can be calculated by Equation 7 below:

**Equation 7**

$$t = \frac{13,800}{CAE}$$

Where

| | | |
|---|---|---|
| t | = | time period for static count(s) |

C = contamination guideline (dpm/100cm$^2$)

A = physical probe area (cm$^2$)

E = detector efficiency (4π)

### *8.9.7 Scan MDC (Alpha)*

Using the following equation (Abelquist, 2001), one can calculate the activity of a 100 cm$^2$ "hot spot" with a 90 % probability of detection using Equation 8 below:

**Equation 8**

$$\alpha\ scanMDC = \frac{[-\ln(1 - P(n \geq 1))]60}{t\varepsilon_i\varepsilon_s}$$

Where

t = dwell time over source (seconds)

$\varepsilon_i$ = Instrument efficiency (counts per particle)

$\varepsilon_s$ = contaminated surface efficiency (particles per disintegration)

Table 6 below presents a summary of the instrumentation used during the performance of the characterization surveys.

## Table 6 Radiological Survey Instrumentation

| | Alpha Measurements | Beta Measurements | Gamma Measurements | |
|---|---|---|---|---|
| Areas Surveyed | Tools/Equipment | Tools/Equipment | Soil | Soil |
| Instrument Model | Ludlum 2360 | Ludlum 2360 | Ludlum 2350-1 | Ludlum 2350-1 |
| Instrument Serial No. | 184905 | 184905 | 232920 | 228710 |
| Instrument Detector | Scintillation Ludlum 43-89 | Scintillation Ludlum 43-89 | 2” by 2” NaI Ludlum 44-10 | 2” by 2” NaI Ludlum 44-10 |
| Probe Serial No. | PR194989 | PR194989 | PR 242823 | PR 242829 |
| Calibration Source | Th-230 100 $cm^2$ | Tc-99 100 $cm^2$ | Cs-137 Button | Cs-37 Button |
| Probe Window Thickness $mg/cm^2$ | 1.2 | 1.2 | N/A | N/A |
| Probe Size in $cm^2$ | 126 | 126 | N/A | N/A |
| Instrument Efficiency ($\varepsilon_i$) | 0.169 | 0.083 | N/A | N/A |
| Instrument Background (CPM) | 0.5 | 217 | 7267 | 7197 |
| Static Count Time (Minutes) | 2 | 2 | N/A | N/A |
| Surface Efficiency ($\varepsilon_s$) | 0.25 | 0.25 | N/A | N/A |
| Total Efficiency ($4\pi$) ($\varepsilon_t$) | .04 | .02 | N/A | N/A |
| Radionuclides of Concern | U-238 | U-238 | U-238 | U-238 |
| Scan MDC in pCi/g | N/A | N/A | 56 | 56 |
| Action Level Gross CPM | N/A | N/A | 9432 | 9352 |
| Static MDC in $dpm/100cm^2$ | 70.5 | 1910 | N/A | N/A |
| Scan Observation Interval (Seconds) | 7 | 7 | 2 | 2 |
| Scan Probability % Alpha Measurements | 100 | N/A | N/A | N/A |
| Scan MDC in $dpm/100cm^2$ Beta Measurements | N/A | 7652 | N/A | N/A |
| Scan MDC in $dpm/100cm^2$ @ 90% Probability Alpha Measurements | 467 | N/A | N/A | N/A |
| Gross DCGL | 5000 | 5000 | 14 | 14 |
| Data Points Required Per Survey Unit | N/A | N/A | 16 | 16 |
| Data Points Per Survey Unit | N/A | N/A | 18 | 18 |
| Statistical Test | N/A | N/A | WRS | WRS |

## 8.10 Soil Samples

### *8.10.1 Gamma Spectroscopy*

In each survey unit, 18 soil samples were collected from the systematic locations. Surface (0-15 cm below ground surface) samples were collected from each sampling location. The calculations that were used to obtain the number of required samples are presented in Section 8.10.5 of this plan.

Sampling equipment and tools were wiped down and surveyed after each sample to ensure no cross contamination occurs during the sampling process.

Approximately 300 to 500 grams of soil was collected from each location. Samples were prepared by removing vegetation, rocks, and foreign objects exceeding ¼ inch in diameter. The samples, once prepared, were placed into an appropriate container. Collection methodology, chain of custody, and analysis requirements are detailed in NWT's FOP’s.

The samples were sent to an off-site laboratory for gamma spectroscopy analysis.

The laboratory utilized the gamma emissions from the daughter products Th-234 and Pa-234m to determine the total activity of DU.

The samples were counted at the laboratory for the period of time to achieve a Minimum Detectable Activity (MDA) of less than or equal to approximately 2 pCi/gram. The MDA is the *a priori* net activity level above the critical level that the counting system can be expected to detect 95% of the time. This level of activity represents 14% of the specified DCGL of 14.0 pCi/g.

### *8.10.2 Alpha Spectroscopy*

In addition to the gamma spectroscopy analysis, two samples from Area A and two samples from Area B were also analyzed by alpha spectroscopy analysis. The alpha spectroscopy analysis included U-234, U-235, and U-238.

## 8.11 Asphalt Samples

Two random samples each were collected from the two separate piles of asphalt removed from Areas A and B.

Sampling equipment and tools were wiped down and surveyed after each sample to ensure no cross contamination occurs during the sampling process.

Approximately 300 to 500 grams of asphalt was collected from each sample location. The samples, once prepared, were placed into an appropriate container. Collection methodology, chain of custody, and analysis requirements are detailed in NWT's FOP's.

The samples were sent to an off-site laboratory for gamma spectroscopy analysis.

The laboratory utilized the gamma emissions from the daughter products Th-234 and Pa-234m to determine the total activity of DU.

The samples were counted at the laboratory for the period of time, determined *a priori*, to achieve a Minimum Detectable Activity (MDA) of less than or equal to approximately 2 pCi/gram at a 95% confidence level. This level of activity represents 14% of the specified DCGL of 14.0 pCi/g.

## 8.12 Statistical Considerations

### *8.12.1 Demonstration of Compliance*

When determining compliance with remediation goals, the survey unit is examined. One measurement does not determine compliance. Rather, the site data are examined statistically. The three compliance tests are summarized in Table 7 below. They include:

- Compare the largest site measurement to the smallest background measurement.
- Compare the average site measurement to the average background measurement.
- Use the Wilcoxon Rank Sum test (MARSSIM, 2000) to determine if the site data (less background) exceed the surface contamination release limits.

**Table 7 Statistical Comparisons with Release Limits**

| Survey Result | Conclusion |
|---|---|
| Difference between the largest survey measurement and the smallest background reference area measurement is less than the surface contamination release limits. | Site meets release criterion. |
| Difference of survey unit and background reference area average is greater than the surface contamination release limits. | Site does not meet release criterion. |
| Difference between any survey unit measurement and any background reference area measurement greater than the surface contamination release limits and the difference of survey unit average and background reference area average is less than the surface contamination release limits. | Site meets release criterion if Wilcoxon Rank Sum test rejects the hypothesis that the survey unit exceeds the release criterion. |

### *8.12.2 Null Hypothesis*

Using the MARSSIM methodology, the null hypothesis is stated as "the residual activity in the survey unit exceeds the release criteria" (Rev. 1, August 2000). Thus, in order to pass the survey unit (that is, release the area), the null hypothesis must be rejected

### *8.12.3 Confidence Levels*

The Characterization Survey was designed to limit Type I and Type II errors to 5%. It is important to minimize the chances that area grids exceeding the release limits will be missed (Type I) and area grids meeting the release limits will be rejected as too high (Type II). The probability of either of these occurring is set at a maximum of 5%. The Critical Value for the Wilcoxon Rank Sum Test is calculated from these probability values and from the number of samples/measurements taken.

### *8.12.4 Wilcoxon Rank Sum Test*

Since gross gamma measurements and not radionuclide specific measurements were performed as part of this Characterization Survey, Chapter 8, Subsection 8.2.3 of MARSSIM suggests use of the Wilcoxon Rank Sum Test to test the statistical null hypothesis instead of the Sign Test.

The WRS test is a two-sample test that compares the distribution of a set of measurements in a survey unit to that of a set of measurements in a reference area. The test is performed by first adding the value of the release limits to each measurement in the reference area. The combined set of survey unit data and adjusted reference area data are listed, or ranked, in increasing numerical order. If the ranks of the adjusted reference site measurements are significantly higher than the ranks of the survey unit measurements, the survey unit demonstrates compliance with the release criterion. The advantage of this nonparametric test is that it does not assume the data are normally or log-normally distributed. The WRS test also allows for “less than” measurements to be present in the reference area and the survey units.

For this case, the release limit value is added to each of background reference area measurement results that were obtained in the background reference area to obtain the adjusted reference area measurement $Z_i$.

The $m$ adjusted reference sample measurements, $Z_i$, from the reference area and the $n$ sample measurements, $Y_i$, from the survey unit are pooled and ranked in order of increasing size from 1 to N, where $N = m+n$. For this case N=26.

If several measurements are tied *(i.e.*, have the same value), they are all assigned the average rank of that group of tied measurements.

If there are *t* "less than" values, they are all given the average of the ranks from 1 to *t*.

Therefore, they are all assigned the rank t(t+1)/(2t) = (t+1)/2, which is the average of the first *t* integers. If there is more than one detection limit, all observations below the largest detection limit should be treated as "less than" values.

The ranks of the adjusted measurements from the background reference area are then summed, $W_r$.

Since the sum of the first N integers is N(N+1)/2, one can equivalently sum the ranks of the measurements from the survey unit, $W_s$, and compute $W_r = N(N+1)/2 - W_s$.

Compare $W_r$ with the critical value given in Table I.4 found in Appendix I of MARSSIM for the appropriate values of n, m, and $\alpha$. If $W_r$ is greater than the critical value, the hypothesis that the survey unit exceeds the release criterion is rejected.

If the test shows that the first group is larger than the second, then the release criteria is not met.

### *8.12.5 Soil Sampling Frequency*

It is assumed that there will be no radioactive contamination in the background reference area. The MARSSIM guidelines were used and a 95 percent confidence level for detecting radioactivity above the investigation level will be assumed. Using the Wilcoxon Rank Sum Test, a release limit of 14 pCi/g, a LBGR value of 7 pCi/g (one half of the release limit value), and a Standard Deviation value of 4.2 pCi/ (conservative estimate of 30% of the release limit value) with a false negative ($\beta$) error rate of 5 percent, and a false positive error ($\alpha$) rate of 5 percent, the number of survey/sampling data points can then be calculated.

The initial step in determining the number of data points is to calculate the relative shift, $\Delta/\sigma$ = (Release Limit Value-LBGR)/$\sigma$, from the release limit value, the lower bound of the gray region (LBGR), and the standard deviation of the contaminant in the survey unit, $\sigma$. Values of the relative shift that are less than one will result in a large number of measurements needed to demonstrate compliance.

The calculated value of the relative shift is 1.67.

The corresponding value of $P_r$ from Table 5.4 in Chapter 5 of MARSSIM is 0.871014.

The number of direct measurement sample data points (N/2) can then be obtained directly from Table 5.3 in Chapter 5 of MARSSIM. For $\alpha = 0.05$, $\beta = 0.05$ and $\Delta/\sigma = 1.67$, a value of 16 is obtained for N/2. The table value has already been increased by 20% to account for missing or unusable data and uncertainty in the calculated value of N/2.

**Note: In order to maintain the proper spacing interval, the number of soil sample data points for the outdoor area survey units was increased to 18. Resulting in a Critical Value of 138.**

*8.12.6 Determining Data Points for Small Areas of Elevated Activity*

The statistical test described above evaluates whether or not the residual radioactivity in an area exceeds the $DCGL_W$ for contamination conditions that are approximately uniform across the survey unit. In order to obtain reasonable assurance that any small areas of elevated residual radioactivity are not missed during the Characterization Survey the total number of samples might have to be increased.

For example, the scan MDC has for DU has been determined to be 56 pCi/g. The area in between the 16 (rounded up to 18) sampling points calculated above for Area A is 32 $m^2$. Interpolating into Table 8.1 of NUREG 1505 gives an area factor for 32 $m^2$ of 5.45 for $^{238}U$. This results in a $DCGL_{EMC} = 5.45\ (DCGL_W) = 5.45(14) = 76.3$ pCi/g. The scan MDC of 56 pCi/g is less than the $DCGL_{EMC}$ so no additional samples were needed in order to find elevated areas of activity.

# 9.0 QUALITY ASSURANCE

## 9.1 Equipment

The instruments and systems were calibrated on an annual frequency using the manufacturer's calibration protocol to National Institute of Standards and Technology (NIST) traceable sources. Copies of the instrument calibration data in presented in Appendix D of this report.

The survey instruments were source checked each day with NIST traceable sources prior to the start of the survey activities each day to verify proper operation of the detectors and detection systems. Copies of the quality control checks and daily instrument response check data is presented in Appendix E of this report.

## 9.2 Data Management

Data was maintained in the on-site office. Back up copies of data were made routinely and maintained on the computer and/or copier provided. Further, back up copies of survey and sample results were routinely made to CDs or other electronic media.

# 10.0 SURVEY PROCEDURES AND MEASUREMENT DATA INTERPRETATION

## 10.1 Surface Activity Measurements

Measurements to quantify surface activity levels represent the fundamental compliance measurements for buildings and structures. ISO-7503, NUREG-1507, and ASTM were used as technical guidance to ensure the accurate measurement of surface activity.

Equation 9 was used to document and calculate the surface activity in dpm per 100 cm$^2$.

**Equation 9**

$$A_S = \frac{R_{S+B} - R_B}{\varepsilon_i \varepsilon_s \frac{W_A}{100\,cm^2}}$$

Where;

$A_S$ = total surface activity (dpm/100 cm$^2$)

$R_{S+B}$ = the gross count rate of the measurement in cpm,

$R_B$ = the background count rate in cpm

$\varepsilon_\iota$ = the instrument efficiency (counts per particle)

$\varepsilon_s$ = the contaminated surface efficiency (particles per disintegration)

$W_A$ = the area of the detector window (cm$^2$)

This equation has two efficiency terms, which account for differences between the conditions under which the detector is calibrated, and conditions under which the detector is used in the field. The instrument efficiency ($\varepsilon_i$) is discussed in Section 7.8.1, and is determined under ideal conditions in the laboratory. The surface efficiency, is discussed in Section 7.8.3, and is used to determine the 4Π total efficiency for a particular surface and condition.

## 10.2 Removable Activity Measurements

Equation 10 was used to calculate the removable surface activity in units of dpm per 100 $cm^2$.

**Equation 10**

$$A_S = \frac{R_{S+B} - R_B}{\varepsilon_i \varepsilon_s}$$

Where:

$A_S$ = removable surface activity (dpm/100 $cm^2$)
$R_{S+B}$ = the gross count rate of the measurement in cpm
$R_B$ = the background count rate in cpm
$\varepsilon_i$ = the instrument efficiency
$\varepsilon_s$ = the contaminated surface efficiency

This equation has two efficiency terms, which account for differences between the conditions under which the detector is calibrated, and conditions under which the swipe is used in the field. The instrument efficiency ($\varepsilon_i$), as discussed in Section 7.8.1, is determined under ideal conditions in the laboratory. The surface efficiency, discussed in Section 7.8.3, is used to determine the total efficiency for a particular surface and condition. The surface efficiency used for the swipe samples for gross alpha activity was 0.25, and for gross beta activity was 0.50.

## 10.3 Data Assessment

Basic statistical quantities were calculated for the data in order to identify patterns, relationships and any type anomaly.

The Project Manager reviewed data at the end of each phase of the survey to determine the validity of the results and adequate coverage of the survey areas.

# 11.0 SURVEY ANALYSIS AND RESULTS

The survey design always makes use of the statistical tests in helping to assure that the number of sampling points and the instrument measurement sensitivities are adequate, but not excessive, for the decision made. Radiological survey data was obtained in units of cpm and activity that have no intrinsic meaning to the release limits. Data was converted to pCi/g to evaluate results with the release limits and to help identify which statistical tests would prove to be the best in interpreting data.

The statistical model used to interpret the data for the tow Building 200 outdoor areas was the WRS test. The WRS test is designed to test a hypothesis about the data results of a population distribution. It is most often used to test the hypothesis about a population median and often involves the use of matched pairs, for example, before and after data, in which case it tests for a median difference of zero. The WRS test does not require the assumption that the population is normally distributed. This test is a nonparametric test that may be of use when it is only necessary (or possible) to know if observed differences between two conditions are significant. The WRS test is structured to denote change in magnitude, as opposed to any attempt at quantitative measurement.

There are two types of decision errors that can be made when performing the statistical tests described in this report. The first type of decision error, called a Type I error, occurs when the null hypothesis is rejected when it is actually true. A Type I error is sometimes called a "false positive." The probability of a Type I error is usually denoted by $\alpha$. The Type I error rate is often referred to as the significance level or size of the test.

The second type of decision error, called a Type II error, occurs when the null hypothesis is not rejected when it is actually false. A Type II error is sometimes called a "false negative." The probability of a Type II error is usually denoted by $\beta$ . The *power* of a statistical test is defined as the probability of rejecting the null hypotheses when it is false. It is numerically equal to $1-\beta$, where $\beta$ is the Type II error rate.

This survey was designed to limit Type I and Type II errors to 5%. It is important to minimize the chances of concluding that a survey unit meets the release limits (reject the null hypothesis) when it actually exceeds the limits (Type I Error) and concluding that a survey unit exceeds the release limit (accept the null hypothesis) when it actually meets the limit (Type II Error). The probability of either of these occurring was set at a maximum of 5 percent.

## 11.1 Area A and Area B Removed Asphalt Surveys

### *11.1.1 Gamma Scan Surveys of Asphalt Surfaces*

No elevated areas of activity above the action levels were detected during the scan surveys.

### *11.1.2 Asphalt Samples*

The results of the asphalt samples collected from the two stockpiles of removed asphalt were below the release criteria of 14 pCi/g.

Table 8 presents a summary of the sample results.

The laboratory sample data is presented in Appendix F of this report.

**Table 8 Asphalt Sample Summary Table**

| | | | Gamma Spectroscopy | | |
|---|---|---|---|---|---|
| **Sample ID#** | **Sample Matrix** | **Location/Description** | **U-238 Results in pCi/g** | **2 σ Uncertainty +/- pCi/g** | **U-238 Detection Limit in pCi/g** |
| APA-1 | Ashpalt | Area A Asphalt Pile | 2.66 | 0.80 | 1.40 |
| APA-2 | Ashpalt | Area A Asphalt Pile | 4.40 | 1.20 | 1.90 |
| APB-1 | Ashpalt | Area B Asphalt Pile | 0.08 | 0.61 | 1.10 |
| APB-2 | Ashpalt | Area B Asphalt Pile | 2.60 | 1.20 | 1.30 |
| | | **Maximum:** | **4.40** | | |
| | | **Average:** | **2.44** | | |
| | | **Standard Deviation:** | **1.78** | | |

## 11.2 Heavy Equipment Incoming/Outgoing Surveys

### *11.2.1 Alpha/Beta Scans of Equipment Surfaces*

No elevated areas of activity above background levels were detected during the scan surveys.

### *11.2.2 Fixed Alpha/Beta Measurements of Heavy Equipment Surfaces*

Release surveys were performed on the heavy equipment used during remediation activities. 2-minute direct measurements were taken on each piece of equipment and compared directly to the release limit. The survey data was converted to units of dpm per 100 $cm^2$ so the results could be compared directly to the release criteria. Table 6 presents a summary of the instruments used to evaluate alpha surface activities and the efficiencies used to convert instrument readings to DCGL units. Table 6 also provides a summary of instrument sensitivities and the release criteria. All of the survey results were less than the release criteria.

The survey data is presented in Appendix G of this report.

### *11.2.3 Swipe Measurements for Removable Gross Alpha/Beta Activity of Heavy Equipment Surfaces*

Swipe samples were conducted on all of the heavy equipment surfaces most likely to have become contaminated with residual radioactive material during remediation activities. Each swipe covered an area of 100 $cm^2$. Although swipe measurements cannot be used to quantify the total surface activity, swipe measurements can indicate the presence of loose surface activity and its removable fraction. As a rule, if the removable fraction of the total surface activity is 10%, the loose surface alpha and beta levels should not exceed approximately 10% of the release criteria.

Appendix G provides the swipe results. All of the swipe measurement results were less than the minimum detectable activity (MDA) of the counting system.

## 11.3 Outdoor Area A

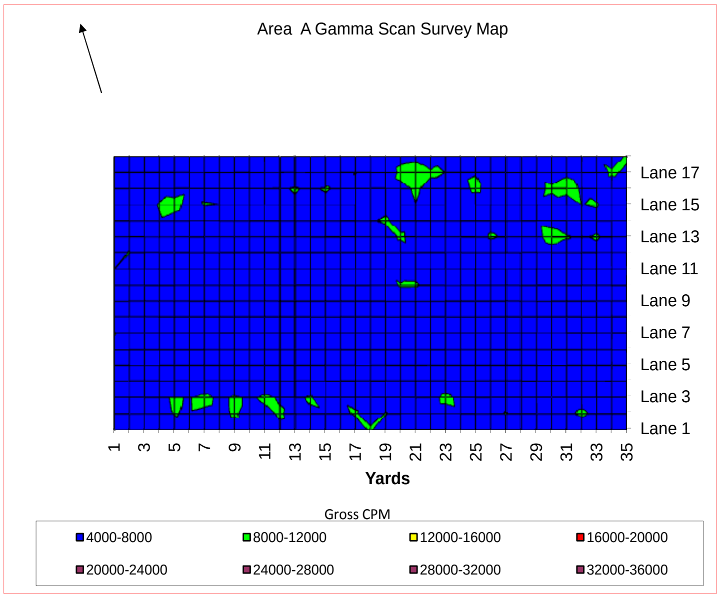
### *11.3.1 Gamma Scan Surveys of Ground Surfaces*

No elevated areas of activity above the action levels were detected during the scan surveys.

Figure 8 presents a map of the scan survey.

The gamma scan survey data is presented in this report in Appendix H.

**Figure 8 Area A Gamma Scan Survey Map**




### *11.3.2 Soil Samples*

The results of the 18 soil samples collected from Area A were below the release criteria of 14 pCi/g.

Table 9 presents a summary of the soil sample results.

## Table 9 Area A Soil Sample Summary Table

| | | | Gamma Spectroscopy | | | Alpha Spectroscopy | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample ID#** | **Sample Matrix** | **Location/Description** | **U-238 Results in pCi/g** | **2 σ Uncertainty +/- pCi/g** | **U-238 Detection Limit in pCi/g** | **U-234 Results in pCi/g** | **2 σ Uncertainty +/- pCi/g** | **U-234 Detection Limit in pCi/g** | **U-235 Results in pCi/g** | **2 σ Uncertainty +/- pCi/g** | **U-235 Detection Limit in pCi/g** | **U-238 Results in pCi/g** | **2 σ Uncertainty +/- pCi/g** | **U-238 Detection Limit in pCi/g** |
| AA-A1 | Soil | Area A | 2.77 | 0.75 | 1.40 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AA-A2 | Soil | Area A | 1.16 | 0.69 | 2.80 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AA-A3 | Soil | Area A | 1.66 | 0.72 | 1.30 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AA-B1 | Soil | Area A | 9.40 | 2.20 | 2.30 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AA-B2 | Soil | Area A | 5.80 | 1.30 | 1.90 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AA-B3 | Soil | Area A | 5.70 | 1.00 | 1.60 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AA-C1 | Soil | Area A | 5.30 | 1.30 | 2.30 | 1.79 | 0.37 | 0.07 | 0.24 | 0.13 | 0.04 | 11.10 | 1.60 | 0.06 |
| AA-C2 | Soil | Area A | 2.88 | 0.72 | 1.40 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AA-C3 | Soil | Area A | 4.50 | 1.10 | 1.70 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AA-D1 | Soil | Area A | 9.20 | 4.00 | 2.90 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AA-D2 | Soil | Area A | -0.50 | 19.00 | 2.00 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AA-D3 | Soil | Area A | 2.86 | 0.84 | 1.60 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AA-E1 | Soil | Area A | 1.95 | 0.82 | 1.00 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AA-E2 | Soil | Area A | 2.60 | 1.10 | 1.20 | 0.54 | 0.17 | 0.07 | 0.03 | 0.05 | 0.08 | 3.17 | 0.55 | 0.06 |
| AA-E3 | Soil | Area A | 3.62 | 0.99 | 1.80 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AA-F1 | Soil | Area A | 3.40 | 1.40 | 1.60 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AA-F2 | Soil | Area A | 2.58 | 0.56 | 1.00 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AA-F3 | Soil | Area A | 4.20 | 1.00 | 1.80 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | **Maximum:** | **9.40** | | | | | | | | | | | |
| | | **Average:** | **3.84** | | | | | | | | | | | |
| | | **Standard Deviation:** | **2.55** | | | | | | | | | | | |

The soil sample laboratory data is presented in this report in Appendix I.

Table 10 presents the WRS test results for Area A.

**Table 10 Area A WRS Test**

DCGL = 14 pCi/g

| Survey Point | DATA pCi/g | AREA | ADJUSTED DATA | RANKS | REFERENCE AREA RANKS |
|---|---|---|---|---|---|
| 1 | 1.3 | R | 15.3 | 26 | 26 |
| 2 | 1.2 | R | 15.2 | 25 | 25 |
| 3 | 0.5 | R | 14.5 | 24 | 24 |
| 4 | 0.3 | R | 14.3 | 21 | 21 |
| 5 | 0.1 | R | 14.1 | 19 | 19 |
| 6 | 0.2 | R | 14.2 | 20 | 20 |
| 7 | 0.4 | R | 14.4 | 23 | 23 |
| 8 | 0.4 | R | 14.4 | 22 | 22 |
| A1 | 2.8 | S | 2.8 | 7 | 0 |
| A2 | 1.2 | S | 1.2 | 2 | 0 |
| A3 | 1.7 | S | 1.7 | 3 | 0 |
| B1 | 9.4 | S | 9.4 | 18 | 0 |
| B2 | 5.8 | S | 5.8 | 16 | 0 |
| B3 | 5.7 | S | 5.7 | 15 | 0 |
| C1 | 5.3 | S | 5.3 | 14 | 0 |
| C2 | 2.9 | S | 2.9 | 9 | 0 |
| C3 | 4.5 | S | 4.5 | 13 | 0 |
| D1 | 9.2 | S | 9.2 | 17 | 0 |
| D2 | -0.5 | S | -0.5 | 1 | 0 |
| D3 | 2.9 | S | 2.9 | 8 | 0 |
| E1 | 2.0 | S | 2.0 | 4 | 0 |
| E2 | 2.6 | S | 2.6 | 6 | 0 |
| E3 | 3.6 | S | 3.6 | 11 | 0 |
| F1 | 3.4 | S | 3.4 | 10 | 0 |
| F2 | 2.6 | S | 2.6 | 5 | 0 |
| F3 | 4.2 | S | 4.2 | 12 | 0 |
| | | | **SUM** | 351 | 180 |
| | | | **$W_r$ =** | | 180 |
| | | | **Critical Value =** | | 138 |

**Reject the null hypothesis - the survey unit meets the release criterion.**

## 11.4 Outdoor Area B

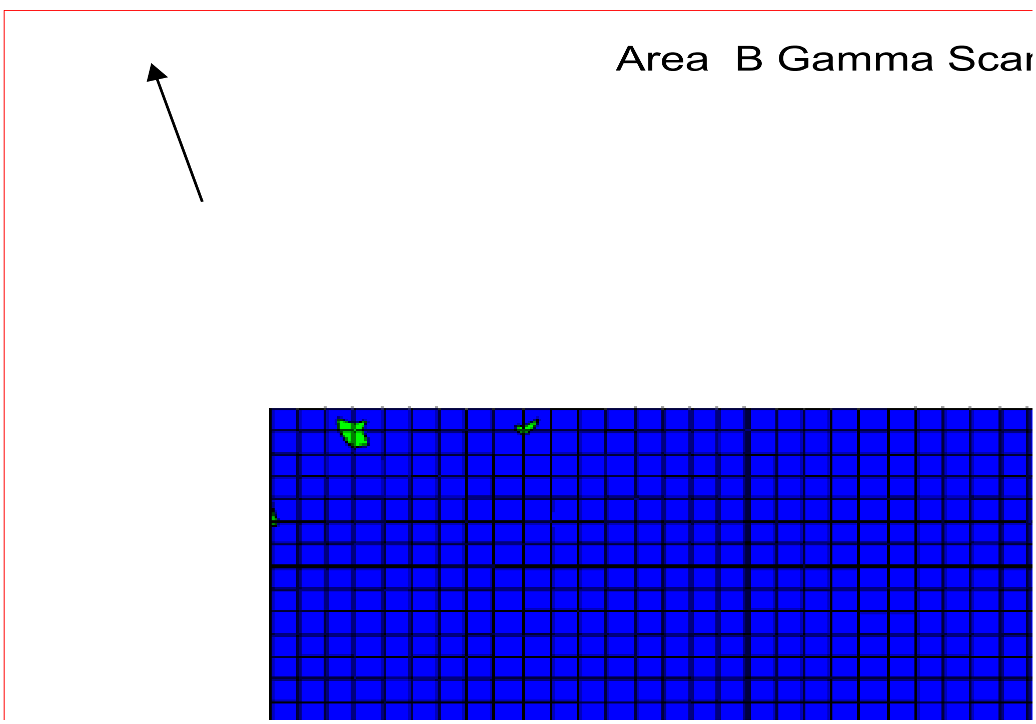
### *11.4.1 Gamma Scan Surveys of Ground Surfaces*

No elevated areas of activity above the action levels were detected during the scan surveys.

Figure 9 presents a map of the scan survey.

The gamma scan survey data is presented in this report in Appendix J.

**Figure 9 Area B Gamma Scan Survey Map**




### *11.4.2 Soil Samples*

The results of the 18 soil samples collected from Area B were below the release criteria of 14 pCi/g.

Table 11 presents a summary of the soil sample results.

**Table 11 Area B Soil Sample Summary Table**

| | | | Gamma Spectroscopy | | | Alpha Spectroscopy | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID# | Sample Matrix | Location/Description | U-238 Results in pCi/g | 2 σ Uncertainty +/- pCi/g | U-238 Detection Limit in pCi/g | U-234 Results in pCi/g | 2 σ Uncertainty +/- pCi/g | U-234 Detection Limit in pCi/g | U-235 Results in pCi/g | 2 σ Uncertainty +/- pCi/g | U-235 Detection Limit in pCi/g | U-238 Results in pCi/g | 2 σ Uncertainty +/- pCi/g | U-238 Detection Limit in pCi/g |
| AB-A1 | Soil | Area B | 0.34 | 0.70 | 1.20 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AB-A2 | Soil | Area B | 1.45 | 0.70 | 1.30 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AB-A3 | Soil | Area B | 0.63 | 0.48 | 1.40 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AB-B1 | Soil | Area B | 1.51 | 0.59 | 1.00 | 0.66 | 0.19 | 0.05 | 0.05 | 0.05 | 0.05 | 1.80 | 0.35 | 0.05 |
| AB-B2 | Soil | Area B | 1.47 | 0.56 | 1.00 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AB-B3 | Soil | Area B | 12.30 | 2.60 | 1.40 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AB-C1 | Soil | Area B | 0.69 | 0.50 | 1.30 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AB-C2 | Soil | Area B | 5.30 | 1.00 | 1.50 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AB-C3 | Soil | Area B | 0.69 | 0.49 | 1.20 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AB-D1 | Soil | Area B | 0.19 | 0.67 | 1.20 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AB-D2 | Soil | Area B | 0.66 | 0.40 | 1.60 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AB-D3 | Soil | Area B | 6.67 | 0.97 | 1.30 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AB-E1 | Soil | Area B | 0.46 | 0.35 | 1.10 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AB-E2 | Soil | Area B | 0.49 | 0.32 | 1.30 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AB-E3 | Soil | Area B | 7.30 | 1.10 | 1.60 | 1.66 | 0.34 | 0.05 | 0.24 | 0.12 | 0.07 | 10.00 | 1.40 | 0.06 |
| AB-F1 | Soil | Area B | 0.48 | 0.60 | 1.00 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AB-F2 | Soil | Area B | 0.31 | 0.77 | 1.40 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AB-F3 | Soil | Area B | 0.70 | 1.40 | 2.40 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Maximum: | 12.30 | | | | | | | | | | | |
| | | Average: | 2.31 | | | | | | | | | | | |
| | | Standard Deviation: | 3.35 | | | | | | | | | | | |

The soil sample laboratory data is presented in this report in Appendix K.

Table 12 presents the WRS test results for Area B.

**Table 12 Area B WRS Test**

DCGL = 14 pCi/g

| Survey Point | DATA pCi/g | AREA | ADJUSTED DATA | RANKS | REFERENCE AREA RANKS |
|---|---|---|---|---|---|
| 1 | 1.3 | R | 15.3 | 26 | 26 |
| 2 | 1.2 | R | 15.2 | 25 | 25 |
| 3 | 0.5 | R | 14.5 | 24 | 24 |
| 4 | 0.3 | R | 14.3 | 21 | 21 |
| 5 | 0.1 | R | 14.1 | 19 | 19 |
| 6 | 0.2 | R | 14.2 | 20 | 20 |
| 7 | 0.4 | R | 14.4 | 23 | 23 |
| 8 | 0.4 | R | 14.4 | 22 | 22 |
| A1 | 0.3 | S | 0.3 | 3 | 0 |
| A2 | 1.5 | S | 1.5 | 12 | 0 |
| A3 | 0.6 | S | 0.6 | 7 | 0 |
| B1 | 1.5 | S | 1.5 | 14 | 0 |
| B2 | 1.5 | S | 1.5 | 13 | 0 |
| B3 | 12.3 | S | 12.3 | 18 | 0 |
| C1 | 0.7 | S | 0.7 | 9.5 | 0 |
| C2 | 5.3 | S | 5.3 | 15 | 0 |
| C3 | 0.7 | S | 0.7 | 9.5 | 0 |
| D1 | 0.2 | S | 0.2 | 1 | 0 |
| D2 | 0.7 | S | 0.7 | 8 | 0 |
| D3 | 6.7 | S | 6.7 | 16 | 0 |
| E1 | 0.5 | S | 0.5 | 4 | 0 |
| E2 | 0.5 | S | 0.5 | 6 | 0 |
| E3 | 7.3 | S | 7.3 | 17 | 0 |
| F1 | 0.5 | S | 0.5 | 5 | 0 |
| F2 | 0.3 | S | 0.3 | 2 | 0 |
| F3 | 0.7 | S | 0.7 | 11 | 0 |
| | | | **SUM** | 351 | 180 |
| | | | **$W_{r}$ =** | | 180 |
| | | | **Critical Value =** | | 138 |

**Reject the null hypothesis - the survey unit meets the release criterion.**

# 12.0 CONCLUSION

Statistical tests were used to determine if the residual radioactivity levels in the survey units of the Building 200 Outdoor Area A and Area B met the release criterion or did not exceed natural background radiation levels. The survey and sampling data both show that the residual radioactivity in the outdoor areas is less than the release criteria, and is similar to the background levels of radioactivity for a similar type outdoor open land area.

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# Appendix A

# Radiation Work Permit

# RADIATION WORK PERMIT (RWP)

RWP #: D-01 Regular X Extended

**SECTION I**

| Contract # 6A00617 | Date: 6/14/07 | Time: 1600 |
|---|---|---|

Location/Project: Dahlgren NW

Exposure Category: D&D Source Transfer Waste Processing Characterization

Job Description: Characterization surveys of outdoor areas for depleted uranium.

Estimated Start Date: 6/14/07 Estimated End Date: 6/18/07

**SECTION II**

Existing Radiological Conditions:

Radiation Survey No.________ Airborne Survey No.________ Contamination Survey No.

| Existing General Area Radiation Level(s): | Existing General Contamination Levels: | Airborne DAC Level(s): |
|---|---|---|
| .01 mR/hr/$\gamma$<br>NA mrad/hr/corrected $\beta$<br>NA mrem/hr/$\eta$ | <10 dpm/100cm$^2$ $\alpha$<br><1000 dpm/100cm$^2$ $\beta\gamma$ | <10 % P<br><10 % P<br>NA % $H_3$ |
| **Existing Maximum Radiation Level(s):** | **Existing Maximum Contamination Level(s)** | **Hot Particle?** |
| .01 mR/hr/$\gamma$<br>NA mrad/hr/corrected $\beta$<br>NA mrem/hr/$\eta$ | <10 dpm/100cm$^2$ $\alpha$<br><1,000 dpm/100cm$^2$ $\beta\gamma$ | Yes<br>No |

Remarks:

**SECTION III**

Radiological Limits:
Maximum Allowed WB Exposure Rate : 5 mr/hr $\gamma$ or mrem/hr $\eta$
Corrected : NA mrad/hr Maximum Extremity Exposure Rate: 5 mr/hr
Maximum Allowed Contamination Level : 10 dpm/100cm$^2$ $\alpha$ : 1,000 dpm/100cm$^2$ $\beta\gamma$
Maximum Allowed Airborne Concentration Level: 10 % DAC
Remarks:

Industrial Hygiene/Safety Concerns: UXO, unexploded ordnance.

# RADIATION WORK PERMIT (RWP)

RWP #: D-01 Regular X Extended

## SECTION IV

WORKER REQUIREMENTS

| CLOTHING: | DOSIMETRY: | INSTRUCTIONS: | RESPIRATORY: |
|---|---|---|---|
| ☐ Coveralls<br>☐ Lab Coat<br>☐ Cloth Hood<br>☐ Paper Coveralls<br>☐ Plastic Suit<br>☒ Plastic Booties ①<br>☐ Rubber Shoe Covers<br>☐ Canvas Shoe Covers<br>☐ Cotton Gloves<br>☒ Rubber Gloves ①<br>☐ Leather Gloves<br>☐ Beta Goggles/Face Shield<br>☐ Extra<br>☐ Other Clothing<br><br>Stay Time (Heat Stress, Radiaton, Exposure Limits, etc.):<br>_______ hrs. | ☒ TLD<br>☐ Film Badge<br>☐ SRD<br>☒ Standard<br>☐ Elbows<br>☐ Gonad Pack<br>☐ Hot Cell Entry<br>☐ Extremity<br>☐ Head Pack<br>☐ Special<br>☐ Knees<br>☐ Varying Field<br>☐ Upper Field<br>☐ Ground Field<br>☐ Alarming Dosimetry<br>☐ None | ☒ Contact HP for Line Breaks<br>☒ Protect Cuts<br>☒ Pre-Job Briefing<br>☒ Post-Job Briefing<br>☐ Contact HP Prior to Work In New Areas<br>☐ Modesty Required<br>☒ Site Specific Instructions<br>☒ Equipment Monitor at Job End<br>☒ Clean Up Work Area During and After Job<br>☒ Eating, Drinking, Smoking, Chewing Prohibited<br>☒ Frisk Upon Exiting Contaminated Area<br>☒ Have Prescribed HP Coverage or Stop Work<br>☒ Exit Area Immediately Upon Emergency or Injury. Notify HP Immediately | ☐ FFNP<br>☐ FFAL<br>☐ SCBA<br>☐ PAPR<br>☐ Dust Mask<br>☐ Half Face<br>☐ Bubble Hood<br><br>Cartridges:<br><br>☐ Particulate<br>☐ Vapor<br>☐ Combination<br>☐ Other |

Special Instructions: ① When surveying or sampling

## SECTION V

Health Physics Requirements

1. Job Coverage: Continuous ☐ Intermittent ☒ Start ☐ End of Job ☐
2. Air Sampling: General Area ☐ Breathing Zone ☐ Lapel ☐ AgZ ☐ Tritium/C-14 ☐ Particulate ☐ Charcoal ☐ LoVol ☐ HiVol ☐
3. Exposure Rate Surveys: Start of Job ☐ Continuous Monitoring ☐ Area Monitoring ☐ Intermittent Monitoring ☒ End of Job ☐
4. Contamination Surveys: Start of Job ☐ Continuous Monitoring ☐ Intermittent Monitoring ☒ End of Job ☐
5. Is the ALARA Consideration Complete and Attached? Yes No Why? Low Exposure
6. Other: ____________

RWP #: D-01 Regular X Extended

## SECTION VI

Personnel Authorized to Perform Work & Acceptance of Responsibility

*My signature verifies that I have read and fully understand the RWP Requirements

| Date | Name (Print) | Signature* | SSN | HPS Init | Year Dose to Date (Rem) TEDE | TODE | LDE | SDE WB | SDE EX |
|---|---|---|---|---|---|---|---|---|---|
| 6-14-07 | Richard Kountz | Richard Kountz | 4199 | RK | 0 | 0 | 0 | 0 | 0 |
| 6-14-07 | Anthony Smith | Anthony Smith | 4030 | AS | 0 | 0 | 0 | 0 | 0 |
| 6-14-07 | Alan Campellone | Alan Campellone | 9914 | AC | 0 | 0 | 0 | 0 | 0 |
| 6-14-07 | Dan Spainard | Dan S | 4551 | [illegible] | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | |
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NA

| H Approvals/Reviews | I Termination |
|---|---|
| Technician Generating RWP: Richard Kountz<br>Date/Time: 6-14-07 0800 | Date: 6-16-07<br>Time: 1600 |
| Industrial Hygiene Approval: Richard Kountz<br>Date/Time: 6-14-07 0800 | Health Physics Rep: Dan S |
| HP Supervisor Approval: Dan S<br>Date/Time: 6-14-07 1600 | Reason: Job Complete RWP Revision |
| RSO Manager Approval: Dan S<br>Date/Time: 6-14-07 1600 | HP Supervisor Review: Dan S |

**TRAINING RECORD**

| | |
|---|---|
| **TRAINING DATE:06/15/2007** | **INSTRUCTOR:N/A** |
| **LOCATION: Dahlgren NSWCDD** | **TOTAL CLASS HOURS:N/A** |
| **TRAINING COURSE TITLE:Overview of Project Work Plan** | |
| **SCOPE OF TRAINING: Reviewed project work plan.** | |

| NAME OF STUDENT | SOCIAL SECURITY NO. | SIGNATURE |
|---|---|---|
| [illegible] | 4551 | [illegible] |
| Richard Kaney | 4199 | [illegible] |
| Anthony Smith | 4030 | Anthony Smith |
| Alan Campbell | 9914 | [illegible] |
| | N/A | |

TRAINING APPROVED BY (Project Director): [illegible]

# Appendix B

# Background Reference Area Survey Data

# New World Technology
## Background Determination Data Sheet

| | | | | | |
|---|---|---|---|---|---|
| Project/Location: | Dahlgren | | | | |
| Instrument Model: | 2350-1 | | Instrument Serial No. | 228710 | |
| Last Calibration Date: | 2/26/2007 | | | | |
| Detector Model: | 44-10 | | Detector Serial No.: | 242829 | |
| Today's Date: | 6/14/2007 | | Data Collected by: | Anthony Smith | |
| | Alpha | | Beta-Gamma | X | Gamma |
| Remarks: | Background Reference Area Outside Building 161 | | | | |
| Type of Surface: | Soil | | Count Time: | 1 | Min |

| Count Number | Gross Counts | CPM (x) |
|---|---|---|
| 1 | 6486 | 6486 |
| 2 | 5775 | 5775 |
| 3 | 5558 | 5558 |
| 4 | 5482 | 5482 |
| 5 | 6930 | 6930 |
| 6 | 6893 | 6893 |
| 7 | 7770 | 7770 |
| 8 | 8097 | 8097 |
| 9 | 7806 | 7806 |
| 10 | 7863 | 7863 |
| 11 | 7731 | 7731 |
| 12 | 8482 | 8482 |
| 13 | 7831 | 7831 |
| 14 | 7273 | 7273 |
| 15 | 7360 | 7360 |
| 16 | 8515 | 8515 |
| 17 | 6690 | 6690 |
| 18 | 7271 | 7271 |
| 19 | 7369 | 7369 |
| 20 | 6689 | 6689 |
| 21 | 7730 | 7730 |
| 22 | 7502 | 7502 |
| 23 | 7971 | 7971 |
| 24 | 7421 | 7421 |
| 25 | 7451 | 7451 |
| 26 | 7314 | 7314 |
| 27 | 6768 | 6768 |
| 28 | 6980 | 6980 |
| 29 | 6637 | 6637 |
| 30 | 6269 | 6269 |
| Mean Count: ($\overline{X}$) | | 7197 |
| Standard Deviation ($\sigma$) | | 775.44 |

| | | | |
|---|---|---|---|
| Action Level | 9352 | | |
| Background Count Rate: | 7197.03 | CPM | |
| Calculations Completed by: | Anthony Smith | Date: | 6/14/2007 |
| Reviewed by: | Daniel Spicuzza | Date: | 6/14/2007 |

# New World Technology
## Background Determination Data Sheet

| | | | | | |
|---|---|---|---|---|---|
| Project/Location: | Dahlgren | | | | |
| Instrument Model: | 2350 | | Instrument Serial No. | 228693 | |
| Last Calibration Date: | 2/22/2007 | | | | |
| Detector Model: | 44-10 | | Detector Serial No.: | 245172 | |
| Today's Date: | 6/14/2007 | | Data Collected by: | Richard Kountz | |
| | Alpha | | Beta-Gamma | X | Gamma |
| Remarks: | Background Reference Area Outside Building 161 | | | | |
| Type of Surface: | Soil | | Count Time: | 1 | Min |

| Count Number | Gross Counts | CPM (x) | | |
|---|---|---|---|---|
| 1 | **6872** | **6872** | | |
| 2 | **7128** | **7128** | | |
| 3 | **6565** | **6565** | | |
| 4 | **6464** | **6464** | | |
| 5 | **6738** | **6738** | | |
| 6 | **6572** | **6572** | | |
| 7 | **6709** | **6709** | | |
| 8 | **6827** | **6827** | | |
| 9 | **6650** | **6650** | | |
| 10 | **7290** | **7290** | | |
| 11 | **6731** | **6731** | | |
| 12 | **7673** | **7673** | | |
| 13 | **7621** | **7621** | | |
| 14 | **6840** | **6840** | | |
| 15 | **7597** | **7597** | | |
| 16 | **6841** | **6841** | | |
| 17 | **6673** | **6673** | | |
| 18 | **6853** | **6853** | | |
| 19 | **6870** | **6870** | | |
| 20 | **6555** | **6555** | | |
| 21 | **6951** | **6951** | | |
| 22 | **6770** | **6770** | | |
| 23 | **7568** | **7568** | | |
| 24 | **7574** | **7574** | | |
| 25 | **6436** | **6436** | | |
| 26 | **6590** | **6590** | | |
| 27 | **6784** | **6784** | | |
| 28 | **6973** | **6973** | | |
| 29 | **6860** | **6860** | | |
| 30 | **6605** | **6605** | | |
| Mean Count: ($\overline{X}$) | | **6906** | | |
| Standard Deviation ($\sigma$) | | 366.48 | Action Level | **9017** |
| Background Count Rate: | | | 6905.91 | CPM |

| | | | |
|---|---|---|---|
| Calculations Completed by: | Richard Kountz | Date: | 6/14/2007 |
| Reviewed by: | Daniel Spicuzza | Date: | 6/14/2007 |

New World Technology
Background Determination Data Sheet

| | | | | | | |
|---|---|---|---|---|---|---|
| Project/Location: | | Dahlgren | | | | |
| Instrument Model: | | 2350-1 | | | Instrument Serial No. | 232920 |
| Last Calibration Date: | | 2/22/2007 | | | | |
| Detector Model: | | 44-10 | | | Detector Serial No.: | 242823 |
| Today's Date: | | 6/14/2007 | | | Data Collected by: | Alan Campellone |
| | Alpha | | Beta-Gamma | X | Gamma | |
| Remarks: | Background Reference Area Outside Building 161 | | | | | |
| Type of Surface: | | Soil | | Count Time: | 1 | Min |
| Count Number | Gross Counts | CPM (x) | | | | |
| 1 | **6937** | **6937** | | | | |
| 2 | **6842** | **6842** | | | | |
| 3 | **5973** | **5973** | | | | |
| 4 | **6423** | **6423** | | | | |
| 5 | **7061** | **7061** | | | | |
| 6 | **7838** | **7838** | | | | |
| 7 | **7611** | **7611** | | | | |
| 8 | **7922** | **7922** | | | | |
| 9 | **7468** | **7468** | | | | |
| 10 | **7200** | **7200** | | | | |
| 11 | **7903** | **7903** | | | | |
| 12 | **8288** | **8288** | | | | |
| 13 | **7631** | **7631** | | | | |
| 14 | **7665** | **7665** | | | | |
| 15 | **6318** | **6318** | | | | |
| 16 | **6130** | **6130** | | | | |
| 17 | **7340** | **7340** | | | | |
| 18 | **8134** | **8134** | | | | |
| 19 | **8351** | **8351** | | | | |
| 20 | **7647** | **7647** | | | | |
| 21 | **6450** | **6450** | | | | |
| 22 | **7598** | **7598** | | | | |
| 23 | **6660** | **6660** | | | | |
| 24 | **7631** | **7631** | | | | |
| 25 | **6720** | **6720** | | | | |
| 26 | **7585** | **7585** | | | | |
| 27 | **6741** | **6741** | | | | |
| 28 | **7484** | **7484** | | | | |
| 29 | **7371** | **7371** | | | | |
| 30 | **7076** | **7076** | | | | |
| Mean Count: ($\overline{X}$) | | **7267** | | | | |
| Standard Deviation ($\sigma$) | | 634.97 | Action Level | **9433** | | |
| Background Count Rate: | | | 7266.54 | CPM | | |
| Calculations Completed by: | | | Alan Campellone | | Date: | 6/14/2007 |
| Reviewed by: | | | Daniel Spicuzza | | Date: | 6/14/2007 |

New World Technology
Background Determination Data Sheet

| | | | | | |
|---|---|---|---|---|---|
| Project/Location: | Dahlgren | | | | |
| Instrument Model: | 2350 | | Instrument Serial No. | 228710 | |
| Last Calibration Date: | 2/26/2007 | | | | |
| Detector Model: | 44-10 | | Detector Serial No.: | 242829 | |
| Today's Date: | 6/14/2007 | | Data Collected by: | Anthony Smith | |
| | Alpha | | Beta-Gamma | X | Gamma |
| Remarks: | Background Reference Area Outside Building 161 | | | | |
| Type of Surface: | Asphalt | Count Time: | 1 | Min | |

| Count Number | Gross Counts | CPM (x) |
|---|---|---|
| 1 | 6872 | 6872 |
| 2 | 6128 | 6128 |
| 3 | 6565 | 6565 |
| 4 | 6464 | 6464 |
| 5 | 5738 | 5738 |
| 6 | 6572 | 6572 |
| 7 | 6709 | 6709 |
| 8 | 6827 | 6827 |
| 9 | 6650 | 6650 |
| 10 | 7290 | 7290 |
| 11 | 6731 | 6731 |
| 12 | 6673 | 6673 |
| 13 | 6621 | 6621 |
| 14 | 6840 | 6840 |
| 15 | 6597 | 6597 |
| 16 | 6841 | 6841 |
| 17 | 6673 | 6673 |
| 18 | 6853 | 6853 |
| 19 | 6870 | 6870 |
| 20 | 6555 | 6555 |
| 21 | 6951 | 6951 |
| 22 | 6770 | 6770 |
| 23 | 6568 | 6568 |
| 24 | 6574 | 6574 |
| 25 | 6436 | 6436 |
| 26 | 6590 | 6590 |
| 27 | 6784 | 6784 |
| 28 | 6973 | 6973 |
| 29 | 6860 | 6860 |
| 30 | 6605 | 6605 |
| Mean Count: ($\overline{X}$) | | 6673 |

| | | | |
|---|---|---|---|
| Standard Deviation ($\sigma$) | 272.18 | Action Level | **8748** |
| Background Count Rate: | | 6672.58 | CPM |

| | | | |
|---|---|---|---|
| Calculations Completed by: | Anthony Smith | Date: | 6/14/2007 |
| Reviewed by: | Daniel Spicuzza | Date: | 6/14/2007 |

New World Technology
Background Determination Data Sheet

| | | | | | | |
|---|---|---|---|---|---|---|
| Project/Location: | | Dahlgren | | | | |
| Instrument Model: | | 2350 | | Instrument Serial No. | 228693 | |
| Last Calibration Date: | | 2/22/2007 | | | | |
| Detector Model: | | 44-10 | | Detector Serial No.: | 245172 | |
| Today's Date: | | 6/14/2007 | | Data Collected by: | Richard Kountz | |
| | Alpha | | Beta-Gamma | X | Gamma | |
| Remarks: | Background Reference Area Outside Building 161 | | | | | |
| Type of Surface: | | Asphalt | Count Time: | 1 | Min | |

| Count Number | Gross Counts | CPM (x) |
|---|---|---|
| 1 | **5973** | **5973** |
| 2 | **5768** | **5768** |
| 3 | **6507** | **6507** |
| 4 | **5769** | **5769** |
| 5 | **6082** | **6082** |
| 6 | **5933** | **5933** |
| 7 | **6282** | **6282** |
| 8 | **6247** | **6247** |
| 9 | **6608** | **6608** |
| 10 | **5672** | **5672** |
| 11 | **6495** | **6495** |
| 12 | **5601** | **5601** |
| 13 | **6529** | **6529** |
| 14 | **5715** | **5715** |
| 15 | **5706** | **5706** |
| 16 | **5901** | **5901** |
| 17 | **5781** | **5781** |
| 18 | **5384** | **5384** |
| 19 | **5672** | **5672** |
| 20 | **5791** | **5791** |
| 21 | **5898** | **5898** |
| 22 | **5723** | **5723** |
| 23 | **6103** | **6103** |
| 24 | **5237** | **5237** |
| 25 | **5699** | **5699** |
| 26 | **5769** | **5769** |
| 27 | **5706** | **5706** |
| 28 | **5753** | **5753** |
| 29 | **5721** | **5721** |
| 30 | **5689** | **5689** |

| | | | |
|---|---|---|---|
| Mean Count: ($\overline{X}$) | **5890** | | |
| Standard Deviation ($\sigma$) | 333.20 | Action Level | **7840** |
| Background Count Rate: | | 5890.43 | CPM |

| | | | |
|---|---|---|---|
| Calculations Completed by: | Richard Kountz | Date: | 6/14/2007 |
| Reviewed by: | Daniel Spicuzza | Date: | 6/14/2007 |

NEW WORLD TECHNOLOGY FORM NWT HPQA003

New World Technology
Background Determination Data Sheet

| | | | | | | |
|---|---|---|---|---|---|---|
| Project/Location: | Dahlgren | | | | | |
| Instrument Model: | 2350-1 | | | Instrument Serial No. | 232920 | |
| Last Calibration Date: | 2/22/2007 | | | | | |
| Detector Model: | 44-10 | | | Detector Serial No.: | 242823 | |
| Today's Date: | 6/14/2007 | | | Data Collected by: | Alan Campellone | |
| | Alpha | | Beta-Gamma | X | Gamma | |
| Remarks: | Background Reference Area Outside Building 161 | | | | | |
| Type of Surface: | Asphalt | | Count Time: | 1 | Min | |

| Count Number | Gross Counts | CPM (x) |
|---|---|---|
| 1 | **5438** | **5438** |
| 2 | **6493** | **6493** |
| 3 | **6453** | **6453** |
| 4 | **6433** | **6433** |
| 5 | **6385** | **6385** |
| 6 | **6211** | **6211** |
| 7 | **5945** | **5945** |
| 8 | **6628** | **6628** |
| 9 | **6391** | **6391** |
| 10 | **6438** | **6438** |
| 11 | **6719** | **6719** |
| 12 | **6120** | **6120** |
| 13 | **6726** | **6726** |
| 14 | **5996** | **5996** |
| 15 | **6145** | **6145** |
| 16 | **6215** | **6215** |
| 17 | **6265** | **6265** |
| 18 | **6370** | **6370** |
| 19 | **6065** | **6065** |
| 20 | **6665** | **6665** |
| 21 | **6220** | **6220** |
| 22 | **6299** | **6299** |
| 23 | **5993** | **5993** |
| 24 | **6112** | **6112** |
| 25 | **6329** | **6329** |
| 26 | **5903** | **5903** |
| 27 | **6162** | **6162** |
| 28 | **6191** | **6191** |
| 29 | **6641** | **6641** |
| 30 | **6319** | **6319** |

| | | | |
|---|---|---|---|
| Mean Count: ($\overline{X}$) | **6276** | | |
| Standard Deviation ($\sigma$) | 277.27 | Action Level | **8289** |
| Background Count Rate: | | 6275.57 | CPM |

| | | | |
|---|---|---|---|
| Calculations Completed by: | Alan Campellone | Date: | 6/14/2007 |
| Reviewed by: | Daniel Spicuzza | Date: | 6/14/2007 |

# Appendix C

# Background Reference Area Soil Sample Laboratory Data

SEVERN TRENT STL®

**STL St. Louis**
13715 Rider Trail North
Earth City, MO 63045

Tel: 314 298 8566 Fax: 314 298 8757
www.stl-inc.com

# ANALYTICAL REPORT

Dahlgren

Lot #: F7C120135

Dan Spicuzza

New World Technology
448 Commerce Way
Livermore, CA 94551

SEVERN TRENT LABORATORIES, INC.

Terry Romanko
Project Manager

March 29, 2007

Leaders in Environmental Testing

Severn Trent Laboratories, Inc.

**Case Narrative**
LOT NUMBER: F7C120135

This report contains the analytical results for the 24 samples received under chain of custody by STL St. Louis on March 12, 2007. These samples are associated with your Dahlgren project.

The analytical results included in this report meet all applicable quality control procedure requirements except as noted on the following page.

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

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

Observations/Nonconformances

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

**Gamma Spectroscopy**

The reporting limit for Uranium-238 analyzed by gamma spectroscopy was not met due to high levels of the nuclide present in the sample. The data is reported with the MDA achieved.
**Affected Samples:**
F7C120135 (10): B200R-2
F7C120135 (12): B200R-4
F7C120135 (14): B200AA-2
F7C120135 (15): B200AA-3
F7C120135 (18): B200AA-6
F7C120135 (19): B200AB-1

**Isotopic Uranium by Alpha Spectroscopy**

The samples were reanalyzed due to high activity. The reanalysis results are reported.
**Affected Samples:**
F7C120135 (18): B200AA-6
F7C120135 (19): B200AB-1

# METHODS SUMMARY

**F7C120135**

| PARAMETER | ANALYTICAL METHOD | PREPARATION METHOD |
|---|---|---|
| Gamma Spectroscopy - Cesium-137 & Hits | EML GA-01-R MOD | |
| Isotopic Uranium by Alpha Spectroscopy | EML A-01-R MOD | |

**References:**

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

# SAMPLE SUMMARY

**F7C120135**

| WO # | SAMPLE# | CLIENT SAMPLE ID | SAMPLED DATE | SAMP TIME |
|---|---|---|---|---|
| JQV2F | 001 | BK6-1 | 03/06/07 | 09:25 |
| JQV2H | 002 | BK6-2 | 03/06/07 | 09:30 |
| JQV2J | 003 | BK6-3 | 03/06/07 | 09:35 |
| JQV2K | 004 | BK6-4 | 03/06/07 | 09:40 |
| JQV2L | 005 | BK6-5 | 03/06/07 | 09:45 |
| JQV2M | 006 | BK6-6 | 03/06/07 | 09:50 |
| JQV2N | 007 | BK6-7 | 03/06/07 | 09:55 |
| JQV2P | 008 | BK6-8 | 03/06/07 | 10:00 |
| JQV2R | 009 | B200R-1 | 03/06/07 | 12:50 |
| JQV2T | 010 | B200R-2 | 03/06/07 | 13:00 |
| JQV2V | 011 | B200R-3 | 03/06/07 | 13:10 |
| JQV2W | 012 | B200R-4 | 03/06/07 | 13:15 |
| JQV20 | 013 | B200AA-1 | 03/07/07 | 10:15 |
| JQV21 | 014 | B200AA-2 | 03/07/07 | 10:18 |
| JQV22 | 015 | B200AA-3 | 03/07/07 | 10:20 |
| JQV23 | 016 | B200AA-4 | 03/07/07 | 10:25 |
| JQV24 | 017 | B200AA-5 | 03/07/07 | 10:30 |
| JQV25 | 018 | B200AA-6 | 03/07/07 | 10:45 |
| JQV26 | 019 | B200AB-1 | 03/07/07 | 09:40 |
| JQV27 | 020 | B200AB-2 | 03/07/07 | 09:50 |
| JQV28 | 021 | B200AB-3 | 03/07/07 | 09:55 |
| JQV29 | 022 | B200AB-4 | 03/07/07 | 10:00 |
| JQV3A | 023 | B200AB-5 | 03/07/07 | 10:05 |
| JQV3C | 024 | B200AB-6 | 03/07/07 | 10:10 |

**NOTE(S):**

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

# New World Technology

## Client Sample ID: BK6-1

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7C120135-001 | Date Collected: | 03/06/07 0925 |
| Work Order: | JQV2F | Date Received: | 03/12/07 0915 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | **Batch # 7073380** | | **Yld %** |
| Uranium 238 | 1.31 | U | 0.67 | 14.0 | 1.7 | 03/14/07 | 03/16/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: BK6-1 DUP

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7C120135-001X | Date Collected: | 03/06/07 0925 |
| Work Order: | JQV2F | Date Received: | 03/12/07 0915 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| Gamma Cs-137 & Hits by DOE GA-01-R MOD. | | | | pCi/g | Batch # 7073380 | | Yld % |
| Uranium 238 | 1.8 | J | 1.1 | 4.0 | 1.4 | 03/14/07 | 03/16/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: BK6-2

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7C120135-002 | Date Collected: | 03/06/07 0930 |
| Work Order: | JQV2H | Date Received: | 03/12/07 0915 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| Gamma Cs-137 & Hits by DOE GA-01-R MOD. | | | | pCi/g | Batch # 7073380 | | Yld % |
| Uranium 238 | 1.18 | J | 0.61 | 14.0 | 0.99 | 03/14/07 | 03/16/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: BK6-3

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7C120135-003 | Date Collected: | 03/06/07 0935 |
| Work Order: | JQV2J | Date Received: | 03/12/07 0915 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | pCi/g | Batch # 7073380 | | Yld % |
| Uranium 238 | 0.5 | U | 1.0 | 14.0 | 1.7 | 03/14/07 | 03/16/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: BK6-4

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7C120135-004 | Date Collected: | 03/06/07 0940 |
| Work Order: | JQV2K | Date Received: | 03/12/07 0915 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | | **Batch # 7073380** | **Yld %** |
| Uranium 238 | 0.31 | U | 0.96 | 14.0 | 1.7 | 03/14/07 | 03/16/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U    Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: BK6-5

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7C120135-005
Work Order: JQV2L
Matrix: SOLID

Date Collected: 03/06/07 0945
Date Received: 03/12/07 0915

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | | **Batch # 7073380** | **Yld %** |
| Uranium 238 | 0.07 | U | 0.87 | 14.0 | 1.6 | 03/14/07 | 03/16/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: BK6-6

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7C120135-006 | Date Collected: | 03/06/07 0950 |
| Work Order: | JQV2M | Date Received: | 03/12/07 0915 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | pCi/g | Batch # 7073380 | | Yld % |
| Uranium 238 | 0.16 | U | 0.91 | 14.0 | 1.6 | 03/14/07 | 03/16/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: BK6-7

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7C120135-007
Work Order: JQV2N
Matrix: SOLID

Date Collected: 03/06/07 0955
Date Received: 03/12/07 0915

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | **Batch # 7073380** | | **Yld %** |
| Uranium 238 | 0.39 | U | 0.79 | 14.0 | 1.4 | 03/14/07 | 03/16/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: BK6-8

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7C120135-008
Work Order: JQV2P
Matrix: SOLID

Date Collected: 03/06/07 1000
Date Received: 03/12/07 0915

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | | **Batch # 7073380** | **Yld %** |
| Uranium 238 | 0.36 | U | 0.92 | 14.0 | 1.7 | 03/14/07 | 03/16/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# Appendix D

# Instrumentation Calibration Data

# Safety and Ecology Corporation

2800 Solway Road
Knoxville, TN 37931

## Calibration Certificate

SEC PROCEDURE #



10/16/2006

### Calibration Certificate for 2929,Serial # 185291, Bar Code # ,Property # SEC-5734

**Date:** 10/16/06 **Date Last Cal. Expires:** 01/25/07 **Technician:** Carl Hall

**Location:** 9999, **Reason For Calibration:** Due for Calibration

**EQUIPMENT USED DURING CALIBRATION**

**MODEL:** 500-2 **SERIAL #:** 132896 **CAL DUE:** 02/25/07

**MODEL:** **SERIAL #:** **CAL DUE:**

**AS FOUND DATA**

**AS FOUND Instrument Condition:** SAT **AS LEFT Instrument Condition:** SAT

**AS FOUND Mechanical Zero:** 0 **AS LEFT Mechanical Zero:** 0

| Scaler Function Check | AS FOUND | | AS LEFT | | |
|---|---|---|---|---|---|
| Beta Channel Window (4-50 mV): | 4.0-50.0 | mV | AF | mV | |
| Alpha Channel Threshold (175 mV): | 175 | mV | AF | mV | |
| Alpha Counts w/Pulser @ 10,000 CPM: | 9,999 | CPM | AF | CPM | % Error: 0.01% |
| Beta Counts w/Pulser @ 10,000 CPM: | 10,000 | CPM | AF | CPM | % Error: 0.00% |
| High Voltage Setpoint: | | V | | V | |
| Vernier Setting: | | | | | |

If AS FOUND data in Scaler Function Check is within 10%, the technician may place AF in AS LEFT section and proceed to High Voltage power supply section.

**HIGH VOLTAGE POWER SUPPLY CALIBRATION**

| | | | | |
|---|---|---|---|---|
| 1 KV Reading (R-5 on HV Board): | 999 | V | AF | V |
| Max HV (1500 V +): | SAT | | | |

**DIGITAL SCALER**

| | | | | | |
|---|---|---|---|---|---|
| AF 250: | 250 | % ERR: 0.00% | AL 250: | AF | % ERR: 0.00% |
| AF 2500: | 2499 | % ERR: 0.04% | AL 2500: | AF | % ERR: 0.04% |
| AF 25K: | 24.99 K | % ERR: 0.04% | AL 25K: | AF K | % ERR: 0.04% |
| AF 250K: | 249.9 K | % ERR: 0.04% | AL 250K: | AF K | % ERR: 0.04% |

✓ Is the As Found Data Within 20% of the Set Point?

**Comments:** Married as a set with: Model: 43-10-1 Serial #: PR194723 Bar Code #:

✓ Does Instrument Meet Final Acceptance Criteria? ✓ Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 10/16/07

Performed by: [signature] Reviewed by: [signature] Date: 10/16/06

Printed Name: Carl Hall

Entered in Computer Inventory By: [signature] Date: 10/16/06

**Safety and Ecology Corporation**

**2800 Solway Road, Knoxville, TN 37931**

**Calibration Certificate**

**SEC PROCEDURE #**



10/16/2006

**Calibration Certificate for 43-10-1,Serial # PR194723, Bar Code # ,Property # SEC-5735**

Date: 10/16/06 Date Last Cal. Expires: 01/25/07 Technician: Carl Hall

Location: 9999, Reason For Calibration: Due for Calibration

**EQUIPMENT USED DURING CALIBRATION** MODEL: 2929 SERIAL #: 185291 CAL DUE: 10/16/07

MODEL: SERIAL #: CAL DUE:

**NIST TRACEABLE SOURCES USED**

| SOURCE | ISOTOPE | ACTIVITY | 2π | ASSAY DATE |
|---|---|---|---|---|
| 98TC470-0729 | Tc-99 | 32100 dpm | 20,100 cpm | 4/14/2000 |
| 99PU470-0268 | Pu-239 | 15400 dpm | 7,820 cpm | 5/2/2000 |
| 99TH470-0273 | Th-230 | 51000 dpm | 25,900 cpm | 3/13/1999 |
| 98SR470-0731 | Sr-90 | 25300 dpm | 17,700 cpm | 2/7/2006 |

## AS FOUND DATA

AS FOUND Instrument Condition: SAT

Calibration Setpoints

HV: 800 V Vernier: 3.26

Threshold Beta: - mV Alpha: mV

| Efficiencies from last calibration | |
|---|---|
| Pu: | 37.72 % |
| Tc: | 20.71 % |
| Th: | 33.48 % |
| SrY: | 42.14 % |

| | Alpha | | Beta | | A-B XTLK |
|---|---|---|---|---|---|
| Back ground: | 0 | CPM | 31 | CPM | |
| Pu-239: | 5424 | CPM | 268 | CPM | 4.4% |
| Tc-99: | 1 | CPM | 5492 | CPM | |
| Th-230: | 16798 | CPM | N/A | | |
| SrY-90: | N/A | | 11259 | CPM | |

AS FOUND Efficiencies: Pu-239: 35.22% Tc-99: 17.01% Th-230: 32.94% SrY-90: 44.38%

AS LEFT Instrument Condition: SAT

AS LEFT DATA after repair or HV adjust

HV: V Vernier:

| | Alpha | | Beta | | A-B XTLK |
|---|---|---|---|---|---|
| Back ground: | | CPM | | CPM | |
| Pu-239: | | CPM | | CPM | |
| Tc-99: | | CPM | | CPM | |
| Th-230: | | CPM | N/A | | |
| SrY-90: | N/A | | | CPM | |

AS LEFT Efficiencies: Pu-239: Tc-99: Th-230: SrY-90:

✓ Is the As Found Data Within 20% of the efficiency from the last cal.?

Reproducibility: Isotope: Sr-90 11427 11205 11386 Average: 11339.3 ✓ Are the individual counts within 10% of the average?

If the As Found date (even after repair) is within 10% of the last calibration and the B-A Xtalk is <1% and the A-B Xtalk is <10%, then the technician may N/A the Plateau Data and go directly to Comments Geometry = NaI probes are 4 1/2" from source. All other probes are in contact with surface unless otherwise specified. Calibrated with a 3 foot cable unless otherwise specified

## PLATEAU DATA

Source 1: Tc-99 Source 2: Th-230

| High Voltage | Response (CPM) A ch. | B ch. | Net Eff. | Response (CPM) A ch. | B ch. | Net Eff. | Background (CPM) A ch. | B ch. | Net A to B Xtalk: <10% |
|---|---|---|---|---|---|---|---|---|---|
| N/A | | | | | | | | | N/A |
| | | | | | | | | | N/A |
| | | | | | | | | | N/A |
| | | | | | | | | | N/A |
| | | | | | | | | | N/A |
| | | | | | | | | | N/A |

| | Alpha | Beta | Pu-239 | Tc-99 | Th-230 | SrY-90 |
|---|---|---|---|---|---|---|
| Background: | | | CPM | CPM | CPM | CPM |
| AL Efficiencies: | | | | | | |

**Comments:** Married as a set with: Model: 2929 Serial #: 185291 Bar Code #:

✓ Does Instrument Meet Final Acceptance Criteria? ✓ Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 10/16/07

Performed by: [signature] Reviewed by: [signature] Date: 10/16/06

Printed Name: Carl Hall

Entered in Computer Inventory By: [signature] Date: 10/16/06

**Safety and Ecology Corporation**
2800 Solway Road
Knoxville, TN 37931

# Calibration Certificate

**Calibration Certificate for 2360,Serial # 184905, Bar Code # ,Property # SEC-5245**

Date: 04/24/07 Date Last Cal. Expires: 03/03/07 Technician: Carl Hall

Location: 9999, Reason For Calibration: Due for Calibration

**EQUIPMENT USED DURING CALIBRATION**

MODEL: 500-2 SERIAL #: 132896 CAL DUE: 08/08/07

MODEL: SERIAL #: CAL DUE:

## AS FOUND DATA

Geotropism: SAT AS FOUND Instrument Condition: SAT AS LEFT Instrument Condition: SAT

☐ New Batteries? Battery Check: SAT AS FOUND Mechanical Zero: 0 AS LEFT Mechanical Zero: 0

| HIGH VOLTAGE (+/- 10% tolerance) | AS FOUND HV | AS LEFT HV |
|---|---|---|
| 500 V: | 491 V | AF V |
| 1000 V: | 994 V | AF V |
| 1500 V: | 1493 V | AF V |

AF HV Setting: 719 V AL HV Setting: 600 V

| WINDOW SETTINGS | AS FOUND | AS LEFT |
|---|---|---|
| BT (4 mV +/- .4 mV): | 2.7 mV | 3.5 mV |
| BW (40 mV +/- 4 mV): | 32.9 mV | 40.0 mV |
| AT (120 mV +/- 10 mV): | 115 mV | 120 mV |

## RATE METER

| SCALE | RATE CPM | AS FOUND | % ERROR | AS LEFT | % ERROR |
|---|---|---|---|---|---|
| x.1 or x1 | 100 | 100 | 0.00% | AF | 0.00% |
| | 250 | 250 | 0.00% | AF | 0.00% |
| | 400 | 400 | 0.00% | AF | 0.00% |
| x1 or x10 | 1000 | 1000 | 0.00% | AF | 0.00% |
| | 2500 | 2500 | 0.00% | AF | 0.00% |
| | 4000 | 4000 | 0.00% | AF | 0.00% |
| x10 or x100 | 10K | 10 | 0.00% | AF | 0.00% |
| | 25K | 25 | 0.00% | AF | 0.00% |
| | 40K | 40 | 0.00% | AF | 0.00% |
| x100 or x1000 | 100K | 100 | 0.00% | AF | 0.00% |
| | 250K | 250 | 0.00% | AF | 0.00% |
| | 400K | 400 | 0.00% | AF | 0.00% |

☑ Is the As Found Data Within 20% of the Set Point?

## DIGITAL SCALER

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| AF 250: | 250 | % ERR: | 0.00% | AL 250: | AF | % ERR: | 0.00% |
| AF 2500: | 2499 | % ERR: | 0.04% | AL 2500: | AF | % ERR: | 0.04% |
| AF 25K: | 24.99 K | % ERR: | 0.04% | AL 25K: | AF K | % ERR: | 0.04% |
| AF 250K: | 249.8 K | % ERR: | 0.08% | AL 250K: | AF K | % ERR: | 0.08% |

☑ Is the As Found Data Within 20% of the Set Point?

## REPRODUCIBILITY

| | | | |
|---|---|---|---|
| x.1 or x1 Scale: | 250 | 250 | 250 |
| x1 or x10 Scale: | 2500 | 2500 | 2500 |
| x10 or x100 Scale: | 25 K | 25 K | 25 K |
| x100 or x1000 Scale: | 250 K | 250 K | 250 K |

☑ Are the Individual Counts Within 10% of the Average?

Audio Response: SAT

Overload Light: SAT

Low Battery (2.2V): SAT

**Comments:** Married as a set with: Model: 43-89 Serial #: PR194989 Bar Code #:

☑ Does Instrument Meet Final Acceptance Criteria? ☑ Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 04/24/08

Performed by: [signature] Reviewed by: [signature] Date: 4 24 7

Printed Name: Carl Hall

Entered in Computer Inventory By: [signature] Date: 4/24/07

**Safety and Ecology Corporation**
2800 Solway Road, Knoxville, TN 37931

# Calibration Certificate

## Calibration Certificate for 43-89,Serial # PR194989, Bar Code # ,Property # SEC-5867

**Date:** 04/24/07 **Date Last Cal. Expires:** 08/07/07 **Technician:** Carl Hall

**Location:** 9999, **Reason For Calibration:** Due for Calibration

**EQUIPMENT USED DURING CALIBRATION** MODEL: 2360 SERIAL #: 184905 CAL DUE 04/24/08

MODEL: SERIAL #: CAL DUE

**NIST TRACEABLE SOURCES USED**

| SOURCE | ISOTOPE | ACTIVITY | $2\pi$ | ASSAY DATE |
|---|---|---|---|---|
| 5744-06 | Sr-90 | 21700 dpm | 15,200 cpm | 12/6/2006 |
| 5746-06 | Tc-99 | 34000 dpm | 21,200 cpm | 12/7/2006 |
| 5748-06 | Th-230 | 34700 dpm | 17,600 cpm | 12/6/2006 |
| 4078-02 | Pu-239 | 17200 dpm | 8,730 cpm | 2/4/2003 |

**AS FOUND DATA** AS FOUND Instrument Condition: SAT

**Calibration Setpoints**

HV : 575 V

Threshold Beta: 3.5 - 40 mV Alpha: 120 mV

**AS LEFT Instrument Condition:** SAT

**AS LEFT DATA after repair or HV adjust**

HV: 600 V CH

**Efficiencies from last calibration**

| | |
|---|---|
| Pu: | 19.17 % |
| Tc: | 14.82 % |
| Th: | 16.06 % |
| SrY: | 27.07 % |

AS FOUND:

| | Alpha | | Beta | | A-B XTLK |
|---|---|---|---|---|---|
| Back ground: | 0 | CPM | 152 | CPM | |
| Pu-239: | 3004 | CPM | 364 | CPM | 7.1% |
| Tc-99: | 1 | CPM | 3217 | CPM | |
| Th-230: | 5129 | CPM | N/A | | |
| SrY-90: | N/A | | 5073 | CPM | |

AS FOUND Efficiencies: Pu-239: 17.47% Tc-99: 9.01% Th-230: 14.78% SrY-90: 22.68%

AS LEFT:

| | Alpha | | Beta | | A-B XTLK |
|---|---|---|---|---|---|
| Back ground: | 0 | CPM | 173 | CPM | |
| Pu-239: | 3169 | CPM | 434 | CPM | 8.2% |
| Tc-99: | 4 | CPM | 3746 | CPM | |
| Th-230: | 5474 | CPM | N/A | | |
| SrY-90: | N/A | | 5380 | CPM | |

AS LEFT Efficiencies: Pu-239: 18.42% Tc-99: 10.51% Th-230: 15.78% SrY-90: 24.00%

☑ Is the As Found Data Within 20% of the efficiency from the last cal.?

**Reproducibility:** Isotope: Sr-90 5443 5349 5452 Average: 5414.7 ☑ Are the individual counts within 10% of the average?

If the As Found data (even after repair) is within 10% of the last calibration and the B-A Xtalk is <1% and the A-B Xtalk is <10%, then the technician may N/A the Plateau Data and go directly to Comments. Geometry of source = flush to surface, except gas proportional probes = 1/8" from surface unless otherwise specified. Calibrated with a 5 foot cable unless otherwise specified.

**PLATEAU DATA** Source 1: Tc-99 Source 2: Th-230

| High Voltage | Response (CPM) A ch. | B ch. | Net Eff. | Response (CPM) A ch. | B ch. | Net Eff. | Background (CPM) A ch. | B ch. | Net A to B Xtalk: <10% |
|---|---|---|---|---|---|---|---|---|---|
| N/A | | | | | | | | | N/A |
| | | | | | | | | | N/A |
| | | | | | | | | | N/A |
| | | | | | | | | | N/A |
| | | | | | | | | | N/A |
| | | | | | | | | | N/A |

| | Alpha | Beta | Pu-239 | Tc-99 | Th-230 | SrY-90 |
|---|---|---|---|---|---|---|
| Background: | | | CPM | CPM | CPM | CPM |
| AL Efficiencies: | | | | | | |

**Comments:** Married as a set with: Model: 2360 Serial #: 184905 Bar Code #:

Increased high voltage setpoint to 600 volts due to low efficiencies.

☑ Does Instrument Meet Final Acceptance Criteria? ☑ Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 04/24/08

Performed by: [signature] Reviewed by: [signature] Date: 4-24-7

Printed Name: Carl Hall

Entered in Computer Inventory By: [signature] Date: 4/24/07

# Safety and Ecology Corporation

2800 Solway Road
Knoxville, TN 37931

## Calibration Certificate

SEC PROCEDURE #



4/24/2007

**Calibration Certificate for 2360,Serial # 227404, Bar Code # ,Property # SEC-6280**

Date: 04/24/07 Date Last Cal. Expires: 08/16/07 Technician: Carl Hall

Location: 9999, Reason For Calibration: Due for Calibration

**EQUIPMENT USED DURING CALIBRATION**

MODEL: 500-2 SERIAL #: 132896 CAL DUE: 08/08/07

MODEL: SERIAL #: CAL DUE:

**AS FOUND DATA** Geotropism: SAT AS FOUND Instrument Condition: SAT AS LEFT Instrument Condition: SAT

☐ New Batteries? Battery Check: SAT AS FOUND Mechanical Zero: 0 AS LEFT Mechanical Zero: 0

| HIGH VOLTAGE (+/- 10% tolerance) | | AS FOUND HV | AS LEFT HV |
|---|---|---|---|
| | 500 V: | 497 V | AF V |
| | 1000 V: | 1004 V | AF V |
| | 1500 V: | 1515 V | AF V |
| | AF HV Setting: | 528 V | AL HV Setting: 650 V |

| WINDOW SETTINGS | AS FOUND | AS LEFT |
|---|---|---|
| BT (4 mV +/- .4 mV): | 3.5 mV | 3.5 mV |
| BW (40 mV +/- 4 mV): | 39.7 mV | 40.0 mV |
| AT (120 mV +/- 10 mV): | 120 mV | 120 mV |

## RATE METER

| SCALE | RATE CPM | AS FOUND | % ERROR | AS LEFT | % ERROR |
|---|---|---|---|---|---|
| x.1 or x1 | 100 | 100 | 0.00% | AF | 0.00% |
| | 250 | 250 | 0.00% | AF | 0.00% |
| | 400 | 400 | 0.00% | AF | 0.00% |
| x1 or x10 | 1000 | 1000 | 0.00% | AF | 0.00% |
| | 2500 | 2500 | 0.00% | AF | 0.00% |
| | 4000 | 4000 | 0.00% | AF | 0.00% |
| x10 or x100 | 10K | 10 | 0.00% | AF | 0.00% |
| | 25K | 25 | 0.00% | AF | 0.00% |
| | 40K | 40 | 0.00% | AF | 0.00% |
| x100 or x1000 | 100K | 100 | 0.00% | AF | 0.00% |
| | 250K | 250 | 0.00% | AF | 0.00% |
| | 400K | 400 | 0.00% | AF | 0.00% |

☑ Is the As Found Data Within 20% of the Set Point?

## DIGITAL SCALER

| | | | | | |
|---|---|---|---|---|---|
| AF 250: | 250 | % ERR: 0.00% | AL 250: | AF | % ERR: 0.00% |
| AF 2500: | 2500 | % ERR: 0.00% | AL 2500: | AF | % ERR: 0.00% |
| AF 25K: | 24.99 K | % ERR: 0.04% | AL 25K: | AF K | % ERR: 0.04% |
| AF 250K: | 249.9 K | % ERR: 0.04% | AL 250K: | AF K | % ERR: 0.04% |

☑ Is the As Found Data Within 20% of the Set Point?

## REPRODUCIBILITY

| | | | |
|---|---|---|---|
| x.1 or x1 Scale: | 250 | 250 | 250 |
| x1 or x10 Scale: | 2500 | 2500 | 2500 |
| x10 or x100 Scale: | 25 K | 25 K | 25 K |
| x100 or x1000 Scale: | 250 K | 250 K | 250 K |

☑ Are the Individual Counts Within 10% of the Average?

Audio Response: SAT

Overload Light: SAT

Low Battery (2.2V): SAT

**Comments:** Married as a set with: Model: 43-89 Serial #: PR171342 Bar Code #:

☑ Does Instrument Meet Final Acceptance Criteria? ☑ Calibration Sticker Attached?

Date Instrument Is Due For Next Calibration: 04/24/08

Performed by: [signature] Reviewed by: [signature] Date: 4.24.7

Printed Name: Carl Hall

Entered in Computer Inventory By: [signature] Date: 4/24/07

**Safety and Ecology Corporation**

**2800 Solway Road, Knoxville, TN 37931**

# Calibration Certificate

**Calibration Certificate for 43-89,Serial # PR171342, Bar Code # ,Property # SEC-5427**

**Date:** 04/24/07 **Date Last Cal. Expires:** 03/03/07 **Technician:** Carl Hall

**Location:** 9999, **Reason For Calibration:** Due for Calibration

## EQUIPMENT USED DURING CALIBRATION

**MODEL:** 2360 **SERIAL #:** 227404 **CAL DUE** 04/24/08

**MODEL:** **SERIAL #:** **CAL DUE**

| NIST TRACEABLE SOURCES USED | SOURCE | ISOTOPE | ACTIVITY | 2π | ASSAY DATE |
|---|---|---|---|---|---|
| | 5744-06 | Sr-90 | 21700 dpm | 15,200 cpm | 12/6/2006 |
| | 5746-06 | Tc-99 | 34000 dpm | 21,200 cpm | 12/7/2006 |
| | 5748-06 | Th-230 | 34700 dpm | 17,600 cpm | 12/6/2006 |
| | 4078-02 | Pu-239 | 17200 dpm | 8,730 cpm | 2/4/2003 |

## AS FOUND DATA

**AS FOUND Instrument Condition:** SAT

**Calibration Setpoints**

**HV :** 625 **V**

**Threshold Beta:** 3.5 - 40 **mV** **Alpha:** 120 mV

| Efficiencies from last calibration | |
|---|---|
| Pu: | 18.11 % |
| Tc: | 10.67 % |
| Th: | 14.84 % |
| SrY: | 25.77 % |

| | Alpha | | Beta | | A-B XTLK |
|---|---|---|---|---|---|
| Background: | 0 | CPM | 184 | CPM | |
| Pu-239: | 2846 | CPM | 410 | CPM | 7.9% |
| Tc-99: | 3 | CPM | 3215 | CPM | |
| Th-230: | 4998 | CPM | N/A | | |
| SrY-90: | N/A | | 5006 | CPM | |

**AS FOUND Efficiencies:** Pu-239: 16.55% Tc-99: 8.91% Th-230: 14.40% SrY-90: 22.22%

☑ **Is the As Found Data Within 20% of the efficiency from the last cal.?**

**AS LEFT Instrument Condition:** SAT

**AS LEFT DATA after repair or HV adjust**

**HV :** 650 **V** HH

| | Alpha | | Beta | | A-B XTLK |
|---|---|---|---|---|---|
| Background: | 0 | CPM | 244 | CPM | |
| Pu-239: | 3081 | CPM | 551 | CPM | 10.0% |
| Tc-99: | 5 | CPM | 3814 | CPM | |
| Th-230: | 5207 | CPM | N/A | | |
| SrY-90: | N/A | | 5262 | CPM | |

**AS LEFT Efficiencies:** Pu-239: 17.91% Tc-99: 10.50% Th-230: 15.01% SrY-90: 23.12%

**Reproducibility: Isotope:** Sr-90 5289 5231 5247 **Average:** 5255.7 ☑ **Are the individual counts within 10% of the average?**

If the As Found data (even after repair) is within 10% of the last calibration and the B-A Xtalk is <1% and the A-B Xtalk is <10%, then the technician may N/A the Plateau Data and go directly to Comments. Geometry of source = flush to surface, except gas proportional probes = 1/8" from surface unless otherwise specified. Calibrated with a 5 foot cable unless otherwise specified.

## PLATEAU DATA

**Source 1:** Tc-99 **Source 2:** Th-230

| High Voltage | Source 1 Response (CPM) A ch. | B ch. | Net Eff. | Source 2 Response (CPM) A ch. | B ch. | Net Eff. | Background (CPM) A ch. | B ch. | Net A to B Xtalk: <10% |
|---|---|---|---|---|---|---|---|---|---|
| N/A | | | | | | | | | N/A |
| | | | | | | | | | N/A |
| | | | | | | | | | N/A |
| | | | | | | | | | N/A |
| | | | | | | | | | N/A |
| | | | | | | | | | N/A |

| | Alpha | Beta | Pu-239 | Tc-99 | Th-230 | SrY-90 |
|---|---|---|---|---|---|---|
| Background: | | | CPM | CPM | CPM | CPM |
| AL Efficiencies: | | | | | | |

**Comments:** **Married as a set with:** **Model:** 2360 **Serial #:** 227404 **Bar Code #:**

Increased high voltage setpoint to 650 volts due to low efficiencies.

☑ **Does Instrument Meet Final Acceptance Criteria?** ☑ **Calibration Sticker Attached?**

**Date Instrument is Due For Next Calibration:** 04/24/08

**Performed by:** [signature] **Reviewed by:** VM **Date:** 4 24 7

**Printed Name:** Carl Hall

**Entered in Computer Inventory By:** [signature] **Date:** 4/24/07

*Safety and Ecology Corporation*
*2800 Solway Road, Knoxville, TN 37931*

## *Calibration Certificate*

*Calibration Certificate for 2350-1,Serial # 232920, Bar Code # ,Property # SEC-6324*

**Date:** 02/22/07 **Date Last Cal. Expires:** 09/25/07 **Technician:** Carl Hall

**Location:** 9999, **Reason For Calibration:** #Error

**EQUIPMENT USED DURING CALIBRATION**

**MODEL:** 500-2 **SERIAL #:** 132896 **CAL. DUE:** 08/08/07
**MODEL:** **SERIAL #:** **CAL DUE:**

## AS FOUND DATA

**AS FOUND Instrument Condition:** SAT **AS LEFT Instrument Condition: SAT**

☐ **New Batteries?**

**Battery Check:** SAT

| High Voltage (+/- 10% tolerance) | AS FOUND High Voltage | AS LEFT High Voltage |
|---|---|---|
| **500 V:** | 502 | AF |
| **1000 V:** | 1000 | AF |
| **1500 V:** | 1494 | AF |

**AS FOUND HV Setting:** 950 **V** **AS LEFT HV Setting:** 950 **V**

**AS FOUND THRESHOLD:** 10 **mV** **AS LEFT THRESHOLD:** 10 **mV**

## REPRODUCIBILITY

| | | | |
|---|---|---|---|
| **x.1 or x1 Scale:** | 250 | 250 | 250 |
| **x1 or x10 Scale:** | 2500 | 2500 | 2500 |
| **x10 or x100 Scale:** | 25 K | 25 K | 25 K |
| **x100 or x1000 Scale:** | 250 K | 250 K | 250 K |

☑ **Are the Individual Counts Within 10% of the Average?**

☑ **Fast / Slow Response Switch Functions Properly?**

**Audio Response:** SAT

## DIGITAL SCALER

| | | | | | |
|---|---|---|---|---|---|
| **AF 250:** | 250 | **% ERR:** 0.00% | **AL 250:** | AF | **% ERR:** 0.00% |
| **AF 2500:** | 2500 | **% ERR:** 0.00% | **AL 2500:** | AF | **% ERR:** 0.00% |
| **AF 25K:** | 25 K | **% ERR:** 0.00% | **AL 25K:** | AF K | **% ERR:** 0.00% |
| **AF 250K:** | 250 K | **% ERR:** 0.00% | **AL 250K:** | AF K | **% ERR:** 0.00% |

☑ **Is the As Found Data Within 20% of the Set Point?**

**Push Buttons:** SAT **Lamp:** SAT **Audio/Divide:** SAT

**Comments:** **Married as a set with:** **Model:** 44-10 **Serial #:** PR242823 **Bar Code #:**

Recalibrated for rental purposes.

☑ **Does Instrument Meet Final Acceptance Criteria?**

☑ **Calibration Sticker Attached?**

**Date Instrument is Due For Next Calibration:** 02/22/08

**Performed by:** [signature] **Reviewed by:** [signature] **Date:** 2-22-07

**Printed Name:** Carl Hall

**Entered in Computer Inventory By:** [signature] **Date:** 2/22/07

**Safety and Ecology Corporation**
2800 Solway Road, Knoxville, TN 37931

# Calibration Certificate

## Calibration Certificate for 44-10,Serial # PR242823, Bar Code # ,Property # SEC-6307

**Date:** 02/22/07 **Date Last Cal. Expires:** 09/25/07 **Technician:** Carl Hall

**Location:** 9999, **Reason For Calibration:** Other (See Comments)

**EQUIPMENT USED DURING CALIBRATION**

**MODEL:** 2350-1 **SERIAL #:** 232920 **CAL DUE:** 02/22/08

**MODEL:** **SERIAL #:** **CAL DUE:**

**NIST TRACEABLE SOURCES USED**

| SOURCE | ISOTOPE | ACTIVITY | 2π | ASSAY DATE |
|---|---|---|---|---|
| 99CS250-0288 | Cs-137 | 7.5 uCi | | 3/18/1999 |

**Efficiency from Last Calibration:** 0.69 % **HV From Last Calibration:** 950 V **Calibration Threshold:** 10 mV

**AS FOUND DATA** | **1 MINUTE COUNTS (CPM)** | **AS LEFT DATA after repair of HV adjust**

**AS FOUND Instrument Condition:** SAT

**HV:** 950 V

**Center:** 118550

**Background:** 3872

**Probe Efficiency:** Cs-137 0.69%

**AS LEFT Instrument Condition: SAT**

**HV:** AF V

**Heel:**

**Center:**

**Toe:**

**Background:**

**Uniformity:**

**Probe Efficiency:** Cs-137

☑ **Is the As Found Efficiency Within 20% of the efficiency from the last cal.?**

**Reproducibility: Isotope:**Cs-137 118305 118774 118571 **Average:** 118550 ☑ **Are the individual counts within 10% of the average?**

* If As Found Efficiency (even after repair) is within 10% of the last calibration and uniformity is <10%, the technician may N/A the Plateau Data and proceed to Comments. Geometry = Nal probes are 4 1/2" from source. All other probes are in contact with surface unless otherwise specified. Calibrated with a 5 foot cable unless otherwise specified.

**PLATEAU AND SET POINT DATA (CPM)**

| High Voltage | Source Response | Background |
|---|---|---|
| N/A | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

**HV** V **CENTER** **Background** **Efficiency** Cs-137

**Comments: Married as a set with: Model:** 2350-1 **Serial #:** 232920 **Bar Code #:**

Recalibrated for rental purposes.

☑ **Does Instrument Meet Final Acceptance Criteria?** ☑ **Calibration Sticker Attached?**

**Date Instrument is Due For Next Calibration:** 02/22/08

**Performed by:** [signature] **Reviewed by:** [signature] **Date:** 2.22.07

**Printed Name:** Carl Hall

**Entered in Computer Inventory By:** [signature] **Date:** 2/22/07

**Safety and Ecology Corporation**

2800 Solway Road, Knoxville, TN 37931

# Calibration Certificate

*Calibration Certificate for 2350-1,Serial # 228710, Bar Code # ,Property # SEC-6286*

**Date:** 02/26/07 **Date Last Cal. Expires:** 07/25/07 **Technician:** David Moyer

**Location:** 9999, **Reason For Calibration:** Other (See Comments)

**EQUIPMENT USED DURING CALIBRATION**

**MODEL:** 500-2 **SERIAL #:** 209797 **CAL. DUE:** 07/25/07

**MODEL:** **SERIAL #:** **CAL DUE:**

## AS FOUND DATA

**AS FOUND Instrument Condition:** SAT **AS LEFT Instrument Condition:** SAT

☐ **New Batteries?**

**Battery Check:** SAT

| High Voltage (+/- 10% tolerance) | AS FOUND High Voltage | AS LEFT High Voltage |
|---|---|---|
| 500 V: | 509 | 503 |
| 1000 V: | 1011 | 1000 |
| 1500 V: | 1510 | 1493 |

**AS FOUND HV Setting:** 1012 V **AS LEFT HV Setting:** 950 V

**AS FOUND THRESHOLD:** 10.3 mV **AS LEFT THRESHOLD:** 10 mV

## REPRODUCIBILITY

| | | | |
|---|---|---|---|
| x.1 or x1 Scale: | 250 | 250 | 250 |
| x1 or x10 Scale: | 2500 | 2500 | 2500 |
| x10 or x100 Scale: | 25 K | 25 K | 25 K |
| x100 or x1000 Scale: | 250 K | 250 K | 250 K |

☑ **Are the Individual Counts Within 10% of the Average?**

☑ **Fast / Slow Response Switch Functions Properly?**

**Audio Response:** SAT

## DIGITAL SCALER

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **AF 250:** | 250 | **% ERR:** | 0.00% | **AL 250:** | AF | **% ERR:** | 0.00% |
| **AF 2500:** | 2500 | **% ERR:** | 0.00% | **AL 2500:** | AF | **% ERR:** | 0.00% |
| **AF 25K:** | 24.99 K | **% ERR:** | 0.04% | **AL 25K:** | AF K | **% ERR:** | 0.04% |
| **AF 250K:** | 249.9 K | **% ERR:** | 0.04% | **AL 250K:** | AF K | **% ERR:** | 0.04% |

☑ **Is the As Found Data Within 20% of the Set Point?**

**Push Buttons:** SAT **Lamp:** SAT **Audio/Divide:** SAT

**Comments:** **Married as a set with:** **Model:** 44-10 **Serial #:** PR242829 **Bar Code #:**

Short cycled for new rental.

☑ **Does Instrument Meet Final Acceptance Criteria?**

☑ **Calibration Sticker Attached?**

**Date Instrument is Due For Next Calibration:** 02/26/08

**Performed by:** [signature] **Reviewed by:** [signature] **Date:** 3/2/07

**Printed Name:** David Moyer

**Entered in Computer Inventory By:** WM **Date:** 2 26 7

# Safety and Ecology Corporation

2800 Solway Road, Knoxville, TN 37931

## Calibration Certificate

***Calibration Certificate for 44-10, Serial # PR242829, Bar Code # , Property # SEC-6301***

**Date:** 02/26/07 **Date Last Cal. Expires:** 08/10/07 **Technician:** David Moyer

**Location:** 9999, **Reason For Calibration:** Other (See Comments)

**EQUIPMENT USED DURING CALIBRATION**

**MODEL:** 2350-1 **SERIAL #:** 228710 **CAL DUE:** 02/26/08

**MODEL:** **SERIAL #:** **CAL DUE:**

**NIST TRACEABLE SOURCES USED**

| SOURCE | ISOTOPE | ACTIVITY | 2π | ASSAY DATE |
|---|---|---|---|---|
| 99CS250-0288 | Cs-137 | 7.5 uCi | | 3/18/1999 |

**Efficiency from Last Calibration:** 0.75 % **HV From Last Calibration:** 950 V **Calibration Threshold:** 10 mV

**AS FOUND DATA** | **1 MINUTE COUNTS (CPM)** | **AS LEFT DATA after repair of HV adjust**

**AS FOUND Instrument Condition:** SAT

HV: 950 V

Center: 119958

Background: 4174

Probe Efficiency: Cs-137 0.70%

**AS LEFT Instrument Condition: SAT**

HV: AF V

Heel:

Center:

Toe:

Background:

Uniformity:

Probe Efficiency: Cs-137

☑ Is the As Found Efficiency Within 20% of the efficiency from the last cal.?

**Reproducibility:** Isotope: Cs-137 120347 120564 120372 Average: 120428 ☑ Are the individual counts within 10% of the average?

* If As Found Efficiency (even after repair) is within 10% of the last calibration and uniformity is <10%, the technician may N/A the Plateau Data and proceed to Comments. Geometry = NaI probes are 4 1/2" from source. All other probes are in contact with surface unless otherwise specified. Calibrated with a 5 foot cable unless otherwise specified.

**PLATEAU AND SET POINT DATA (CPM)**

| High Voltage | Source Response | Background |
|---|---|---|
| N/A | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

| HV | CENTER | Background | Efficiency |
|---|---|---|---|
| V | | | Cs-137 |

**Comments:** Married as a set with: Model: 2350-1 Serial #: 228710 Bar Code #:

Short cycled for new rental.

☑ Does Instrument Meet Final Acceptance Criteria? ☑ Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 02/26/08

Performed by: [signature] Reviewed by: [signature] Date: 3/2/07

Printed Name: David Moyer

Entered in Computer Inventory By: [signature] Date: 2·26·7

# Safety and Ecology Corporation

2800 Solway Road, Knoxville, TN 37931

## Calibration Certificate

*Calibration Certificate for 3,Serial # 187583, Bar Code # ,Property # SEC-5126*

**Date:** 06/12/07 **Date Last Cal. Expires:** 02/16/08 **Technician:** Carl Hall

**Location:** 9999, **Reason For Calibration:** Due for Calibration

**EQUIPMENT USED DURING CALIBRATION**

**MODEL:** 500-2 **SERIAL #:** 132896 **CAL DUE:** 08/08/07

**MODEL:** **SERIAL #:** **CAL DUE:**

**AS FOUND DATA** **Geotropism:** SAT **AS FOUND Instrument Condition:** SAT **AS LEFT Instrument Condition: SAT**

| HIGH VOLTAGE (+/- 10% tolerance) | | AS FOUND HV | AS LEFT HV |
|---|---|---|---|
| | 500 V: | N/A | N/A |
| | 1000 V: | N/A | N/A |
| | 1500 V: | N/A | N/A |

**HV Range 400-1500V:** SAT

☐ **New Batteries?** **Battery Check:** SAT **Alarm:** N/A

**AS FOUND Mechanical Zero:** 0 **AS LEFT Mechanical Zero:** 0

**AS FOUND THRESHOLD:** 36.7 mV **AS LEFT THRESHOLD:** 36.7 mV

**AS FOUND HV Reading:** 900 V **AS LEFT HV Reading:** 900 V

## RATE METER

| SCALE | RATE CPM | AS FOUND | % ERROR | AS LEFT | % ERROR |
|---|---|---|---|---|---|
| x.1 or x1 | 100 | 100 | 0.00% | AF | 0.00% |
| | 250 | 250 | 0.00% | AF | 0.00% |
| | 400 | 400 | 0.00% | AF | 0.00% |
| x1 or x10 | 1000 | 1000 | 0.00% | AF | 0.00% |
| | 2500 | 2500 | 0.00% | AF | 0.00% |
| | 4000 | 4000 | 0.00% | AF | 0.00% |
| x10 or x100 | 10K | 10 | 0.00% | AF | 0.00% |
| | 25K | 25 | 0.00% | AF | 0.00% |
| | 40K | 40 | 0.00% | AF | 0.00% |
| x100 or x1000 | 100K | 100 | 0.00% | AF | 0.00% |
| | 250K | 250 | 0.00% | AF | 0.00% |
| | 400K | 400 | 0.00% | AF | 0.00% |

☑ **Is the As Found Data Within 20% of the Set Point?**

## DIGITAL SCALER

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **AF 250:** | 250 | **% ERR:** | 0.00% | **AL 250:** | AF | **% ERR:** | 0.00% |
| **AF 2500:** | 2500 | **% ERR:** | 0.00% | **AL 2500:** | AF | **% ERR:** | 0.00% |
| **AF 25K:** | 25 K | **% ERR:** | 0.00% | **AL 25K:** | AF K | **% ERR:** | 0.00% |
| **AF 250K:** | 100 K | **% ERR:** | 60.00 | **AL 250K:** | AF K | **% ERR:** | 60.00% |

☑ **Is the As Found Data Within 20% of the Set Point?**

## REPRODUCIBILITY

| | | | |
|---|---|---|---|
| **x.1 or x1 Scale:** | 250 | 250 | 250 |
| **x1 or x10 Scale:** | 2500 | 2500 | 2500 |
| **x10 or x100 Scale:** | 25 K | 25 K | 25 K |
| **x100 or x1000 Scale:** | 250 K | 250 K | 250 K |

☑ **Are the Individual Counts Within 10% of the Average?**

☑ **Fast / Slow Response Switch Functions Properly?**

**Audio Response:** SAT **Audio Divide:** N/A

**Push Buttons:** SAT **Lamp:** N/A

**Scaler/Digital:** SAT

**Comments** **Married as a set with:** **Model:** 44-9 **Serial #:** PR191712 **Bar Code #:**

Calibrated X100 range at 100,000 cpm due to meters digital limit of 199,999 cpm.

☑ **Does Instrument Meet Final Acceptance Criteria?** ☑ **Calibration Sticker Attached?**

**Date Instrument is Due For Next Calibration:** 06/12/08

**Performed by:** [signature] **Reviewed by:** [signature] **Date:** 6-12-7

**Printed Name:** Carl Hall

**Entered in Computer Inventory By:** [signature] **Date:** 6/12/07

**Safety and Ecology Corporation**

*2800 Solway Road, Knoxville, TN 37931*

**Calibration Certificate**



***Calibration Certificate for 44-9,Serial # PR191712, Bar Code # ,Property # SEC-5608***

**Date:** 06/12/07 **Date Last Cal. Expires:** 09/09/06 **Technician:** Carl Hall

**Location:** 9999, **Reason For Calibration:** Due for Calibration

**EQUIPMENT USED DURING CALIBRATION**

**MODEL:** 3 **SERIAL #** 187583 **CAL DUE:** 06/12/08

**MODEL:** **SERIAL #** **CAL DUE:**

**NIST TRACEABLE SOURCES USED**

| SOURCE | ISOTOPE | ACTIVITY | $2\pi$ | ASSAY DATE |
|---|---|---|---|---|
| 4050-02 | Tc-99 | 36600 dpm | 22,900 cpm | 9/25/2002 |
| 4052-02 | Sr-90 | 22400 dpm | 15,700 cpm | 9/25/2002 |

Geometry = in contact with surface unless otherwise specified. Calibrated with a 5 foot cable unless otherwise specified.

**PREVIOUS Tc-99 EFFICIENCY:** 13.34 % **Calibration Voltage:** 900 V **Calibration Threshold:** 36.7 mV

**AS FOUND Instrument Condition:** SAT

## AS FOUND DATA

**1 MINUTE COUNTS (CPM)**

| | | | | AVERAGE |
|---|---|---|---|---|
| **AF Background:** | 36 | | | |
| **Tc-99 Count:** | 5522 | 5712 | 5658 | 5630.7 |
| **Sr-90 Count:** | 6047 | | | |

**Efficiencies**

Tc-99 EFF: 15.29% Sr-90 EFF: 26.83%

**AS LEFT Instrument Condition:** SAT

## AS LEFT DATA

**1 MINUTE COUNTS (CPM)**

| | | | | AVERAGE |
|---|---|---|---|---|
| **AL Background:** | AF | | | |
| **Tc-99 Count:** | AF | AF | AF | |
| **Sr-90 Count:** | AF | | | |

**Efficiencies**

Tc-99 EFF: Sr-90 EFF:

- ☑ Is the AS FOUND efficiency within 20% of efficiency from last calibration?
- ☑ Reproducibility: Are the individual counts within 10% of the average?
- ☑ Does the probe meet final acceptance criteria?
- ☑ Calibration sticker attached?

**Comments:** Married as a set with: **Model:** 3 **Serial #:** 187583 **Bar Code #:**

**Date Instrument Is Due For Next Calibration:** 06/12/08

**Performed by:** [signature] **Reviewed by:** [signature] **Date:** 6-12-7

**Printed Name:** Carl Hall

**Entered in Computer Inventory By:** [signature] **Date:** 6/12/07

**Safety and Ecology Corporation**
**2800 Solway Road, Knoxville, TN 37931**
## Calibration Certificate

**Calibration Certificate for 3,Serial # 187558, Bar Code # ,Property # SEC-6447**

**Date:** 06/12/07 **Date Last Cal. Expires:** 11/14/07 **Technician:** Carl Hall

**Location:** 9999, **Reason For Calibration:** Due for Calibration

**EQUIPMENT USED DURING CALIBRATION**

**MODEL:** 500-2 **SERIAL #:** 132896 **CAL DUE:** 08/08/07

**MODEL:** **SERIAL #:** **CAL DUE:**

**AS FOUND DATA** **Geotropism:** SAT **AS FOUND Instrument Condition:** SAT **AS LEFT Instrument Condition: SAT**

| HIGH VOLTAGE (+/- 10% tolerance) | | AS FOUND HV | AS LEFT HV |
|---|---|---|---|
| | 500 V: | N/A | N/A |
| | 1000 V: | N/A | N/A |
| | 1500 V: | N/A | N/A |

**HV Range 400-1500V:** SAT

☐ **New Batteries?** **Battery Check:** SAT **Alarm:** N/A

**AS FOUND Mechanical Zero:** 0 **AS LEFT Mechanical Zero:** 0

**AS FOUND THRESHOLD:** 38.8 mV **AS LEFT THRESHOLD:** 38.8 mV

**AS FOUND HV Reading:** 900 V **AS LEFT HV Reading:** 900 V

## RATE METER

| SCALE | RATE CPM | AS FOUND | % ERROR | AS LEFT | % ERROR |
|---|---|---|---|---|---|
| x.1 or x1 | 100 | 100 | 0.00% | AF | 0.00% |
| | 250 | 250 | 0.00% | AF | 0.00% |
| | 400 | 400 | 0.00% | AF | 0.00% |
| x1 or x10 | 1000 | 1000 | 0.00% | AF | 0.00% |
| | 2500 | 2500 | 0.00% | AF | 0.00% |
| | 4000 | 4000 | 0.00% | AF | 0.00% |
| x10 or x100 | 10K | 10 | 0.00% | AF | 0.00% |
| | 25K | 25 | 0.00% | AF | 0.00% |
| | 40K | 40 | 0.00% | AF | 0.00% |
| x100 or x1000 | 100K | 100 | 0.00% | AF | 0.00% |
| | 250K | 250 | 0.00% | AF | 0.00% |
| | 400K | 400 | 0.00% | AF | 0.00% |

☑ **Is the As Found Data Within 20% of the Set Point?**

## DIGITAL SCALER

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **AF 250:** | 250 | **% ERR:** | 0.00% | **AL 250:** | AF | **% ERR:** | 0 00% |
| **AF 2500:** | 2500 | **% ERR:** | 0.00% | **AL 2500:** | AF | **% ERR:** | 0.00% |
| **AF 25K:** | 24.99 K | **% ERR:** | 0.04% | **AL 25K:** | AF K | **% ERR:** | 0.04% |
| **AF 250K:** | 100 K | **% ERR:** | 60.00 | **AL 250K:** | AF K | **% ERR:** | 60.00% |

☑ **Is the As Found Data Within 20% of the Set Point?**

## REPRODUCIBILITY

| | | | |
|---|---|---|---|
| x.1 or x1 Scale: | 250 | 250 | 250 |
| x1 or x10 Scale: | 2500 | 2500 | 2500 |
| x10 or x100 Scale: | 25 K | 25 K | 25 K |
| x100 or x1000 Scale: | 250 K | 250 K | 250 K |

☑ **Are the Individual Counts Within 10% of the Average?**

☑ **Fast / Slow Response Switch Functions Properly?**

**Audio Response:** SAT **Audio Divide:** N/A

**Push Buttons:** SAT **Lamp:** N/A

**Scaler/Digital:** SAT

**Comments** **Married as a set with:** **Model:** 44-9 **Serial #:** PR193581 **Bar Code #:**

Calibrated X100 range at 100,000 cpm due to meters digital limit of 199,999 cpm.

☑ **Does Instrument Meet Final Acceptance Criteria?** ☑ **Calibration Sticker Attached?**

**Date Instrument is Due For Next Calibration:** 06/12/08

**Performed by:** [signature] **Reviewed by:** [signature] **Date:** 6.12.7

**Printed Name:** Carl Hall

**Entered in Computer Inventory By:** [signature] **Date:** 6/12/07

**Calibration Certificate for 44-9,Serial # PR193581, Bar Code # ,Property # SEC-6339**

Date: 06/12/07 Date Last Cal. Expires: 11/14/07 Technician: Carl Hall

Location: 9999, Reason For Calibration: Due for Calibration

**EQUIPMENT USED DURING CALIBRATION**

MODEL: 3 SERIAL # 187558 CAL DUE: 06/12/08

MODEL: SERIAL # CAL DUE:

**NIST TRACEABLE SOURCES USED**

| SOURCE | ISOTOPE | ACTIVITY | $2\pi$ | ASSAY DATE |
|---|---|---|---|---|
| 4050-02 | Tc-99 | 36600 dpm | 22,900 cpm | 9/25/2002 |
| 4052-02 | Sr-90 | 22400 dpm | 15,700 cpm | 9/25/2002 |

Geometry = in contact with surface unless otherwise specified. Calibrated with a 5 foot cable unless otherwise specified.

PREVIOUS Tc-99 EFFICIENCY: 14.24 % Calibration Voltage: 900 V Calibration Threshold: 38.8 mV

AS FOUND Instrument Condition: SAT

## AS FOUND DATA

**1 MINUTE COUNTS (CPM)**

| | | | | AVERAGE |
|---|---|---|---|---|
| AF Background: | 32 | | | |
| Tc-99 Count: | 4998 | 4995 | 4846 | 4946.3 |
| Sr-90 Count: | 5488 | | | |

**Efficiencies**

Tc-99 EFF: 13.43% Sr-90 EFF: 24.36%

AS LEFT Instrument Condition: SAT

## AS LEFT DATA

**1 MINUTE COUNTS (CPM)**

| | | | | AVERAGE |
|---|---|---|---|---|
| AL Background: | AF | | | |
| Tc-99 Count: | AF | AF | AF | |
| Sr-90 Count: | AF | | | |

**Efficiencies**

Tc-99 EFF: Sr-90 EFF:

- [x] Is the AS FOUND efficiency within 20% of efficiency from last calibration?
- [x] Reproducibility: Are the individual counts within 10% of the average?
- [x] Does the probe meet final acceptance criteria?
- [x] Calibration sticker attached?

**Comments:** Married as a set with: Model: 3 Serial #: 187558 Bar Code #:

Date Instrument is Due For Next Calibration: 06/12/08

Performed by: [signature] Reviewed by: [signature] Date: 6-12-7

Printed Name: Carl Hall

Entered in Computer Inventory By: [signature] Date: 6/12/07

SAFETY AND ECOLOGY CORP.
CALIBRATION DATA SHEET

FORM 73-1
REV. 0

| | | | |
|---|---|---|---|
| CUSTOMER NAME | : SAFETY AND ECOLOGY | INST. MANUFACTURER | : LUDLUM INST |
| PLANT NAME | : SEC LAB | TYPE | : SCINTILLATION |
| ADDRESS | : 10512 Lexington Dr. | MODEL NO. | : 19 |
| | KNOXVILLE | SERIAL NO. | : **148206** |
| | TN | | |
| CONTACT PERSON | : JERRY DEGROODT | | |

**SOURCE USED**

CAL SOURCE USED : CESIUM -137 400 CURIE/130 MILLICURIE S/N 9115 CAL DUE : 09/07/2007

**M&TE**

| | | | |
|---|---|---|---|
| MINIPULSER S/N | : 314 | CALIBRATION DUE DATE : | 07/25/2007 |
| DVM S/N | : 82730524 | CALIBRATION DUE DATE : | 02/28/2009 |
| H.V. PROBE S/N | : 82630102 | CALIBRATION DUE DATE : | 03/02/2009 |

**CALIBRATION DATA**

| | | AS FOUND | AS LEFT | |
|---|---|---|---|---|
| HIGH VOLTAGE | : | 950 | 950 | VOLTS |
| INPUT SENSITIVITY | : | 40 | 40 | MILLIVOLTS |

| SCALE | EXPOSURE RATE | | INSTRUMENT READING | | PER CENT ERROR | |
|---|---|---|---|---|---|---|
| | uR/HR | (MR/HR) | AS FOUND | AS LEFT | AS FOUND | AS LEFT |
| 25 | 5 | (PULSED = TO) | 5.00 | 5.00 | 0.00 | 0.00 |
| | 12 | (PULSED = TO) | 12.00 | 12.00 | 0.00 | 0.00 |
| | 20 | (PULSED = TO) | 20.00 | 20.00 | 0.00 | 0.00 |
| 50 | 10 | (PULSED = TO) | 10 0 | 10.0 | 0.00 | 0.00 |
| | 25 | (PULSED = TO) | 25 0 | 25 0 | 0.00 | 0.00 |
| | 40 | (PULSED = TO) | 40.0 | 40.0 | 0.00 | 0 00 |
| 250 | 50 | (PULSED = TO) | 50.0 | 50.0 | 0.00 | 0 00 |
| | 120 | (PULSED = TO) | 120.0 | 120.0 | 0.00 | 0 00 |
| | 200 | (PULSED = TO) | 200.0 | 200.0 | 0.00 | 0.00 |
| 500 | 200 | (0.2) | 200 | 200 | 0.00 | 0.00 |
| | 250 | (0.25) | 250 | 250 | 0.00 | 0.00 |
| | 400 | (0.4) | 390 | 390 | -2.50 | -2.50 |
| 5000 | 1000 | (1.0) | 1000 | 1000 | 0.00 | 0 00 |
| | 2500 | (2.5) | 2500 | 2500 | 0 00 | 0.00 |
| | 4000 | (4.0) | 3900 | 3900 | -2.50 | -2.50 |

**PRECISION**

| SCALE | EXPOSURE RATE | | AS FOUND | MEAN VALUE | % DEV. |
|---|---|---|---|---|---|
| 5000 | 2500 | (2.5) | 2500 | | 0.00 |
| | | | 2500 | 2500 | 0.00 |
| | | | 2500 | | 0.00 |

COMMENTS/REMARKS:

DOSE RATE CALIBRATION DONE WITH N.I.S.T. TRACEABLE SOURCES AND CALIBRATED TEST EQUIPMENT.
PULSE RATE CALIBRATION DONE AS REQUIRED DUE TO BACKGROUND RADIATION AND CORRELATED TO DOSE RATE CALIBRATION ON HIGHER SCALES.
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 73.

CALIBRATED BY : [signature] REVIEWED BY : [signature]

DATE CALIBRATED : 6-12-07 DATE REVIEWED : 6/12/07

CALIBRATION DUE DATE : 6-12-08

SAFETY AND ECOLOGY CORP.
REPAIR AND SERVICE RECORD

FORM 73-2
REV. 0

| | | | |
|---|---|---|---|
| CUSTOMER NAME: | SAFETY AND ECOLOGY | MANUFACTURER: | LUDLUM INST. |
| PLANT NAME: | SEC LAB | TYPE: | SCINTILLATION |
| ADDRESS: | 10512 LEXINGTON Dr. | MODEL NO. : | 19 |
| | KNOXVILLE | SERIAL NO. : | 148206 |
| | TN | | |
| CONTACT PERSON: | JERRY DEGROODT | | |

| DATE | PROBLEM DESCRIPTION | WORK PERFORMED |
|---|---|---|
| 06/12/2007 | ROUTINE SERVICE:<br>CHECK BATTERIES<br>CHECK METER ZERO<br>CHECK GEOTROPISM<br>CHECK F/S RESPONSE<br>CHECK AUDIO<br>CHECK LIGHT<br>CHECK HIGH VOLTAGE<br>CHECK INPUT SENSITIVITY<br>DOSE AND/OR PULSE RATE CALIBRATED | PERFORMED PER PROCEDURE 73<br>ALL SATISFACTORY UNLESS<br>DENOTED BELOW.<br><br>LABOR: 2.0 MAN-HOURS |

WORK PERFORMED BY: ____________

# Safety and Ecology Corporation

2800 Solway Road, Knoxville, TN 37931

## Calibration Certificate

*Calibration Certificate for 2350-1, Serial # 228693, Bar Code # , Property # SEC-6330*

**Date:** 02/22/07 **Date Last Cal. Expires:** 09/25/07 **Technician:** Carl Hall

**Location:** 106699, **Reason For Calibration:** Other (See Comments)

**EQUIPMENT USED DURING CALIBRATION**

**MODEL:** 500-2 **SERIAL #:** 132896 **CAL. DUE:** 08/08/07
**MODEL:** **SERIAL #:** **CAL DUE:**

## AS FOUND DATA

**AS FOUND Instrument Condition:** SAT **AS LEFT Instrument Condition:** SAT

☐ **New Batteries?**

**Battery Check:** SAT

| High Voltage (+/- 10% tolerance) | AS FOUND High Voltage | AS LEFT High Voltage |
|---|---|---|
| 500 V: | 503 | AF |
| 1000 V: | 1000 | AF |
| 1500 V: | 1494 | AF |

**AS FOUND HV Setting:** 950 V **AS LEFT HV Setting:** 950 V

**AS FOUND THRESHOLD:** 10 mV **AS LEFT THRESHOLD:** 10 mV

## REPRODUCIBILITY

| | | | |
|---|---|---|---|
| x.1 or x1 Scale: | 250 | 250 | 250 |
| x1 or x10 Scale: | 2500 | 2500 | 2500 |
| x10 or x100 Scale: | 25 K | 25 K | 25 K |
| x100 or x1000 Scale: | 250 K | 250 K | 250 K |

☑ Are the Individual Counts Within 10% of the Average?

☑ Fast / Slow Response Switch Functions Properly?

**Audio Response:** SAT

## DIGITAL SCALER

| | | | | | |
|---|---|---|---|---|---|
| AF 250: | 250 | % ERR: 0.00% | AL 250: | AF | % ERR: 0.00% |
| AF 2500: | 2500 | % ERR: 0.00% | AL 2500: | AF | % ERR: 0.00% |
| AF 25K: | 25 K | % ERR: 0.00% | AL 25K: | AF K | % ERR: 0.00% |
| AF 250K: | 250 K | % ERR: 0.00% | AL 250K: | AF K | % ERR: 0.00% |

☑ Is the As Found Data Within 20% of the Set Point?

**Push Buttons:** SAT **Lamp:** SAT **Audio/Divide:** SAT

**Comments:** Married as a set with: **Model:** 44-10 **Serial #:** PR245172 **Bar Code #:**

Re calibrated for rental use.

☑ Does Instrument Meet Final Acceptance Criteria?

☑ Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 02/22/08

Performed by: [signature] Reviewed by: [signature] Date: 2-22-07

Printed Name: Carl Hall

Entered in Computer Inventory By: [signature] Date: 2/22/07

# Safety and Ecology Corporation

2800 Solway Road, Knoxville, TN 37931

## Calibration Certificate



**Calibration Certificate for 44-10,Serial # PR245172, Bar Code # ,Property # SEC-6341**

**Date:** 02/22/07 **Date Last Cal. Expires:** 09/25/07 **Technician:** Carl Hall

**Location:** 106699, **Reason For Calibration:** Other (See Comments)

**EQUIPMENT USED DURING CALIBRATION**

**MODEL:** 2350-1 **SERIAL #:** 228693 **CAL DUE:** 02/22/08

**MODEL:** **SERIAL #:** **CAL DUE:**

**NIST TRACEABLE SOURCES USED**

| SOURCE | ISOTOPE | ACTIVITY | 2π | ASSAY DATE |
|---|---|---|---|---|
| 99CS250-0288 | Cs-137 | 7.5 uCi | | 3/18/1999 |

**Efficiency from Last Calibration:** 0.69 % **HV From Last Calibration:** 950 V **Calibration Threshold:** 10 mV

**AS FOUND DATA** — **1 MINUTE COUNTS (CPM)** — **AS LEFT DATA after repair of HV adjust**

**AS FOUND Instrument Condition:** SAT

**HV:** 950 V

**Center:** 118545

**Background:** 3841

**Probe Efficiency:** Cs-137 0.69%

**AS LEFT Instrument Condition:** SAT

**HV:** AF V

**Heel:**

**Center:**

**Toe:**

**Background:**

**Uniformity:**

**Probe Efficiency:** Cs-137

☑ Is the As Found Efficiency Within 20% of the efficiency from the last cal.?

**Reproducibility: Isotope:** Cs-137 118635 118512 118488 **Average:** 118545 ☑ Are the individual counts within 10% of the average?

* If As Found Efficiency (even after repair) is within 10% of the last calibration and uniformity is <10%, the technician may N/A the Plateau Data and proceed to Comments. Geometry = NaI probes are 4 1/2" from source. All other probes are in contact with surface unless otherwise specified. Calibrated with a 5 foot cable unless otherwise specified.

**PLATEAU AND SET POINT DATA (CPM)**

| High Voltage | Source Response | Background |
|---|---|---|
| N/A | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

**HV:** V **CENTER** **Background** **Efficiency** Cs-137

**Comments:** Married as a set with: **Model:** 2350-1 **Serial #:** 228693 **Bar Code #:**

Recalibrated for rental purposes.

☑ Does Instrument Meet Final Acceptance Criteria? ☑ Calibration Sticker Attached?

Date Instrument Is Due For Next Calibration: 02/22/08

Performed by: [signature] Reviewed by: [signature] Date: 2-22-07

Printed Name: Carl Hall

Entered in Computer Inventory By: [signature] Date: 2/22/07

# CERTIFICATE OF CALIBRATION
# BETA STANDARD SOURCE

| | | | |
|---|---|---|---|
| Radionuclide: | Tc-99 | Customer: | NEW WORLD TECHNOLOGY |
| Half Life: | $(2.13 \pm 0.05) \times 10^5$ years | P.O.No.: | 1367 |
| Catalog No.: | EAB-099 | Reference Date: | 1 May 98 12:00 PST. |
| Source No.: | 564-13-3 | Contained Radioactivity: | 14.74 nCi (545.4 Bq) |
| | | Surface Emission rate (in $2\pi$) : | 16030 betas/min |

Description of Source

| | |
|---|---|
| a. Capsule type: | LDS |
| b. Nature of active deposit: | Tc-99 incorporated into an anodized layer |
| c. Active diameter/volume: | 10 cm x 10 cm |
| d. Backing: | Aluminum |
| e. Cover: | None |

Radioimpurities

None detected

Method of Calibration

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement

| | |
|---|---|
| a. Systematic uncertainty in instrument calibration: | $\pm$ 3.0% |
| b. Random uncertainty in assay: | $\pm$ 1.3% |
| c. Random uncertainty in weighing(s): | $\pm$ 0.0% |
| d. Total uncertainty at the 99% confidence level: | $\pm$ 3.3% |

NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

Leak Test(s)

See reverse side for Leak Test(s) applied to this source

Notes

1. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).

QUALITY CONTROL

5 MAY 98
Date Signed

ISOTOPE PRODUCTS LABORATORIES
1800 N. KEYSTONE STREET
BURBANK, CALIFORNIA 91504
818·843·7000 FAX 818·843·6168

IPL Ref. No.: 564-13

# CERTIFICATE OF CALIBRATION
# ALPHA STANDARD SOURCE

| | | | |
|---|---|---|---|
| Radionuclide: | Th-230 | Customer: | NEW WORLD TECHNOLOGY |
| Half Life: | $(7.54 \pm 0.03) \times 10^4$ years | P.O.No.: | 1367 |
| Catalog No.: | LDS-230 | Reference Date: | 1 May 98 12.00 PST. |
| Source No.: | 564-33-1 | Contained Radioactivity: | 3.979 nCi ( 147.2 Bq) |
| | | Surface Emission rate (in 2π) : | 4222 alphas/min |

Description of Source

| | |
|---|---|
| a. Capsule type: | LDS |
| b. Nature of active deposit: | Th-230 incorporated into an anodized layer |
| c. Active diameter/volume: | 10 cm x 10 cm |
| d. Backing: | Aluminum |
| e. Cover: | None |

Radioimpurities

None detected

Method of Calibration

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement

| | |
|---|---|
| a. Systematic uncertainty in instrument calibration: | ± 3.0% |
| b. Random uncertainty in assay: | ± 1.4% |
| c. Random uncertainty in weighing(s): | ± 0.0% |
| d. Total uncertainty at the 99% confidence level: | ± 3.3% |

NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

Leak Test(s)

See reverse side for Leak Test(s) applied to this source

Notes

1. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).

Jeff J. Kuysta

QUALITY CONTROL

5 Jun 98

Date Signed

ISOTOPE PRODUCTS LABORATORIES
1800 N. KEYSTONE STREET
BURBANK, CALIFORNIA 91504
818·843·7000 FAX 818·843·6168

IPL Ref. No.: 564-33

# CERTIFICATE OF CALIBRATION
# ALPHA STANDARD SOURCE

| | | | |
|---|---|---|---|
| Radionuclide: | Th-230 | Customer: | NEW WORLD TECHNOLOGY |
| Half Life: | $(7.54 \pm 0.03) \times 10^4$ years | P.O.No.: | 1367 |
| Catalog No.: | EAB-230 | Reference Date: | 1 May 98 12:00 PST. |
| Source No.: | 564-38-2 | Contained Radioactivity: | 21.43 nCi (792.9 Bq) |
| | | Surface Emission rate (in $2\pi$) : | 22742 alphas/min |

Description of Source

| | |
|---|---|
| a. Capsule type: | EAB-LB |
| b. Nature of active deposit: | Th-230 incorporated into an anodized layer |
| c. Active diameter/volume: | 41 mm |
| d. Backing: | Aluminum |
| e. Cover: | None |

Radioimpurities

None detected

Method of Calibration

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement

| | |
|---|---|
| a. Systematic uncertainty in instrument calibration: | ± 3.0% |
| b. Random uncertainty in assay: | ± 1.0% |
| c. Random uncertainty in weighing(s): | ± 0.0% |
| d. Total uncertainty at the 99% confidence level: | ± 3.2% |

NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

Leak Test(s)

See reverse side for Leak Test(s) applied to this source

Notes

1. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).

QUALITY CONTROL

5MAY97

Date Signed

ISOTOPE PRODUCTS LABORATORIES
1800 N. KEYSTONE STREET
BURBANK, CALIFORNIA 91504
818·843·7000 FAX 818·843·6168

IPL Ref. No.: 572-64

# CERTIFICATE OF CALIBRATION
# BETA STANDARD SOURCE

| | | | |
|---|---|---|---|
| Radionuclide: | Tc-99 | Customer: | NEW WORLD TECHNOLOGY |
| Half Life: | $(2.13 \pm 0.05) \times 10^5$ years | P.O.No.: | 1367 |
| Catalog No.: | EAB-099 | Reference Date: | 1 May 98 12:00 PST. |
| Source No.: | 564-29-14 | Contained Radioactivity: | 35.59 nCi (1317 Bq) |
| | | Surface Emission rate (in $2\pi$) : | 38720 betas/min |

Description of Source

| | |
|---|---|
| a. Capsule type: | EAB-LB |
| b. Nature of active deposit: | Tc-99 incorporated into an anodized layer |
| c. Active diameter/volume: | 41 mm |
| d. Backing: | Aluminum |
| e. Cover: | None |

Radioimpurities

None detected

Method of Calibration

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement

| | |
|---|---|
| a. Systematic uncertainty in instrument calibration: | $\pm$ 3.0% |
| b. Random uncertainty in assay: | $\pm$ 0.5% |
| c. Random uncertainty in weighing(s): | $\pm$ 0.0% |
| d. Total uncertainty at the 99% confidence level: | $\pm$ 3.0% |

NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

Leak Test(s)

See reverse side for Leak Test(s) applied to this source

Notes

1. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).

QUALITY CONTROL

5 MAY 98

Date Signed

ISOTOPE PRODUCTS LABORATORIES
1800 N. KEYSTONE STREET
BURBANK, CALIFORNIA 91504
818·843·7000 FAX 818·843·6168

IPL Ref. No.: 564-29

Isotope Products Laboratories
An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661·309·1010
Fax 661·257·8303

# CERTIFICATE OF CALIBRATION
# BETA STANDARD SOURCE

| | | | |
|---|---|---|---|
| **Radionuclide:** | Cs-137 | **Customer:** | NEW WORLD TECHNOLOGY |
| **Half-life:** | 30.17 ± 0.16 years | **P.O. No.:** | 20400 |
| **Catalog No.:** | EAB-137-47LB | **Reference Date:** | 15-Sep-02 12:00 PST |
| **Source No.:** | A7-275 | **Contained Radioactivity:** | 44.86 nCi 1660 Bq<br>99590 dpm |

**Physical description:**

| | |
|---|---|
| A. Capsule type: | EAB-LB (47 mm OD x 3.18 mm THK) |
| B. Nature of active deposit: | Distributed and evaporated metallic salt on polymeric membrane |
| C. Active Diameter: | 41 mm |
| D. Backing: | Stainless steel |
| E. Cover: | 0.9 mg/cm² aluminized mylar |

**Radioimpurities:**

None detected

**Method of Calibration:**

This source was prepared from a weighed aliquot of solution whose activity in µCi/g was determined using gamma ray spectrometry.

| | |
|---|---|
| Peak energy used for integration: | 661.7 keV |
| Branching ratio used: | 0.851 gammas per decay |

**Uncertainty of Measurement:**

| | |
|---|---|
| A. Type A (random) uncertainty: | ± 0.5 % |
| B. Type B (systematic) uncertainty: | ± 3.0 % |
| C. Uncertainty in aliquot weighing: | ± 0.6 % |
| D. Total uncertainty at the 99% confidence level: | ± 3.1 % |

**Notes:**

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from IAEA-TECDOC-619, 1991.
- This source has a working life of 2 years.
- This source had a surface emission rate of 56650 β/min in 2π on 20 Aug 02.

Tiffany Catterman
Quality Control

26 Aug 02
Date Signed

IPL Ref. No.: 941-83

Isotope Products Laboratories
An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661·309·1010
Fax 661·257·8303

# CERTIFICATE OF CALIBRATION
# BETA STANDARD SOURCE

**Radionuclide:** Cs-137
**Half-life:** 30.17 ± 0.16 years
**Catalog No.:** EAB-137-47LB
**Source No.:** A7-275

**Customer:** NEW WORLD TECHNOLOGY
**P.O. No.:** 20400
**Reference Date:** 15-Sep-02 12:00 PST
**Contained Radioactivity:** 44.86 nCi 1660 Bq
99590 dpm

**Physical description:**

| | |
|---|---|
| A. Capsule type: | EAB-LB (47 mm OD x 3.18 mm THK) |
| B. Nature of active deposit: | Distributed and evaporated metallic salt on polymeric membrane |
| C. Active Diameter: | 41 mm |
| D. Backing: | Stainless steel |
| E. Cover: | 0.9 mg/cm² aluminized mylar |

**Radioimpurities:**

None detected

**Method of Calibration:**

This source was prepared from a weighed aliquot of solution whose activity in µCi/g was determined using gamma ray spectrometry.

| | |
|---|---|
| Peak energy used for integration: | 661.7 keV |
| Branching ratio used: | 0.851 gammas per decay |

**Uncertainty of Measurement:**

| | |
|---|---|
| A. Type A (random) uncertainty: | ± 0.5 % |
| B. Type B (systematic) uncertainty: | ± 3.0 % |
| C. Uncertainty in aliquot weighing: | ± 0.6 % |
| D. Total uncertainty at the 99% confidence level: | ± 3.1 % |

**Notes:**

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from IAEA-TECDOC-619, 1991.
- This source has a working life of 2 years.
- This source had a surface emission rate of 56650 β/min in 2π on 20 Aug 02.

Tiffany Catterman
Quality Control

26 Aug 02
Date Signed

IPL Ref. No.: 941-83

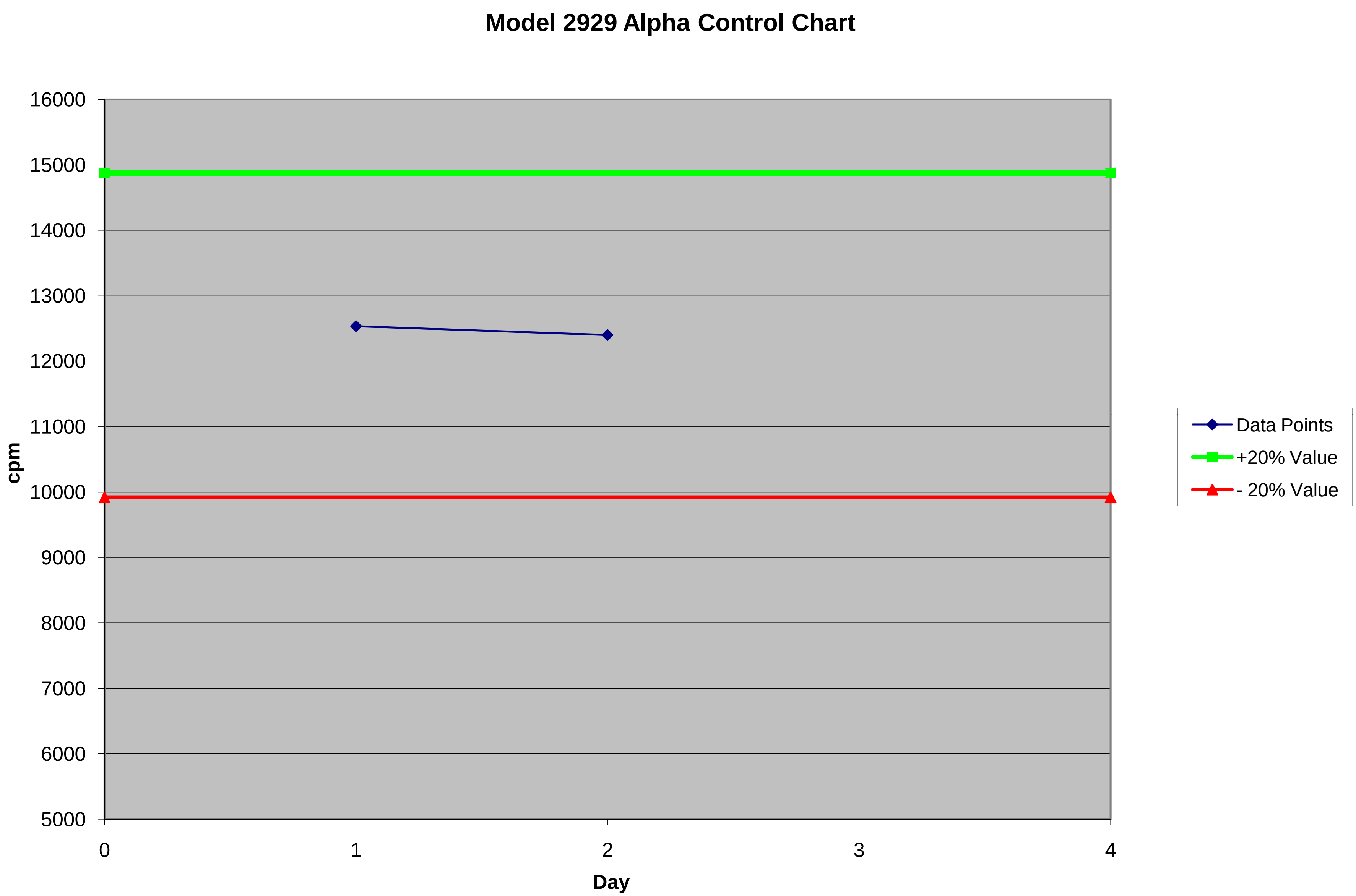
# Appendix E

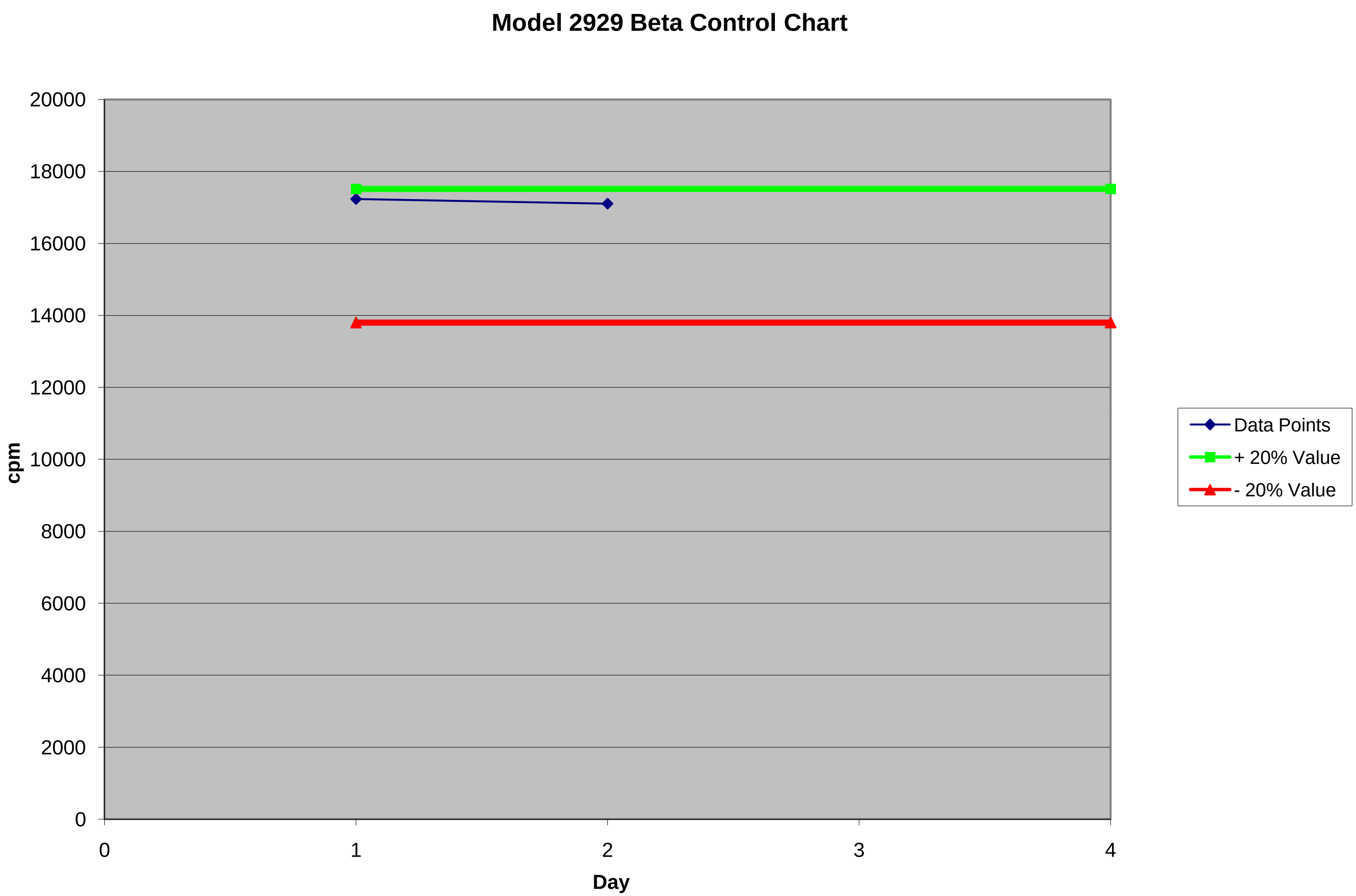
# Daily Instrument Response Check Data

LUDLUM MODEL 2929
DAILY 20 MINUTE BACKGROUND AND EFFICIENCY
DAHLGREN LABS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| For: | June, 2007 | | | | | | | | |
| Instrument ID: | 185291 | | | | | | Detector ID: | 194723 | |
| Cal Due Date: | 10/16/2007 | | | | | | | | |
| Sources Used: | | | | Alpha S/N: | Th-230 564-38-2 | | Activity: | 22,742 | alphas/min |
| | | | | Beta S/N: | Tc-99 564-29-14 | | Activity: | 38,720 | betas/min |
| | | | Acceptable Range of Background: | | 0 | CPM to | 2.9 | CPM α | |
| Background Count Time: | | 20 | Minutes | | 22 | CPM to | 59 | CPM βγ | |
| Date | Total Counts α | Total Counts βγ | 20-Minute Background (CPM) α | 20-Minute Background (CPM) βγ | 1-min α Source Counts | Eff. α | 1- min βγ Source Counts | Eff. βγ | Initials |
| 6/15/2007 | 17 | 779 | 0.9 | 39.0 | 12536 | 55 | 17233 | 44 | DK |
| 6/16/2007 | 4 | 773 | 0.2 | 38.7 | 12399 | 55 | 17102 | 44 | DK |

| | | | |
|---|---|---|---|
| Reviewed by: | Dan Spicuzza | Date: | 6/17/2007 |

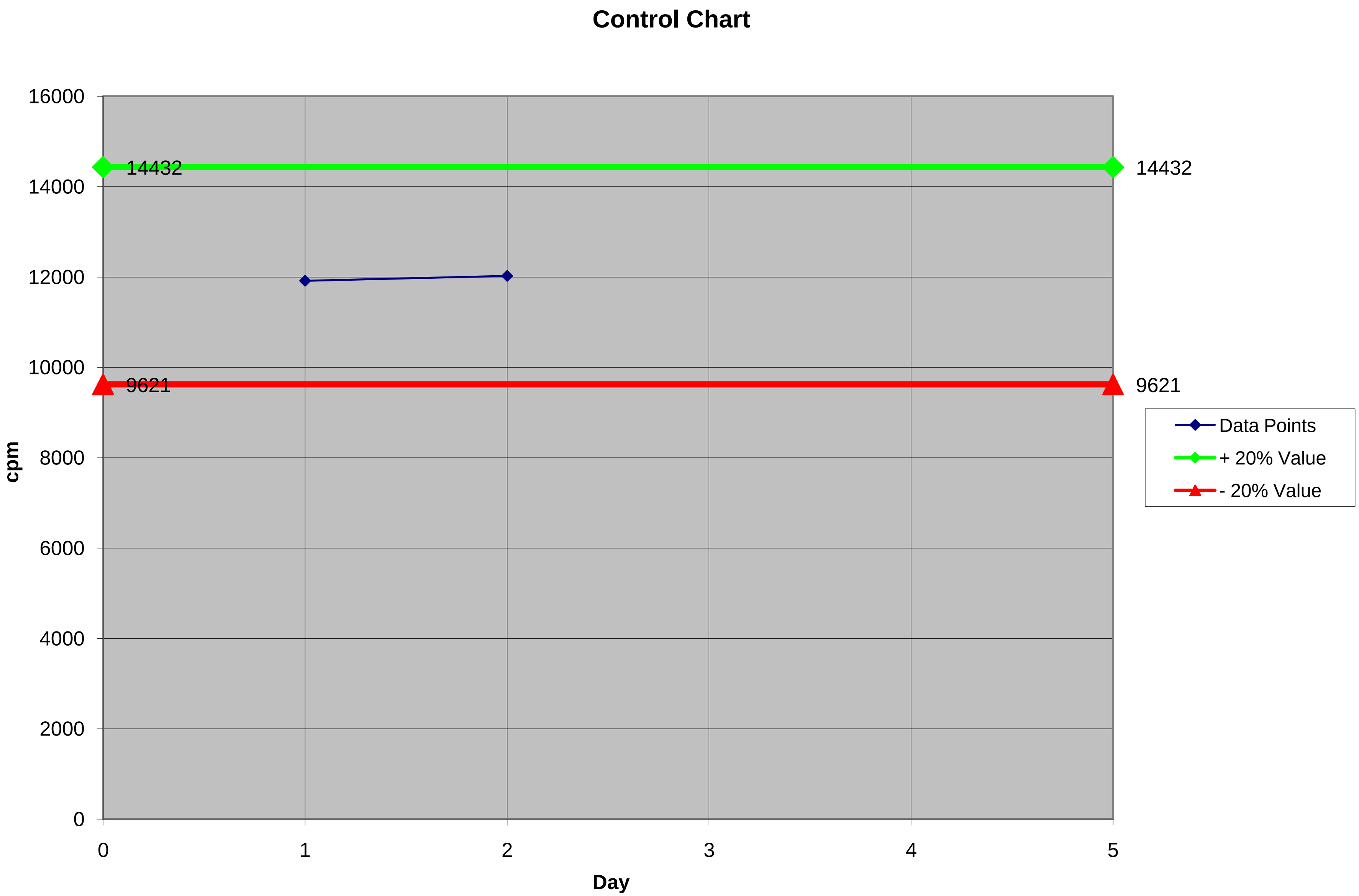

Model 2929 Alpha Control Chart
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
cpm
0
1
2
3
4
Day
Data Points
+20% Value
- 20% Value


Model 2929 Beta Control Chart
cpm
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0
1
2
3
4
Day
Data Points
+ 20% Value
- 20% Value

DAILY INSTRUMENT PERFORMANCE TEST LOG SHEET

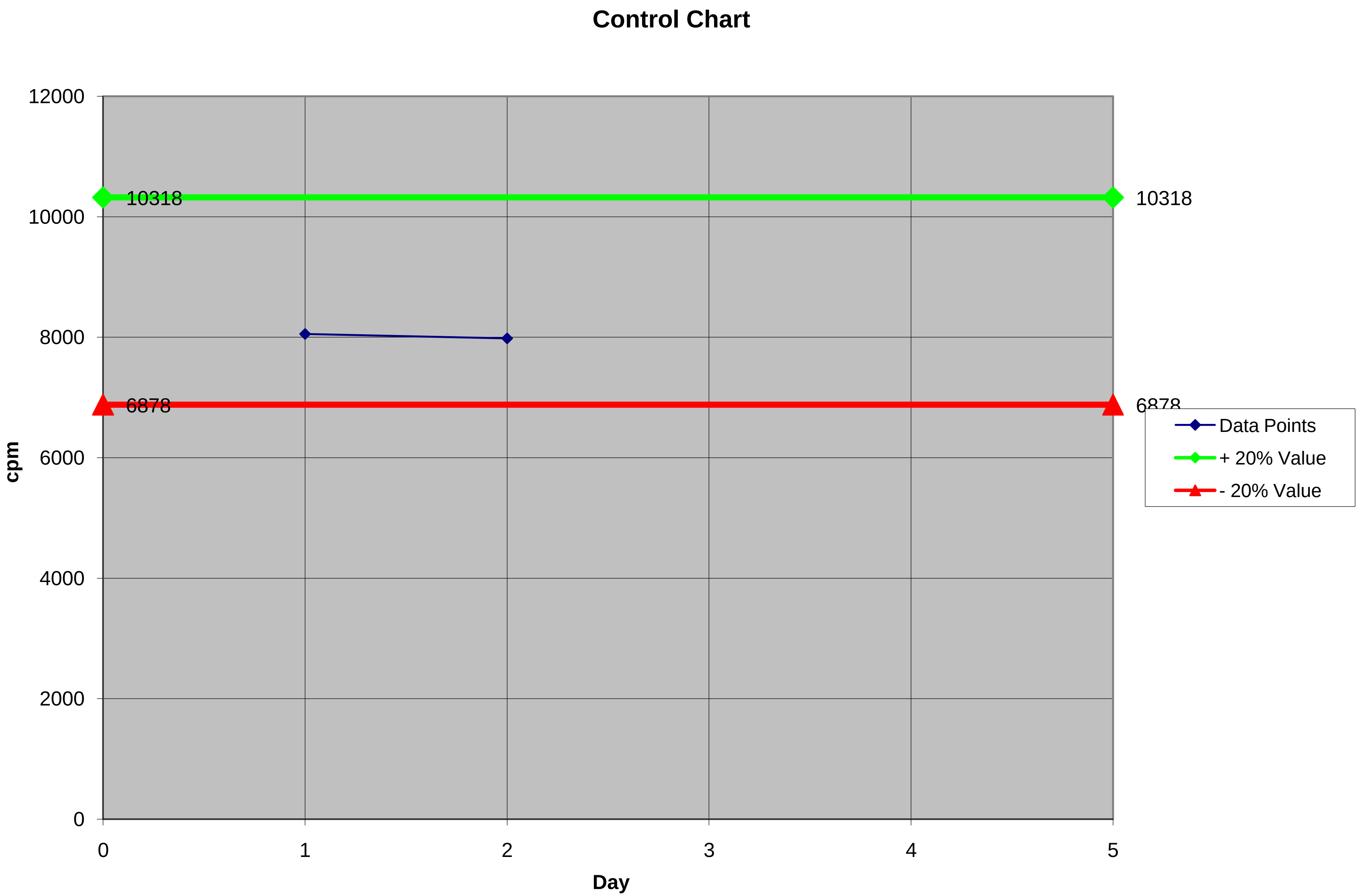
Project: Dahlgren Phase III

| DATE | MODEL/TYPE (Meter/Detector) | S/N (Meter/Detector) | PHYSICAL DAMAGE Y/N | CAL. DUE DATE | SOURCE I.D Cs-137 | SOURCE ACTIVITY (DPM) | BACKGROUND CPM | READING CPM | Net CPM | EFF. % | PASS/ FAIL (P/F) | TECH. INIT. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6/15/2007 | 2350-1/44-10 | 228710/242829 | N | 2/26/2008 | A7-275 | 99,590 | 6011 | 17923 | 11912 | 12 | P | AC |
| 6/16/2007 | 2350-1/44-10 | 228710/242829 | N | 2/26/2008 | A7-275 | 99,590 | 6000 | 18021 | 12021 | 12 | P | AC |


Control Chart
16000
14000
12000
10000
8000
6000
4000
2000
0
cpm
14432
14432
9621
9621
0
1
2
3
4
5
Day
Data Points
+ 20% Value
- 20% Value

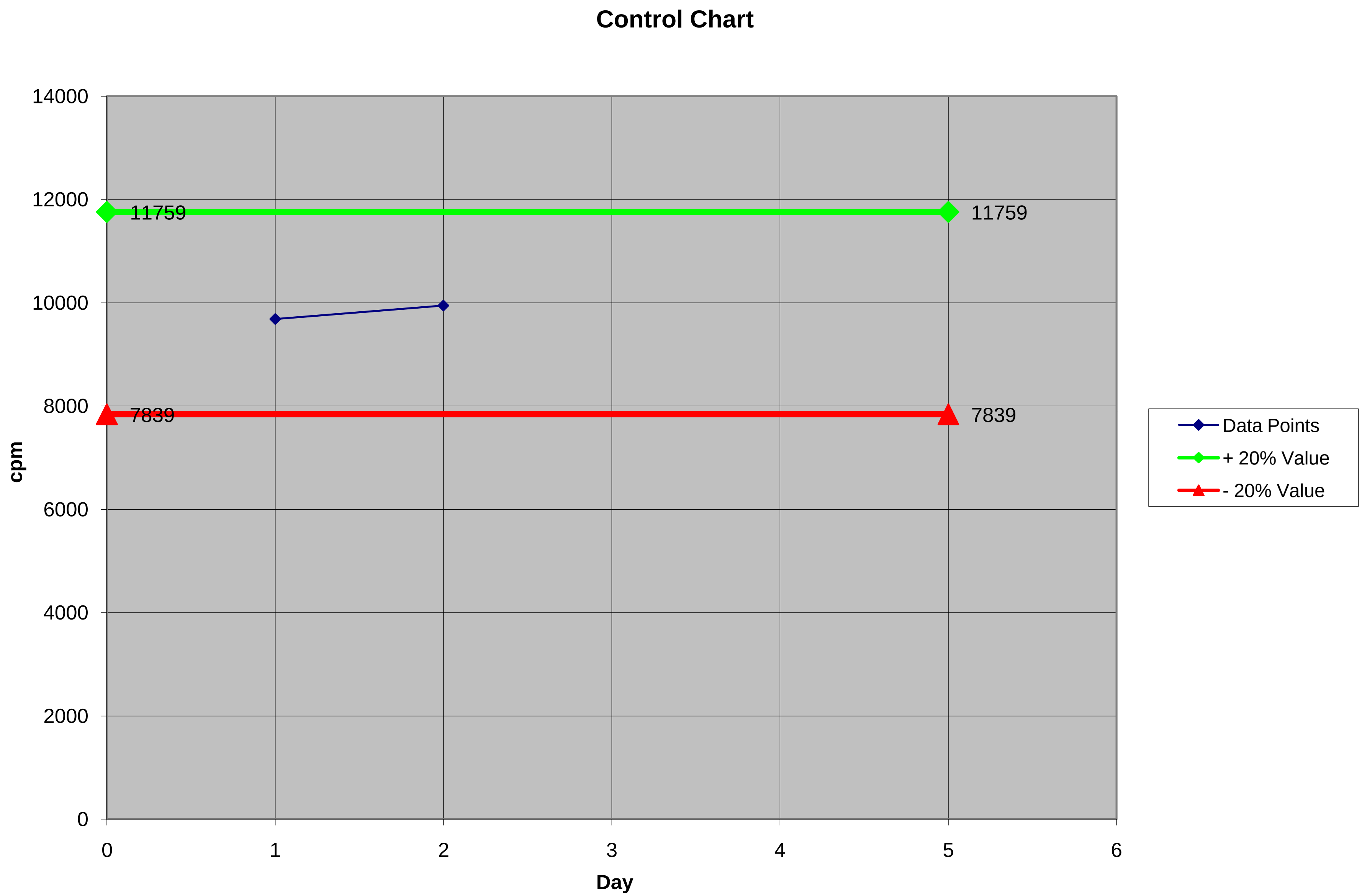
DAILY INSTRUMENT PERFORMANCE TEST LOG SHEET

| Project: Dahlgren Phase III | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | MODEL/TYPE (Meter/Detector) | S/N (Meter/Detector) | PHYSICAL DAMAGE Y/N | CAL. DUE DATE | SOURCE I.D Cs-137 | SOURCE ACTIVITY (DPM) | BACKGROUND CPM | READING CPM | Net CPM | EFF. % | PASS/ FAIL (P/F) | TECH. INIT. |
| 6/15/2007 | 2350-1/44-10 | 228693/245122 | N | 2/22/2008 | A7-275 | 99,590 | 7143 | 15195 | 8052 | 8 | P | AC |
| 6/16/2007 | 2350-1/44-10 | 228693/245122 | N | 2/22/2008 | A7-275 | 99,590 | 7021 | 14998 | 7977 | 8 | P | AC |


Control Chart
12000
10000
8000
6000
4000
2000
0
cpm
0
1
2
3
4
5
Day
10318
10318
6878
6878
Data Points
+ 20% Value
- 20% Value

DAILY INSTRUMENT PERFORMANCE TEST LOG SHEET

| Project: Dahlgren Phase III | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | MODEL/TYPE (Meter/Detector) | S/N (Meter/Detector) | PHYSICAL DAMAGE Y/N | CAL. DUE DATE | SOURCE I.D Cs-137 | SOURCE ACTIVITY (DPM) | BACKGROUND CPM | READING CPM | Net CPM | EFF. % | PASS/ FAIL (P/F) | TECH. INIT. |
| 6/15/2007 | 2350-1/44-10 | 232920/242823 | N | 2/22/2008 | A7-275 | 99,590 | 6157 | 15840 | 9683 | 10 | P | AC |
| 6/16/2007 | 2350-1/44-10 | 232920/242823 | N | 2/22/2008 | A7-275 | 99,590 | 5778 | 15721 | 9943 | 10 | P | AC |

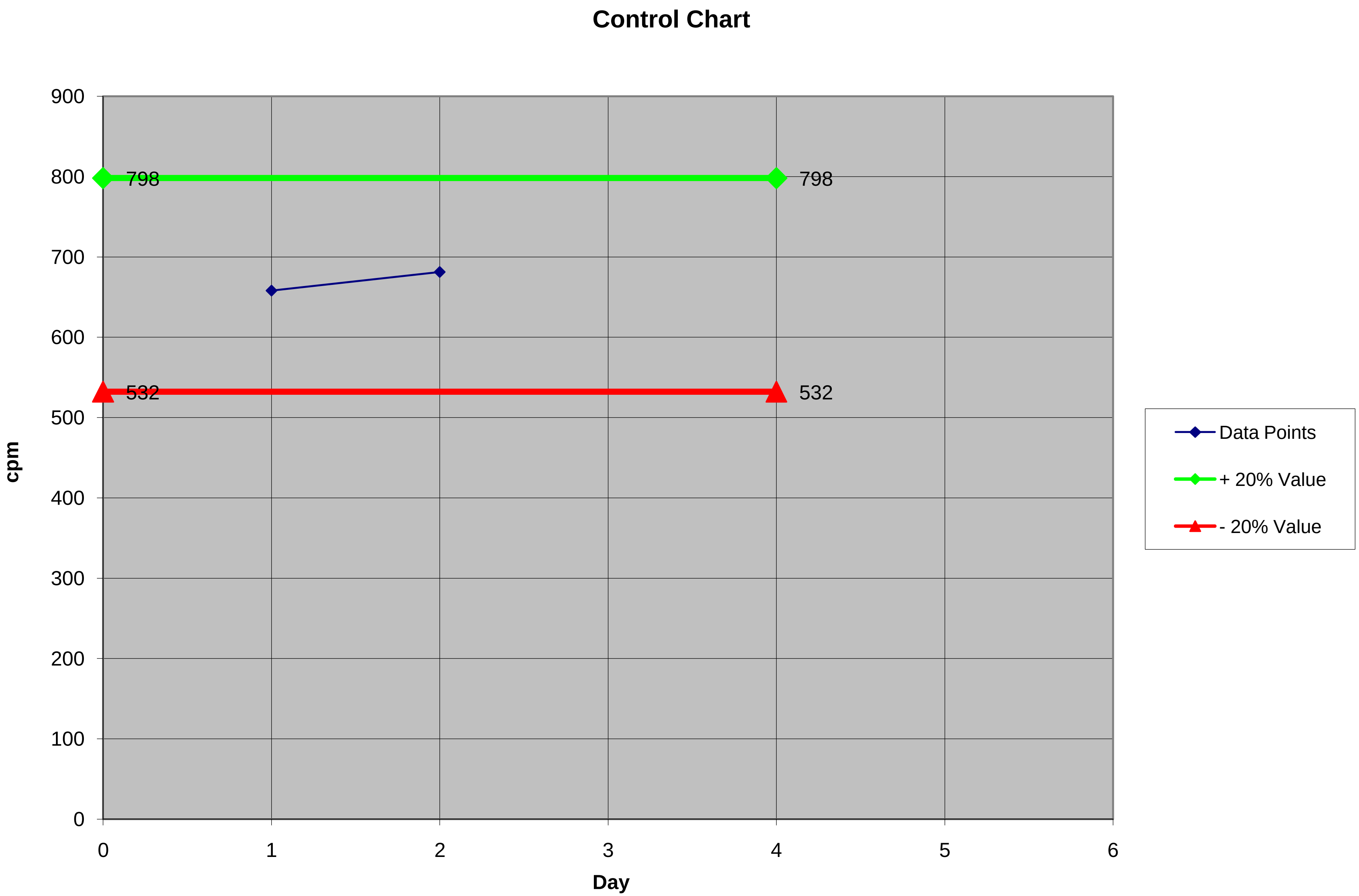


Control Chart
14000
12000
10000
8000
6000
4000
2000
0
cpm
0
1
2
3
4
5
6
Day
11759
11759
7839
7839
Data Points
+ 20% Value
- 20% Value

DAILY INSTRUMENT PERFORMANCE TEST LOG SHEET

Project: Dahlgren Phase III

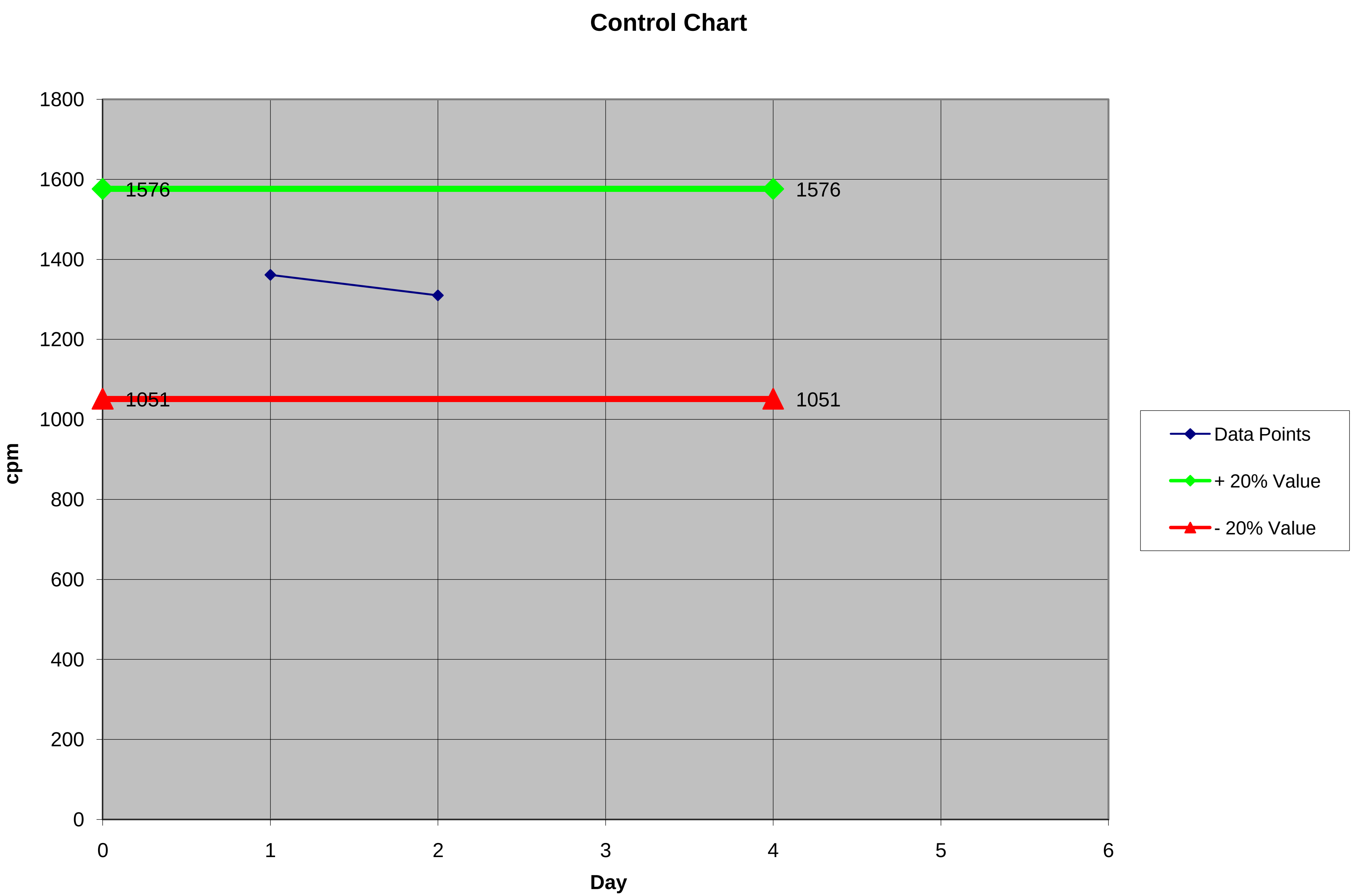
| DATE | MODEL/TYPE (Meter/Detector) | S/N (Meter/Detector) | PHYSICAL DAMAGE Y/N | CAL. DUE DATE | SOURCE I.D Th-230 | SOURCE ACTIVITY alphas/min | BACKGROUND CPM | READING CPM | Net CPM | EFF. % | PASS/ FAIL (P/F) | TECH. INIT. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6/15/2007 | 2360/43-89 | 227404/171342 | N | 4/24/2008 | 564-33-1 | 4,222 | 4 | 662 | 658 | 16 | P | AS |
| 6/16/2007 | 2360/43-89 | 227404/171342 | N | 4/24/2008 | 564-33-1 | 4,222 | 3 | 684 | 681 | 16 | P | AS |


Control Chart
cpm
900
800
700
600
500
400
300
200
100
0
798
798
532
532
0
1
2
3
4
5
6
Day
Data Points
+ 20% Value
- 20% Value

DAILY INSTRUMENT PERFORMANCE TEST LOG SHEET

Project: Dahlgren Phase III

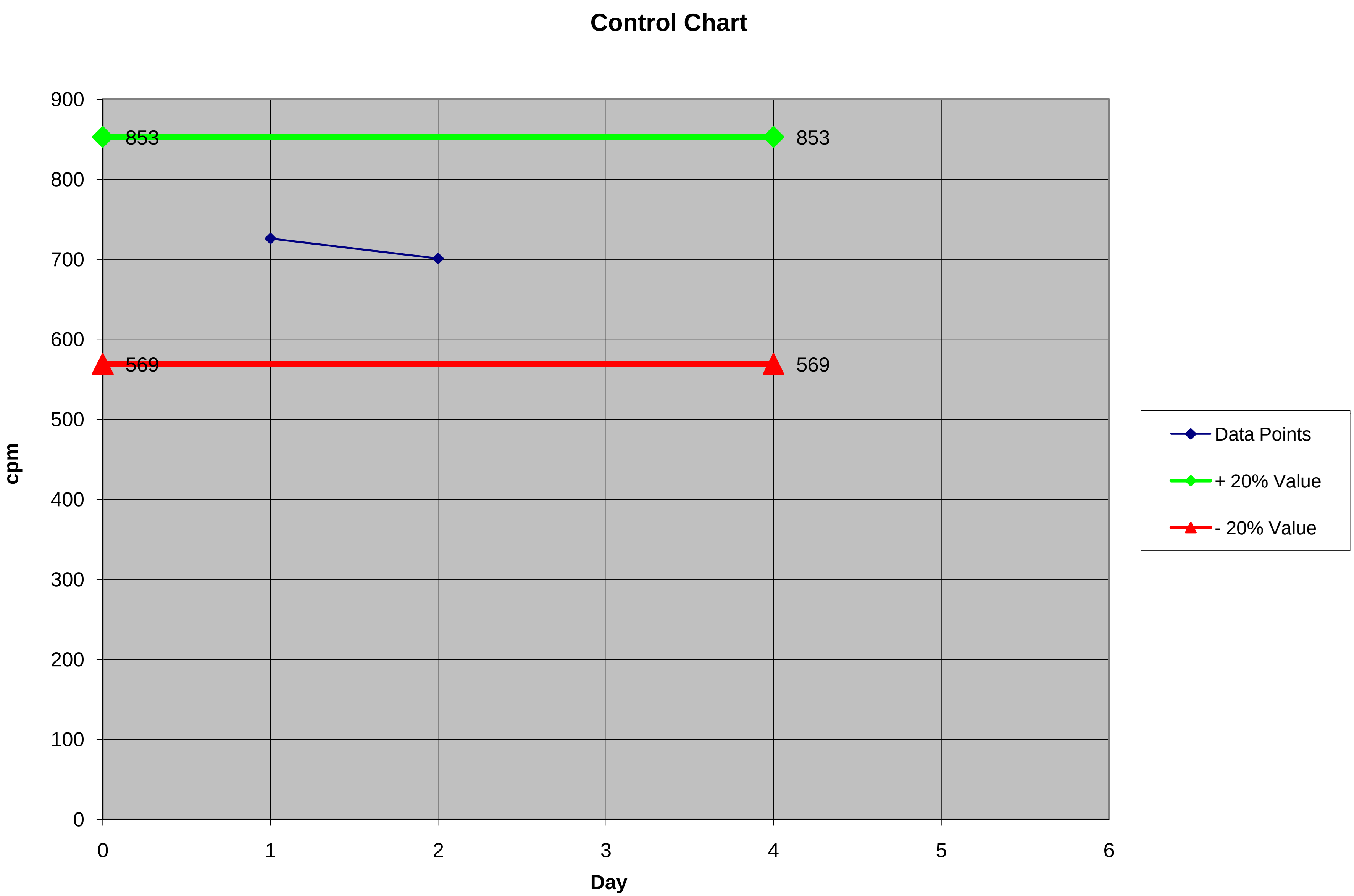
| DATE | MODEL/TYPE (Meter/Detector) | S/N (Meter/Detector) | PHYSICAL DAMAGE Y/N | CAL. DUE DATE | SOURCE I.D Tc-99 | SOURCE ACTIVITY betas/min | BACKGROUND CPM | READING CPM | Net CPM | EFF. % | PASS/ FAIL (P/F) | TECH. INIT. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6/15/2007 | 2360/43-89 | 227404/171342 | N | 4/24/2008 | 564-13-3 | 16,030 | 231 | 1592 | 1361 | 8 | P | AS |
| 6/16/2007 | 2360/43-89 | 227404/171342 | N | 4/24/2008 | 564-13-3 | 16,030 | 224 | 1534 | 1310 | 8 | P | AS |



Control Chart
cpm
1800
1600
1400
1200
1000
800
600
400
200
0
1576
1576
1051
1051
0
1
2
3
4
5
6
Day
Data Points
+ 20% Value
- 20% Value

DAILY INSTRUMENT PERFORMANCE TEST LOG SHEET

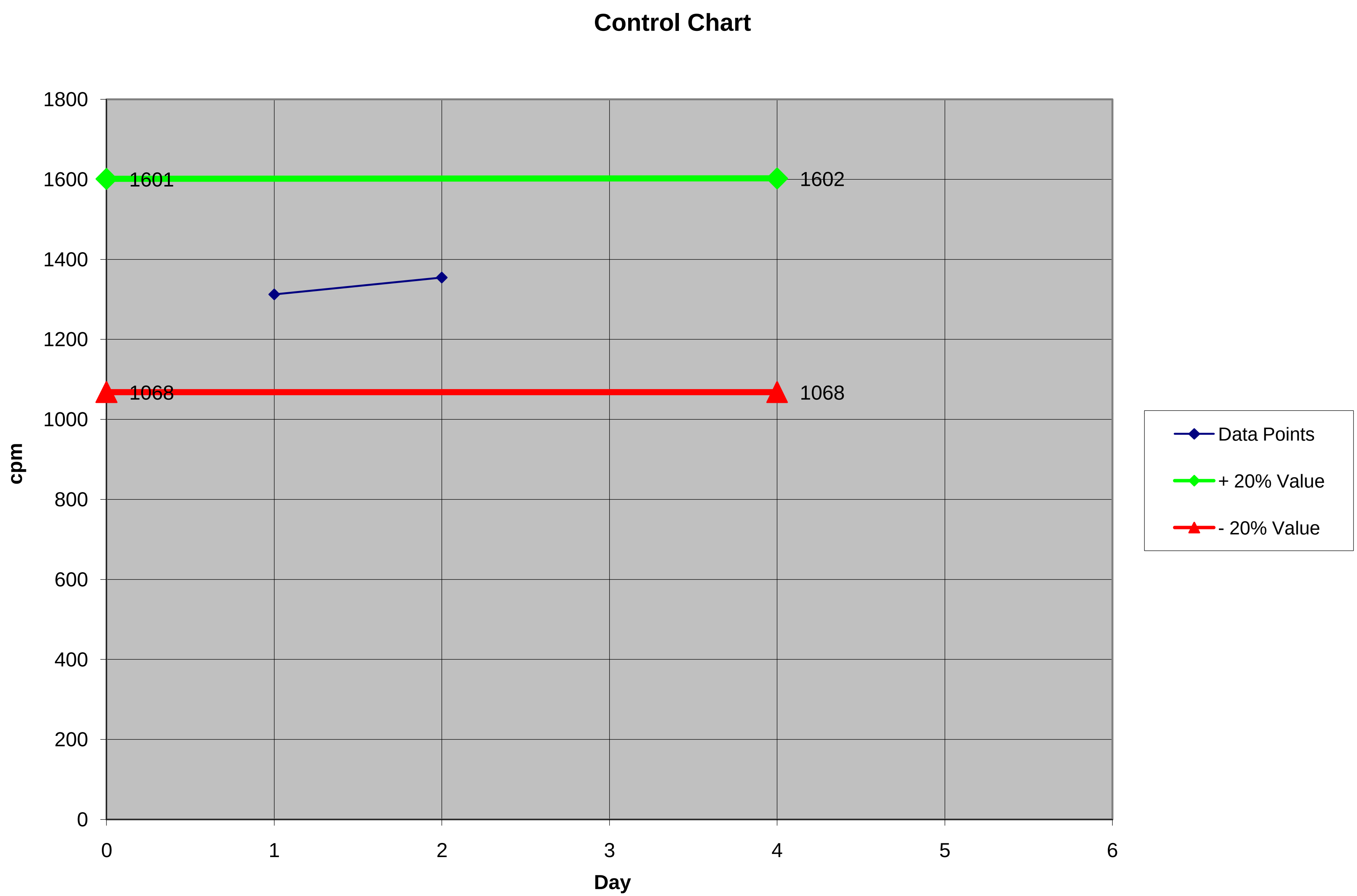
| Project: Dahlgren Phase III | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | MODEL/TYPE (Meter/Detector) | S/N (Meter/Detector) | PHYSICAL DAMAGE Y/N | CAL. DUE DATE | SOURCE I.D Th-230 | SOURCE ACTIVITY alphas/min | BACKGROUND CPM | READING CPM | Net CPM | EFF. % | PASS/ FAIL (P/F) | TECH. INIT. |
| 6/15/2007 | 2360/43-89 | 184905/194989 | N | 4/24/2008 | 564-33-1 | 4,222 | 2 | 728 | 726 | 17 | P | AS |
| 6/16/2007 | 2360/43-89 | 184905/194989 | N | 4/24/2008 | 564-33-1 | 4,222 | 3 | 704 | 701 | 17 | P | AS |


Control Chart
900
800
700
600
500
400
300
200
100
0
853
853
569
569
cpm
0
1
2
3
4
5
6
Day
Data Points
+ 20% Value
- 20% Value

DAILY INSTRUMENT PERFORMANCE TEST LOG SHEET

Project: Dahlgren Phase III

| DATE | MODEL/TYPE (Meter/Detector) | S/N (Meter/Detector) | PHYSICAL DAMAGE Y/N | CAL. DUE DATE | SOURCE I.D Tc-99 | SOURCE ACTIVITY betas/min | BACKGROUND CPM | READING CPM | Net CPM | EFF. % | PASS/ FAIL (P/F) | TECH. INIT. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6/15/2007 | 2360/43-89 | 184905/194989 | N | 4/24/2008 | 564-13-3 | 16,030 | 199 | 1511 | 1312 | 8 | P | AS |
| 6/16/2007 | 2360/43-89 | 184905/194989 | N | 4/24/2008 | 564-13-3 | 16,030 | 184 | 1538 | 1354 | 8 | P | AS |



Control Chart
cpm
1800
1600
1400
1200
1000
800
600
400
200
0
1601
1602
1068
1068
0
1
2
3
4
5
6
Day
Data Points
+ 20% Value
- 20% Value

# Ambient Background Data

New World Technology
Background Determination Data Sheet

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Project/Location: | Dahlgren | | | | | | |
| Instrument Model: | 2360 | | | Instrument Serial No. | | 184905 | |
| Last Calibration Date: | 4/24/2007 | | | | | | |
| Detector Model: | 43-89 | | | Detector Serial No.: | | 194989 | |
| Today's Date: | 6/14/2007 | | | Data Collected by: | | Anthony Smith | |
| X | Alpha | | Beta-Gamma | | | Other | |
| Remarks: | Instrument Ambient Background | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Type of Surface: | | | Count Time: | 1 | Minutes | | |
| Count Number | Count (x) | $(x - \bar{x})$ | | $(x - \bar{x})^2$ | | | |
| 1 | 3 | 2.53 | | 6.42 | | | |
| 2 | 0 | -0.47 | | 0.22 | | | |
| 3 | 0 | -0.47 | | 0.22 | | | |
| 4 | 1 | 0.53 | | 0.28 | | | |
| 5 | 2 | 1.53 | | 2.35 | | | |
| 6 | 0 | -0.47 | | 0.22 | | | |
| 7 | 0 | -0.47 | | 0.22 | | | |
| 8 | 0 | -0.47 | | 0.22 | | | |
| 9 | 0 | -0.47 | | 0.22 | | | |
| 10 | 0 | -0.47 | | 0.22 | | | |
| 11 | 1 | 0.53 | | 0.28 | | | |
| 12 | 0 | -0.47 | | 0.22 | | | |
| 13 | 1 | 0.53 | | 0.28 | | | |
| 14 | 0 | -0.47 | | 0.22 | | | |
| 15 | 0 | -0.47 | | 0.22 | | | |
| 16 | 0 | -0.47 | | 0.22 | | | |
| 17 | 1 | 0.53 | | 0.28 | | | |
| 18 | 1 | 0.53 | | 0.28 | | | |
| 19 | 0 | -0.47 | | 0.22 | | | |
| 20 | 0 | -0.47 | | 0.22 | | | |
| 21 | 1 | 0.53 | | 0.28 | | | |
| 22 | 0 | -0.47 | | 0.22 | | | |
| 23 | 0 | -0.47 | | 0.22 | | | |
| 24 | 2 | 1.53 | | 2.35 | | | |
| 25 | 0 | -0.47 | | 0.22 | | | |
| 26 | 0 | -0.47 | | 0.22 | | | |
| 27 | 0 | -0.47 | | 0.22 | | | |
| 28 | 1 | 0.53 | | 0.28 | | | |
| 29 | 0 | -0.47 | | 0.22 | | | |
| 30 | 0 | -0.47 | | 0.22 | | | |
| Mean Count: $\bar{x}$ | 0.47 | | SUM | 17.47 | | | |
| Standard Deviation (σ) | 0.78 | | Variance: | 0.60 | | CPM Low | CPM High |
| Background Count Rate: | | 0.47 | CPM + - | 2.33 | CPM | -1.86 | 2.79 |
| Calculations Completed by: | | Anthony Smith | | | | Date: | 6/14/2007 |
| Reviewed by: | | Daniel Spicuzza | | | | Date: | 6/14/2007 |

# New World Technology
## Background Determination Data Sheet

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Project/Location: | Dahlgren | | | | | | |
| Instrument Model: | 2929 | | | Instrument Serial No. | | 185291 | |
| Last Calibration Date: | 10/16/2006 | | | | | | |
| Detector Model: | 43-10-1 | | | Detector Serial No.: | | 194723 | |
| Today's Date: | 6/14/2007 | | | Data Collected by: | | Richard Kountz | |
| X | Alpha | | Beta-Gamma | | | | Other |
| Remarks: | Instrument Ambient Background | | | | | | |
| Type of Surface: | | | Count Time: | 1 | Minutes | | |
| Count Number | Count (x) | $(x - \bar{x})$ | | $(x - \bar{x})^2$ | | | |
| 1 | 0 | -0.50 | | 0.25 | | | |
| 2 | 1 | 0.50 | | 0.25 | | | |
| 3 | 1 | 0.50 | | 0.25 | | | |
| 4 | 2 | 1.50 | | 2.25 | | | |
| 5 | 0 | -0.50 | | 0.25 | | | |
| 6 | 1 | 0.50 | | 0.25 | | | |
| 7 | 0 | -0.50 | | 0.25 | | | |
| 8 | 0 | -0.50 | | 0.25 | | | |
| 9 | 2 | 1.50 | | 2.25 | | | |
| 10 | 2 | 1.50 | | 2.25 | | | |
| 11 | 0 | -0.50 | | 0.25 | | | |
| 12 | 0 | -0.50 | | 0.25 | | | |
| 13 | 0 | -0.50 | | 0.25 | | | |
| 14 | 0 | -0.50 | | 0.25 | | | |
| 15 | 0 | -0.50 | | 0.25 | | | |
| 16 | 0 | -0.50 | | 0.25 | | | |
| 17 | 0 | -0.50 | | 0.25 | | | |
| 18 | 1 | 0.50 | | 0.25 | | | |
| 19 | 0 | -0.50 | | 0.25 | | | |
| 20 | 0 | -0.50 | | 0.25 | | | |
| 21 | 1 | 0.50 | | 0.25 | | | |
| 22 | 0 | -0.50 | | 0.25 | | | |
| 23 | 0 | -0.50 | | 0.25 | | | |
| 24 | 0 | -0.50 | | 0.25 | | | |
| 25 | 0 | -0.50 | | 0.25 | | | |
| 26 | 0 | -0.50 | | 0.25 | | | |
| 27 | 1 | 0.50 | | 0.25 | | | |
| 28 | 0 | -0.50 | | 0.25 | | | |
| 29 | 0 | -0.50 | | 0.25 | | | |
| 30 | 3 | 2.50 | | 6.25 | | | |
| Mean Count: $\bar{x}$ | 0.50 | | SUM | 19.50 | | | |
| Standard Deviation (σ) | 0.82 | | Variance: | 0.67 | | CPM Low | CPM High |
| Background Count Rate: | | 0.50 | CPM + - | 2.46 | CPM | -1.96 | 2.96 |
| Calculations Completed by: | | Richard Kountz | | | | Date: | 6/14/2007 |
| Reviewed by: | | Daniel Spicuzza | | | | Date: | 6/14/2007 |

NEW WORLD TECHNOLOGY FORM NWT HPQA003

# New World Technology
## Background Determination Data Sheet

| | | | | |
|---|---|---|---|---|
| Project/Location: | Dahlgren | | | |
| Instrument Model: | 2360 | | Instrument Serial No. | 227404 |
| Last Calibration Date: | 4/24/2007 | | | |
| Detector Model: | 43-89 | | Detector Serial No.: | 171342 |
| Today's Date: | 6/14/2007 | | Data Collected by: | Anthony Smith |

| | | | | | |
|---|---|---|---|---|---|
| X | Alpha | | Beta-Gamma | | Other |

Remarks: Instrument Ambient Background

| Type of Surface: | | | Count Time: | 1 | Minutes |
|---|---|---|---|---|---|
| Count Number | Count (x) | $(x - \bar{x})$ | | $(x - \bar{x})^2$ | |
| 1 | 0 | -0.30 | | 0.09 | |
| 2 | 0 | -0.30 | | 0.09 | |
| 3 | 0 | -0.30 | | 0.09 | |
| 4 | 1 | 0.70 | | 0.49 | |
| 5 | 0 | -0.30 | | 0.09 | |
| 6 | 0 | -0.30 | | 0.09 | |
| 7 | 1 | 0.70 | | 0.49 | |
| 8 | 0 | -0.30 | | 0.09 | |
| 9 | 0 | -0.30 | | 0.09 | |
| 10 | 0 | -0.30 | | 0.09 | |
| 11 | 0 | -0.30 | | 0.09 | |
| 12 | 1 | 0.70 | | 0.49 | |
| 13 | 0 | -0.30 | | 0.09 | |
| 14 | 1 | 0.70 | | 0.49 | |
| 15 | 0 | -0.30 | | 0.09 | |
| 16 | 1 | 0.70 | | 0.49 | |
| 17 | 1 | 0.70 | | 0.49 | |
| 18 | 0 | -0.30 | | 0.09 | |
| 19 | 0 | -0.30 | | 0.09 | |
| 20 | 0 | -0.30 | | 0.09 | |
| 21 | 0 | -0.30 | | 0.09 | |
| 22 | 1 | 0.70 | | 0.49 | |
| 23 | 2 | 1.70 | | 2.89 | |
| 24 | 0 | -0.30 | | 0.09 | |
| 25 | 0 | -0.30 | | 0.09 | |
| 26 | 0 | -0.30 | | 0.09 | |
| 27 | 0 | -0.30 | | 0.09 | |
| 28 | 0 | -0.30 | | 0.09 | |
| 29 | 0 | -0.30 | | 0.09 | |
| 30 | 0 | -0.30 | | 0.09 | |
| Mean Count: $\bar{x}$ | 0.30 | | SUM | 8.30 | |
| Standard Deviation ($\sigma$) | 0.53 | | Variance: | 0.29 | |
| Background Count Rate: | | 0.30 | CPM + - | 1.60 | CPM |

| CPM Low | CPM High |
|---|---|
| -1.30 | 1.90 |

| | | | |
|---|---|---|---|
| Calculations Completed by: | Anthony Smith | Date: | 6/14/2007 |
| Reviewed by: | Daniel Spicuzza | Date: | 6/14/2007 |

# New World Technology
## Background Determination Data Sheet

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Project/Location: | Dahlgren | | | | | | |
| Instrument Model: | 2360 | | | Instrument Serial No. | | 184905 | |
| Last Calibration Date: | 4/24/2007 | | | | | | |
| Detector Model: | 43-89 | | | Detector Serial No.: | | 194989 | |
| Today's Date: | 6/14/2007 | | | Data Collected by: | | Anthony Smith | |
| | Alpha | X | Beta-Gamma | | | | Other |
| Remarks: | Instrument Ambient Background | | | | | | |
| Type of Surface: | | | Count Time: | 1 | Minutes | | |
| Count Number | Count (x) | (x - $\bar{x}$ ) | | $(x - \bar{x})^2$ | | | |
| 1 | 215 | -1.93 | | 3.74 | | | |
| 2 | 230 | 13.07 | | 170.74 | | | |
| 3 | 190 | -26.93 | | 725.40 | | | |
| 4 | 211 | -5.93 | | 35.20 | | | |
| 5 | 217 | 0.07 | | 0.00 | | | |
| 6 | 231 | 14.07 | | 197.87 | | | |
| 7 | 189 | -27.93 | | 780.27 | | | |
| 8 | 215 | -1.93 | | 3.74 | | | |
| 9 | 206 | -10.93 | | 119.54 | | | |
| 10 | 216 | -0.93 | | 0.87 | | | |
| 11 | 232 | 15.07 | | 227.00 | | | |
| 12 | 233 | 16.07 | | 258.14 | | | |
| 13 | 235 | 18.07 | | 326.40 | | | |
| 14 | 201 | -15.93 | | 253.87 | | | |
| 15 | 209 | -7.93 | | 62.94 | | | |
| 16 | 232 | 15.07 | | 227.00 | | | |
| 17 | 205 | -11.93 | | 142.40 | | | |
| 18 | 205 | -11.93 | | 142.40 | | | |
| 19 | 204 | -12.93 | | 167.27 | | | |
| 20 | 230 | 13.07 | | 170.74 | | | |
| 21 | 243 | 26.07 | | 679.47 | | | |
| 22 | 217 | 0.07 | | 0.00 | | | |
| 23 | 216 | -0.93 | | 0.87 | | | |
| 24 | 232 | 15.07 | | 227.00 | | | |
| 25 | 218 | 1.07 | | 1.14 | | | |
| 26 | 220 | 3.07 | | 9.40 | | | |
| 27 | 221 | 4.07 | | 16.54 | | | |
| 28 | 212 | -4.93 | | 24.34 | | | |
| 29 | 202 | -14.93 | | 223.00 | | | |
| 30 | 221 | 4.07 | | 16.54 | | | |
| Mean Count: $\bar{x}$ | 216.93 | | SUM | 5213.87 | | | |
| Standard Deviation (σ) | 13.41 | | Variance: | 179.79 | | CPM Low | CPM High |
| Background Count Rate: | | 216.93 | CPM + - | 40.23 | CPM | 176.71 | 257.16 |
| Calculations Completed by: | | Anthony Smith | | | | Date: | 6/14/2007 |
| Reviewed by: | | Daniel Spicuzza | | | | Date: | 6/14/2007 |

NEW WORLD TECHNOLOGY FORM NWT HPQA003

# New World Technology
## Background Determination Data Sheet

| | | | | | | |
|---|---|---|---|---|---|---|
| Project/Location: | Dahlgren | | | | | |
| Instrument Model: | 2929 | | | Instrument Serial No. | 185291 | |
| Last Calibration Date: | 10/16/2006 | | | | | |
| Detector Model: | 43-10-1 | | | Detector Serial No.: | 194723 | |
| Today's Date: | 6/14/2007 | | | Data Collected by: | Richard Kountz | |
| | Alpha | X | Beta-Gamma | | | Other |
| Remarks: | Instrument Ambient Background | | | | | |
| Type of Surface: | | | Count Time: | 1 | Minutes | |
| Count Number | Count (x) | $(x - \bar{x})$ | | $(x - \bar{x})^2$ | | |
| 1 | 48 | 7.47 | | 55.75 | | |
| 2 | 49 | 8.47 | | 71.68 | | |
| 3 | 37 | -3.53 | | 12.48 | | |
| 4 | 39 | -1.53 | | 2.35 | | |
| 5 | 53 | 12.47 | | 155.42 | | |
| 6 | 45 | 4.47 | | 19.95 | | |
| 7 | 41 | 0.47 | | 0.22 | | |
| 8 | 47 | 6.47 | | 41.82 | | |
| 9 | 35 | -5.53 | | 30.62 | | |
| 10 | 31 | -9.53 | | 90.88 | | |
| 11 | 40 | -0.53 | | 0.28 | | |
| 12 | 37 | -3.53 | | 12.48 | | |
| 13 | 37 | -3.53 | | 12.48 | | |
| 14 | 36 | -4.53 | | 20.55 | | |
| 15 | 44 | 3.47 | | 12.02 | | |
| 16 | 40 | -0.53 | | 0.28 | | |
| 17 | 43 | 2.47 | | 6.08 | | |
| 18 | 43 | 2.47 | | 6.08 | | |
| 19 | 31 | -9.53 | | 90.88 | | |
| 20 | 32 | -8.53 | | 72.82 | | |
| 21 | 50 | 9.47 | | 89.62 | | |
| 22 | 34 | -6.53 | | 42.68 | | |
| 23 | 38 | -2.53 | | 6.42 | | |
| 24 | 42 | 1.47 | | 2.15 | | |
| 25 | 40 | -0.53 | | 0.28 | | |
| 26 | 45 | 4.47 | | 19.95 | | |
| 27 | 38 | -2.53 | | 6.42 | | |
| 28 | 50 | 9.47 | | 89.62 | | |
| 29 | 42 | 1.47 | | 2.15 | | |
| 30 | 29 | -11.53 | | 133.02 | | |
| Mean Count: $\bar{x}$ | 40.53 | | SUM | 1107.47 | | |
| Standard Deviation ($\sigma$) | 6.18 | | Variance: | 38.19 | CPM Low | CPM High |
| Background Count Rate: | | 40.53 | CPM + - | 18.54 | CPM 21.99 | 59.07 |
| Calculations Completed by: | | Richard Kountz | | | Date: | 6/14/2007 |
| Reviewed by: | | Daniel Spicuzza | | | Date: | 6/14/2007 |

# New World Technology
## Background Determination Data Sheet

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Project/Location: | Dahlgren | | | | | | |
| Instrument Model: | 2360 | | | Instrument Serial No. | | 2274004 | |
| Last Calibration Date: | 4/24/2007 | | | | | | |
| Detector Model: | 43-89 | | | Detector Serial No.: | | 171342 | |
| Today's Date: | 6/14/2007 | | | Data Collected by: | | Anthony Smith | |
| | Alpha | X | Beta-Gamma | | | | Other |
| Remarks: | Instrument Ambient Background | | | | | | |
| Type of Surface: | | | Count Time: | 1 | Minutes | | |
| Count Number | Count (x) | $(x - \bar{x})$ | | $(x - \bar{x})^2$ | | | |
| 1 | 222 | -3.53 | | 12.48 | | | |
| 2 | 223 | -2.53 | | 6.42 | | | |
| 3 | 239 | 13.47 | | 181.35 | | | |
| 4 | 215 | -10.53 | | 110.95 | | | |
| 5 | 221 | -4.53 | | 20.55 | | | |
| 6 | 212 | -13.53 | | 183.15 | | | |
| 7 | 225 | -0.53 | | 0.28 | | | |
| 8 | 216 | -9.53 | | 90.88 | | | |
| 9 | 219 | -6.53 | | 42.68 | | | |
| 10 | 229 | 3.47 | | 12.02 | | | |
| 11 | 214 | -11.53 | | 133.02 | | | |
| 12 | 240 | 14.47 | | 209.28 | | | |
| 13 | 238 | 12.47 | | 155.42 | | | |
| 14 | 225 | -0.53 | | 0.28 | | | |
| 15 | 243 | 17.47 | | 305.08 | | | |
| 16 | 236 | 10.47 | | 109.55 | | | |
| 17 | 248 | 22.47 | | 504.75 | | | |
| 18 | 231 | 5.47 | | 29.88 | | | |
| 19 | 229 | 3.47 | | 12.02 | | | |
| 20 | 235 | 9.47 | | 89.62 | | | |
| 21 | 225 | -0.53 | | 0.28 | | | |
| 22 | 210 | -15.53 | | 241.28 | | | |
| 23 | 214 | -11.53 | | 133.02 | | | |
| 24 | 209 | -16.53 | | 273.35 | | | |
| 25 | 233 | 7.47 | | 55.75 | | | |
| 26 | 220 | -5.53 | | 30.62 | | | |
| 27 | 229 | 3.47 | | 12.02 | | | |
| 28 | 239 | 13.47 | | 181.35 | | | |
| 29 | 220 | -5.53 | | 30.62 | | | |
| 30 | 207 | -18.53 | | 343.48 | | | |
| Mean Count: $\bar{x}$ | 225.53 | | SUM | 3511.47 | | | |
| Standard Deviation (σ) | 11.00 | | Variance: | 121.09 | | CPM Low | CPM High |
| Background Count Rate: | | 225.53 | CPM + - | 33.01 | CPM | 192.52 | 258.54 |
| Calculations Completed by: | | Anthony Smith | | | | Date: | 6/14/2007 |
| Reviewed by: | | Daniel Spicuzza | | | | Date: | 6/14/2007 |

NEW WORLD TECHNOLOGY FORM NWT HPQA003

New World Technology
Background Determination Data Sheet

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Project/Location: | Dahlgren | | | | | | |
| Instrument Model: | 2350 | | | Instrument Serial No. | | 228698 | |
| Last Calibration Date: | 2/22/2007 | | | | | | |
| Detector Model: | 44-40 | | | Detector Serial No.: | | 245172 | |
| Today's Date: | 6/14/2007 | | | Data Collected by: | | Alan Campellone | |
| Alpha | | Beta-Gamma | | | X | Gamma | |
| Remarks: | Instrument Ambient Background | | | | | | |
| Type of Surface: | | | Count Time: | 1 | Minutes | | |
| Count Number | Count (x) | $(x - \bar{x})$ | | $(x - \bar{x})^2$ | | | |
| 1 | 5614 | 301.50 | | 90902.25 | | | |
| 2 | 5190 | -122.50 | | 15006.25 | | | |
| 3 | 5364 | 51.50 | | 2652.25 | | | |
| 4 | 5579 | 266.50 | | 71022.25 | | | |
| 5 | 5222 | -90.50 | | 8190.25 | | | |
| 6 | 5253 | -59.50 | | 3540.25 | | | |
| 7 | 5311 | -1.50 | | 2.25 | | | |
| 8 | 5266 | -46.50 | | 2162.25 | | | |
| 9 | 5491 | 178.50 | | 31862.25 | | | |
| 10 | 5331 | 18.50 | | 342.25 | | | |
| 11 | 5182 | -130.50 | | 17030.25 | | | |
| 12 | 5132 | -180.50 | | 32580.25 | | | |
| 13 | 5284 | -28.50 | | 812.25 | | | |
| 14 | 5265 | -47.50 | | 2256.25 | | | |
| 15 | 5238 | -74.50 | | 5550.25 | | | |
| 16 | 5197 | -115.50 | | 13340.25 | | | |
| 17 | 5291 | -21.50 | | 462.25 | | | |
| 18 | 5304 | -8.50 | | 72.25 | | | |
| 19 | 5187 | -125.50 | | 15750.25 | | | |
| 20 | 5192 | -120.50 | | 14520.25 | | | |
| 21 | 5345 | 32.50 | | 1056.25 | | | |
| 22 | 5288 | -24.50 | | 600.25 | | | |
| 23 | 5306 | -6.50 | | 42.25 | | | |
| 24 | 5220 | -92.50 | | 8556.25 | | | |
| 25 | 5475 | 162.50 | | 26406.25 | | | |
| 26 | 5273 | -39.50 | | 1560.25 | | | |
| 27 | 5362 | 49.50 | | 2450.25 | | | |
| 28 | 5313 | 0.50 | | 0.25 | | | |
| 29 | 5349 | 36.50 | | 1332.25 | | | |
| 30 | 5551 | 238.50 | | 56882.25 | | | |
| Mean Count: $\bar{x}$ | 5312.50 | | SUM | 426943.50 | | | |
| Standard Deviation ($\sigma$) | 121.34 | | Variance: | 14722.19 | | CPM Low | CPM High |
| Background Count Rate: | | 5312.50 | CPM + - | 364.01 | CPM | 4948.49 | 5676.51 |
| Calculations Completed by: | | Alan Campellone | | | | Date: | 6/14/2007 |
| Reviewed by: | | Daniel Spicuzza | | | | Date: | 6/14/2007 |

# New World Technology
## Background Determination Data Sheet

| | | | | | | |
|---|---|---|---|---|---|---|
| Project/Location: | Dahlgren | | | | | |
| Instrument Model: | 2350 | | | Instrument Serial No. | 228710 | |
| | | | | | | |
| Last Calibration Date: | 2/26/2007 | | | | | |
| | | | | | | |
| Detector Model: | 44-10 | | | Detector Serial No.: | 242829 | |
| | | | | | | |
| Today's Date: | 6/14/2007 | | | Data Collected by: | Alan Campellone | |
| | | | | | | |
| Alpha | | Beta-Gamma | | X | Gamma | |
| Remarks: | Instrument Ambient Background | | | | | |
| Type of Surface: | | | Count Time: | 1 | Minutes | |
| Count Number | Count (x) | $(x - \bar{x})$ | | $(x - \bar{x})^2$ | | |
| 1 | 5610 | -110.63 | | 12239.73 | | |
| 2 | 5768 | 47.37 | | 2243.60 | | |
| 3 | 5958 | 237.37 | | 56342.93 | | |
| 4 | 5023 | -697.63 | | 486692.27 | | |
| 5 | 5796 | 75.37 | | 5680.13 | | |
| 6 | 5824 | 103.37 | | 10684.67 | | |
| 7 | 5788 | 67.37 | | 4538.27 | | |
| 8 | 5807 | 86.37 | | 7459.20 | | |
| 9 | 5837 | 116.37 | | 13541.20 | | |
| 10 | 5810 | 89.37 | | 7986.40 | | |
| 11 | 5822 | 101.37 | | 10275.20 | | |
| 12 | 5672 | -48.63 | | 2365.20 | | |
| 13 | 5584 | -136.63 | | 18668.67 | | |
| 14 | 5701 | -19.63 | | 385.47 | | |
| 15 | 5630 | -90.63 | | 8214.40 | | |
| 16 | 5694 | -26.63 | | 709.33 | | |
| 17 | 5834 | 113.37 | | 12852.00 | | |
| 18 | 5623 | -97.63 | | 9532.27 | | |
| 19 | 5686 | -34.63 | | 1199.47 | | |
| 20 | 5748 | 27.37 | | 748.93 | | |
| 21 | 5774 | 53.37 | | 2848.00 | | |
| 22 | 5775 | 54.37 | | 2955.73 | | |
| 23 | 5619 | -101.63 | | 10329.33 | | |
| 24 | 5714 | -6.63 | | 44.00 | | |
| 25 | 5737 | 16.37 | | 267.87 | | |
| 26 | 5665 | -55.63 | | 3095.07 | | |
| 27 | 5659 | -61.63 | | 3798.67 | | |
| 28 | 5772 | 51.37 | | 2638.53 | | |
| 29 | 5696 | -24.63 | | 606.80 | | |
| 30 | 5993 | 272.37 | | 74183.60 | | |
| Mean Count: $\bar{x}$ | 5720.63 | | SUM | 773126.97 | | |
| Standard Deviation (σ) | 163.28 | | Variance: | 26659.55 | CPM Low | CPM High |
| Background Count Rate: | | 5720.63 | CPM + - | 489.83 | CPM 5230.80 | 6210.47 |
| Calculations Completed by: | | Alan Campellone | | | Date: | 6/14/2007 |
| Reviewed by: | | Daniel Spicuzza | | | Date: | 6/14/2007 |

NEW WORLD TECHNOLOGY FORM NWT HPQA003

# New World Technology
## Background Determination Data Sheet

| | | | | | | |
|---|---|---|---|---|---|---|
| Project/Location: | Dahlgren | | | | | |
| Instrument Model: | 2350 | | Instrument Serial No. | | 232920 | |
| Last Calibration Date: | 2/22/2007 | | | | | |
| Detector Model: | 44-10 | | Detector Serial No.: | | 242823 | |
| Today's Date: | 6/14/2007 | | Data Collected by: | | Alan Campellone | |
| | Alpha | | Beta-Gamma | X | Gamma | |
| Remarks: | Instrument Ambient Background | | | | | |
| Type of Surface: | | | Count Time: | 1 | Minutes | |

| Count Number | Count (x) | $(x - \bar{x})$ | | $(x - \bar{x})^2$ |
|---|---|---|---|---|
| 1 | 6115 | 20.50 | | 420.25 |
| 2 | 6132 | 37.50 | | 1406.25 |
| 3 | 6285 | 190.50 | | 36290.25 |
| 4 | 6117 | 22.50 | | 506.25 |
| 5 | 6363 | 268.50 | | 72092.25 |
| 6 | 6249 | 154.50 | | 23870.25 |
| 7 | 6163 | 68.50 | | 4692.25 |
| 8 | 6143 | 48.50 | | 2352.25 |
| 9 | 6031 | -63.50 | | 4032.25 |
| 10 | 6065 | -29.50 | | 870.25 |
| 11 | 6119 | 24.50 | | 600.25 |
| 12 | 6143 | 48.50 | | 2352.25 |
| 13 | 6070 | -24.50 | | 600.25 |
| 14 | 6109 | 14.50 | | 210.25 |
| 15 | 5870 | -224.50 | | 50400.25 |
| 16 | 6014 | -80.50 | | 6480.25 |
| 17 | 6024 | -70.50 | | 4970.25 |
| 18 | 6031 | -63.50 | | 4032.25 |
| 19 | 6034 | -60.50 | | 3660.25 |
| 20 | 5974 | -120.50 | | 14520.25 |
| 21 | 6237 | 142.50 | | 20306.25 |
| 22 | 6056 | -38.50 | | 1482.25 |
| 23 | 6033 | -61.50 | | 3782.25 |
| 24 | 6170 | 75.50 | | 5700.25 |
| 25 | 6126 | 31.50 | | 992.25 |
| 26 | 6074 | -20.50 | | 420.25 |
| 27 | 5930 | -164.50 | | 27060.25 |
| 28 | 6006 | -88.50 | | 7832.25 |
| 29 | 6099 | 4.50 | | 20.25 |
| 30 | 6053 | -41.50 | | 1722.25 |
| Mean Count: $\bar{x}$ | 6094.50 | | SUM | 303677.50 |
| Standard Deviation ($\sigma$) | 102.33 | | Variance: | 10471.64 |
| Background Count Rate: | | 6094.50 | CPM + - | 306.99 |

| | | |
|---|---|---|
| CPM | CPM Low | CPM High |
| | 5787.51 | 6401.49 |

| | | | |
|---|---|---|---|
| Calculations Completed by: | Alan Campellone | Date: | 6/14/2007 |
| Reviewed by: | Daniel Spicuzza | Date: | 6/14/2007 |

# Chi-Square Test Data

New World Technology
Chi-Squared Test of Reliability Data Sheet

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Project/Location: | Dahlgren | | | | | | |
| Instrument Model: | 2360 | | | Instrument Serial No. | | 184905 | |
| | | | | | | | |
| Last Calibration Date: | 4/24/2007 | | | Background Count Rate: | | 0.4 | $C_B$ |
| | | | | | | | |
| Detector Model: | 43-89 | | | Detector Serial No.: | | 194989 | |
| | | | | | | | |
| Today's Date: | 6/14/2007 | | | Data Collected by: | | Anthony Smith | |
| Source ID: 564-13-3 | Activity | 4222 | Alphas/Min | Efficiency: | 16.9 | % | |
| Radionuclide: Th-230 | CPM | CPM | | | | | |
| Count Number | (Gross) $C_G$ | (Net) $C_I$ | | $(C_I - \bar{c})$ | $(C_I - \bar{c})^2$ | | |
| 1 | **740** | 739.6 | | 26.70 | 712.89 | | |
| 2 | **713** | 712.6 | | -0.30 | 0.09 | | |
| 3 | **696** | 695.6 | | -17.30 | 299.29 | | |
| 4 | **690** | 689.6 | | -23.30 | 542.89 | | |
| 5 | **757** | 756.6 | | 43.70 | 1909.69 | | |
| 6 | **706** | 705.6 | | -7.30 | 53.29 | | |
| 7 | **692** | 691.6 | | -21.30 | 453.69 | | |
| 8 | **673** | 672.6 | | -40.30 | 1624.09 | | |
| 9 | **684** | 683.6 | | -29.30 | 858.49 | | |
| 10 | **707** | 706.6 | | -6.30 | 39.69 | | |
| 11 | **712** | 711.6 | | -1.30 | 1.69 | | |
| 12 | **693** | 692.6 | | -20.30 | 412.09 | | |
| 13 | **737** | 736.6 | | 23.70 | 561.69 | | |
| 14 | **734** | 733.6 | | 20.70 | 428.49 | | |
| 15 | **736** | 735.6 | | 22.70 | 515.29 | | |
| 16 | **674** | 673.6 | | -39.30 | 1544.49 | | |
| 17 | **733** | 732.6 | | 19.70 | 388.09 | | |
| 18 | **738** | 737.6 | | 24.70 | 610.09 | | |
| 19 | **737** | 736.6 | | 23.70 | 561.69 | | |
| 20 | **714** | 713.6 | | 0.70 | 0.49 | | |
| Total | 14266 | 14258 | | SUM | 11518.2 | $\Sigma(C_I - c)^2$ | |
| Mean Count: $\bar{c}$ | | 713 | | | | | |
| Chi Squared Value ($C^2$): | 16.16 | 10.11 - 30.14 | Standard Deviation: | 25 | | | |
| + 2 σ Value: 762 | - 2 σ Value: | 664 | | | | | |
| Calculations Completed by: | | Anthony Smith | | | | Date: | 6/14/2007 |
| Reviewed by: | | Daniel Spicuzza | | | | Date: | 6/14/2007 |

New World Technology
Chi-Squared Test of Reliability Data Sheet

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Project/Location: | | Dahlgren | | | | | |
| Instrument Model: | | 2360 | | | Instrument Serial No. | 184905 | |
| Last Calibration Date: | | 4/24/2007 | | | Background Count Rate: | 174.6 | $C_B$ |
| Detector Model: | | 43-89 | | | Detector Serial No.: | 194989 | |
| Today's Date: | | 6/14/2007 | | | Data Collected by: | Anthony Smith | |
| Source ID: | 564-13-3 | Activity | 16030 | Betas/Min | Efficiency: | 8.3 % | |
| Radionuclide: | Tc-99 | CPM | CPM | | | | |
| Count Number | | (Gross) $C_G$ | (Net) $C_I$ | | $(C_I - \bar{c})$ | $(C_I - \bar{c})^2$ | |
| 1 | | **1528** | 1353.4 | | 18.10 | 327.61 | |
| 2 | | **1497** | 1322.4 | | -12.90 | 166.41 | |
| 3 | | **1511** | 1336.4 | | 1.10 | 1.21 | |
| 4 | | **1587** | 1412.4 | | 77.10 | 5944.41 | |
| 5 | | **1519** | 1344.4 | | 9.10 | 82.81 | |
| 6 | | **1515** | 1340.4 | | 5.10 | 26.01 | |
| 7 | | **1535** | 1360.4 | | 25.10 | 630.01 | |
| 8 | | **1439** | 1264.4 | | -70.90 | 5026.81 | |
| 9 | | **1525** | 1350.4 | | 15.10 | 228.01 | |
| 10 | | **1523** | 1348.4 | | 13.10 | 171.61 | |
| 11 | | **1489** | 1314.4 | | -20.90 | 436.81 | |
| 12 | | **1474** | 1299.4 | | -35.90 | 1288.81 | |
| 13 | | **1514** | 1339.4 | | 4.10 | 16.81 | |
| 14 | | **1486** | 1311.4 | | -23.90 | 571.21 | |
| 15 | | **1492** | 1317.4 | | -17.90 | 320.41 | |
| 16 | | **1479** | 1304.4 | | -30.90 | 954.81 | |
| 17 | | **1504** | 1329.4 | | -5.90 | 34.81 | |
| 18 | | **1516** | 1341.4 | | 6.10 | 37.21 | |
| 19 | | **1486** | 1311.4 | | -23.90 | 571.21 | |
| 20 | | **1579** | 1404.4 | | 69.10 | 4774.81 | |
| Total | | 30198 | 26706 | | SUM | 21611.8 | $\Sigma(C_I - c)^2$ |
| Mean Count: $\bar{c}$ | | | 1335 | | | | |
| Chi Squared Value ($C^2$): | | 16.18 | 10.11 - 30.14 | Standard Deviation: | 34 | | |
| + 2 σ Value: | 1403 | - 2 σ Value: | 1268 | | | | |
| Calculations Completed by: | | | Anthony Smith | | | Date: | 6/14/2007 |
| Reviewed by: | | | Daniel Spicuzza | | | Date: | 6/14/2007 |

NEW WORLD TECHNOLOGY FORM NWT-HPQA004

New World Technology
Chi-Squared Test of Reliability Data Sheet

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Project/Location: | | Dahlgren | | | | | |
| Instrument Model: | | 2929 | | | Instrument Serial No. | | 185291 |
| Last Calibration Date: | | 10/16/2006 | | | Background Count Rate: | | 0.4 | $C_B$ |
| Detector Model: | | 43-10-1 | | | Detector Serial No.: | | 194723 |
| Today's Date: | | 6/14/2007 | | | Data Collected by: | | Richard Kountz |
| Source ID: | 564-38-2 | Activity | 22742 | Alphas/Min | Efficiency: | 54.5 % | |
| Radionuclide: | Th-230 | CPM | CPM | | | | |
| Count Number | | (Gross) $C_G$ | (Net) $C_I$ | | $(C_I - \bar{c})$ | $(C_I - \bar{c})^2$ | |
| 1 | | **12425** | 12424.6 | | 26.50 | 702.25 | |
| 2 | | **12376** | 12375.6 | | -22.50 | 506.25 | |
| 3 | | **12262** | 12261.6 | | -136.50 | 18632.25 | |
| 4 | | **12284** | 12283.6 | | -114.50 | 13110.25 | |
| 5 | | **12302** | 12301.6 | | -96.50 | 9312.25 | |
| 6 | | **12475** | 12474.6 | | 76.50 | 5852.25 | |
| 7 | | **12402** | 12401.6 | | 3.50 | 12.25 | |
| 8 | | **12563** | 12562.6 | | 164.50 | 27060.25 | |
| 9 | | **12349** | 12348.6 | | -49.50 | 2450.25 | |
| 10 | | **12230** | 12229.6 | | -168.50 | 28392.25 | |
| 11 | | **12524** | 12523.6 | | 125.50 | 15750.25 | |
| 12 | | **12554** | 12553.6 | | 155.50 | 24180.25 | |
| 13 | | **12516** | 12515.6 | | 117.50 | 13806.25 | |
| 14 | | **12316** | 12315.6 | | -82.50 | 6806.25 | |
| 15 | | **12551** | 12550.6 | | 152.50 | 23256.25 | |
| 16 | | **12253** | 12252.6 | | -145.50 | 21170.25 | |
| 17 | | **12378** | 12377.6 | | -20.50 | 420.25 | |
| 18 | | **12408** | 12407.6 | | 9.50 | 90.25 | |
| 19 | | **12419** | 12418.6 | | 20.50 | 420.25 | |
| 20 | | **12383** | 12382.6 | | -15.50 | 240.25 | |
| Total | | 247970 | 247962 | | SUM | 212171 | $\Sigma(C_I - c)^2$ |
| Mean Count: $\bar{c}$ | | | 12398 | | | | |
| Chi Squared Value ($C^2$): | | 17.11 | 10.11 - 30.14 | Standard Deviation: | 106 | | |
| + 2 σ Value: | 12609 | - 2 σ Value: | 12187 | | | | |
| Calculations Completed by: | | | Richard Kountz | | | Date: | 6/14/2007 |
| Reviewed by: | | | Daniel Spicuzza | | | Date: | 6/14/2007 |

New World Technology
Chi-Squared Test of Reliability Data Sheet

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Project/Location: | | Dahlgren | | | | | |
| Instrument Model: | | 2929 | | Instrument Serial No. | | 185291 | |
| | | | | | | | |
| Last Calibration Date: | | 10/16/2006 | | Background Count Rate: | | 50.4 | $C_B$ |
| | | | | | | | |
| Detector Model: | | 43-10-1 | | Detector Serial No.: | | 194723 | |
| | | | | | | | |
| Today's Date: | | 6/14/2007 | | Data Collected by: | | Richard Kountz | |
| Source ID: | 564-29-14 | Activity | 38720 Betas/Min | Efficiency: | 44.5 % | | |
| Radionuclide: | Tc-99 | CPM | CPM | | | | |
| Count Number | | (Gross) $C_G$ | (Net) $C_I$ | $(C_I - \overline{c})$ | $(C_I - \overline{c})^2$ | | |
| 1 | | **17394** | 17343.6 | 94.95 | 9015.50 | | |
| 2 | | **17342** | 17291.6 | 42.95 | 1844.70 | | |
| 3 | | **17381** | 17330.6 | 81.95 | 6715.80 | | |
| 4 | | **17282** | 17231.6 | -17.05 | 290.70 | | |
| 5 | | **17291** | 17240.6 | -8.05 | 64.80 | | |
| 6 | | **17502** | 17451.6 | 202.95 | 41188.70 | | |
| 7 | | **17140** | 17089.6 | -159.05 | 25296.90 | | |
| 8 | | **17070** | 17019.6 | -229.05 | 52463.90 | | |
| 9 | | **17217** | 17166.6 | -82.05 | 6732.20 | | |
| 10 | | **17113** | 17062.6 | -186.05 | 34614.60 | | |
| 11 | | **17171** | 17120.6 | -128.05 | 16396.80 | | |
| 12 | | **17179** | 17128.6 | -120.05 | 14412.00 | | |
| 13 | | **17229** | 17178.6 | -70.05 | 4907.00 | | |
| 14 | | **17366** | 17315.6 | 66.95 | 4482.30 | | |
| 15 | | **17356** | 17305.6 | 56.95 | 3243.30 | | |
| 16 | | **17267** | 17216.6 | -32.05 | 1027.20 | | |
| 17 | | **17465** | 17414.6 | 165.95 | 27539.40 | | |
| 18 | | **17326** | 17275.6 | 26.95 | 726.30 | | |
| 19 | | **17322** | 17271.6 | 22.95 | 526.70 | | |
| 20 | | **17568** | 17517.6 | 268.95 | 72334.10 | | |
| Total | | 345981 | 344973 | SUM | 323822.95 | $\Sigma(C_I - c)^2$ | |
| Mean Count: $\overline{c}$ | | | 17249 | | | | |
| Chi Squared Value ($C^2$): | | 18.77 | 10.11 - 30.14 | Standard Deviation: | 131 | | |
| + 2 σ Value: | 17510 | - 2 σ Value: | 16988 | | | | |
| Calculations Completed by: | | | Richard Kountz | | | Date: | 6/14/2007 |
| Reviewed by: | | | Daniel Spicuzza | | | Date: | 6/14/2007 |

New World Technology
Chi-Squared Test of Reliability Data Sheet

| | | | | | | |
|---|---|---|---|---|---|---|
| Project/Location: | Dahlgren | | | | | |
| Instrument Model: | 2360 | | | Instrument Serial No. | 227404 | |
| Last Calibration Date: | 4/24/2007 | | | Background Count Rate: | 0.4 | $C_B$ |
| Detector Model: | 43-89 | | | Detector Serial No.: | 171342 | |
| Today's Date: | 6/14/2007 | | | Data Collected by: | Anthony Smith | |
| Source ID: 564-33-1 | Activity | 4222 | Alphas/Min | Efficiency: | 15.8 % | |
| Radionuclide: Th-230 | CPM | CPM | | | | |
| Count Number | (Gross) $C_G$ | (Net) $C_I$ | | $(C_I - \bar{c})$ | $(C_I - \bar{c})^2$ | |
| 1 | **692** | 691.6 | | 26.25 | 689.06 | |
| 2 | **654** | 653.6 | | -11.75 | 138.06 | |
| 3 | **672** | 671.6 | | 6.25 | 39.06 | |
| 4 | **688** | 687.6 | | 22.25 | 495.06 | |
| 5 | **658** | 657.6 | | -7.75 | 60.06 | |
| 6 | **652** | 651.6 | | -13.75 | 189.06 | |
| 7 | **640** | 639.6 | | -25.75 | 663.06 | |
| 8 | **652** | 651.6 | | -13.75 | 189.06 | |
| 9 | **671** | 670.6 | | 5.25 | 27.56 | |
| 10 | **635** | 634.6 | | -30.75 | 945.56 | |
| 11 | **614** | 613.6 | | -51.75 | 2678.06 | |
| 12 | **640** | 639.6 | | -25.75 | 663.06 | |
| 13 | **670** | 669.6 | | 4.25 | 18.06 | |
| 14 | **668** | 667.6 | | 2.25 | 5.06 | |
| 15 | **704** | 703.6 | | 38.25 | 1463.06 | |
| 16 | **711** | 710.6 | | 45.25 | 2047.56 | |
| 17 | **670** | 669.6 | | 4.25 | 18.06 | |
| 18 | **709** | 708.6 | | 43.25 | 1870.56 | |
| 19 | **642** | 641.6 | | -23.75 | 564.06 | |
| 20 | **673** | 672.6 | | 7.25 | 52.56 | |
| Total | 13315 | 13307 | | SUM | 12815.75 | $\Sigma(C_I - c)^2$ |
| Mean Count: $\bar{c}$ | | 665 | | | | |
| Chi Squared Value ($C^2$): | 19.26 | 10.11 - 30.14 | Standard Deviation: | 26 | | |
| + 2 σ Value: 717 | - 2 σ Value: | 613 | | | | |
| Calculations Completed by: | | Anthony Smith | | | Date: | 6/14/2007 |
| Reviewed by: | | Daniel Spicuzza | | | Date: | 6/14/2007 |

New World Technology
Chi-Squared Test of Reliability Data Sheet

| | | | | | | |
|---|---|---|---|---|---|---|
| Project/Location: | Dahlgren | | | | | |
| Instrument Model: | 2360 | | | Instrument Serial No. | 227404 | |
| Last Calibration Date: | 4/24/2007 | | | Background Count Rate: | 225.5 | $C_B$ |
| Detector Model: | 43-89 | | | Detector Serial No.: | 171342 | |
| Today's Date: | 6/14/2007 | | | Data Collected by: | Anthony Smith | |
| Source ID: 564-13-3 | Activity | 16030 | Betas/Min | Efficiency: 8.2 % | | |
| Radionuclide: Tc-99 | CPM | CPM | | | | |
| Count Number | (Gross) $C_G$ | (Net) $C_I$ | | $(C_I - \bar{c})$ | $(C_I - \bar{c})^2$ | |
| 1 | **1529** | 1303.5 | | -10.05 | 101.00 | |
| 2 | **1546** | 1320.5 | | 6.95 | 48.30 | |
| 3 | **1520** | 1294.5 | | -19.05 | 362.90 | |
| 4 | **1536** | 1310.5 | | -3.05 | 9.30 | |
| 5 | **1546** | 1320.5 | | 6.95 | 48.30 | |
| 6 | **1626** | 1400.5 | | 86.95 | 7560.30 | |
| 7 | **1553** | 1327.5 | | 13.95 | 194.60 | |
| 8 | **1485** | 1259.5 | | -54.05 | 2921.40 | |
| 9 | **1492** | 1266.5 | | -47.05 | 2213.70 | |
| 10 | **1561** | 1335.5 | | 21.95 | 481.80 | |
| 11 | **1574** | 1348.5 | | 34.95 | 1221.50 | |
| 12 | **1527** | 1301.5 | | -12.05 | 145.20 | |
| 13 | **1533** | 1307.5 | | -6.05 | 36.60 | |
| 14 | **1454** | 1228.5 | | -85.05 | 7233.50 | |
| 15 | **1623** | 1397.5 | | 83.95 | 7047.60 | |
| 16 | **1510** | 1284.5 | | -29.05 | 843.90 | |
| 17 | **1542** | 1316.5 | | 2.95 | 8.70 | |
| 18 | **1520** | 1294.5 | | -19.05 | 362.90 | |
| 19 | **1548** | 1322.5 | | 8.95 | 80.10 | |
| 20 | **1556** | 1330.5 | | 16.95 | 287.30 | |
| Total | 30781 | 26271 | | SUM | 31208.95 | $\Sigma(C_I - c)^2$ |
| Mean Count: $\bar{c}$ | | 1314 | | | | |
| Chi Squared Value ($C^2$): | 23.76 | 10.11 - 30.14 | Standard Deviation: | 41 | | |
| + 2 σ Value: 1395 | - 2 σ Value: | 1232 | | | | |
| Calculations Completed by: | | Anthony Smith | | | Date: | 6/14/2007 |
| Reviewed by: | | Daniel Spicuzza | | | Date: | 6/14/2007 |

New World Technology
Chi-Squared Test of Reliability Data Sheet

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Project/Location: | | Dahlgren | | | | | |
| Instrument Model: | | 2350-1 | | | Instrument Serial No. | 228693 | |
| Last Calibration Date: | | 2/22/2007 | | | Background Count Rate: | 7429.6 | $C_B$ |
| Detector Model: | | 44-10 | | | Detector Serial No.: | 245122 | |
| Today's Date: | | 6/14/2007 | | | Data Collected by: | Alan Campellone | |
| Source ID: | A7-275 | Activity | 99590 | dpm | Efficiency: 8.6 % | | |
| Radionuclide: | Cs-137 | CPM | CPM | | | | |
| Count Number | | (Gross) $C_G$ | (Net) $C_I$ | | $(C_I - \bar{c})$ | $(C_I - \bar{c})^2$ | |
| 1 | | **16192** | 8762.4 | | 164.45 | 27043.80 | |
| 2 | | **15935** | 8505.4 | | -92.55 | 8565.50 | |
| 3 | | **15965** | 8535.4 | | -62.55 | 3912.50 | |
| 4 | | **16032** | 8602.4 | | 4.45 | 19.80 | |
| 5 | | **16039** | 8609.4 | | 11.45 | 131.10 | |
| 6 | | **16145** | 8715.4 | | 117.45 | 13794.50 | |
| 7 | | **16261** | 8831.4 | | 233.45 | 54498.90 | |
| 8 | | **15974** | 8544.4 | | -53.55 | 2867.60 | |
| 9 | | **16102** | 8672.4 | | 74.45 | 5542.80 | |
| 10 | | **15955** | 8525.4 | | -72.55 | 5263.50 | |
| 11 | | **15846** | 8416.4 | | -181.55 | 32960.40 | |
| 12 | | **15921** | 8491.4 | | -106.55 | 11352.90 | |
| 13 | | **15865** | 8435.4 | | -162.55 | 26422.50 | |
| 14 | | **15958** | 8528.4 | | -69.55 | 4837.20 | |
| 15 | | **16088** | 8658.4 | | 60.45 | 3654.20 | |
| 16 | | **15991** | 8561.4 | | -36.55 | 1335.90 | |
| 17 | | **16066** | 8636.4 | | 38.45 | 1478.40 | |
| 18 | | **16126** | 8696.4 | | 98.45 | 9692.40 | |
| 19 | | **16118** | 8688.4 | | 90.45 | 8181.20 | |
| 20 | | **15972** | 8542.4 | | -55.55 | 3085.80 | |
| Total | | 320551 | 171959 | | SUM | 224640.95 | $\Sigma(C_I - c)^2$ |
| Mean Count: $\bar{c}$ | | | 8598 | | | | |
| Chi Squared Value ($C^2$): | | 26.13 | 10.11 - 30.14 | Standard Deviation: | 109 | | |
| + 2 σ Value: | 8815 | - 2 σ Value: | 8380 | | | | |
| Calculations Completed by: | | | Alan Campellone | | | Date: | 6/14/2007 |
| Reviewed by: | | | Daniel Spicuzza | | | Date: | 6/14/2007 |

# New World Technology
## Chi-Squared Test of Reliability Data Sheet

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Project/Location: | | Dahlgren | | | | | |
| Instrument Model: | | 2350-1 | | Instrument Serial No. | | 228710 | |
| Last Calibration Date: | | 2/26/2007 | | Background Count Rate: | | 7429.6 | $C_B$ |
| Detector Model: | | 44-10 | | Detector Serial No.: | | 242829 | |
| Today's Date: | | 6/14/2007 | | Data Collected by: | | Alan Campellone | |
| Source ID: | A7-275 | Activity | 99590 dpm | Efficiency: | 12.1 % | | |
| Radionuclide: | Cs-137 | CPM | CPM | | | | |
| Count Number | | (Gross) $C_G$ | (Net) $C_I$ | | $(C_I - \bar{c})$ | $(C_I - \bar{c})^2$ | |
| 1 | | **19485** | 12055.4 | | 28.75 | 826.56 | |
| 2 | | **19657** | 12227.4 | | 200.75 | 40300.56 | |
| 3 | | **19541** | 12111.4 | | 84.75 | 7182.56 | |
| 4 | | **19521** | 12091.4 | | 64.75 | 4192.56 | |
| 5 | | **19428** | 11998.4 | | -28.25 | 798.06 | |
| 6 | | **19345** | 11915.4 | | -111.25 | 12376.56 | |
| 7 | | **19221** | 11791.4 | | -235.25 | 55342.56 | |
| 8 | | **19661** | 12231.4 | | 204.75 | 41922.56 | |
| 9 | | **19494** | 12064.4 | | 37.75 | 1425.06 | |
| 10 | | **19363** | 11933.4 | | -93.25 | 8695.56 | |
| 11 | | **19265** | 11835.4 | | -191.25 | 36576.56 | |
| 12 | | **19510** | 12080.4 | | 53.75 | 2889.06 | |
| 13 | | **19452** | 12022.4 | | -4.25 | 18.06 | |
| 14 | | **19387** | 11957.4 | | -69.25 | 4795.56 | |
| 15 | | **19561** | 12131.4 | | 104.75 | 10972.56 | |
| 16 | | **19388** | 11958.4 | | -68.25 | 4658.06 | |
| 17 | | **19421** | 11991.4 | | -35.25 | 1242.56 | |
| 18 | | **19502** | 12072.4 | | 45.75 | 2093.06 | |
| 19 | | **19665** | 12235.4 | | 208.75 | 43576.56 | |
| 20 | | **19258** | 11828.4 | | -198.25 | 39303.06 | |
| Total | | 389125 | 240533 | | SUM | 319187.75 | $\Sigma(C_I - c)^2$ |
| Mean Count: $\bar{c}$ | | | 12027 | | | | |
| Chi Squared Value ($C^2$): | | 26.54 | 10.11 - 30.14 | Standard Deviation: | 130 | | |
| + 2 σ Value: | 12286 | - 2 σ Value: | 11767 | | | | |
| Calculations Completed by: | | | Alan Campellone | | | Date: | 6/14/2007 |
| Reviewed by: | | | Daniel Spicuzza | | | Date: | 6/14/2007 |

New World Technology
Chi-Squared Test of Reliability Data Sheet

| | | | | | | |
|---|---|---|---|---|---|---|
| Project/Location: | Dahlgren | | | | | |
| Instrument Model: | 2350-1 | | | Instrument Serial No. | 232920 | |
| Last Calibration Date: | 2/22/2007 | | | Background Count Rate: | 7429.6 | $C_B$ |
| Detector Model: | 44-10 | | | Detector Serial No.: | 242823 | |
| Today's Date: | 6/14/2007 | | | Data Collected by: | Alan Campellone | |
| Source ID: A7-275 | Activity | 99590 | dpm | Efficiency: | 9.8 | % |
| Radionuclide: Cs-137 | CPM | CPM | | | | |
| Count Number | (Gross) $C_G$ | (Net) $C_I$ | | $(C_I - \bar{c})$ | $(C_I - \bar{c})^2$ | |
| 1 | **17351** | 9921.4 | | 122.25 | 14945.06 | |
| 2 | **17228** | 9798.4 | | -0.75 | 0.56 | |
| 3 | **17349** | 9919.4 | | 120.25 | 14460.06 | |
| 4 | **17046** | 9616.4 | | -182.75 | 33397.56 | |
| 5 | **17184** | 9754.4 | | -44.75 | 2002.56 | |
| 6 | **17278** | 9848.4 | | 49.25 | 2425.56 | |
| 7 | **17016** | 9586.4 | | -212.75 | 45262.56 | |
| 8 | **17198** | 9768.4 | | -30.75 | 945.56 | |
| 9 | **17401** | 9971.4 | | 172.25 | 29670.06 | |
| 10 | **17165** | 9735.4 | | -63.75 | 4064.06 | |
| 11 | **17261** | 9831.4 | | 32.25 | 1040.06 | |
| 12 | **17309** | 9879.4 | | 80.25 | 6440.06 | |
| 13 | **17221** | 9791.4 | | -7.75 | 60.06 | |
| 14 | **17312** | 9882.4 | | 83.25 | 6930.56 | |
| 15 | **17265** | 9835.4 | | 36.25 | 1314.06 | |
| 16 | **17121** | 9691.4 | | -107.75 | 11610.06 | |
| 17 | **17312** | 9882.4 | | 83.25 | 6930.56 | |
| 18 | **17221** | 9791.4 | | -7.75 | 60.06 | |
| 19 | **17092** | 9662.4 | | -136.75 | 18700.56 | |
| 20 | **17245** | 9815.4 | | 16.25 | 264.06 | |
| Total | 344575 | 195983 | | SUM | 200523.75 | $\Sigma(C_I - c)^2$ |
| Mean Count: $\bar{c}$ | | 9799 | | | | |
| Chi Squared Value ($C^2$): | 20.46 | 10.11 - 30.14 | Standard Deviation: | 103 | | |
| + 2 σ Value: 10005 | - 2 σ Value: | 9594 | | | | |
| Calculations Completed by: | | Alan Campellone | | | Date: | 6/14/2007 |
| Reviewed by: | | Daniel Spicuzza | | | Date: | 6/14/2007 |

# Appendix F

# Asphalt Sample Laboratory Data

STL

**STL St. Louis**
13715 Rider Trail North
Earth City, MO 63045

Tel: 314 298 8566 Fax: 314 298 8757
www.stl-inc.com

# ANALYTICAL REPORT

Dahlgren

Lot #: F7F190283

Dan Spicuzza

New World Technology
448 Commerce Way
Livermore, CA 94551

SEVERN TRENT LABORATORIES, INC.

Ivan Vania
Project Manager

June 22, 2007

Leaders in Environmental Testing

**Case Narrative**
LOT NUMBER: **F7F190283**

This report contains the analytical results for the 22 samples received under chain of custody by STL St. Louis on June 19, 2007. These samples are associated with your Dahlgren project.

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

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

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

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

There were no nonconformances or observations noted with any analysis on this lot.

# METHODS SUMMARY

**F7F190283**

| PARAMETER | ANALYTICAL METHOD | PREPARATION METHOD |
|---|---|---|
| Gamma Spectroscopy - Cesium-137 & Hits | EML GA-01-R MOD | |
| Isotopic Uranium by Alpha Spectroscopy | EML A-01-R MOD | |

**References:**

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

# SAMPLE SUMMARY

**F7F190283**

| WO # | SAMPLE# | CLIENT SAMPLE ID | SAMPLED DATE | SAMP TIME |
|---|---|---|---|---|
| J1A26 | 001 | APA-1 | 06/15/07 | 15:45 |
| J1A3A | 002 | APA-2 | 06/15/07 | 15:50 |
| J1A3E | 003 | APB-1 | 06/15/07 | 15:55 |
| J1A3G | 004 | APB-2 | 06/15/07 | 16:00 |
| J1A3K | 005 | AB-A1 | 06/16/07 | 13:55 |
| J1A3L | 006 | AB-A2 | 06/16/07 | 13:45 |
| J1A3N | 007 | AB-A3 | 06/16/07 | 13:50 |
| J1A3R | 008 | AB-B1 | 06/16/07 | 14:00 |
| J1A3V | 009 | AB-B2 | 06/16/07 | 14:05 |
| J1A3X | 010 | AB-B3 | 06/16/07 | 14:10 |
| J1A34 | 011 | AB-C1 | 06/16/07 | 14:25 |
| J1A4N | 012 | AB-C2 | 06/16/07 | 14:20 |
| J1A4P | 013 | AB-C3 | 06/16/07 | 14:15 |
| J1A4Q | 014 | AB-D1 | 06/16/07 | 14:30 |
| J1A4T | 015 | AB-D2 | 06/16/07 | 14:35 |
| J1A4W | 016 | AB-D3 | 06/16/07 | 14:40 |
| J1A44 | 017 | AB-E1 | 06/16/07 | 14:55 |
| J1A46 | 018 | AB-E2 | 06/16/07 | 14:50 |
| J1A49 | 019 | AB-E3 | 06/16/07 | 14:45 |
| J1A5C | 020 | AB-F1 | 06/16/07 | 15:00 |
| J1A5E | 021 | AB-F2 | 06/16/07 | 15:05 |
| J1A5L | 022 | AB-F3 | 06/16/07 | 15:10 |

**NOTE(S):**

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

# New World Technology

## Client Sample ID: APA-1

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F190283-001 | Date Collected: | 06/15/07 1545 |
| Work Order: | J1A26 | Date Received: | 06/19/07 1450 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| Gamma Cs-137 & Hits by DOE GA-01-R MOD. | | | | pCi/g | Batch # 7171412 | | Yld % |
| Uranium 238 | 2.66 | J | 0.80 | 4.00 | 1.4 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: APA-1 DUP

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F190283-001X
Work Order: J1A26
Matrix: SOLID

Date Collected: 06/15/07 1545
Date Received: 06/19/07 1450

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | pCi/g | | Batch # 7171412 | Yld % |
| Uranium 238 | 2.56 | J | 0.92 | 4.00 | 1.5 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: APA-2

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F190283-002
Work Order: J1A3A
Matrix: SOLID

Date Collected: 06/15/07 1550
Date Received: 06/19/07 1450

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | | **Batch # 7171412** | **Yld %** |
| Uranium 238 | 4.4 | | 1.2 | 4.0 | 1.9 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

# New World Technology

## Client Sample ID: APB-1

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F190283-003
Work Order: J1A3E
Matrix: SOLID

Date Collected: 06/15/07 1555
Date Received: 06/19/07 1450

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | **Batch # 7171412** | | **Yld %** |
| Uranium 238 | 0.08 | U | 0.61 | 4.00 | 1.1 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: APB-2

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F190283-004
Work Order: J1A3G
Matrix: SOLID

Date Collected: 06/15/07 1600
Date Received: 06/19/07 1450

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| Gamma Cs-137 & Hits by DOE GA-01-R MOD. | | | | pCi/g | | Batch # 7171412 | Yld % |
| Uranium 238 | 2.6 | J | 1.2 | 4.0 | 1.3 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

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

# Appendix G

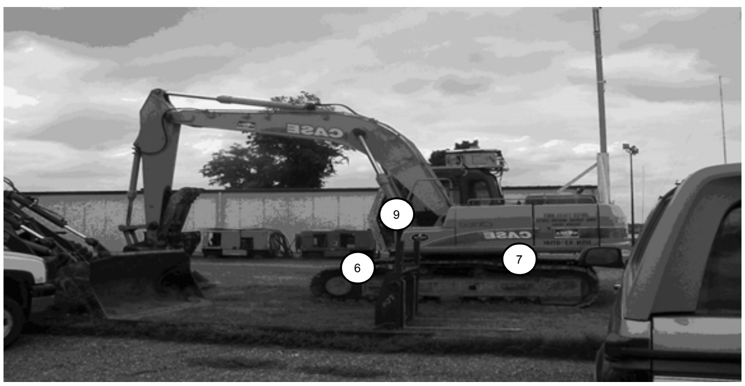
# Heavy Equipment Survey Data

# RADIATION/CONTAMINATION SURVEY FORM

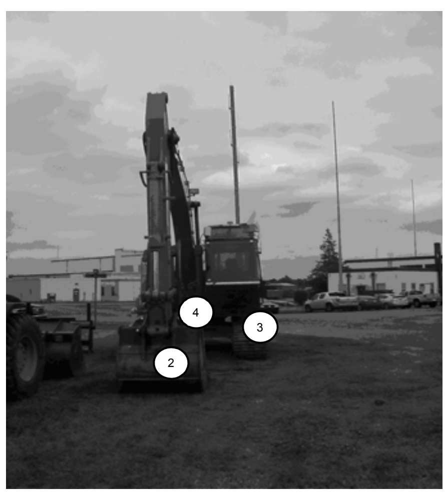


| | INSTRUMENTATION USED | | | | | | |
|---|---|---|---|---|---|---|---|
| DATE: 6/15/2007 TIME: 12:30 | Model Inst/Det. | Serial Number | Calibration Due Date | Instrument % Efficiency | Total % Efficiency | MDC/MDA + (dpm/100cm$^2$) | Background + (dpm/100cm$^2$) |
| | 2360 | 184905 | 4/24/2008 | α 16.90% | α 4.23% | α 70.52 | α 8.83 |
| SURVEY NUMBER: N/A | 43-89 | 194989 | | βγ 8.30% | βγ 2.08% | βγ 1909.66 | βγ 8297.19 |
| | 2929 | 185291 | 10/16/2007 | α 54.50% | α 13.63% | α 19.80 | α 2.94 |
| LOCATION: Dahlgren Building 200 | | | | βγ 44.50% | βγ 11.13% | βγ 150.73 | βγ 310.11 |
| SURVEYOR: Richard Kountz | | | | | | | |
| Reviewed By: Dan Spicuzza | | | | | | | |
| Isotopes of Concern: $^{238}$U | Static Count Time: 2 Minutes | | | | | | |

Description of drawing: Excavator








**Comments:**

All LAW's were ≤ background α β

All accessible areas were 100% alpha-beta scan surveyed. No detectable activity over background was noted.

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

| | |
|---|---|
| # (circled) | denotes swipe location and fixed α/β readings |
| # | denotes G/A radiation readings |
| # / # | denotes contact / 1 meter radiation readings. |
| * | denotes highest radiation reading on contact |
| LAW | denotes large area masslinn wipe |
| Δ | denotes static location. |
| + | Unless Otherwise Noted |
| | All readings in μr/hr unless otherwise noted |
| | K = 1000 |

# RADIATION/CONTAMINATION SURVEY SUPPLEMENT



SURVEY NUMBER: N/A

SURVEYOR: Richard Kountz | LOCATION: Dahlgren Building 200

| Location | Exposure Rate (μR/hr) | | Fixed + Removable (NET) | | | Removable (NET) | | Comments |
|---|---|---|---|---|---|---|---|---|
| | Contact | 1 Meter | Gamma (cpm) | Alpha dpm/100cm$^2$ | Beta/Gamma dpm/100cm$^2$ | Alpha dpm/100cm$^2$ | Beta/Gamma dpm/100cm$^2$ | |
| 1 | | | | 10.0 | 136.5 | -0.5 | -28.5 | |
| 2 | | | | 0.6 | 60.0 | -2.9 | -40.4 | |
| 3 | | | | 19.3 | -92.9 | 2.0 | -7.5 | |
| 4 | | | | -8.8 | -92.9 | -0.5 | 16.5 | |
| 5 | | | | 10.0 | -226.8 | -2.9 | -13.5 | |
| 6 | | | | 10.0 | -92.9 | -0.5 | -4.5 | |
| 7 | | | | 0.6 | -35.6 | -0.5 | -22.5 | |
| 8 | | | | -8.8 | -265.1 | -2.9 | -16.5 | |
| 9 | | | | 0.6 | -35.6 | -0.5 | 1.5 | |
| 10 | | | | 0.6 | -131.2 | -0.5 | -7.5 | |
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| Reviewer | Date: 6/15/2007 | |
|---|---|---|
| Daniel Spicuzza | Time: 1300 | |

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# UNCONDITIONAL RELEASE OF EQUIPMENT OR MATERIALS FORM

| | |
|---|---|
| Survey # N/A | Date : 6/15/2007 |
| Project Location : Dahlgren Building 200 | |
| Description of Equipment or Materials: Excavator | |

## Survey Equipment:

| Model # | Serial # | Cal Due Date | Efficiency | Background |
|---|---|---|---|---|
| 2929 | 185291 | 10/16/2007 | α 13.63% | α 2.94 |
| | | | β 11.13% | β 310.11 |
| 2360<br>43-89 | 184905 | 4/24/2008 | α 4.23% | α 8.83 |
| | | | β 2.08% | β 8297.19 |

## Contamination Levels:

| | | |
|---|---|---|
| 19.3 | dpm / $100cm^2$ α | **Maximum Fixed** |
| 136.5 | dpm / $100cm^2$ β | |
| 2.0 | dpm / $100cm^2$ α | **Maximum Removable** |
| 16.5 | dpm / $100cm^2$ β | |

**THIS IS TO CERTIFY THAT THE ABOVE DESCRIBED EQUIPMENT OR MATERIALS HAS/HAVE BEEN SURVEYED AND BEEN FOUND TO BE WITHIN ACCEPTABLE SURFACE CONTAMINATION LEVELS FOR UNCONDITIONAL RELEASE AS REQUIRED BY NUCLEAR REGULATORY GUIDE 1.86.**

| | |
|---|---|
| Radiological Control Technician: Richard Kountz | Date: 6/15/2007<br>Time: 1230 |
| Disposition of Equipment or Materials: Free Release. | |
| Reviewed by: Daniel Spicuzza | Date: 6/15/2007<br>1300 |

# SMEAR COUNTING ANALYSIS REPORT

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DATE: | 6/15/2007 | NWTS# N/A | | ANALYSIS PERFORMED BY: | | Richard Kountz | |
| COUNTING SYSTEM DATA | | | | | | | |
| INSTRUMENT I.D.: | | α 185291 | β 185291 | DETECTOR I.D.: | α 194723 | β 194723 | |
| MODEL NUMBER: | | α 2929 | β 2929 | MODEL NUMBER: | α 43–10–1 | β 43–10–1 | |
| EFFICIENCIES: α: | | 0.558 | | MDA: α: | 19.3 | dpm | Cal DueDate: 10/16/2007 |
| βγ: | | 0.444 | | βγ: | 151.1 | dpm | |
| SMEARS COLLECTED BY: | | Richard Kountz | | SURFACE EFFICIENCY FACTOR (α): 0.25 | | | |
| | | | | SURFACE EFFICIENCY FACTOR (β): 0.25 | | | |
| SAMPLE COUNT TIME: | | | 3 Minute | ACTIVITY REPORT IN: | dpm/100 $cm^2$ | | |
| α BACKGROUND: | | 0.4 | CPM | βγ BACKGROUND: | 34.5 | CPM | |

| SAMPLE I.D./DESCRIPTION | | GROSS COUNTS α | GROSS COUNTS βγ | NET CPM α | NET CPM βγ | NET ACTIVITY in dpm/100$cm^2$ α | NET ACTIVITY in dpm/100$cm^2$ βγ |
|---|---|---|---|---|---|---|---|
| 1 | | 1 | 94 | -0.1 | -3.2 | -0.5 | -28.5 |
| 2 | | 0 | 90 | -0.4 | -4.5 | -2.9 | -40.5 |
| 3 | | 2 | 101 | 0.3 | -0.8 | 1.9 | -7.5 |
| 4 | | 1 | 109 | -0.1 | 1.8 | -0.5 | 16.5 |
| 5 | | 0 | 99 | -0.4 | -1.5 | -2.9 | -13.5 |
| 6 | | 1 | 102 | -0.1 | -0.5 | -0.5 | -4.5 |
| 7 | | 1 | 96 | -0.1 | -2.5 | -0.5 | -22.5 |
| 8 | | 0 | 98 | -0.4 | -1.8 | -2.9 | -16.5 |
| 9 | | 1 | 104 | -0.1 | 0.2 | -0.5 | 1.5 |
| 10 | | 1 | 101 | -0.1 | -0.8 | -0.5 | -7.5 |
| Remarks: Excavator Incoming Survey | | | | | **Average:** | **-1.0** | **-12.3** |
| | | | | | **Maximum:** | **1.9** | **16.5** |

| | | | |
|---|---|---|---|
| Reviewed by: | Daniel Spicuzza | Date: | 6/15/2007 |

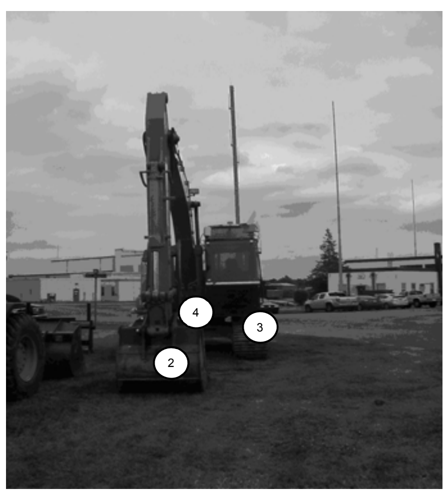
# RADIATION/CONTAMINATION SURVEY FORM



| DATE: 6/16/2007 TIME: 10:30 | INSTRUMENTATION USED | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Model Inst/Det.** | **Serial Number** | **Calibration Due Date** | **Instrument % Efficiency** | **Total % Efficiency** | **MDC/MDA + (dpm/100cm²)** | **Background + (dpm/100cm²)** |
| | 2360 | 184905 | 4/24/2008 | α 16.90% | α 4.23% | α 70.52 | α 8.83 |
| SURVEY NUMBER: N/A | 43-89 | 194989 | | βγ 8.30% | βγ 2.08% | βγ 1909.66 | βγ 8297.19 |
| | 2929 | 185291 | 10/16/2007 | α 54.50% | α 13.63% | α 18.13 | α 2.20 |
| LOCATION: Dahlgren Building 200 | | | | βγ 44.50% | βγ 11.13% | βγ 149.29 | βγ 303.82 |
| SURVEYOR: Richard Kountz | | | | | | | |
| Reviewed By: Dan Spicuzza | | | | | | | |
| Isotopes of Concern: $^{238}U$ | Static Count Time: 2 Minutes | | | | | | |

Description of drawing: Excavator






**Comments:**

All LAW's were ≤ background α β

All accessible areas were 100% alpha-beta scan surveyed. No detectable activity over background was noted.

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

| | |
|---|---|
| (#) | denotes swipe location and fixed α/β readings |
| # | denotes G/A radiation readings |
| # / # | denotes contact / 1 meter radiation readings. |
| * | denotes highest radiation reading on contact |
| LAW | denotes large area masslinn wipe |
| Δ | denotes static location. |
| + | Unless Otherwise Noted |
| | All readings in µr/hr unless otherwise noted |
| | K = 1000 |

## RADIATION/CONTAMINATION SURVEY SUPPLEMENT



SURVEY NUMBER: N/A

SURVEYOR: Richard Kountz | LOCATION: Dahlgren Building 200

| Location | Exposure Rate (μR/hr) | | Fixed + Removable (NET) | | | Removable (NET) | | Comments |
|---|---|---|---|---|---|---|---|---|
| | Contact | 1 Meter | Gamma (cpm) | Alpha dpm/100cm$^2$ | Beta/Gamma dpm/100cm$^2$ | Alpha dpm/100cm$^2$ | Beta/Gamma dpm/100cm$^2$ | |
| 1 | | | | 10.0 | 366.0 | 2.7 | 4.8 | |
| 2 | | | | -8.8 | 174.8 | -2.2 | -7.2 | |
| 3 | | | | 28.7 | -16.4 | -2.2 | -28.2 | |
| 4 | | | | 0.6 | -475.4 | 2.7 | -37.2 | |
| 5 | | | | 10.0 | -418.1 | 5.1 | -31.2 | |
| 6 | | | | 19.3 | -475.4 | -2.2 | -25.2 | |
| 7 | | | | 19.3 | -609.3 | -2.2 | -40.1 | |
| 8 | | | | -8.8 | -666.7 | -2.2 | -1.2 | |
| 9 | | | | -8.8 | -245.9 | 0.2 | -28.2 | |
| 10 | | | | 10.0 | -494.5 | 2.7 | 31.8 | |
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| Reviewer<br>Daniel Spicuzza | Date: 6/16/2007<br>Time: 1200 | |

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# UNCONDITIONAL RELEASE OF EQUIPMENT OR MATERIALS FORM

| | |
|---|---|
| Survey # N/A | Date : 6/16/2007 |
| Project Location : Dahlgren Building 200 | |
| Description of Equipment or Materials: Excavator | |

## Survey Equipment:

| Model # | Serial # | Cal Due Date | Efficiency | Background |
|---|---|---|---|---|
| 2929 | 185291 | 10/16/2007 | α 13.63% | α 2.20 |
| | | | β 11.13% | β 303.82 |
| 2360<br>43-89 | 184905 | 4/24/2008 | α 4.23% | α 8.83 |
| | | | β 2.08% | β 8297.19 |

## Contamination Levels:

| | | | |
|---|---|---|---|
| 28.7 | dpm / 100cm$^2$ | α | **Maximum Fixed** |
| 366.0 | dpm / 100cm$^2$ | β | |
| 5.1 | dpm / 100cm$^2$ | α | **Maximum Removable** |
| 31.8 | dpm / 100cm$^2$ | β | |

**THIS IS TO CERTIFY THAT THE ABOVE DESCRIBED EQUIPMENT OR MATERIALS HAS/HAVE BEEN SURVEYED AND BEEN FOUND TO BE WITHIN ACCEPTABLE SURFACE CONTAMINATION LEVELS FOR UNCONDITIONAL RELEASE AS REQUIRED BY NUCLEAR REGULATORY GUIDE 1.86.**

| | |
|---|---|
| Radiological Control Technician: Richard Kountz | Date: 6/16/2007<br>Time: 1030 |
| Disposition of Equipment or Materials: Free Release. | |
| Reviewed by: Daniel Spicuzza | Date: 6/16/2007<br>1200 |

SMEAR COUNTING ANALYSIS REPORT

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DATE: | 6/16/2007 | NWTS# N/A | | ANALYSIS PERFORMED BY: | | Richard Kountz | |
| COUNTING SYSTEM DATA | | | | | | | |
| INSTRUMENT I.D.: | | α 185291 | β 185291 | DETECTOR I.D.: | | α 194723 | β 194723 |
| MODEL NUMBER: | | α 2929 | β 2929 | MODEL NUMBER: | | α 43–10–1 | β 43–10–1 |
| EFFICIENCIES: α: | | 0.558 | | MDA: α: | 17.7 | dpm | Cal DueDate: 10/16/2007 |
| βγ: | | 0.444 | | βγ: | 149.6 | dpm | |
| SMEARS COLLECTED BY: | | Richard Kountz | | SURFACE EFFICIENCY FACTOR (α): 0.25 | | | |
| | | | | SURFACE EFFICIENCY FACTOR (β): 0.25 | | | |
| SAMPLE COUNT TIME: | | | 3 Minute | ACTIVITY REPORT IN: | dpm/100 $cm^2$ | | |
| α BACKGROUND: | | 0.3 | CPM | βγ BACKGROUND: | 33.8 | CPM | |

| SAMPLE I.D./DESCRIPTION | GROSS COUNTS α | GROSS COUNTS βγ | NET CPM α | NET CPM βγ | NET ACTIVITY in dpm/100$cm^2$ α | NET ACTIVITY in dpm/100$cm^2$ βγ |
|---|---|---|---|---|---|---|
| 1 | 2 | 103 | 0.4 | 0.5 | 2.6 | 4.8 |
| 2 | 0 | 99 | -0.3 | -0.8 | -2.2 | -7.2 |
| 3 | 0 | 92 | -0.3 | -3.1 | -2.2 | -28.2 |
| 4 | 2 | 89 | 0.4 | -4.1 | 2.6 | -37.2 |
| 5 | 3 | 91 | 0.7 | -3.5 | 5.0 | -31.2 |
| 6 | 0 | 93 | -0.3 | -2.8 | -2.2 | -25.2 |
| 7 | 0 | 88 | -0.3 | -4.5 | -2.2 | -40.2 |
| 8 | 0 | 101 | -0.3 | -0.1 | -2.2 | -1.2 |
| 9 | 1 | 92 | 0.0 | -3.1 | 0.2 | -28.2 |
| 10 | 2 | 112 | 0.4 | 3.5 | 2.6 | 31.8 |
| | | | | **Average:** | **0.2** | **-16.2** |
| | | | | **Maximum:** | **5.0** | **31.8** |

Remarks: Excavator Release Survey

Reviewed by: Daniel Spicuzza Date: 6/16/2007

# RADIATION/CONTAMINATION SURVEY FORM



| DATE: 6/15/2007 TIME: 13:00 | INSTRUMENTATION USED | | | | | | |
|---|---|---|---|---|---|---|---|
| | Model Inst/Det. | Serial Number | Calibration Due Date | Instrument % Efficiency | Total % Efficiency | MDC/MDA + (dpm/100cm$^2$) | Background + (dpm/100cm$^2$) |
| SURVEY NUMBER: N/A | 2360<br>43-89 | 184905<br>194989 | 4/24/2008 | α 16.90%<br>βγ 8.30% | α 4.23%<br>βγ 2.08% | α 70.52<br>βγ 1909.66 | α 8.83<br>βγ 8297.19 |
| LOCATION: Dahlgren Building 200 | 2929 | 185291 | 10/16/2007 | α 54.50%<br>βγ 44.50% | α 13.63%<br>βγ 11.13% | α 19.80<br>βγ 150.73 | α 2.94<br>βγ 310.11 |
| SURVEYOR: Alan Campellone, Anthony Smith | | | | | | | |
| Reviewed By: Dan Spicuzza | | | | | | | |
| Isotopes of Concern: $^{238}$U | Static Count Time: 2 Minutes | | | | | | |

Description of drawing: Front End Loader



**Comments:**

All LAW's were ≤ background α β

All accessible areas were 100% alpha-beta scan surveyed. No detectable activity over background was noted.

Routine (Daily / Weekly / Monthly) [ ] Non-routine [X]

| | |
|---|---|
| (#) | denotes swipe location and fixed α/β readings |
| # | denotes G/A radiation readings |
| # / # | denotes contact / 1 meter radiation readings. |
| * | denotes highest radiation reading on contact |
| LAW | denotes large area masslinn wipe |
| Δ | denotes static location. |
| + | Unless Otherwise Noted |
| | All readings in μr/hr unless otherwise noted |
| | K = 1000 |

SURVEY NUMBER: N/A

SURVEYOR: Alan Campellone, Anthony Smith | LOCATION: Dahlgren Building 200

| Location | Exposure Rate (μR/hr) | | Fixed + Removable (NET) | | | Removable (NET) | | Comments |
|---|---|---|---|---|---|---|---|---|
| | Contact | 1 Meter | Gamma (cpm) | Alpha dpm/100cm$^2$ | Beta/Gamma dpm/100cm$^2$ | Alpha dpm/100cm$^2$ | Beta/Gamma dpm/100cm$^2$ | |
| 1 | | | | 0.6 | 40.9 | -2.9 | 16.5 | |
| 2 | | | | -8.8 | 270.4 | -0.5 | -13.5 | |
| 3 | | | | 0.6 | 79.2 | -0.5 | 28.5 | |
| 4 | | | | -8.8 | -16.4 | -2.9 | 1.5 | |
| 5 | | | | 0.6 | -150.3 | -0.5 | 1.5 | |
| 6 | | | | 10.0 | 213.0 | -2.9 | -13.5 | |
| 7 | | | | 10.0 | 251.3 | -2.9 | 4.5 | |
| 8 | | | | 0.6 | 79.2 | -0.5 | 43.4 | |
| 9 | | | | -8.8 | 136.5 | -2.9 | 10.5 | |
| 10 | | | | 0.6 | 79.2 | -0.5 | 4.5 | |
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| Reviewer | Date: 6/15/2007 | |
|---|---|---|
| Daniel Spicuzza | Time: 1400 | |

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# UNCONDITIONAL RELEASE OF EQUIPMENT OR MATERIALS FORM

| | |
|---|---|
| Survey # N/A | Date : 6/15/2007 |
| Project Location : Dahlgren Building 200 | |
| Description of Equipment or Materials: Front End Loader | |

## Survey Equipment:

| Model # | Serial # | Cal Due Date | Efficiency | Background |
|---|---|---|---|---|
| 2929 | 185291 | 10/16/2007 | α 13.63% | α 2.94 |
| | | | β 11.13% | β 310.11 |
| 2360<br>43-89 | 184905 | 4/24/2008 | α 4.23% | α 8.83 |
| | | | β 2.08% | β 8297.19 |

## Contamination Levels:

| | | |
|---|---|---|
| 10.0 | dpm / $100cm^2$ α | **Maximum Fixed** |
| 270.4 | dpm / $100cm^2$ β | |
| -0.5 | dpm / $100cm^2$ α | **Maximum Removable** |
| 43.4 | dpm / $100cm^2$ β | |

**THIS IS TO CERTIFY THAT THE ABOVE DESCRIBED EQUIPMENT OR MATERIALS HAS/HAVE BEEN SURVEYED AND BEEN FOUND TO BE WITHIN ACCEPTABLE SURFACE CONTAMINATION LEVELS FOR UNCONDITIONAL RELEASE AS REQUIRED BY NUCLEAR REGULATORY GUIDE 1.86.**

| | |
|---|---|
| Radiological Control Technician: Alan Campellone, Anthony Smith | Date: 6/15/2007<br>Time: 1300 |
| Disposition of Equipment or Materials: Free Release. | |
| Reviewed by: Daniel Spicuzza | Date: 6/15/2007<br>1400 |

SMEAR COUNTING ANALYSIS REPORT

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| DATE: | 6/15/2007 | NWTS# N/A | | ANALYSIS PERFORMED BY: | | | Richard Kountz | | |
| COUNTING SYSTEM DATA | | | | | | | | | |
| INSTRUMENT I.D.: | | α 185291 | β 185291 | DETECTOR I.D.: | | α 194723 | β 194723 | | |
| MODEL NUMBER: | | α 2929 | β 2929 | MODEL NUMBER: | | α 43–10–1 | β 43–10–1 | | |
| EFFICIENCIES: α: | | 0.558 | | MDA: α: | 19.3 | dpm | Cal DueDate: | 10/16/2007 | |
| βγ: | | 0.444 | | βγ: | 151.1 | dpm | | | |
| SMEARS COLLECTED BY: | | Richard Kountz | | SURFACE EFFICIENCY FACTOR (α): | | | 0.25 | | |
| | | | | SURFACE EFFICIENCY FACTOR (β): | | | 0.25 | | |
| SAMPLE COUNT TIME: | | | 3 Minute | ACTIVITY REPORT IN: | dpm/100 $cm^2$ | | | | |
| α BACKGROUND: | | 0.4 | CPM | βγ BACKGROUND: | | 34.5 | CPM | | |

| SAMPLE I.D./DESCRIPTION | | GROSS COUNTS α | GROSS COUNTS βγ | NET CPM α | NET CPM βγ | NET ACTIVITY in dpm/100$cm^2$ α | NET ACTIVITY in dpm/100$cm^2$ βγ |
|---|---|---|---|---|---|---|---|
| 1 | | 0 | 109 | -0.4 | 1.8 | -2.9 | 16.5 |
| 2 | | 1 | 99 | -0.1 | -1.5 | -0.5 | -13.5 |
| 3 | | 1 | 113 | -0.1 | 3.2 | -0.5 | 28.5 |
| 4 | | 0 | 104 | -0.4 | 0.2 | -2.9 | 1.5 |
| 5 | | 1 | 104 | -0.1 | 0.2 | -0.5 | 1.5 |
| 6 | | 0 | 99 | -0.4 | -1.5 | -2.9 | -13.5 |
| 7 | | 0 | 105 | -0.4 | 0.5 | -2.9 | 4.5 |
| 8 | | 1 | 118 | -0.1 | 4.8 | -0.5 | 43.5 |
| 9 | | 0 | 107 | -0.4 | 1.2 | -2.9 | 10.5 |
| 10 | | 1 | 105 | -0.1 | 0.5 | -0.5 | 4.5 |
| Remarks: Front End Loader Incoming Survey | | | | | **Average:** | **-1.7** | **8.4** |
| | | | | | **Maximum:** | **-0.5** | **43.5** |

Reviewed by: Daniel Spicuzza Date: 6/15/2007

| | INSTRUMENTATION USED | | | | | | |
|---|---|---|---|---|---|---|---|
| DATE: 6/16/2007 TIME: 11:45 | Model Inst/Det. | Serial Number | Calibration Due Date | Instrument % Efficiency | Total % Efficiency | MDC/MDA + (dpm/100cm²) | Background + (dpm/100cm²) |
| | 2360 | 184905 | 4/24/2008 | α 16.90% | α 4.23% | α 70.52 | α 8.83 |
| SURVEY NUMBER: N/A | 43-89 | 194989 | | βγ 8.30% | βγ 2.08% | βγ 1909.66 | βγ 8297.19 |
| | 2929 | 185291 | 10/16/2007 | α 54.50% | α 13.63% | α 18.13 | α 2.20 |
| LOCATION: Dahlgren Building 200 | | | | βγ 44.50% | βγ 11.13% | βγ 149.29 | βγ 303.82 |
| SURVEYOR: Alan Campellone, Anthony Smith | | | | | | | |
| Reviewed By: Dan Spicuzza | | | | | | | |
| Isotopes of Concern: $^{238}U$ | Static Count Time: 2 Minutes | | | | | | |

Description of drawing: Front End Loader



**Comments:**

All LAW's were ≤ background α β

All accessible areas were 100% alpha-beta scan surveyed. No detectable activity over background was noted.

Routine (Daily / Weekly / Monthly) [ ] Non-routine [X]

(#) denotes swipe location and fixed α/β readings
# denotes G/A radiation readings
# / # denotes contact / 1 meter radiation readings.
* denotes highest radiation reading on contact
LAW denotes large area masslinn wipe
Δ denotes static location.
+ Unless Otherwise Noted
All readings in μr/hr unless otherwise noted
K = 1000

**RADIATION/CONTAMINATION SURVEY SUPPLEMENT** **Page 2 of 2**

SURVEY NUMBER: N/A

SURVEYOR: Alan Campellone, Anthony Smith | LOCATION: Dahlgren Building 200

| Location | Exposure Rate (μR/hr) | | Fixed + Removable (NET) | | | Removable (NET) | | Comments |
|---|---|---|---|---|---|---|---|---|
| | Contact | 1 Meter | Gamma (cpm) | Alpha dpm/100cm$^2$ | Beta/Gamma dpm/100cm$^2$ | Alpha dpm/100cm$^2$ | Beta/Gamma dpm/100cm$^2$ | |
| 1 | | | | 10.0 | 327.8 | 0.2 | 4.8 | |
| 2 | | | | 10.0 | 98.3 | -2.2 | -16.2 | |
| 3 | | | | 0.6 | -112.1 | -2.2 | 31.8 | |
| 4 | | | | 10.0 | 174.8 | 2.7 | 13.8 | |
| 5 | | | | -8.8 | 327.8 | 0.2 | -7.2 | |
| 6 | | | | 10.0 | -112.1 | -2.2 | 22.8 | |
| 7 | | | | 10.0 | 2.7 | 0.2 | 7.8 | |
| 8 | | | | 10.0 | 136.5 | -2.2 | 37.8 | |
| 9 | | | | -8.8 | 98.3 | -2.2 | 13.8 | |
| 10 | | | | 0.6 | 117.4 | 0.2 | 1.8 | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |
| 13 | | | | | | | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | |
| 16 | | | | | | | | |
| 17 | | | | | | | | |
| 18 | | | | | | | | |
| 19 | | | | | | | | |
| 20 | | | | | | | | |
| 21 | | | | | | | | |
| 22 | | | | | | | | |
| 23 | | | | | | | | |
| 24 | | | | | | | | |
| 25 | | | | | | | | |
| 26 | | | | | | | | |
| 27 | | | | | | | | |
| 28 | | | | | | | | |
| 29 | | | | | | | | |
| 30 | | | | | | | | |
| 31 | | | | | | | | |
| 32 | | | | | | | | |
| Blank | | | | | | | | |

| Reviewer Daniel Spicuzza | Date: 6/16/2007 | |
|---|---|---|
| | Time: 1300 | |

THIS AREA INTENTIONALLY LEFT BLANK

# UNCONDITIONAL RELEASE OF EQUIPMENT OR MATERIALS FORM

| | |
|---|---|
| Survey # N/A | Date : 6/16/2007 |
| Project Location : Dahlgren Building 200 | |
| Description of Equipment or Materials: Front End Loader | |

## Survey Equipment:

| Model # | Serial # | Cal Due Date | Efficiency | Background |
|---|---|---|---|---|
| 2929 | 185291 | 10/16/2007 | α 13.63% | α 2.20 |
| | | | β 11.13% | β 303.82 |
| 2360<br>43-89 | 184905 | 4/24/2008 | α 4.23% | α 8.83 |
| | | | β 2.08% | β 8297.19 |

## Contamination Levels:

| | | | |
|---|---|---|---|
| 10.0 | dpm / 100cm$^2$ | α | **Maximum Fixed** |
| 327.8 | dpm / 100cm$^2$ | β | |
| 2.7 | dpm / 100cm$^2$ | α | **Maximum Removable** |
| 37.8 | dpm / 100cm$^2$ | β | |

**THIS IS TO CERTIFY THAT THE ABOVE DESCRIBED EQUIPMENT OR MATERIALS HAS/HAVE BEEN SURVEYED AND BEEN FOUND TO BE WITHIN ACCEPTABLE SURFACE CONTAMINATION LEVELS FOR UNCONDITIONAL RELEASE AS REQUIRED BY NUCLEAR REGULATORY GUIDE 1.86.**

| | |
|---|---|
| Radiological Control Technician: Alan Campellone, Anthony Smith | Date: 6/16/2007<br>Time: 1145 |
| Disposition of Equipment or Materials: Free Release. | |
| Reviewed by: Daniel Spicuzza | Date: 6/16/2007<br>1300 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DATE: | 6/16/2007 | NWTS# N/A | | ANALYSIS PERFORMED BY: | | Richard Kountz | |
| COUNTING SYSTEM DATA | | | | | | | |
| INSTRUMENT I.D.: | | α 185291 | β 185291 | DETECTOR I.D.: | α 194723 | β 194723 | |
| MODEL NUMBER: | | α 2929 | β 2929 | MODEL NUMBER: | α 43–10–1 | β 43–10–1 | |
| EFFICIENCIES: α: | | 0.558 | | MDA: α: | 17.7 dpm | Cal DueDate: | 10/16/2007 |
| βγ: | | 0.444 | | βγ: | 149.6 dpm | | |
| SMEARS COLLECTED BY: | | Richard Kountz | | SURFACE EFFICIENCY FACTOR (α): 0.25 | | | |
| | | | | SURFACE EFFICIENCY FACTOR (β): 0.25 | | | |
| SAMPLE COUNT TIME: | | | 3 Minute | ACTIVITY REPORT IN: | dpm/100 $cm^2$ | | |
| α BACKGROUND: | | 0.3 | CPM | βγ BACKGROUND: | 33.8 | CPM | |

| SAMPLE I.D./DESCRIPTION | GROSS COUNTS α | GROSS COUNTS βγ | NET CPM α | NET CPM βγ | NET ACTIVITY in dpm/100$cm^2$ α | NET ACTIVITY in dpm/100$cm^2$ βγ |
|---|---|---|---|---|---|---|
| 1 | 1 | 103 | 0.0 | 0.5 | 0.2 | 4.8 |
| 2 | 0 | 96 | -0.3 | -1.8 | -2.2 | -16.2 |
| 3 | 0 | 112 | -0.3 | 3.5 | -2.2 | 31.8 |
| 4 | 2 | 106 | 0.4 | 1.5 | 2.6 | 13.8 |
| 5 | 1 | 99 | 0.0 | -0.8 | 0.2 | -7.2 |
| 6 | 0 | 109 | -0.3 | 2.5 | -2.2 | 22.8 |
| 7 | 1 | 104 | 0.0 | 0.9 | 0.2 | 7.8 |
| 8 | 0 | 114 | -0.3 | 4.2 | -2.2 | 37.8 |
| 9 | 0 | 106 | -0.3 | 1.5 | -2.2 | 13.8 |
| 10 | 1 | 102 | 0.0 | 0.2 | 0.2 | 1.8 |
| | | | | **Average:** | **-0.7** | **11.1** |
| | | | | **Maximum:** | **2.6** | **37.8** |

Remarks: Front End Loader Outgoing Survey

Reviewed by: Daniel Spicuzza Date: 6/16/2007

# Appendix H

# Area A Gamma Scan Survey Data

Meter Model #: 2350-1
Meter S/N: 232920
Probe S/N: 242823
Cal Due Date: 2/22/08
Surveyed By:Anthony Smith

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 1 | 6 | 16 | 7 | 13 | 24 | 5140 |
| 2 | 6 | 16 | 7 | 13 | 24 | 5614 |
| 3 | 6 | 16 | 7 | 13 | 24 | 6017 |
| 4 | 6 | 16 | 7 | 13 | 24 | 6426 |
| 5 | 6 | 16 | 7 | 13 | 25 | 6761 |
| 6 | 6 | 16 | 7 | 13 | 25 | 7679 |
| 7 | 6 | 16 | 7 | 13 | 25 | 6100 |
| 8 | 6 | 16 | 7 | 13 | 25 | 6777 |
| 9 | 6 | 16 | 7 | 13 | 25 | 6271 |
| 10 | 6 | 16 | 7 | 13 | 25 | 7056 |
| 11 | 6 | 16 | 7 | 13 | 25 | 5732 |
| 12 | 6 | 16 | 7 | 13 | 25 | 7456 |
| 13 | 6 | 16 | 7 | 13 | 25 | 7295 |
| 14 | 6 | 16 | 7 | 13 | 26 | 5605 |
| 15 | 6 | 16 | 7 | 13 | 26 | 5770 |
| 16 | 6 | 16 | 7 | 13 | 26 | 5741 |
| 17 | 6 | 16 | 7 | 13 | 26 | 7042 |
| 18 | 6 | 16 | 7 | 13 | 26 | 8258 |
| 19 | 6 | 16 | 7 | 13 | 26 | 6721 |
| 20 | 6 | 16 | 7 | 13 | 26 | 7281 |
| 21 | 6 | 16 | 7 | 13 | 26 | 7603 |
| 22 | 6 | 16 | 7 | 13 | 27 | 7678 |
| 23 | 6 | 16 | 7 | 13 | 27 | 7909 |
| 24 | 6 | 16 | 7 | 13 | 27 | 6538 |
| 25 | 6 | 16 | 7 | 13 | 27 | 5765 |
| 26 | 6 | 16 | 7 | 13 | 27 | 6934 |
| 27 | 6 | 16 | 7 | 13 | 27 | 6311 |
| 28 | 6 | 16 | 7 | 13 | 27 | 5757 |
| 29 | 6 | 16 | 7 | 13 | 27 | 5331 |
| 30 | 6 | 16 | 7 | 13 | 27 | 5850 |
| 31 | 6 | 16 | 7 | 13 | 28 | 5222 |
| 32 | 6 | 16 | 7 | 13 | 28 | 5596 |
| 33 | 6 | 16 | 7 | 13 | 28 | 5759 |
| 34 | 6 | 16 | 7 | 13 | 28 | 6002 |
| 35 | 6 | 16 | 7 | 13 | 28 | 6394 |
| 36 | 6 | 16 | 7 | 13 | 28 | 7776 |
| 37 | 6 | 16 | 7 | 13 | 28 | 7809 |
| 38 | 6 | 16 | 7 | 13 | 28 | 6004 |
| 39 | 6 | 16 | 7 | 13 | 29 | 7014 |
| 40 | 6 | 16 | 7 | 13 | 29 | 8078 |
| 41 | 6 | 16 | 7 | 13 | 29 | 7837 |
| 42 | 6 | 16 | 7 | 13 | 29 | 7508 |
| 43 | 6 | 16 | 7 | 13 | 29 | 7203 |
| 44 | 6 | 16 | 7 | 13 | 29 | 8364 |
| 45 | 6 | 16 | 7 | 13 | 29 | 6542 |
| 46 | 6 | 16 | 7 | 13 | 29 | 7239 |
| 47 | 6 | 16 | 7 | 13 | 29 | 8315 |
| 48 | 6 | 16 | 7 | 13 | 30 | 6794 |
| 49 | 6 | 16 | 7 | 13 | 30 | 7559 |
| 50 | 6 | 16 | 7 | 13 | 30 | 7799 |
| 51 | 6 | 16 | 7 | 13 | 30 | 7563 |
| 52 | 6 | 16 | 7 | 13 | 30 | 8179 |
| 53 | 6 | 16 | 7 | 13 | 30 | 7120 |
| 54 | 6 | 16 | 7 | 13 | 30 | 8059 |
| 55 | 6 | 16 | 7 | 13 | 30 | 7384 |
| 56 | 6 | 16 | 7 | 13 | 30 | 6213 |
| 57 | 6 | 16 | 7 | 13 | 31 | 6658 |
| 58 | 6 | 16 | 7 | 13 | 31 | 6680 |
| 59 | 6 | 16 | 7 | 13 | 31 | 7361 |
| 60 | 6 | 16 | 7 | 13 | 31 | 6753 |
| 61 | 6 | 16 | 7 | 13 | 31 | 6406 |
| 62 | 6 | 16 | 7 | 13 | 31 | 8081 |
| 63 | 6 | 16 | 7 | 13 | 31 | 7016 |
| 64 | 6 | 16 | 7 | 13 | 31 | 7507 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 65 | 6 | 16 | 7 | 13 | 32 | 6509 |
| 66 | 6 | 16 | 7 | 13 | 32 | 7410 |
| 67 | 6 | 16 | 7 | 13 | 32 | 8416 |
| 68 | 6 | 16 | 7 | 13 | 32 | 7497 |
| 69 | 6 | 16 | 7 | 13 | 32 | 6743 |
| 70 | 6 | 16 | 7 | 13 | 32 | 7046 |
| 71 | 6 | 16 | 7 | 13 | 32 | 7703 |
| 72 | 6 | 16 | 7 | 13 | 32 | 5161 |
| 73 | 6 | 16 | 7 | 13 | 32 | 7609 |
| 74 | 6 | 16 | 7 | 13 | 33 | 7718 |
| 75 | 6 | 16 | 7 | 13 | 33 | 8171 |
| 76 | 6 | 16 | 7 | 13 | 33 | 7879 |
| 77 | 6 | 16 | 7 | 13 | 33 | 8736 |
| 78 | 6 | 16 | 7 | 13 | 33 | 7416 |
| 79 | 6 | 16 | 7 | 13 | 33 | 8362 |
| 80 | 6 | 16 | 7 | 13 | 33 | 7621 |
| 81 | 6 | 16 | 7 | 13 | 33 | 8538 |
| 82 | 6 | 16 | 7 | 13 | 34 | 7708 |
| 83 | 6 | 16 | 7 | 13 | 34 | 7242 |
| 84 | 6 | 16 | 7 | 13 | 34 | 8354 |
| 85 | 6 | 16 | 7 | 13 | 35 | 5256 |
| 86 | 6 | 16 | 7 | 13 | 35 | 7832 |
| 87 | 6 | 16 | 7 | 13 | 35 | 7392 |
| 88 | 6 | 16 | 7 | 13 | 35 | 7232 |
| 89 | 6 | 16 | 7 | 13 | 35 | 6168 |
| 90 | 6 | 16 | 7 | 13 | 35 | 7545 |
| 91 | 6 | 16 | 7 | 13 | 35 | 7643 |
| 92 | 6 | 16 | 7 | 13 | 35 | 6945 |
| 93 | 6 | 16 | 7 | 13 | 36 | 8827 |
| 94 | 6 | 16 | 7 | 13 | 36 | 7082 |
| 95 | 6 | 16 | 7 | 13 | 36 | 7302 |
| 96 | 6 | 16 | 7 | 13 | 36 | 7422 |
| 97 | 6 | 16 | 7 | 13 | 36 | 7066 |
| 98 | 6 | 16 | 7 | 13 | 36 | 6976 |
| 99 | 6 | 16 | 7 | 13 | 36 | 6130 |
| 100 | 6 | 16 | 7 | 13 | 36 | 7693 |
| 101 | 6 | 16 | 7 | 13 | 36 | 6662 |
| 102 | 6 | 16 | 7 | 13 | 37 | 6886 |
| 103 | 6 | 16 | 7 | 13 | 37 | 6564 |
| 104 | 6 | 16 | 7 | 13 | 37 | 5898 |
| 105 | 6 | 16 | 7 | 13 | 38 | 6401 |
| 106 | 6 | 16 | 7 | 13 | 38 | 5144 |
| 107 | 6 | 16 | 7 | 13 | 38 | 5776 |
| 108 | 6 | 16 | 7 | 13 | 38 | 5998 |
| 109 | 6 | 16 | 7 | 13 | 38 | 5740 |
| 110 | 6 | 16 | 7 | 13 | 38 | 5662 |
| 111 | 6 | 16 | 7 | 13 | 39 | 5353 |
| 112 | 6 | 16 | 7 | 13 | 39 | 5164 |
| 113 | 6 | 16 | 7 | 13 | 39 | 5839 |
| 114 | 6 | 16 | 7 | 13 | 39 | 6168 |
| 115 | 6 | 16 | 7 | 13 | 39 | 5488 |
| 116 | 6 | 16 | 7 | 13 | 39 | 5765 |
| 117 | 6 | 16 | 7 | 13 | 39 | 5765 |
| 118 | 6 | 16 | 7 | 13 | 39 | 5678 |
| 119 | 6 | 16 | 7 | 13 | 39 | 5909 |
| 120 | 6 | 16 | 7 | 13 | 40 | 5885 |
| 121 | 6 | 16 | 7 | 13 | 40 | 6898 |
| 122 | 6 | 16 | 7 | 13 | 40 | 5500 |
| 123 | 6 | 16 | 7 | 13 | 40 | 6492 |
| 124 | 6 | 16 | 7 | 13 | 40 | 5579 |
| 125 | 6 | 16 | 7 | 13 | 40 | 5807 |
| 126 | 6 | 16 | 7 | 13 | 40 | 6179 |
| 127 | 6 | 16 | 7 | 13 | 40 | 5567 |
| 128 | 6 | 16 | 7 | 13 | 40 | 5716 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 129 | 6 | 16 | 7 | 13 | 41 | 5406 |
| 130 | 6 | 16 | 7 | 13 | 41 | 5374 |
| 131 | 6 | 16 | 7 | 13 | 41 | 5177 |
| 132 | 6 | 16 | 7 | 13 | 41 | 5670 |
| 133 | 6 | 16 | 7 | 13 | 41 | 5843 |
| 134 | 6 | 16 | 7 | 13 | 41 | 5372 |
| 135 | 6 | 16 | 7 | 13 | 41 | 5356 |
| 136 | 6 | 16 | 7 | 13 | 41 | 5311 |
| 137 | 6 | 16 | 7 | 13 | 42 | 5276 |
| 138 | 6 | 16 | 7 | 13 | 42 | 5098 |
| 139 | 6 | 16 | 7 | 13 | 43 | 5820 |
| 140 | 6 | 16 | 7 | 13 | 43 | 5636 |
| 141 | 6 | 16 | 7 | 13 | 43 | 6503 |
| 142 | 6 | 16 | 7 | 13 | 43 | 5880 |
| 143 | 6 | 16 | 7 | 13 | 43 | 5032 |
| 144 | 6 | 16 | 7 | 13 | 43 | 5597 |
| 145 | 6 | 16 | 7 | 13 | 43 | 5472 |
| 146 | 6 | 16 | 7 | 13 | 44 | 5092 |
| 147 | 6 | 16 | 7 | 13 | 44 | 5396 |
| 148 | 6 | 16 | 7 | 13 | 44 | 5872 |
| 149 | 6 | 16 | 7 | 13 | 44 | 5410 |
| 150 | 6 | 16 | 7 | 13 | 44 | 5516 |
| 151 | 6 | 16 | 7 | 13 | 44 | 6116 |
| 152 | 6 | 16 | 7 | 13 | 44 | 5774 |
| 153 | 6 | 16 | 7 | 13 | 44 | 5408 |
| 154 | 6 | 16 | 7 | 13 | 44 | 5632 |
| 155 | 6 | 16 | 7 | 13 | 45 | 6359 |
| 156 | 6 | 16 | 7 | 13 | 45 | 5124 |
| 157 | 6 | 16 | 7 | 13 | 45 | 4959 |
| 158 | 6 | 16 | 7 | 13 | 45 | 4973 |
| 159 | 6 | 16 | 7 | 13 | 45 | 5476 |
| 160 | 6 | 16 | 7 | 13 | 45 | 5451 |
| 161 | 6 | 16 | 7 | 13 | 45 | 5392 |
| 162 | 6 | 16 | 7 | 13 | 45 | 4864 |
| 163 | 6 | 16 | 7 | 13 | 46 | 5123 |
| 164 | 6 | 16 | 7 | 13 | 46 | 5868 |
| 165 | 6 | 16 | 7 | 13 | 46 | 5140 |
| 166 | 6 | 16 | 7 | 13 | 46 | 4856 |
| 167 | 6 | 16 | 7 | 13 | 46 | 5482 |
| 168 | 6 | 16 | 7 | 13 | 46 | 5287 |
| 169 | 6 | 16 | 7 | 13 | 46 | 5504 |
| 170 | 6 | 16 | 7 | 13 | 46 | 5350 |
| 171 | 6 | 16 | 7 | 13 | 46 | 4809 |
| 172 | 6 | 16 | 7 | 13 | 47 | 5347 |
| 173 | 6 | 16 | 7 | 13 | 47 | 5351 |
| 174 | 6 | 16 | 7 | 13 | 48 | 7654 |
| 175 | 6 | 16 | 7 | 13 | 48 | 6881 |
| 176 | 6 | 16 | 7 | 13 | 48 | 6785 |
| 177 | 6 | 16 | 7 | 13 | 48 | 6110 |
| 178 | 6 | 16 | 7 | 13 | 48 | 7100 |
| 179 | 6 | 16 | 7 | 13 | 48 | 5787 |
| 180 | 6 | 16 | 7 | 13 | 48 | 5888 |
| 181 | 6 | 16 | 7 | 13 | 48 | 5408 |
| 182 | 6 | 16 | 7 | 13 | 48 | 5280 |
| 183 | 6 | 16 | 7 | 13 | 49 | 5418 |
| 184 | 6 | 16 | 7 | 13 | 49 | 5404 |
| 185 | 6 | 16 | 7 | 13 | 49 | 5452 |
| 186 | 6 | 16 | 7 | 13 | 49 | 5381 |
| 187 | 6 | 16 | 7 | 13 | 49 | 5170 |
| 188 | 6 | 16 | 7 | 13 | 49 | 5591 |
| 189 | 6 | 16 | 7 | 13 | 49 | 5618 |
| 190 | 6 | 16 | 7 | 13 | 49 | 4945 |
| 191 | 6 | 16 | 7 | 13 | 49 | 5652 |
| 192 | 6 | 16 | 7 | 13 | 50 | 5867 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 193 | 6 | 16 | 7 | 13 | 50 | 5426 |
| 194 | 6 | 16 | 7 | 13 | 50 | 5187 |
| 195 | 6 | 16 | 7 | 13 | 50 | 5043 |
| 196 | 6 | 16 | 7 | 13 | 50 | 5063 |
| 197 | 6 | 16 | 7 | 13 | 50 | 5151 |
| 198 | 6 | 16 | 7 | 13 | 50 | 5768 |
| 199 | 6 | 16 | 7 | 13 | 50 | 5292 |
| 200 | 6 | 16 | 7 | 13 | 51 | 5039 |
| 201 | 6 | 16 | 7 | 13 | 51 | 5254 |
| 202 | 6 | 16 | 7 | 13 | 51 | 5579 |
| 203 | 6 | 16 | 7 | 13 | 51 | 5415 |
| 204 | 6 | 16 | 7 | 13 | 51 | 4877 |
| 205 | 6 | 16 | 7 | 13 | 51 | 6365 |
| 206 | 6 | 16 | 7 | 13 | 51 | 4948 |
| 207 | 6 | 16 | 7 | 13 | 51 | 5775 |
| 208 | 6 | 16 | 7 | 13 | 51 | 4890 |
| 209 | 6 | 16 | 7 | 13 | 52 | 5976 |
| 210 | 6 | 16 | 7 | 13 | 53 | 6451 |
| 211 | 6 | 16 | 7 | 13 | 53 | 8198 |
| 212 | 6 | 16 | 7 | 13 | 53 | 5297 |
| 213 | 6 | 16 | 7 | 13 | 53 | 7249 |
| 214 | 6 | 16 | 7 | 13 | 53 | 6210 |
| 215 | 6 | 16 | 7 | 13 | 53 | 5660 |
| 216 | 6 | 16 | 7 | 13 | 54 | 5261 |
| 217 | 6 | 16 | 7 | 13 | 54 | 5696 |
| 218 | 6 | 16 | 7 | 13 | 54 | 6028 |
| 219 | 6 | 16 | 7 | 13 | 54 | 5448 |
| 220 | 6 | 16 | 7 | 13 | 54 | 4964 |
| 221 | 6 | 16 | 7 | 13 | 54 | 5938 |
| 222 | 6 | 16 | 7 | 13 | 54 | 5770 |
| 223 | 6 | 16 | 7 | 13 | 54 | 5739 |
| 224 | 6 | 16 | 7 | 13 | 54 | 5381 |
| 225 | 6 | 16 | 7 | 13 | 55 | 5239 |
| 226 | 6 | 16 | 7 | 13 | 55 | 5138 |
| 227 | 6 | 16 | 7 | 13 | 55 | 5031 |
| 228 | 6 | 16 | 7 | 13 | 55 | 4853 |
| 229 | 6 | 16 | 7 | 13 | 55 | 4956 |
| 230 | 6 | 16 | 7 | 13 | 55 | 5504 |
| 231 | 6 | 16 | 7 | 13 | 55 | 4917 |
| 232 | 6 | 16 | 7 | 13 | 55 | 4794 |
| 233 | 6 | 16 | 7 | 13 | 56 | 4965 |
| 234 | 6 | 16 | 7 | 13 | 56 | 4979 |
| 235 | 6 | 16 | 7 | 13 | 56 | 5274 |
| 236 | 6 | 16 | 7 | 13 | 56 | 5190 |
| 237 | 6 | 16 | 7 | 13 | 56 | 4913 |
| 238 | 6 | 16 | 7 | 13 | 56 | 5439 |
| 239 | 6 | 16 | 7 | 13 | 56 | 5122 |
| 240 | 6 | 16 | 7 | 13 | 56 | 4407 |
| 241 | 6 | 16 | 7 | 13 | 56 | 5078 |
| 242 | 6 | 16 | 7 | 13 | 57 | 5913 |
| 243 | 6 | 16 | 7 | 13 | 57 | 5125 |
| 244 | 6 | 16 | 7 | 13 | 58 | 7838 |
| 245 | 6 | 16 | 7 | 13 | 58 | 6932 |
| 246 | 6 | 16 | 7 | 13 | 58 | 5622 |
| 247 | 6 | 16 | 7 | 13 | 58 | 5605 |
| 248 | 6 | 16 | 7 | 13 | 58 | 6244 |
| 249 | 6 | 16 | 7 | 13 | 58 | 5748 |
| 250 | 6 | 16 | 7 | 13 | 59 | 5968 |
| 251 | 6 | 16 | 7 | 13 | 59 | 6561 |
| 252 | 6 | 16 | 7 | 13 | 59 | 5957 |
| 253 | 6 | 16 | 7 | 13 | 59 | 5679 |
| 254 | 6 | 16 | 7 | 13 | 59 | 6267 |
| 255 | 6 | 16 | 7 | 13 | 59 | 6411 |
| 256 | 6 | 16 | 7 | 13 | 59 | 6788 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 257 | 6 | 16 | 7 | 13 | 59 | 5554 |
| 258 | 6 | 16 | 7 | 13 | 59 | 5907 |
| 259 | 6 | 16 | 7 | 14 | 0 | 6172 |
| 260 | 6 | 16 | 7 | 14 | 0 | 5294 |
| 261 | 6 | 16 | 7 | 14 | 0 | 5365 |
| 262 | 6 | 16 | 7 | 14 | 0 | 5389 |
| 263 | 6 | 16 | 7 | 14 | 0 | 5714 |
| 264 | 6 | 16 | 7 | 14 | 0 | 5346 |
| 265 | 6 | 16 | 7 | 14 | 0 | 4887 |
| 266 | 6 | 16 | 7 | 14 | 0 | 4932 |
| 267 | 6 | 16 | 7 | 14 | 1 | 5346 |
| 268 | 6 | 16 | 7 | 14 | 1 | 5671 |
| 269 | 6 | 16 | 7 | 14 | 1 | 4984 |
| 270 | 6 | 16 | 7 | 14 | 1 | 5197 |
| 271 | 6 | 16 | 7 | 14 | 1 | 5980 |
| 272 | 6 | 16 | 7 | 14 | 1 | 5862 |
| 273 | 6 | 16 | 7 | 14 | 1 | 6545 |
| 274 | 6 | 16 | 7 | 14 | 1 | 5669 |
| 275 | 6 | 16 | 7 | 14 | 1 | 5443 |
| 276 | 6 | 16 | 7 | 14 | 2 | 5998 |
| 277 | 6 | 16 | 7 | 14 | 2 | 5485 |
| 278 | 6 | 16 | 7 | 14 | 2 | 6171 |
| 279 | 6 | 16 | 7 | 14 | 3 | 7474 |
| 280 | 6 | 16 | 7 | 14 | 4 | 6503 |
| 281 | 6 | 16 | 7 | 14 | 5 | 5427 |
| 282 | 6 | 16 | 7 | 14 | 5 | 5899 |
| 283 | 6 | 16 | 7 | 14 | 5 | 5347 |
| 284 | 6 | 16 | 7 | 14 | 5 | 5027 |
| 285 | 6 | 16 | 7 | 14 | 5 | 5356 |
| 286 | 6 | 16 | 7 | 14 | 6 | 5916 |
| 287 | 6 | 16 | 7 | 14 | 6 | 5737 |
| 288 | 6 | 16 | 7 | 14 | 6 | 5782 |
| 289 | 6 | 16 | 7 | 14 | 6 | 5644 |
| 290 | 6 | 16 | 7 | 14 | 6 | 5181 |
| 291 | 6 | 16 | 7 | 14 | 6 | 5733 |
| 292 | 6 | 16 | 7 | 14 | 6 | 5399 |
| 293 | 6 | 16 | 7 | 14 | 6 | 6076 |
| 294 | 6 | 16 | 7 | 14 | 6 | 5994 |
| 295 | 6 | 16 | 7 | 14 | 7 | 6851 |
| 296 | 6 | 16 | 7 | 14 | 7 | 5548 |
| 297 | 6 | 16 | 7 | 14 | 7 | 5755 |
| 298 | 6 | 16 | 7 | 14 | 7 | 5606 |
| 299 | 6 | 16 | 7 | 14 | 7 | 5338 |
| 300 | 6 | 16 | 7 | 14 | 7 | 5616 |
| 301 | 6 | 16 | 7 | 14 | 7 | 5595 |
| 302 | 6 | 16 | 7 | 14 | 7 | 5507 |
| 303 | 6 | 16 | 7 | 14 | 8 | 5625 |
| 304 | 6 | 16 | 7 | 14 | 8 | 5583 |
| 305 | 6 | 16 | 7 | 14 | 8 | 6715 |
| 306 | 6 | 16 | 7 | 14 | 8 | 6676 |
| 307 | 6 | 16 | 7 | 14 | 8 | 5916 |
| 308 | 6 | 16 | 7 | 14 | 8 | 5535 |
| 309 | 6 | 16 | 7 | 14 | 8 | 6159 |
| 310 | 6 | 16 | 7 | 14 | 8 | 5735 |
| 311 | 6 | 16 | 7 | 14 | 8 | 5929 |
| 312 | 6 | 16 | 7 | 14 | 9 | 5786 |
| 313 | 6 | 16 | 7 | 14 | 9 | 7614 |
| 314 | 6 | 16 | 7 | 14 | 11 | 5913 |
| 315 | 6 | 16 | 7 | 14 | 11 | 6433 |
| 316 | 6 | 16 | 7 | 14 | 12 | 6632 |
| 317 | 6 | 16 | 7 | 14 | 12 | 5740 |
| 318 | 6 | 16 | 7 | 14 | 12 | 5907 |
| 319 | 6 | 16 | 7 | 14 | 12 | 5371 |
| 320 | 6 | 16 | 7 | 14 | 12 | 6110 |

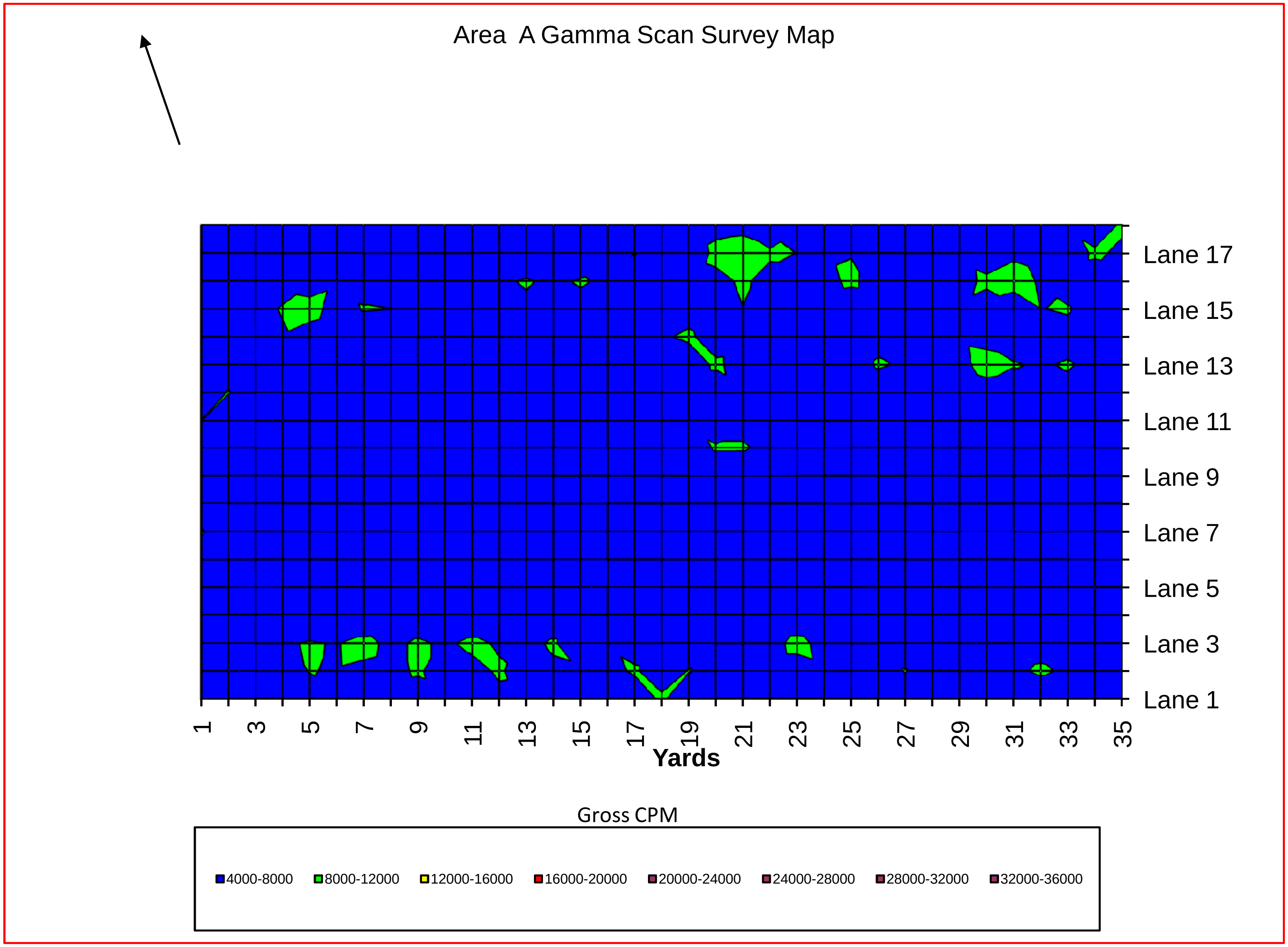
| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 321 | 6 | 16 | 7 | 14 | 12 | 5649 |
| 322 | 6 | 16 | 7 | 14 | 12 | 6388 |
| 323 | 6 | 16 | 7 | 14 | 12 | 5108 |
| 324 | 6 | 16 | 7 | 14 | 12 | 5497 |
| 325 | 6 | 16 | 7 | 14 | 13 | 5379 |
| 326 | 6 | 16 | 7 | 14 | 13 | 5295 |
| 327 | 6 | 16 | 7 | 14 | 13 | 5971 |
| 328 | 6 | 16 | 7 | 14 | 13 | 5797 |
| 329 | 6 | 16 | 7 | 14 | 13 | 6295 |
| 330 | 6 | 16 | 7 | 14 | 13 | 6455 |
| 331 | 6 | 16 | 7 | 14 | 13 | 5942 |
| 332 | 6 | 16 | 7 | 14 | 13 | 6713 |
| 333 | 6 | 16 | 7 | 14 | 14 | 6286 |
| 334 | 6 | 16 | 7 | 14 | 14 | 6425 |
| 335 | 6 | 16 | 7 | 14 | 14 | 8281 |
| 336 | 6 | 16 | 7 | 14 | 14 | 8274 |
| 337 | 6 | 16 | 7 | 14 | 14 | 7242 |
| 338 | 6 | 16 | 7 | 14 | 15 | 5499 |
| 339 | 6 | 16 | 7 | 14 | 15 | 5291 |
| 340 | 6 | 16 | 7 | 14 | 15 | 5948 |
| 341 | 6 | 16 | 7 | 14 | 15 | 6186 |
| 342 | 6 | 16 | 7 | 14 | 15 | 6327 |
| 343 | 6 | 16 | 7 | 14 | 16 | 6563 |
| 344 | 6 | 16 | 7 | 14 | 16 | 7556 |
| 345 | 6 | 16 | 7 | 14 | 16 | 6466 |
| 346 | 6 | 16 | 7 | 14 | 16 | 6535 |
| 347 | 6 | 16 | 7 | 14 | 16 | 5942 |
| 348 | 6 | 16 | 7 | 14 | 16 | 6839 |
| 349 | 6 | 16 | 7 | 14 | 16 | 6144 |
| 350 | 6 | 16 | 7 | 14 | 16 | 7006 |
| 351 | 6 | 16 | 7 | 14 | 16 | 8010 |
| 352 | 6 | 16 | 7 | 14 | 18 | 5029 |
| 353 | 6 | 16 | 7 | 14 | 18 | 5702 |
| 354 | 6 | 16 | 7 | 14 | 18 | 6930 |
| 355 | 6 | 16 | 7 | 14 | 18 | 6612 |
| 356 | 6 | 16 | 7 | 14 | 18 | 5787 |
| 357 | 6 | 16 | 7 | 14 | 18 | 5683 |
| 358 | 6 | 16 | 7 | 14 | 18 | 5863 |
| 359 | 6 | 16 | 7 | 14 | 19 | 5750 |
| 360 | 6 | 16 | 7 | 14 | 19 | 5371 |
| 361 | 6 | 16 | 7 | 14 | 19 | 6439 |
| 362 | 6 | 16 | 7 | 14 | 19 | 5752 |
| 363 | 6 | 16 | 7 | 14 | 19 | 6050 |
| 364 | 6 | 16 | 7 | 14 | 19 | 6498 |
| 365 | 6 | 16 | 7 | 14 | 19 | 6545 |
| 366 | 6 | 16 | 7 | 14 | 19 | 7286 |
| 367 | 6 | 16 | 7 | 14 | 20 | 5875 |
| 368 | 6 | 16 | 7 | 14 | 20 | 7185 |
| 369 | 6 | 16 | 7 | 14 | 20 | 7371 |
| 370 | 6 | 16 | 7 | 14 | 20 | 5607 |
| 371 | 6 | 16 | 7 | 14 | 20 | 7174 |
| 372 | 6 | 16 | 7 | 14 | 20 | 6172 |
| 373 | 6 | 16 | 7 | 14 | 20 | 7145 |
| 374 | 6 | 16 | 7 | 14 | 20 | 7072 |
| 375 | 6 | 16 | 7 | 14 | 20 | 6298 |
| 376 | 6 | 16 | 7 | 14 | 21 | 5496 |
| 377 | 6 | 16 | 7 | 14 | 21 | 6219 |
| 378 | 6 | 16 | 7 | 14 | 21 | 6617 |
| 379 | 6 | 16 | 7 | 14 | 21 | 6970 |
| 380 | 6 | 16 | 7 | 14 | 21 | 6452 |
| 381 | 6 | 16 | 7 | 14 | 21 | 6532 |
| 382 | 6 | 16 | 7 | 14 | 21 | 6631 |
| 383 | 6 | 16 | 7 | 14 | 21 | 6826 |
| 384 | 6 | 16 | 7 | 14 | 21 | 6897 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 385 | 6 | 16 | 7 | 14 | 22 | 7934 |
| 386 | 6 | 16 | 7 | 14 | 22 | 6754 |
| 387 | 6 | 16 | 7 | 14 | 22 | 8089 |
| 388 | 6 | 16 | 7 | 14 | 24 | 6985 |
| 389 | 6 | 16 | 7 | 14 | 24 | 5725 |
| 390 | 6 | 16 | 7 | 14 | 24 | 7684 |
| 391 | 6 | 16 | 7 | 14 | 24 | 6420 |
| 392 | 6 | 16 | 7 | 14 | 24 | 6628 |
| 393 | 6 | 16 | 7 | 14 | 24 | 6580 |
| 394 | 6 | 16 | 7 | 14 | 24 | 6080 |
| 395 | 6 | 16 | 7 | 14 | 24 | 6894 |
| 396 | 6 | 16 | 7 | 14 | 24 | 6758 |
| 397 | 6 | 16 | 7 | 14 | 25 | 7220 |
| 398 | 6 | 16 | 7 | 14 | 25 | 6276 |
| 399 | 6 | 16 | 7 | 14 | 25 | 6155 |
| 400 | 6 | 16 | 7 | 14 | 25 | 6534 |
| 401 | 6 | 16 | 7 | 14 | 25 | 7913 |
| 402 | 6 | 16 | 7 | 14 | 25 | 7642 |
| 403 | 6 | 16 | 7 | 14 | 25 | 7334 |
| 404 | 6 | 16 | 7 | 14 | 25 | 6969 |
| 405 | 6 | 16 | 7 | 14 | 25 | 6799 |
| 406 | 6 | 16 | 7 | 14 | 26 | 7562 |
| 407 | 6 | 16 | 7 | 14 | 26 | 5765 |
| 408 | 6 | 16 | 7 | 14 | 26 | 7562 |
| 409 | 6 | 16 | 7 | 14 | 26 | 6406 |
| 410 | 6 | 16 | 7 | 14 | 26 | 6247 |
| 411 | 6 | 16 | 7 | 14 | 26 | 6716 |
| 412 | 6 | 16 | 7 | 14 | 26 | 5724 |
| 413 | 6 | 16 | 7 | 14 | 26 | 7156 |
| 414 | 6 | 16 | 7 | 14 | 27 | 5701 |
| 415 | 6 | 16 | 7 | 14 | 27 | 6504 |
| 416 | 6 | 16 | 7 | 14 | 27 | 6083 |
| 417 | 6 | 16 | 7 | 14 | 27 | 6906 |
| 418 | 6 | 16 | 7 | 14 | 27 | 7289 |
| 419 | 6 | 16 | 7 | 14 | 28 | 5700 |
| 420 | 6 | 16 | 7 | 14 | 28 | 6277 |
| 421 | 6 | 16 | 7 | 14 | 29 | 7032 |
| 422 | 6 | 16 | 7 | 14 | 29 | 6981 |
| 423 | 6 | 16 | 7 | 14 | 29 | 6282 |
| 424 | 6 | 16 | 7 | 14 | 29 | 6295 |
| 425 | 6 | 16 | 7 | 14 | 29 | 6551 |
| 426 | 6 | 16 | 7 | 14 | 29 | 7582 |
| 427 | 6 | 16 | 7 | 14 | 29 | 7833 |
| 428 | 6 | 16 | 7 | 14 | 29 | 5786 |
| 429 | 6 | 16 | 7 | 14 | 29 | 6558 |
| 430 | 6 | 16 | 7 | 14 | 30 | 6459 |
| 431 | 6 | 16 | 7 | 14 | 30 | 7043 |
| 432 | 6 | 16 | 7 | 14 | 30 | 6720 |
| 433 | 6 | 16 | 7 | 14 | 30 | 6292 |
| 434 | 6 | 16 | 7 | 14 | 30 | 6192 |
| 435 | 6 | 16 | 7 | 14 | 30 | 7036 |
| 436 | 6 | 16 | 7 | 14 | 30 | 7898 |
| 437 | 6 | 16 | 7 | 14 | 30 | 7259 |
| 438 | 6 | 16 | 7 | 14 | 30 | 5421 |
| 439 | 6 | 16 | 7 | 14 | 31 | 7118 |
| 440 | 6 | 16 | 7 | 14 | 31 | 8256 |
| 441 | 6 | 16 | 7 | 14 | 31 | 7402 |
| 442 | 6 | 16 | 7 | 14 | 31 | 6225 |
| 443 | 6 | 16 | 7 | 14 | 31 | 6364 |
| 444 | 6 | 16 | 7 | 14 | 31 | 7948 |
| 445 | 6 | 16 | 7 | 14 | 31 | 6934 |
| 446 | 6 | 16 | 7 | 14 | 31 | 8222 |
| 447 | 6 | 16 | 7 | 14 | 32 | 7740 |
| 448 | 6 | 16 | 7 | 14 | 32 | 6262 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 449 | 6 | 16 | 7 | 14 | 32 | 7029 |
| 450 | 6 | 16 | 7 | 14 | 32 | 9227 |
| 451 | 6 | 16 | 7 | 14 | 32 | 8174 |
| 452 | 6 | 16 | 7 | 14 | 32 | 7747 |
| 453 | 6 | 16 | 7 | 14 | 32 | 8224 |
| 454 | 6 | 16 | 7 | 14 | 32 | 7327 |
| 455 | 6 | 16 | 7 | 14 | 32 | 5693 |
| 456 | 6 | 16 | 7 | 14 | 33 | 6187 |
| 457 | 6 | 16 | 7 | 14 | 33 | 6675 |
| 458 | 6 | 16 | 7 | 14 | 33 | 5510 |
| 459 | 6 | 16 | 7 | 14 | 33 | 7783 |
| 460 | 6 | 16 | 7 | 14 | 33 | 6995 |
| 461 | 6 | 16 | 7 | 14 | 34 | 6518 |
| 462 | 6 | 16 | 7 | 14 | 34 | 6318 |
| 463 | 6 | 16 | 7 | 14 | 34 | 6509 |
| 464 | 6 | 16 | 7 | 14 | 34 | 6352 |
| 465 | 6 | 16 | 7 | 14 | 34 | 7444 |
| 466 | 6 | 16 | 7 | 14 | 34 | 6492 |
| 467 | 6 | 16 | 7 | 14 | 34 | 7616 |
| 468 | 6 | 16 | 7 | 14 | 34 | 7443 |
| 469 | 6 | 16 | 7 | 14 | 34 | 7220 |
| 470 | 6 | 16 | 7 | 14 | 35 | 6823 |
| 471 | 6 | 16 | 7 | 14 | 35 | 6811 |
| 472 | 6 | 16 | 7 | 14 | 35 | 6936 |
| 473 | 6 | 16 | 7 | 14 | 35 | 7819 |
| 474 | 6 | 16 | 7 | 14 | 35 | 8241 |
| 475 | 6 | 16 | 7 | 14 | 35 | 7224 |
| 476 | 6 | 16 | 7 | 14 | 35 | 7376 |
| 477 | 6 | 16 | 7 | 14 | 35 | 7596 |
| 478 | 6 | 16 | 7 | 14 | 36 | 7319 |
| 479 | 6 | 16 | 7 | 14 | 36 | 7739 |
| 480 | 6 | 16 | 7 | 14 | 36 | 6851 |
| 481 | 6 | 16 | 7 | 14 | 36 | 7383 |
| 482 | 6 | 16 | 7 | 14 | 36 | 7138 |
| 483 | 6 | 16 | 7 | 14 | 36 | 7112 |
| 484 | 6 | 16 | 7 | 14 | 36 | 7358 |
| 485 | 6 | 16 | 7 | 14 | 36 | 6922 |
| 486 | 6 | 16 | 7 | 14 | 36 | 6468 |
| 487 | 6 | 16 | 7 | 14 | 37 | 6213 |
| 488 | 6 | 16 | 7 | 14 | 37 | 7124 |
| 489 | 6 | 16 | 7 | 14 | 38 | 6059 |
| 490 | 6 | 16 | 7 | 14 | 38 | 6076 |
| 491 | 6 | 16 | 7 | 14 | 38 | 6543 |
| 492 | 6 | 16 | 7 | 14 | 39 | 6448 |
| 493 | 6 | 16 | 7 | 14 | 39 | 7291 |
| 494 | 6 | 16 | 7 | 14 | 39 | 8142 |
| 495 | 6 | 16 | 7 | 14 | 39 | 8854 |
| 496 | 6 | 16 | 7 | 14 | 39 | 7025 |
| 497 | 6 | 16 | 7 | 14 | 39 | 8123 |
| 498 | 6 | 16 | 7 | 14 | 39 | 8011 |
| 499 | 6 | 16 | 7 | 14 | 39 | 7055 |
| 500 | 6 | 16 | 7 | 14 | 39 | 7005 |
| 501 | 6 | 16 | 7 | 14 | 40 | 6622 |
| 502 | 6 | 16 | 7 | 14 | 40 | 7502 |
| 503 | 6 | 16 | 7 | 14 | 40 | 7846 |
| 504 | 6 | 16 | 7 | 14 | 40 | 6523 |
| 505 | 6 | 16 | 7 | 14 | 40 | 7749 |
| 506 | 6 | 16 | 7 | 14 | 40 | 6827 |
| 507 | 6 | 16 | 7 | 14 | 40 | 7444 |
| 508 | 6 | 16 | 7 | 14 | 40 | 6915 |
| 509 | 6 | 16 | 7 | 14 | 41 | 7452 |
| 510 | 6 | 16 | 7 | 14 | 41 | 6993 |
| 511 | 6 | 16 | 7 | 14 | 41 | 7955 |
| 512 | 6 | 16 | 7 | 14 | 41 | 7087 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 513 | 6 | 16 | 7 | 14 | 41 | 7937 |
| 514 | 6 | 16 | 7 | 14 | 41 | 6823 |
| 515 | 6 | 16 | 7 | 14 | 41 | 6467 |
| 516 | 6 | 16 | 7 | 14 | 41 | 6773 |
| 517 | 6 | 16 | 7 | 14 | 41 | 7928 |
| 518 | 6 | 16 | 7 | 14 | 42 | 7188 |
| 519 | 6 | 16 | 7 | 14 | 42 | 7575 |
| 520 | 6 | 16 | 7 | 14 | 42 | 6908 |
| 521 | 6 | 16 | 7 | 14 | 42 | 5962 |
| 522 | 6 | 16 | 7 | 14 | 42 | 7944 |
| 523 | 6 | 16 | 7 | 14 | 42 | 8233 |
| 524 | 6 | 16 | 7 | 14 | 43 | 5769 |
| 525 | 6 | 16 | 7 | 14 | 43 | 7965 |
| 526 | 6 | 16 | 7 | 14 | 43 | 7110 |
| 527 | 6 | 16 | 7 | 14 | 44 | 7414 |
| 528 | 6 | 16 | 7 | 14 | 44 | 6404 |
| 529 | 6 | 16 | 7 | 14 | 44 | 7163 |
| 530 | 6 | 16 | 7 | 14 | 44 | 6819 |
| 531 | 6 | 16 | 7 | 14 | 44 | 7520 |
| 532 | 6 | 16 | 7 | 14 | 44 | 7176 |
| 533 | 6 | 16 | 7 | 14 | 44 | 7286 |
| 534 | 6 | 16 | 7 | 14 | 44 | 6823 |
| 535 | 6 | 16 | 7 | 14 | 44 | 6841 |
| 536 | 6 | 16 | 7 | 14 | 45 | 6903 |
| 537 | 6 | 16 | 7 | 14 | 45 | 7859 |
| 538 | 6 | 16 | 7 | 14 | 45 | 8083 |
| 539 | 6 | 16 | 7 | 14 | 45 | 7823 |
| 540 | 6 | 16 | 7 | 14 | 45 | 8093 |
| 541 | 6 | 16 | 7 | 14 | 45 | 7845 |
| 542 | 6 | 16 | 7 | 14 | 45 | 6743 |
| 543 | 6 | 16 | 7 | 14 | 45 | 7651 |
| 544 | 6 | 16 | 7 | 14 | 45 | 6773 |
| 545 | 6 | 16 | 7 | 14 | 46 | 7289 |
| 546 | 6 | 16 | 7 | 14 | 46 | 8346 |
| 547 | 6 | 16 | 7 | 14 | 46 | 7174 |
| 548 | 6 | 16 | 7 | 14 | 46 | 7255 |
| 549 | 6 | 16 | 7 | 14 | 46 | 7345 |
| 550 | 6 | 16 | 7 | 14 | 46 | 8433 |
| 551 | 6 | 16 | 7 | 14 | 46 | 6952 |
| 552 | 6 | 16 | 7 | 14 | 46 | 7021 |
| 553 | 6 | 16 | 7 | 14 | 47 | 5612 |
| 554 | 6 | 16 | 7 | 14 | 47 | 7229 |
| 555 | 6 | 16 | 7 | 14 | 47 | 8435 |
| 556 | 6 | 16 | 7 | 14 | 47 | 9248 |
| 557 | 6 | 16 | 7 | 14 | 47 | 7650 |
| 558 | 6 | 16 | 7 | 14 | 47 | 6291 |
| 559 | 6 | 16 | 7 | 14 | 48 | 5896 |
| 560 | 6 | 16 | 7 | 14 | 49 | 6317 |
| 561 | 6 | 16 | 7 | 14 | 49 | 7283 |
| 562 | 6 | 16 | 7 | 14 | 49 | 6338 |
| 563 | 6 | 16 | 7 | 14 | 49 | 6535 |
| 564 | 6 | 16 | 7 | 14 | 49 | 6985 |
| 565 | 6 | 16 | 7 | 14 | 49 | 6565 |
| 566 | 6 | 16 | 7 | 14 | 49 | 6060 |
| 567 | 6 | 16 | 7 | 14 | 49 | 6064 |
| 568 | 6 | 16 | 7 | 14 | 49 | 6255 |
| 569 | 6 | 16 | 7 | 14 | 50 | 7134 |
| 570 | 6 | 16 | 7 | 14 | 50 | 7427 |
| 571 | 6 | 16 | 7 | 14 | 50 | 6543 |
| 572 | 6 | 16 | 7 | 14 | 50 | 6503 |
| 573 | 6 | 16 | 7 | 14 | 50 | 7183 |
| 574 | 6 | 16 | 7 | 14 | 50 | 6344 |
| 575 | 6 | 16 | 7 | 14 | 50 | 6513 |
| 576 | 6 | 16 | 7 | 14 | 50 | 7515 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 577 | 6 | 16 | 7 | 14 | 50 | 8025 |
| 578 | 6 | 16 | 7 | 14 | 51 | 6627 |
| 579 | 6 | 16 | 7 | 14 | 51 | 5687 |
| 580 | 6 | 16 | 7 | 14 | 51 | 8721 |
| 581 | 6 | 16 | 7 | 14 | 51 | 8863 |
| 582 | 6 | 16 | 7 | 14 | 51 | 8364 |
| 583 | 6 | 16 | 7 | 14 | 51 | 7981 |
| 584 | 6 | 16 | 7 | 14 | 51 | 7665 |
| 585 | 6 | 16 | 7 | 14 | 51 | 7894 |
| 586 | 6 | 16 | 7 | 14 | 52 | 6986 |
| 587 | 6 | 16 | 7 | 14 | 52 | 7569 |
| 588 | 6 | 16 | 7 | 14 | 52 | 6819 |
| 589 | 6 | 16 | 7 | 14 | 52 | 7355 |
| 590 | 6 | 16 | 7 | 14 | 52 | 6541 |
| 591 | 6 | 16 | 7 | 14 | 52 | 7456 |
| 592 | 6 | 16 | 7 | 14 | 52 | 6878 |
| 593 | 6 | 16 | 7 | 14 | 52 | 6026 |
| 594 | 6 | 16 | 7 | 14 | 52 | 8546 |
| 595 | 6 | 16 | 7 | 14 | 53 | 7350 |
| 596 | 6 | 16 | 7 | 14 | 54 | 6414 |
| 597 | 6 | 16 | 7 | 14 | 55 | 5362 |
| 598 | 6 | 16 | 7 | 14 | 55 | 5734 |
| 599 | 6 | 16 | 7 | 14 | 55 | 5572 |
| 600 | 6 | 16 | 7 | 14 | 55 | 5740 |
| 601 | 6 | 16 | 7 | 14 | 55 | 5612 |
| 602 | 6 | 16 | 7 | 14 | 55 | 6158 |
| 603 | 6 | 16 | 7 | 14 | 55 | 7800 |
| 604 | 6 | 16 | 7 | 14 | 55 | 7080 |
| 605 | 6 | 16 | 7 | 14 | 55 | 7703 |
| 606 | 6 | 16 | 7 | 14 | 56 | 7095 |
| 607 | 6 | 16 | 7 | 14 | 56 | 6845 |
| 608 | 6 | 16 | 7 | 14 | 56 | 7234 |
| 609 | 6 | 16 | 7 | 14 | 56 | 6911 |
| 610 | 6 | 16 | 7 | 14 | 56 | 7150 |
| 611 | 6 | 16 | 7 | 14 | 56 | 7105 |
| 612 | 6 | 16 | 7 | 14 | 56 | 7293 |
| 613 | 6 | 16 | 7 | 14 | 56 | 6513 |
| 614 | 6 | 16 | 7 | 14 | 57 | 6279 |
| 615 | 6 | 16 | 7 | 14 | 57 | 7161 |
| 616 | 6 | 16 | 7 | 14 | 57 | 7475 |
| 617 | 6 | 16 | 7 | 14 | 57 | 5796 |
| 618 | 6 | 16 | 7 | 14 | 57 | 7459 |
| 619 | 6 | 16 | 7 | 14 | 57 | 6435 |
| 620 | 6 | 16 | 7 | 14 | 57 | 7484 |
| 621 | 6 | 16 | 7 | 14 | 57 | 6894 |
| 622 | 6 | 16 | 7 | 14 | 58 | 6308 |
| 623 | 6 | 16 | 7 | 14 | 58 | 7244 |
| 624 | 6 | 16 | 7 | 14 | 58 | 5860 |
| 625 | 6 | 16 | 7 | 14 | 58 | 7099 |
| 626 | 6 | 16 | 7 | 14 | 58 | 6189 |
| 627 | 6 | 16 | 7 | 14 | 58 | 7940 |
| 628 | 6 | 16 | 7 | 14 | 58 | 7376 |
| 629 | 3 | 6 | 7 | 17 | 2 | 5534 |
| 630 | 3 | 6 | 7 | 17 | 2 | 8534 |
| | | | | | **Minimum:** | **4407** |
| | | | | | **Maximum:** | **9248** |
| | | | | | **Average:** | **6494** |
| | | | | | **Standard Deviation:** | **960** |
| | | | | | **Action Level:** | **9432** |


Area A Gamma Scan Survey Map
Lane 17
Lane 15
Lane 13
Lane 11
Lane 9
Lane 7
Lane 5
Lane 3
Lane 1
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35
Yards
Gross CPM
4000-8000
8000-12000
12000-16000
16000-20000
20000-24000
24000-28000
28000-32000
32000-36000

# Appendix I

# Area A Soil Sample Laboratory Data

STL

**STL St. Louis**
13715 Rider Trail North
Earth City, MO 63045

Tel: 314 298 8566 Fax: 314 298 8757
www.stl-inc.com

# ANALYTICAL REPORT

**Dahlgren**

**Lot #: F7F200203**

**Dan Spicuzza**

**New World Technology**
**448 Commerce Way**
**Livermore, CA 94551**

**TESTAMERICA LABORATORIES, INC. (FKA STL)**

**Ivan Vania**
Project Manager

**July 5, 2007**

**Case Narrative**
LOT NUMBER: **F7F200203**

This report contains the analytical results for the 18 samples received under chain of custody by STL St. Louis on June 20, 2007. These samples are associated with your Dahlgren project.

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

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

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

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

There were no nonconformances or observations noted with any analysis on this lot.

# METHODS SUMMARY

**F7F200203**

| PARAMETER | ANALYTICAL METHOD | PREPARATION METHOD |
|---|---|---|
| Gamma Spectroscopy - Cesium-137 & Hits | EML GA-01-R MOD | |
| Isotopic Uranium by Alpha Spectroscopy | EML A-01-R MOD | |

**References:**

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

# SAMPLE SUMMARY

**F7F200203**

| WO # | SAMPLE# | CLIENT SAMPLE ID | SAMPLED DATE | SAMP TIME |
|---|---|---|---|---|
| J1DQ9 | 001 | AA-A1 | 06/16/07 | 16:25 |
| J1DRE | 002 | AA-A2 | 06/16/07 | 16:30 |
| J1DRF | 003 | AA-A3 | 06/16/07 | 16:35 |
| J1DRG | 004 | AA-B1 | 06/16/07 | 16:20 |
| J1DRJ | 005 | AA-B2 | 06/16/07 | 16:15 |
| J1DRL | 006 | AA-B3 | 06/16/07 | 16:10 |
| J1DRP | 007 | AA-C1 | 06/16/07 | 15:55 |
| J1DRQ | 008 | AA-C2 | 06/16/07 | 16:00 |
| J1DRW | 009 | AA-C3 | 06/16/07 | 16:05 |
| J1DR1 | 010 | AA-D1 | 06/16/07 | 15:50 |
| J1DR2 | 011 | AA-D2 | 06/16/07 | 15:45 |
| J1DR3 | 012 | AA-D3 | 06/16/07 | 15:40 |
| J1DR4 | 013 | AA-E1 | 06/16/07 | 15:20 |
| J1DR6 | 014 | AA-E2 | 06/16/07 | 15:10 |
| J1DR9 | 015 | AA-E3 | 06/16/07 | 15:30 |
| J1DTC | 016 | AA-F1 | 06/16/07 | 15:15 |
| J1DTD | 017 | AA-F2 | 06/16/07 | 15:25 |
| J1DTE | 018 | AA-F3 | 06/16/07 | 15:05 |

**NOTE(S):**

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

# New World Technology

## Client Sample ID: AA-A1

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F200203-001
Work Order: J1DO9
Matrix: SOLID

Date Collected: 06/16/07 1625
Date Received: 06/20/07 0845

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | | **Batch # 7173194** | **Yld %** |
| Uranium 238 | 2.77 | J | 0.75 | 4.00 | 1.4 | 06/22/07 | 06/23/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: AA-A1 DUP

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F200203-001X
Work Order: J1DO9
Matrix: SOLID

Date Collected: 06/16/07 1625
Date Received: 06/20/07 0845

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | pCi/g | | Batch # 7173194 | Yld % |
| Uranium 238 | **2.58** | J | 0.75 | 4.00 | 1.3 | 06/22/07 | 06/23/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: AA-A2

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F200203-002
Work Order: J1DRE
Matrix: SOLID

Date Collected: 06/16/07 1630
Date Received: 06/20/07 0845

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | **Batch # 7173194** | | **Yld %** |
| Uranium 238 | 1.16 | U | 0.69 | 4.00 | 2.8 | 06/22/07 | 06/23/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: AA-A3

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F200203-003
Work Order: J1DRF
Matrix: SOLID

Date Collected: 06/16/07 1635
Date Received: 06/20/07 0845

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | | **Batch # 7173194** | **Yld %** |
| Uranium 238 | 1.66 | J | 0.72 | 4.00 | 1.3 | 06/22/07 | 06/23/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: AA-B1

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F200203-004 | Date Collected: | 06/16/07 1620 |
| Work Order: | J1DRG | Date Received: | 06/20/07 0845 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | **Batch # 7173194** | | **Yld %** |
| Uranium 238 | 9.4 | | 2.3 | 4.0 | 2.3 | 06/22/07 | 06/23/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.

Bold results are greater than the MDC

# New World Technology

## Client Sample ID: AA-B2

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F200203-005
Work Order: J1DRJ
Matrix: SOLID

Date Collected: 06/16/07 1615
Date Received: 06/20/07 0845

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | | **Batch # 7173194** | **Yld %** |
| Uranium 238 | 5.8 | | 1.3 | 4.0 | 1.9 | 06/22/07 | 06/23/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

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

# New World Technology

## Client Sample ID: AA-B3

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F200203-006 | Date Collected: | 06/16/07 1610 |
| Work Order: | J1DRL | Date Received: | 06/20/07 0845 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | **Batch # 7173194** | | **Yld %** |
| Uranium 238 | 5.7 | | 1.0 | 4.0 | 1.6 | 06/22/07 | 06/23/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.

Bold results are greater than the MDC

# New World Technology

## Client Sample ID: AA-C1

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F200203-007
Work Order: J1DRP
Matrix: SOLID

Date Collected: 06/16/07 1555
Date Received: 06/20/07 0845

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | pCi/g | Batch # 7173194 | | Yld % |
| Uranium 238 | 5.3 | | 1.3 | 4.0 | 2.3 | 06/22/07 | 06/23/07 |
| **Iso URANIUM (SHORT CT) DOE A-01-R MOD** | | | | pCi/g | Batch # 7176227 | | Yld % 79 |
| Uranium 233/234 | **1.79** | | 0.37 | 1.00 | 0.07 | 06/25/07 | 07/02/07 |
| Uranium 235/236 | **0.24** | J | 0.13 | 1.00 | 0.04 | 06/25/07 | 07/02/07 |
| Uranium 238 | **11.1** | | 1.6 | 1.0 | 0.06 | 06/25/07 | 07/02/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: AA-C1 DUP

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F200203-007X
Work Order: J1DRP
Matrix: SOLID

Date Collected: 06/16/07 1555
Date Received: 06/20/07 0845

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Iso URANIUM (SHORT CT) DOE A-01-R MOD** | | | | pCi/g | Batch # 7176227 | | Yld % 98 |
| Uranium 233/234 | **1.50** | | 0.31 | 1.00 | 0.06 | 06/25/07 | 07/02/07 |
| Uranium 235/236 | **0.31** | J | 0.13 | 1.00 | 0.06 | 06/25/07 | 07/02/07 |
| Uranium 238 | **9.0** | | 1.3 | 1.0 | 0.07 | 06/25/07 | 07/02/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: AA-C2

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F200203-008 | Date Collected: | 06/16/07 1600 |
| Work Order: | J1DRO | Date Received: | 06/20/07 0845 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | | **Batch # 7173194** | **Yld %** |
| Uranium 238 | 2.88 | J | 0.72 | 4.00 | 1.4 | 06/22/07 | 06/23/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: AA-C3

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F200203-009 | Date Collected: | 06/16/07 1605 |
| Work Order: | J1DRW | Date Received: | 06/20/07 0845 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | **Batch # 7173194** | | **Yld %** |
| Uranium 238 | **4.5** | | 1.1 | 4.0 | 1.7 | 06/22/07 | 06/23/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

# New World Technology

## Client Sample ID: AA-D1

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F200203-010
Work Order: J1DR1
Matrix: SOLID

Date Collected: 06/16/07 1550
Date Received: 06/20/07 0845

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | **Batch # 7173194** | | **Yld %** |
| Uranium 238 | 9.2 | | 4.0 | 4.0 | 2.9 | 06/22/07 | 06/23/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

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

# New World Technology

## Client Sample ID: AA-D2

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F200203-011 | Date Collected: | 06/16/07 1545 |
| Work Order: | J1DR2 | Date Received: | 06/20/07 0845 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | | **Batch # 7173194** | **Yld %** |
| Uranium 238 | -0.5 | U | 19 | 4 | 2 | 06/22/07 | 06/23/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

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

U  Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: AA-D3

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F200203-012
Work Order: J1DR3
Matrix: SOLID

Date Collected: 06/16/07 1540
Date Received: 06/20/07 0845

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | pCi/g | Batch # 7173194 | | Yld % |
| Uranium 238 | 2.86 | J | 0.84 | 4.00 | 1.6 | 06/22/07 | 06/23/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: AA-E1

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F200203-013
Work Order: J1DR4
Matrix: SOLID

Date Collected: 06/16/07 1520
Date Received: 06/20/07 0845

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | pCi/g | Batch # 7173194 | | Yld % |
| Uranium 238 | 1.95 | J | 0.82 | 4.00 | 1.0 | 06/22/07 | 06/23/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: AA-E2

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F200203-014 | Date Collected: | 06/16/07 1510 |
| Work Order: | J1DR6 | Date Received: | 06/20/07 0845 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | **Batch # 7173194** | | **Yld %** |
| **Uranium 238** | **2.6** | **J** | **1.1** | 4.0 | **1.2** | **06/22/07** | **06/23/07** |
| **Iso URANIUM (SHORT CT) DOE A-01-R MOD** | | | | **pCi/g** | **Batch # 7176227** | | **Yld % 87** |
| **Uranium 233/234** | **0.54** | **J** | **0.17** | 1.00 | **0.07** | **06/25/07** | **07/02/07** |
| Uranium 235/236 | 0.030 | U | 0.052 | 1.00 | 0.078 | 06/25/07 | 07/02/07 |
| **Uranium 238** | **3.17** | | **0.55** | 1.00 | **0.06** | **06/25/07** | **07/02/07** |

**NOTE(S)**

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: AA-E3

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F200203-015
Work Order: J1DR9
Matrix: SOLID

Date Collected: 06/16/07 1530
Date Received: 06/20/07 0845

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | **Batch # 7173194** | | **Yld %** |
| Uranium 238 | 3.62 | J | 0.99 | 4.00 | 1.8 | 06/22/07 | 06/23/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: AA-F1

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F200203-016 | Date Collected: | 06/16/07 1515 |
| Work Order: | J1DTC | Date Received: | 06/20/07 0845 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | | **Batch # 7173194** | **Yld %** |
| Uranium 238 | 3.4 | J | 1.4 | 4.0 | 1.6 | 06/22/07 | 06/23/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: AA-F2

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F200203-017 | Date Collected: | 06/16/07 1525 |
| Work Order: | J1DTD | Date Received: | 06/20/07 0845 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | | **Batch # 7173194** | **Yld %** |
| Uranium 238 | 2.58 | J | 0.56 | 4.00 | 1.0 | 06/22/07 | 06/23/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: AA-F3

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F200203-018 | Date Collected: | 06/16/07 1505 |
| Work Order: | J1DTE | Date Received: | 06/20/07 0845 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | **Batch # 7173194** | | **Yld %** |
| Uranium 238 | 4.2 | | 1.0 | 4.0 | 1.8 | 06/22/07 | 06/23/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.

Bold results are greater than the MDC

# METHOD BLANK REPORT

## Severn Trent Laboratories - Radiochemistry

Client Lot ID: F7F200203
Matrix: SOLID

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | | Prep Date | Lab Sample ID / Analysis Date |
|---|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | **pCi/g** | **Batch #** | **7173194** | **Yld %** | | **F7F220000-194B** |
| Uranium 238 | 0.28 | U | 0.37 | 4.00 | 0.70 | | 06/22/07 | 06/23/07 |
| **Iso URANIUM (SHORT CT) DOE A-01-R MOD** | | | **pCi/g** | **Batch #** | **7176227** | **Yld % 92** | | **F7F250000-227B** |
| Uranium 233/234 | 0.039 | U | 0.042 | 1.00 | 0.043 | | 06/25/07 | 07/02/07 |
| Uranium 235/236 | 0.0 | U | 0.0 | 1.0 | 0.03 | | 06/25/07 | 07/02/07 |
| Uranium 238 | 0.008 | U | 0.022 | 1.00 | 0.043 | | 06/25/07 | 07/02/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# Laboratory Control Sample Report

## Severn Trent Laboratories - Radiochemistry

Client Lot ID: F7F200203
Matrix: SOLID

| Parameter | Spike Amount | Result | Total Uncert. (2 σ+/-) | MDC | % Yld | % Rec | Lab Sample ID QC Control Limits |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | **pCi/g** | **GA-01-R MOD** | | | **F7F220000-194C** |
| Americium 241 | 103 | 103 | 8.2 | 1.5 | | 100 | (87 - 121) |
| Cesium 137 | 40.0 | 42.1 | 2.6 | 0.4 | | 105 | (90 - 120) |
| Cobalt 60 | 62.7 | 63.8 | 3.8 | 0.3 | | 102 | (90 - 113) |
| | **Batch #:** | 7173194 | | **Analysis Date:** | 06/23/07 | | |
| **Iso URANIUM (SHORT CT) DOE A-01-R MOD** | | | **pCi/g** | **A-01-R MOD** | | | **F7F250000-227C** |
| Uranium 233/234 | 19.6 | 21.8 | 3.9 | 0.4 | 88 | 111 | (78 - 125) |
| Uranium 238 | 19.6 | 20.8 | 3.7 | 0.2 | 88 | 106 | (76 - 122) |
| | **Batch #:** | 7176227 | | **Analysis Date:** | 07/02/07 | | |

**NOTE(S)**

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

# DUPLICATE EVALUATION REPORT

## Severn Trent Laboratories - Radiochemistry

Client Lot ID: F7F200203
Matrix: SOLID

Date Sampled: 06/16/07
Date Received: 06/20/07

| Parameter | SAMPLE Result | | Total Uncert. (2σ +/-) | % Yld | DUPLICATE Result | | Total Uncert. (2 σ +/-) | % Yld | QC Sample ID Precision | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | **GA-01-R MOD** | | | | **F7F200203-001** | |
| Uranium 238 | **2.77** | J | **0.75** | | **2.58** | J | **0.75** | | 7 | %RPD |
| | **Batch #:** | | 7173194 (Sample) | | 7173194 (Duplicate) | | | | | |
| **Iso URANIUM (SHORT CT) DOE A-01-R MOD** | | | | **pCi/g** | **A-01-R MOD** | | | | **F7F200203-007** | |
| Uranium 233/234 | **1.79** | | **0.37** | 79 | **1.50** | | **0.31** | 98 | 18 | %RPD |
| Uranium 235/236 | **0.24** | J | **0.13** | 79 | **0.31** | J | **0.13** | 98 | 28 | %RPD |
| Uranium 238 | **11.1** | | **1.6** | 79 | **9.0** | | **1.3** | 98 | 21 | %RPD |
| | **Batch #:** | | 7176227 (Sample) | | 7176227 (Duplicate) | | | | | |

**NOTE(S)**

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

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

# Chain of Custody Record

SEVERN TRENT **STL** Severn Trent Laboratories, Inc.

cR 1820

STL-4124 (0901)

| | | | |
|---|---|---|---|
| Client: NWT | Project Manager: Daniel Spicuzza | Date: 6/16/07 | Chain of Custody Number: 318639 |
| Address: 448 Commerce Way | Telephone Number (Area Code)/Fax Number: (412) 824-2333 | Lab Number | Page 1 of 2 |
| City: Livermore; State: CA; Zip Code: 94551 | Site Contact: Daniel Spicuzza; Lab Contact: Terry Romanko | Analysis (Attach list if more space is needed) | |
| Project Name and Location (State): Dahlgren VA | Carrier/Waybill Number: Fed Ex 8588 7385 318[illegible] | | Special Instructions/ Conditions of Receipt |
| Contract/Purchase Order/Quote No. | | | |

| Sample I.D. No. and Description (Containers for each sample may be combined on one line) | Date | Time | Air | Aqueous | Sed. | Soil | | Unpres. | H2SO4 | HNO3 | HCl | NaOH | ZnAc/NaOH | | Gamma Spec | [illegible] | Special Instructions/ Conditions of Receipt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AA-A1 | 6/16/07 | 1625 | | | | X | | X | | | | | | | X | | 500p for all |
| AA-A2 | 6/16/07 | 1630 | | | | X | | X | | | | | | | X | | 6.20.07 |
| AA-A3 | 6/16/07 | 1635 | | | | X | | X | | | | | | | X | | |
| AA-B1 | 6/16/07 | 1620 | | | | X | | X | | | | | | | X | | |
| AA-B2 | 6/16/07 | 1615 | | | | X | | X | | | | | | | X | | |
| AA-B3 | 6/16/07 | 1610 | | | | X | | X | | | | | | | X | | |
| AA-C1 | 6/16/07 | 1555 | | | | X | | X | | | | | | | X | X | |
| AA-C2 | 6/16/07 | 1600 | | | | X | | X | | | | | | | X | | |
| AA-C3 | 6/16/07 | 1605 | | | | X | | X | | | | | | | X | | |
| AA-D1 | 6/16/07 | 1550 | | | | X | | X | | | | | | | X | | |
| AA-D2 | 6/16/07 | 1545 | | | | X | | X | | | | | | | X | | |
| AA-D3 | 6/16/07 | 1540 | | | | X | | X | | | | | | | X | | |

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☒ Unknown

Sample Disposal: ☐ Return To Client ☒ Disposal By Lab ☐ Archive For ____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required: ☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☒ 21 Days ☐ Other____

QC Requirements (Specify): IV

| | | | | | |
|---|---|---|---|---|---|
| 1. Relinquished By: [signature] | Date: 6-19-07 | Time: 1000 | 1. Received By: Jill Clark | Date: 6.20.07 | Time: 0845 |
| 2. Relinquished By | Date | Time | 2. Received By | Date | Time |
| 3. Relinquished By | Date | Time | 3. Received By | Date | Time |

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

# Chain of Custody Record

SEVERN TRENT **STL**
**Severn Trent Laboratories, Inc.**

STL-4124 (0901)

| | | | |
|---|---|---|---|
| Client: NWT | Project Manager: Daniel Spicuzza | Date: 6/16/07 | Chain of Custody Number: 318640 |
| Address: 448 Commerce Way | Telephone Number (Area Code)/Fax Number: (412) ~~824-0~~ 824-2333 | Lab Number | Page 2 of 2 |
| City: Livermore; State: CA; Zip Code: 94551 | Site Contact: Daniel Spicuzza; Lab Contact: Terry Romanko | | |
| Project Name and Location (State): Dahlgren Va | Carrier/Waybill Number: Fed Ex 8588 7385 3136 | | |
| Contract/Purchase Order/Quote No.: GA00627 | | | |

Analysis (Attach list if more space is needed)

| Sample I.D. No. and Description (Containers for each sample may be combined on one line) | Date | Time | Air | Aqueous | Sed. | Soil | Unpres. | H2SO4 | HNO3 | HCl | NaOH | ZnAc/NaOH | Gamma spec 1233 | Alpha Spec | Special Instructions/Conditions of Receipt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AA-E1 | 6/16/07 | 1520 | | | | X | X | | | | | | X | | |
| AA-E2 | 6/16/07 | 1510 | | | | X | X | | | | | | X | X | Alpha Spec |
| AA-E3 | 6/16/07 | 1530 | | | | X | X | | | | | | X | | |
| AA-F1 | 6/16/07 | 1515 | | | | X | X | | | | | | X | | |
| AA-F2 | 6/16/07 | 1525 | | | | X | X | | | | | | X | | |
| AA-F3 | 6/16/07 | 1505 | | | | X | X | | | | | | X | | |

NA

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☒ Unknown

Sample Disposal: ☐ Return To Client ☒ Disposal By Lab ☐ Archive For ____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required: ☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☒ 21 Days ☐ Other____

QC Requirements (Specify): IV

| | Date | Time | | Date | Time |
|---|---|---|---|---|---|
| 1. Relinquished By: [signature] | 6-19-07 | 1000 | 1. Received By: [signature] Clarke | 6.20.07 | 0845 |
| 2. Relinquished By | | | 2. Received By | | |
| 3. Relinquished By | | | 3. Received By | | |

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

# STL

Lot #(s): F7F200203

- 1820 -

## Condition Upon Receipt Form

Client: NWT
Quote No: 74472
COC/RFA No: 318639, 318640
Initiated By: [illegible]
Date: 6-20-07
Time: 0845

### Shipping Information

Shipper Name: Fed Ex

Multiple Packages Y **N**

Shipping # (s):*

1. TRK# 8588 7385 3136
2.
3.
4.
5.
6.
7.
8.
9.
10.

Sample Temperature (s):**

1. Ambient
2.
3.
4.
5.
6.
7.
8.
9.
10.

*Numbered shipping lines correspond to Numbered Sample Temp lines

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

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

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

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

Notes:

Corrective Action:

- ☐ Client Contact Name: Informed by:
- ☐ Sample(s) processed "as is"
- ☐ Sample(s) on hold until: If released, notify:

Project Management Review: [signature] Date: 6-21-7

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

ADMIN-0004, REVISED 04/18/07\\Slsvr01\QA\FORMS\ST-LOUIS\ADMIN\Admin004 rev11.doc

# Appendix J

# Area B Gamma Scan Survey Data

Meter Model #: 2350-1
Meter S/N: 228710
Probe S/N: 242829
Cal Due Date: 2/26/08
Surveyed By:Anthony Smith

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 1 | 6 | 16 | 7 | 9 | 14 | 5005 |
| 2 | 6 | 16 | 7 | 9 | 14 | 5155 |
| 3 | 6 | 16 | 7 | 9 | 14 | 5124 |
| 4 | 6 | 16 | 7 | 9 | 14 | 5214 |
| 5 | 6 | 16 | 7 | 9 | 14 | 5226 |
| 6 | 6 | 16 | 7 | 9 | 14 | 4800 |
| 7 | 6 | 16 | 7 | 9 | 15 | 5517 |
| 8 | 6 | 16 | 7 | 9 | 15 | 4947 |
| 9 | 6 | 16 | 7 | 9 | 15 | 4847 |
| 10 | 6 | 16 | 7 | 9 | 15 | 5539 |
| 11 | 6 | 16 | 7 | 9 | 15 | 4746 |
| 12 | 6 | 16 | 7 | 9 | 15 | 4976 |
| 13 | 6 | 16 | 7 | 9 | 15 | 5301 |
| 14 | 6 | 16 | 7 | 9 | 15 | 5141 |
| 15 | 6 | 16 | 7 | 9 | 16 | 5246 |
| 16 | 6 | 16 | 7 | 9 | 16 | 5355 |
| 17 | 6 | 16 | 7 | 9 | 16 | 4662 |
| 18 | 6 | 16 | 7 | 9 | 16 | 5040 |
| 19 | 6 | 16 | 7 | 9 | 16 | 5104 |
| 20 | 6 | 16 | 7 | 9 | 16 | 4719 |
| 21 | 6 | 16 | 7 | 9 | 16 | 5350 |
| 22 | 6 | 16 | 7 | 9 | 16 | 5284 |
| 23 | 6 | 16 | 7 | 9 | 16 | 4875 |
| 24 | 6 | 16 | 7 | 9 | 17 | 5380 |
| 25 | 6 | 16 | 7 | 9 | 17 | 4612 |
| 26 | 6 | 16 | 7 | 9 | 17 | 5661 |
| 27 | 6 | 16 | 7 | 9 | 17 | 4791 |
| 28 | 6 | 16 | 7 | 9 | 17 | 5113 |
| 29 | 6 | 16 | 7 | 9 | 17 | 5323 |
| 30 | 6 | 16 | 7 | 9 | 17 | 4986 |
| 31 | 6 | 16 | 7 | 9 | 17 | 4803 |
| 32 | 6 | 16 | 7 | 9 | 17 | 5854 |
| 33 | 6 | 16 | 7 | 9 | 18 | 5279 |
| 34 | 6 | 16 | 7 | 9 | 18 | 6971 |
| 35 | 6 | 16 | 7 | 9 | 18 | 5340 |
| 36 | 6 | 16 | 7 | 9 | 18 | 6330 |
| 37 | 6 | 16 | 7 | 9 | 18 | 5830 |
| 38 | 6 | 16 | 7 | 9 | 18 | 5160 |
| 39 | 6 | 16 | 7 | 9 | 18 | 5222 |
| 40 | 6 | 16 | 7 | 9 | 18 | 4857 |
| 41 | 6 | 16 | 7 | 9 | 19 | 5719 |
| 42 | 6 | 16 | 7 | 9 | 19 | 4813 |
| 43 | 6 | 16 | 7 | 9 | 19 | 4938 |
| 44 | 6 | 16 | 7 | 9 | 19 | 5129 |
| 45 | 6 | 16 | 7 | 9 | 20 | 5098 |
| 46 | 6 | 16 | 7 | 9 | 20 | 5159 |
| 47 | 6 | 16 | 7 | 9 | 20 | 5282 |
| 48 | 6 | 16 | 7 | 9 | 20 | 5426 |
| 49 | 6 | 16 | 7 | 9 | 21 | 5851 |
| 50 | 6 | 16 | 7 | 9 | 21 | 5420 |
| 51 | 6 | 16 | 7 | 9 | 21 | 5682 |
| 52 | 6 | 16 | 7 | 9 | 21 | 4988 |
| 53 | 6 | 16 | 7 | 9 | 21 | 4747 |
| 54 | 6 | 16 | 7 | 9 | 21 | 5081 |
| 55 | 6 | 16 | 7 | 9 | 21 | 5940 |
| 56 | 6 | 16 | 7 | 9 | 21 | 6099 |
| 57 | 6 | 16 | 7 | 9 | 21 | 5920 |
| 58 | 6 | 16 | 7 | 9 | 22 | 5039 |
| 59 | 6 | 16 | 7 | 9 | 22 | 5617 |
| 60 | 6 | 16 | 7 | 9 | 22 | 4929 |
| 61 | 6 | 16 | 7 | 9 | 22 | 5733 |
| 62 | 6 | 16 | 7 | 9 | 22 | 5301 |
| 63 | 6 | 16 | 7 | 9 | 22 | 5562 |
| 64 | 6 | 16 | 7 | 9 | 22 | 5037 |
| 65 | 6 | 16 | 7 | 9 | 22 | 5539 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 66 | 6 | 16 | 7 | 9 | 23 | 6169 |
| 67 | 6 | 16 | 7 | 9 | 23 | 5703 |
| 68 | 6 | 16 | 7 | 9 | 23 | 5641 |
| 69 | 6 | 16 | 7 | 9 | 23 | 5000 |
| 70 | 6 | 16 | 7 | 9 | 23 | 5394 |
| 71 | 6 | 16 | 7 | 9 | 23 | 5556 |
| 72 | 6 | 16 | 7 | 9 | 23 | 5863 |
| 73 | 6 | 16 | 7 | 9 | 23 | 5736 |
| 74 | 6 | 16 | 7 | 9 | 23 | 5262 |
| 75 | 6 | 16 | 7 | 9 | 24 | 6096 |
| 76 | 6 | 16 | 7 | 9 | 24 | 5325 |
| 77 | 6 | 16 | 7 | 9 | 24 | 5199 |
| 78 | 6 | 16 | 7 | 9 | 24 | 6594 |
| 79 | 6 | 16 | 7 | 9 | 24 | 7138 |
| 80 | 6 | 16 | 7 | 9 | 24 | 5078 |
| 81 | 6 | 16 | 7 | 9 | 24 | 5662 |
| 82 | 6 | 16 | 7 | 9 | 24 | 5134 |
| 83 | 6 | 16 | 7 | 9 | 25 | 5243 |
| 84 | 6 | 16 | 7 | 9 | 25 | 5148 |
| 85 | 6 | 16 | 7 | 9 | 25 | 5424 |
| 86 | 6 | 16 | 7 | 9 | 25 | 5821 |
| 87 | 6 | 16 | 7 | 9 | 25 | 5197 |
| 88 | 6 | 16 | 7 | 9 | 25 | 4942 |
| 89 | 6 | 16 | 7 | 9 | 25 | 5326 |
| 90 | 6 | 16 | 7 | 9 | 26 | 5745 |
| 91 | 6 | 16 | 7 | 9 | 27 | 4785 |
| 92 | 6 | 16 | 7 | 9 | 27 | 5407 |
| 93 | 6 | 16 | 7 | 9 | 27 | 5525 |
| 94 | 6 | 16 | 7 | 9 | 27 | 5624 |
| 95 | 6 | 16 | 7 | 9 | 27 | 5152 |
| 96 | 6 | 16 | 7 | 9 | 27 | 4847 |
| 97 | 6 | 16 | 7 | 9 | 27 | 5048 |
| 98 | 6 | 16 | 7 | 9 | 27 | 5654 |
| 99 | 6 | 16 | 7 | 9 | 27 | 5288 |
| 100 | 6 | 16 | 7 | 9 | 28 | 5029 |
| 101 | 6 | 16 | 7 | 9 | 28 | 5299 |
| 102 | 6 | 16 | 7 | 9 | 28 | 5420 |
| 103 | 6 | 16 | 7 | 9 | 28 | 5265 |
| 104 | 6 | 16 | 7 | 9 | 28 | 5220 |
| 105 | 6 | 16 | 7 | 9 | 28 | 6082 |
| 106 | 6 | 16 | 7 | 9 | 28 | 5211 |
| 107 | 6 | 16 | 7 | 9 | 28 | 5185 |
| 108 | 6 | 16 | 7 | 9 | 29 | 5269 |
| 109 | 6 | 16 | 7 | 9 | 29 | 4926 |
| 110 | 6 | 16 | 7 | 9 | 29 | 4782 |
| 111 | 6 | 16 | 7 | 9 | 29 | 5039 |
| 112 | 6 | 16 | 7 | 9 | 29 | 5212 |
| 113 | 6 | 16 | 7 | 9 | 29 | 5741 |
| 114 | 6 | 16 | 7 | 9 | 29 | 5377 |
| 115 | 6 | 16 | 7 | 9 | 29 | 5628 |
| 116 | 6 | 16 | 7 | 9 | 29 | 5781 |
| 117 | 6 | 16 | 7 | 9 | 30 | 5539 |
| 118 | 6 | 16 | 7 | 9 | 30 | 5596 |
| 119 | 6 | 16 | 7 | 9 | 30 | 4894 |
| 120 | 6 | 16 | 7 | 9 | 30 | 5618 |
| 121 | 6 | 16 | 7 | 9 | 30 | 5542 |
| 122 | 6 | 16 | 7 | 9 | 30 | 6434 |
| 123 | 6 | 16 | 7 | 9 | 30 | 5560 |
| 124 | 6 | 16 | 7 | 9 | 30 | 5051 |
| 125 | 6 | 16 | 7 | 9 | 30 | 5547 |
| 126 | 6 | 16 | 7 | 9 | 31 | 5441 |
| 127 | 6 | 16 | 7 | 9 | 31 | 6183 |
| 128 | 6 | 16 | 7 | 9 | 31 | 5726 |
| 129 | 6 | 16 | 7 | 9 | 31 | 5501 |
| 130 | 6 | 16 | 7 | 9 | 31 | 5223 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 131 | 6 | 16 | 7 | 9 | 31 | 5623 |
| 132 | 6 | 16 | 7 | 9 | 31 | 5411 |
| 133 | 6 | 16 | 7 | 9 | 31 | 5496 |
| 134 | 6 | 16 | 7 | 9 | 32 | 4850 |
| 135 | 6 | 16 | 7 | 9 | 33 | 5673 |
| 136 | 6 | 16 | 7 | 9 | 33 | 5012 |
| 137 | 6 | 16 | 7 | 9 | 33 | 5101 |
| 138 | 6 | 16 | 7 | 9 | 33 | 5027 |
| 139 | 6 | 16 | 7 | 9 | 33 | 5322 |
| 140 | 6 | 16 | 7 | 9 | 33 | 5714 |
| 141 | 6 | 16 | 7 | 9 | 33 | 4981 |
| 142 | 6 | 16 | 7 | 9 | 34 | 5196 |
| 143 | 6 | 16 | 7 | 9 | 34 | 5609 |
| 144 | 6 | 16 | 7 | 9 | 34 | 5487 |
| 145 | 6 | 16 | 7 | 9 | 34 | 4929 |
| 146 | 6 | 16 | 7 | 9 | 34 | 5019 |
| 147 | 6 | 16 | 7 | 9 | 34 | 5048 |
| 148 | 6 | 16 | 7 | 9 | 34 | 4594 |
| 149 | 6 | 16 | 7 | 9 | 34 | 5110 |
| 150 | 6 | 16 | 7 | 9 | 34 | 5010 |
| 151 | 6 | 16 | 7 | 9 | 35 | 5325 |
| 152 | 6 | 16 | 7 | 9 | 35 | 5632 |
| 153 | 6 | 16 | 7 | 9 | 35 | 5687 |
| 154 | 6 | 16 | 7 | 9 | 35 | 5596 |
| 155 | 6 | 16 | 7 | 9 | 35 | 5153 |
| 156 | 6 | 16 | 7 | 9 | 35 | 5088 |
| 157 | 6 | 16 | 7 | 9 | 35 | 5074 |
| 158 | 6 | 16 | 7 | 9 | 35 | 5261 |
| 159 | 6 | 16 | 7 | 9 | 35 | 5150 |
| 160 | 6 | 16 | 7 | 9 | 36 | 4681 |
| 161 | 6 | 16 | 7 | 9 | 36 | 5511 |
| 162 | 6 | 16 | 7 | 9 | 36 | 5142 |
| 163 | 6 | 16 | 7 | 9 | 36 | 5309 |
| 164 | 6 | 16 | 7 | 9 | 36 | 4989 |
| 165 | 6 | 16 | 7 | 9 | 36 | 5047 |
| 166 | 6 | 16 | 7 | 9 | 36 | 5620 |
| 167 | 6 | 16 | 7 | 9 | 36 | 5643 |
| 168 | 6 | 16 | 7 | 9 | 37 | 6031 |
| 169 | 6 | 16 | 7 | 9 | 37 | 5535 |
| 170 | 6 | 16 | 7 | 9 | 37 | 5962 |
| 171 | 6 | 16 | 7 | 9 | 37 | 6108 |
| 172 | 6 | 16 | 7 | 9 | 37 | 6775 |
| 173 | 6 | 16 | 7 | 9 | 37 | 5928 |
| 174 | 6 | 16 | 7 | 9 | 37 | 7789 |
| 175 | 6 | 16 | 7 | 9 | 37 | 5623 |
| 176 | 6 | 16 | 7 | 9 | 37 | 5876 |
| 177 | 6 | 16 | 7 | 9 | 38 | 5214 |
| 178 | 6 | 16 | 7 | 9 | 38 | 5885 |
| 179 | 6 | 16 | 7 | 9 | 38 | 5856 |
| 180 | 6 | 16 | 7 | 9 | 38 | 5586 |
| 181 | 6 | 16 | 7 | 9 | 38 | 5782 |
| 182 | 6 | 16 | 7 | 9 | 38 | 5290 |
| 183 | 6 | 16 | 7 | 9 | 38 | 5944 |
| 184 | 6 | 16 | 7 | 9 | 39 | 5769 |
| 185 | 6 | 16 | 7 | 9 | 40 | 4742 |
| 186 | 6 | 16 | 7 | 9 | 40 | 5314 |
| 187 | 6 | 16 | 7 | 9 | 40 | 4924 |
| 188 | 6 | 16 | 7 | 9 | 40 | 5176 |
| 189 | 6 | 16 | 7 | 9 | 40 | 5436 |
| 190 | 6 | 16 | 7 | 9 | 40 | 5061 |
| 191 | 6 | 16 | 7 | 9 | 40 | 5433 |
| 192 | 6 | 16 | 7 | 9 | 40 | 5249 |
| 193 | 6 | 16 | 7 | 9 | 40 | 5675 |
| 194 | 6 | 16 | 7 | 9 | 41 | 4867 |
| 195 | 6 | 16 | 7 | 9 | 41 | 5396 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 196 | 6 | 16 | 7 | 9 | 41 | 4652 |
| 197 | 6 | 16 | 7 | 9 | 41 | 4755 |
| 198 | 6 | 16 | 7 | 9 | 41 | 5749 |
| 199 | 6 | 16 | 7 | 9 | 41 | 5821 |
| 200 | 6 | 16 | 7 | 9 | 41 | 5340 |
| 201 | 6 | 16 | 7 | 9 | 41 | 5603 |
| 202 | 6 | 16 | 7 | 9 | 42 | 5272 |
| 203 | 6 | 16 | 7 | 9 | 42 | 5508 |
| 204 | 6 | 16 | 7 | 9 | 42 | 5488 |
| 205 | 6 | 16 | 7 | 9 | 42 | 5732 |
| 206 | 6 | 16 | 7 | 9 | 42 | 6095 |
| 207 | 6 | 16 | 7 | 9 | 42 | 5385 |
| 208 | 6 | 16 | 7 | 9 | 42 | 5680 |
| 209 | 6 | 16 | 7 | 9 | 42 | 5906 |
| 210 | 6 | 16 | 7 | 9 | 42 | 5827 |
| 211 | 6 | 16 | 7 | 9 | 43 | 5521 |
| 212 | 6 | 16 | 7 | 9 | 43 | 5682 |
| 213 | 6 | 16 | 7 | 9 | 43 | 5453 |
| 214 | 6 | 16 | 7 | 9 | 43 | 5424 |
| 215 | 6 | 16 | 7 | 9 | 43 | 5180 |
| 216 | 6 | 16 | 7 | 9 | 43 | 5415 |
| 217 | 6 | 16 | 7 | 9 | 43 | 5295 |
| 218 | 6 | 16 | 7 | 9 | 43 | 5597 |
| 219 | 6 | 16 | 7 | 9 | 43 | 5722 |
| 220 | 6 | 16 | 7 | 9 | 44 | 6006 |
| 221 | 6 | 16 | 7 | 9 | 44 | 6099 |
| 222 | 6 | 16 | 7 | 9 | 44 | 5967 |
| 223 | 6 | 16 | 7 | 9 | 44 | 6657 |
| 224 | 6 | 16 | 7 | 9 | 44 | 5982 |
| 225 | 6 | 16 | 7 | 10 | 34 | 5695 |
| 226 | 6 | 16 | 7 | 10 | 34 | 4665 |
| 227 | 6 | 16 | 7 | 10 | 34 | 5550 |
| 228 | 6 | 16 | 7 | 10 | 34 | 5353 |
| 229 | 6 | 16 | 7 | 10 | 34 | 5674 |
| 230 | 6 | 16 | 7 | 10 | 34 | 5216 |
| 231 | 6 | 16 | 7 | 10 | 34 | 5920 |
| 232 | 6 | 16 | 7 | 10 | 34 | 5384 |
| 233 | 6 | 16 | 7 | 10 | 34 | 6157 |
| 234 | 6 | 16 | 7 | 10 | 35 | 5577 |
| 235 | 6 | 16 | 7 | 10 | 35 | 5020 |
| 236 | 6 | 16 | 7 | 10 | 35 | 5455 |
| 237 | 6 | 16 | 7 | 10 | 35 | 5071 |
| 238 | 6 | 16 | 7 | 10 | 35 | 5266 |
| 239 | 6 | 16 | 7 | 10 | 35 | 5275 |
| 240 | 6 | 16 | 7 | 10 | 35 | 4917 |
| 241 | 6 | 16 | 7 | 10 | 35 | 4762 |
| 242 | 6 | 16 | 7 | 10 | 35 | 5632 |
| 243 | 6 | 16 | 7 | 10 | 36 | 5694 |
| 244 | 6 | 16 | 7 | 10 | 36 | 5209 |
| 245 | 6 | 16 | 7 | 10 | 36 | 5647 |
| 246 | 6 | 16 | 7 | 10 | 36 | 5261 |
| 247 | 6 | 16 | 7 | 10 | 36 | 5498 |
| 248 | 6 | 16 | 7 | 10 | 36 | 5524 |
| 249 | 6 | 16 | 7 | 10 | 36 | 5603 |
| 250 | 6 | 16 | 7 | 10 | 36 | 5548 |
| 251 | 6 | 16 | 7 | 10 | 37 | 5640 |
| 252 | 6 | 16 | 7 | 10 | 37 | 5279 |
| 253 | 6 | 16 | 7 | 10 | 37 | 5152 |
| 254 | 6 | 16 | 7 | 10 | 37 | 5551 |
| 255 | 6 | 16 | 7 | 10 | 37 | 5944 |
| 256 | 6 | 16 | 7 | 10 | 37 | 5252 |
| 257 | 6 | 16 | 7 | 10 | 37 | 5092 |
| 258 | 6 | 16 | 7 | 10 | 37 | 5814 |
| 259 | 6 | 16 | 7 | 10 | 37 | 4911 |
| 260 | 6 | 16 | 7 | 10 | 38 | 5450 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 261 | 6 | 16 | 7 | 10 | 38 | 5509 |
| 262 | 6 | 16 | 7 | 10 | 38 | 5610 |
| 263 | 6 | 16 | 7 | 10 | 38 | 6144 |
| 264 | 6 | 16 | 7 | 10 | 38 | 6975 |
| 265 | 6 | 16 | 7 | 10 | 38 | 7433 |
| 266 | 6 | 16 | 7 | 10 | 38 | 6789 |
| 267 | 6 | 16 | 7 | 10 | 38 | 5473 |
| 268 | 6 | 16 | 7 | 10 | 39 | 5608 |
| 269 | 6 | 16 | 7 | 10 | 39 | 5661 |
| 270 | 6 | 16 | 7 | 10 | 40 | 5755 |
| 271 | 6 | 16 | 7 | 10 | 40 | 5707 |
| 272 | 6 | 16 | 7 | 10 | 40 | 5659 |
| 273 | 6 | 16 | 7 | 10 | 40 | 5313 |
| 274 | 6 | 16 | 7 | 10 | 40 | 5289 |
| 275 | 6 | 16 | 7 | 10 | 40 | 5872 |
| 276 | 6 | 16 | 7 | 10 | 40 | 5499 |
| 277 | 6 | 16 | 7 | 10 | 41 | 5436 |
| 278 | 6 | 16 | 7 | 10 | 41 | 5594 |
| 279 | 6 | 16 | 7 | 10 | 41 | 5686 |
| 280 | 6 | 16 | 7 | 10 | 41 | 5599 |
| 281 | 6 | 16 | 7 | 10 | 41 | 4896 |
| 282 | 6 | 16 | 7 | 10 | 41 | 4725 |
| 283 | 6 | 16 | 7 | 10 | 41 | 4874 |
| 284 | 6 | 16 | 7 | 10 | 41 | 4792 |
| 285 | 6 | 16 | 7 | 10 | 41 | 5521 |
| 286 | 6 | 16 | 7 | 10 | 42 | 5365 |
| 287 | 6 | 16 | 7 | 10 | 42 | 5661 |
| 288 | 6 | 16 | 7 | 10 | 42 | 5844 |
| 289 | 6 | 16 | 7 | 10 | 42 | 5463 |
| 290 | 6 | 16 | 7 | 10 | 42 | 5308 |
| 291 | 6 | 16 | 7 | 10 | 42 | 5446 |
| 292 | 6 | 16 | 7 | 10 | 42 | 5386 |
| 293 | 6 | 16 | 7 | 10 | 42 | 5500 |
| 294 | 6 | 16 | 7 | 10 | 43 | 5080 |
| 295 | 6 | 16 | 7 | 10 | 43 | 4481 |
| 296 | 6 | 16 | 7 | 10 | 43 | 5146 |
| 297 | 6 | 16 | 7 | 10 | 43 | 5716 |
| 298 | 6 | 16 | 7 | 10 | 43 | 5339 |
| 299 | 6 | 16 | 7 | 10 | 43 | 5031 |
| 300 | 6 | 16 | 7 | 10 | 43 | 5470 |
| 301 | 6 | 16 | 7 | 10 | 43 | 5736 |
| 302 | 6 | 16 | 7 | 10 | 43 | 4800 |
| 303 | 6 | 16 | 7 | 10 | 44 | 4969 |
| 304 | 6 | 16 | 7 | 10 | 44 | 5392 |
| 305 | 6 | 16 | 7 | 10 | 44 | 4859 |
| 306 | 6 | 16 | 7 | 10 | 44 | 5527 |
| 307 | 6 | 16 | 7 | 10 | 44 | 5295 |
| 308 | 6 | 16 | 7 | 10 | 44 | 5431 |
| 309 | 6 | 16 | 7 | 10 | 44 | 5547 |
| 310 | 6 | 16 | 7 | 10 | 44 | 5991 |
| 311 | 6 | 16 | 7 | 10 | 45 | 7838 |
| 312 | 6 | 16 | 7 | 10 | 45 | 5720 |
| 313 | 6 | 16 | 7 | 10 | 45 | 5496 |
| 314 | 6 | 16 | 7 | 10 | 45 | 5675 |
| 315 | 6 | 16 | 7 | 10 | 46 | 5545 |
| 316 | 6 | 16 | 7 | 10 | 46 | 6023 |
| 317 | 6 | 16 | 7 | 10 | 46 | 5439 |
| 318 | 6 | 16 | 7 | 10 | 46 | 5514 |
| 319 | 6 | 16 | 7 | 10 | 46 | 5567 |
| 320 | 6 | 16 | 7 | 10 | 46 | 5812 |
| 321 | 6 | 16 | 7 | 10 | 47 | 5742 |
| 322 | 6 | 16 | 7 | 10 | 47 | 6031 |
| 323 | 6 | 16 | 7 | 10 | 47 | 5232 |
| 324 | 6 | 16 | 7 | 10 | 47 | 5211 |
| 325 | 6 | 16 | 7 | 10 | 47 | 5697 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 326 | 6 | 16 | 7 | 10 | 47 | 4872 |
| 327 | 6 | 16 | 7 | 10 | 47 | 5274 |
| 328 | 6 | 16 | 7 | 10 | 47 | 4730 |
| 329 | 6 | 16 | 7 | 10 | 47 | 4719 |
| 330 | 6 | 16 | 7 | 10 | 48 | 5215 |
| 331 | 6 | 16 | 7 | 10 | 48 | 5656 |
| 332 | 6 | 16 | 7 | 10 | 48 | 5749 |
| 333 | 6 | 16 | 7 | 10 | 48 | 5299 |
| 334 | 6 | 16 | 7 | 10 | 48 | 5552 |
| 335 | 6 | 16 | 7 | 10 | 48 | 5899 |
| 336 | 6 | 16 | 7 | 10 | 48 | 5618 |
| 337 | 6 | 16 | 7 | 10 | 48 | 5330 |
| 338 | 6 | 16 | 7 | 10 | 49 | 5958 |
| 339 | 6 | 16 | 7 | 10 | 49 | 5561 |
| 340 | 6 | 16 | 7 | 10 | 49 | 5418 |
| 341 | 6 | 16 | 7 | 10 | 49 | 5454 |
| 342 | 6 | 16 | 7 | 10 | 49 | 5481 |
| 343 | 6 | 16 | 7 | 10 | 49 | 5314 |
| 344 | 6 | 16 | 7 | 10 | 49 | 5411 |
| 345 | 6 | 16 | 7 | 10 | 49 | 5782 |
| 346 | 6 | 16 | 7 | 10 | 49 | 5759 |
| 347 | 6 | 16 | 7 | 10 | 50 | 5642 |
| 348 | 6 | 16 | 7 | 10 | 50 | 5142 |
| 349 | 6 | 16 | 7 | 10 | 50 | 4916 |
| 350 | 6 | 16 | 7 | 10 | 50 | 5970 |
| 351 | 6 | 16 | 7 | 10 | 50 | 5407 |
| 352 | 6 | 16 | 7 | 10 | 50 | 5202 |
| 353 | 6 | 16 | 7 | 10 | 50 | 5374 |
| 354 | 6 | 16 | 7 | 10 | 50 | 5216 |
| 355 | 6 | 16 | 7 | 10 | 51 | 5919 |
| 356 | 6 | 16 | 7 | 10 | 51 | 7260 |
| 357 | 6 | 16 | 7 | 10 | 51 | 7356 |
| 358 | 6 | 16 | 7 | 10 | 51 | 7192 |
| 359 | 6 | 16 | 7 | 10 | 51 | 7010 |
| 360 | 6 | 16 | 7 | 10 | 52 | 5406 |
| 361 | 6 | 16 | 7 | 10 | 52 | 6683 |
| 362 | 6 | 16 | 7 | 10 | 53 | 7357 |
| 363 | 6 | 16 | 7 | 10 | 53 | 5734 |
| 364 | 6 | 16 | 7 | 10 | 53 | 5915 |
| 365 | 6 | 16 | 7 | 10 | 53 | 7091 |
| 366 | 6 | 16 | 7 | 10 | 53 | 5924 |
| 367 | 6 | 16 | 7 | 10 | 53 | 6703 |
| 368 | 6 | 16 | 7 | 10 | 53 | 6549 |
| 369 | 6 | 16 | 7 | 10 | 53 | 6052 |
| 370 | 6 | 16 | 7 | 10 | 53 | 5417 |
| 371 | 6 | 16 | 7 | 10 | 54 | 4862 |
| 372 | 6 | 16 | 7 | 10 | 54 | 5142 |
| 373 | 6 | 16 | 7 | 10 | 54 | 4442 |
| 374 | 6 | 16 | 7 | 10 | 54 | 5263 |
| 375 | 6 | 16 | 7 | 10 | 54 | 5797 |
| 376 | 6 | 16 | 7 | 10 | 54 | 5314 |
| 377 | 6 | 16 | 7 | 10 | 54 | 5461 |
| 378 | 6 | 16 | 7 | 10 | 54 | 5568 |
| 379 | 6 | 16 | 7 | 10 | 55 | 5025 |
| 380 | 6 | 16 | 7 | 10 | 55 | 5657 |
| 381 | 6 | 16 | 7 | 10 | 55 | 5332 |
| 382 | 6 | 16 | 7 | 10 | 55 | 5561 |
| 383 | 6 | 16 | 7 | 10 | 55 | 5904 |
| 384 | 6 | 16 | 7 | 10 | 55 | 5944 |
| 385 | 6 | 16 | 7 | 10 | 55 | 5502 |
| 386 | 6 | 16 | 7 | 10 | 55 | 5465 |
| 387 | 6 | 16 | 7 | 10 | 55 | 5645 |
| 388 | 6 | 16 | 7 | 10 | 56 | 5374 |
| 389 | 6 | 16 | 7 | 10 | 56 | 5592 |
| 390 | 6 | 16 | 7 | 10 | 56 | 5147 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 391 | 6 | 16 | 7 | 10 | 56 | 5006 |
| 392 | 6 | 16 | 7 | 10 | 56 | 5004 |
| 393 | 6 | 16 | 7 | 10 | 56 | 5391 |
| 394 | 6 | 16 | 7 | 10 | 56 | 5001 |
| 395 | 6 | 16 | 7 | 10 | 56 | 5737 |
| 396 | 6 | 16 | 7 | 10 | 56 | 4587 |
| 397 | 6 | 16 | 7 | 10 | 57 | 5445 |
| 398 | 6 | 16 | 7 | 10 | 57 | 4824 |
| 399 | 6 | 16 | 7 | 10 | 57 | 5946 |
| 400 | 6 | 16 | 7 | 10 | 57 | 5261 |
| 401 | 6 | 16 | 7 | 10 | 57 | 5810 |
| 402 | 6 | 16 | 7 | 10 | 57 | 5769 |
| 403 | 6 | 16 | 7 | 10 | 57 | 5809 |
| 404 | 6 | 16 | 7 | 10 | 57 | 6347 |
| 405 | 6 | 16 | 7 | 10 | 59 | 6004 |
| 406 | 6 | 16 | 7 | 10 | 59 | 6527 |
| 407 | 6 | 16 | 7 | 10 | 59 | 7424 |
| 408 | 6 | 16 | 7 | 10 | 59 | 5811 |
| 409 | 6 | 16 | 7 | 10 | 59 | 6036 |
| 410 | 6 | 16 | 7 | 10 | 59 | 6712 |
| 411 | 6 | 16 | 7 | 11 | 0 | 6037 |
| 412 | 6 | 16 | 7 | 11 | 0 | 6293 |
| 413 | 6 | 16 | 7 | 11 | 0 | 5328 |
| 414 | 6 | 16 | 7 | 11 | 0 | 6102 |
| 415 | 6 | 16 | 7 | 11 | 0 | 5584 |
| 416 | 6 | 16 | 7 | 11 | 0 | 5219 |
| 417 | 6 | 16 | 7 | 11 | 0 | 5054 |
| 418 | 6 | 16 | 7 | 11 | 0 | 4828 |
| 419 | 6 | 16 | 7 | 11 | 1 | 4918 |
| 420 | 6 | 16 | 7 | 11 | 1 | 5393 |
| 421 | 6 | 16 | 7 | 11 | 1 | 4646 |
| 422 | 6 | 16 | 7 | 11 | 1 | 5114 |
| 423 | 6 | 16 | 7 | 11 | 1 | 5270 |
| 424 | 6 | 16 | 7 | 11 | 1 | 4886 |
| 425 | 6 | 16 | 7 | 11 | 1 | 5907 |
| 426 | 6 | 16 | 7 | 11 | 1 | 5756 |
| 427 | 6 | 16 | 7 | 11 | 1 | 5396 |
| 428 | 6 | 16 | 7 | 11 | 2 | 5560 |
| 429 | 6 | 16 | 7 | 11 | 2 | 5172 |
| 430 | 6 | 16 | 7 | 11 | 2 | 5136 |
| 431 | 6 | 16 | 7 | 11 | 2 | 5571 |
| 432 | 6 | 16 | 7 | 11 | 2 | 5582 |
| 433 | 6 | 16 | 7 | 11 | 2 | 5345 |
| 434 | 6 | 16 | 7 | 11 | 2 | 5150 |
| 435 | 6 | 16 | 7 | 11 | 2 | 5757 |
| 436 | 6 | 16 | 7 | 11 | 3 | 5681 |
| 437 | 6 | 16 | 7 | 11 | 3 | 5132 |
| 438 | 6 | 16 | 7 | 11 | 3 | 4997 |
| 439 | 6 | 16 | 7 | 11 | 3 | 5432 |
| 440 | 6 | 16 | 7 | 11 | 3 | 4908 |
| 441 | 6 | 16 | 7 | 11 | 3 | 5502 |
| 442 | 6 | 16 | 7 | 11 | 3 | 5620 |
| 443 | 6 | 16 | 7 | 11 | 3 | 5374 |
| 444 | 6 | 16 | 7 | 11 | 3 | 5351 |
| 445 | 6 | 16 | 7 | 11 | 4 | 5711 |
| 446 | 6 | 16 | 7 | 11 | 4 | 5601 |
| 447 | 6 | 16 | 7 | 11 | 4 | 5747 |
| 448 | 6 | 16 | 7 | 11 | 4 | 5989 |
| 449 | 6 | 16 | 7 | 11 | 4 | 5518 |
| 450 | 6 | 16 | 7 | 11 | 6 | 5916 |
| 451 | 6 | 16 | 7 | 11 | 6 | 6935 |
| 452 | 6 | 16 | 7 | 11 | 6 | 7093 |
| 453 | 6 | 16 | 7 | 11 | 6 | 6602 |
| 454 | 6 | 16 | 7 | 11 | 6 | 6767 |
| 455 | 6 | 16 | 7 | 11 | 6 | 6135 |

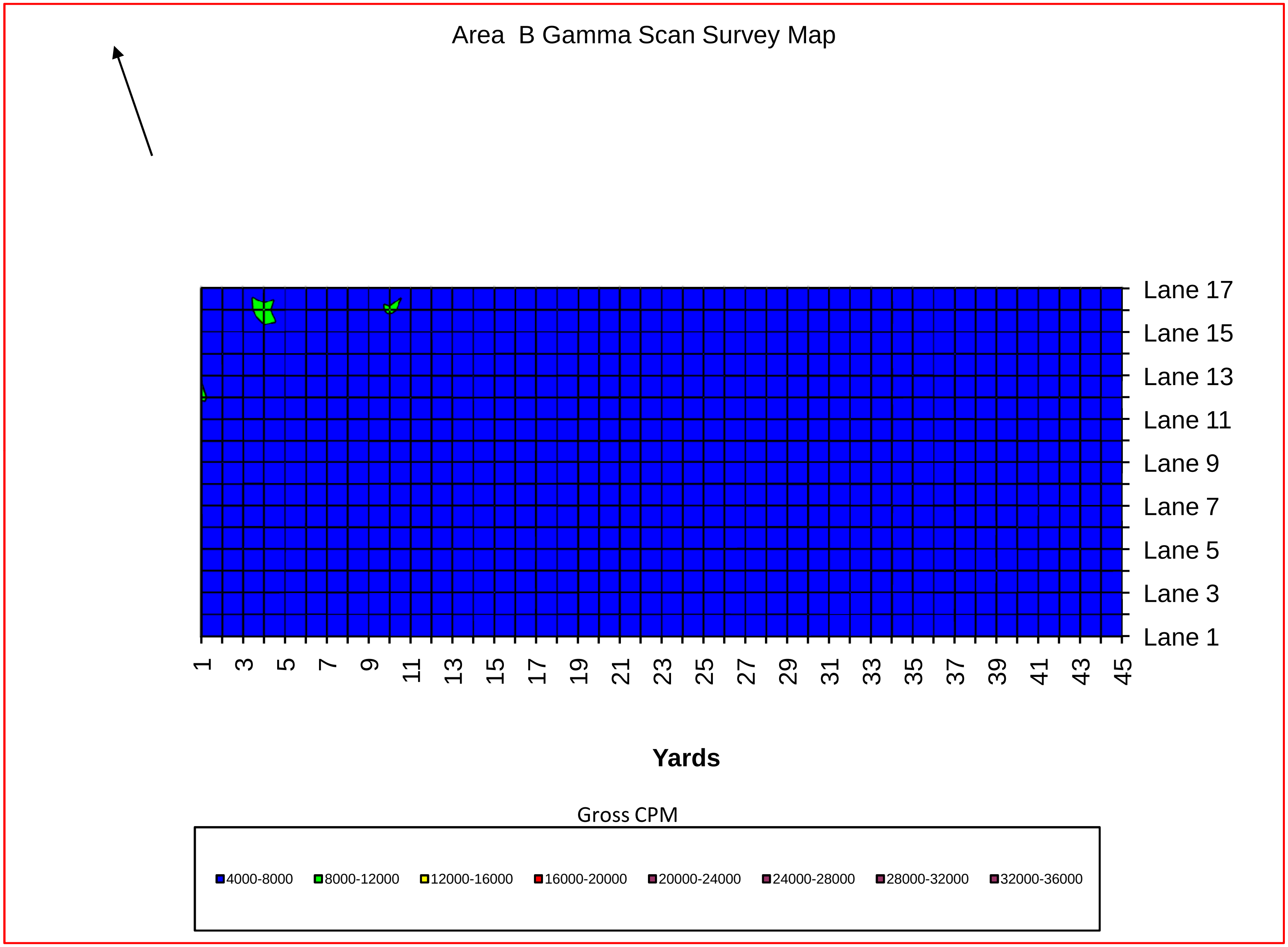
| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 456 | 6 | 16 | 7 | 11 | 7 | 6431 |
| 457 | 6 | 16 | 7 | 11 | 7 | 6100 |
| 458 | 6 | 16 | 7 | 11 | 7 | 6702 |
| 459 | 6 | 16 | 7 | 11 | 7 | 5405 |
| 460 | 6 | 16 | 7 | 11 | 7 | 5931 |
| 461 | 6 | 16 | 7 | 11 | 7 | 5221 |
| 462 | 6 | 16 | 7 | 11 | 7 | 5478 |
| 463 | 6 | 16 | 7 | 11 | 7 | 5242 |
| 464 | 6 | 16 | 7 | 11 | 8 | 4630 |
| 465 | 6 | 16 | 7 | 11 | 8 | 5148 |
| 466 | 6 | 16 | 7 | 11 | 8 | 4780 |
| 467 | 6 | 16 | 7 | 11 | 8 | 4736 |
| 468 | 6 | 16 | 7 | 11 | 8 | 5240 |
| 469 | 6 | 16 | 7 | 11 | 8 | 4756 |
| 470 | 6 | 16 | 7 | 11 | 8 | 4800 |
| 471 | 6 | 16 | 7 | 11 | 8 | 5502 |
| 472 | 6 | 16 | 7 | 11 | 8 | 5070 |
| 473 | 6 | 16 | 7 | 11 | 9 | 5735 |
| 474 | 6 | 16 | 7 | 11 | 9 | 5308 |
| 475 | 6 | 16 | 7 | 11 | 9 | 4981 |
| 476 | 6 | 16 | 7 | 11 | 9 | 5547 |
| 477 | 6 | 16 | 7 | 11 | 9 | 5007 |
| 478 | 6 | 16 | 7 | 11 | 9 | 4891 |
| 479 | 6 | 16 | 7 | 11 | 9 | 5463 |
| 480 | 6 | 16 | 7 | 11 | 9 | 5154 |
| 481 | 6 | 16 | 7 | 11 | 9 | 4844 |
| 482 | 6 | 16 | 7 | 11 | 10 | 5641 |
| 483 | 6 | 16 | 7 | 11 | 10 | 4808 |
| 484 | 6 | 16 | 7 | 11 | 10 | 5475 |
| 485 | 6 | 16 | 7 | 11 | 10 | 5368 |
| 486 | 6 | 16 | 7 | 11 | 10 | 5904 |
| 487 | 6 | 16 | 7 | 11 | 10 | 5711 |
| 488 | 6 | 16 | 7 | 11 | 10 | 5172 |
| 489 | 6 | 16 | 7 | 11 | 10 | 5174 |
| 490 | 6 | 16 | 7 | 11 | 11 | 4784 |
| 491 | 6 | 16 | 7 | 11 | 11 | 5632 |
| 492 | 6 | 16 | 7 | 11 | 11 | 4806 |
| 493 | 6 | 16 | 7 | 11 | 11 | 5207 |
| 494 | 6 | 16 | 7 | 11 | 11 | 4991 |
| 495 | 6 | 16 | 7 | 11 | 13 | 6767 |
| 496 | 6 | 16 | 7 | 11 | 13 | 8201 |
| 497 | 6 | 16 | 7 | 11 | 13 | 7369 |
| 498 | 6 | 16 | 7 | 11 | 13 | 7024 |
| 499 | 6 | 16 | 7 | 11 | 13 | 6151 |
| 500 | 6 | 16 | 7 | 11 | 13 | 6715 |
| 501 | 6 | 16 | 7 | 11 | 14 | 6397 |
| 502 | 6 | 16 | 7 | 11 | 14 | 6916 |
| 503 | 6 | 16 | 7 | 11 | 14 | 7273 |
| 504 | 6 | 16 | 7 | 11 | 14 | 5809 |
| 505 | 6 | 16 | 7 | 11 | 14 | 5727 |
| 506 | 6 | 16 | 7 | 11 | 14 | 6607 |
| 507 | 6 | 16 | 7 | 11 | 14 | 5983 |
| 508 | 6 | 16 | 7 | 11 | 14 | 6176 |
| 509 | 6 | 16 | 7 | 11 | 14 | 5640 |
| 510 | 6 | 16 | 7 | 11 | 15 | 5313 |
| 511 | 6 | 16 | 7 | 11 | 15 | 5782 |
| 512 | 6 | 16 | 7 | 11 | 15 | 5164 |
| 513 | 6 | 16 | 7 | 11 | 15 | 4803 |
| 514 | 6 | 16 | 7 | 11 | 15 | 5435 |
| 515 | 6 | 16 | 7 | 11 | 15 | 4996 |
| 516 | 6 | 16 | 7 | 11 | 15 | 5788 |
| 517 | 6 | 16 | 7 | 11 | 15 | 5430 |
| 518 | 6 | 16 | 7 | 11 | 16 | 5275 |
| 519 | 6 | 16 | 7 | 11 | 16 | 5257 |
| 520 | 6 | 16 | 7 | 11 | 16 | 5903 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 521 | 6 | 16 | 7 | 11 | 16 | 5023 |
| 522 | 6 | 16 | 7 | 11 | 16 | 5435 |
| 523 | 6 | 16 | 7 | 11 | 16 | 5724 |
| 524 | 6 | 16 | 7 | 11 | 16 | 4961 |
| 525 | 6 | 16 | 7 | 11 | 16 | 5239 |
| 526 | 6 | 16 | 7 | 11 | 16 | 5259 |
| 527 | 6 | 16 | 7 | 11 | 17 | 5096 |
| 528 | 6 | 16 | 7 | 11 | 17 | 5139 |
| 529 | 6 | 16 | 7 | 11 | 17 | 5107 |
| 530 | 6 | 16 | 7 | 11 | 17 | 5544 |
| 531 | 6 | 16 | 7 | 11 | 17 | 5082 |
| 532 | 6 | 16 | 7 | 11 | 17 | 4807 |
| 533 | 6 | 16 | 7 | 11 | 17 | 5361 |
| 534 | 6 | 16 | 7 | 11 | 17 | 6182 |
| 535 | 6 | 16 | 7 | 11 | 18 | 5517 |
| 536 | 6 | 16 | 7 | 11 | 18 | 5284 |
| 537 | 6 | 16 | 7 | 11 | 18 | 6167 |
| 538 | 6 | 16 | 7 | 11 | 18 | 5703 |
| 539 | 6 | 16 | 7 | 11 | 18 | 5274 |
| 540 | 6 | 16 | 7 | 11 | 20 | 4497 |
| 541 | 6 | 16 | 7 | 11 | 20 | 7938 |
| 542 | 6 | 16 | 7 | 11 | 20 | 6809 |
| 543 | 6 | 16 | 7 | 11 | 20 | 7043 |
| 544 | 6 | 16 | 7 | 11 | 21 | 6926 |
| 545 | 6 | 16 | 7 | 11 | 21 | 6131 |
| 546 | 6 | 16 | 7 | 11 | 21 | 6135 |
| 547 | 6 | 16 | 7 | 11 | 21 | 6716 |
| 548 | 6 | 16 | 7 | 11 | 21 | 6271 |
| 549 | 6 | 16 | 7 | 11 | 21 | 5954 |
| 550 | 6 | 16 | 7 | 11 | 21 | 6548 |
| 551 | 6 | 16 | 7 | 11 | 21 | 5932 |
| 552 | 6 | 16 | 7 | 11 | 22 | 6191 |
| 553 | 6 | 16 | 7 | 11 | 22 | 6059 |
| 554 | 6 | 16 | 7 | 11 | 22 | 7085 |
| 555 | 6 | 16 | 7 | 11 | 22 | 6132 |
| 556 | 6 | 16 | 7 | 11 | 22 | 5852 |
| 557 | 6 | 16 | 7 | 11 | 22 | 5821 |
| 558 | 6 | 16 | 7 | 11 | 22 | 5304 |
| 559 | 6 | 16 | 7 | 11 | 22 | 5435 |
| 560 | 6 | 16 | 7 | 11 | 22 | 5165 |
| 561 | 6 | 16 | 7 | 11 | 23 | 5416 |
| 562 | 6 | 16 | 7 | 11 | 23 | 4871 |
| 563 | 6 | 16 | 7 | 11 | 23 | 5259 |
| 564 | 6 | 16 | 7 | 11 | 23 | 4988 |
| 565 | 6 | 16 | 7 | 11 | 23 | 4845 |
| 566 | 6 | 16 | 7 | 11 | 23 | 5591 |
| 567 | 6 | 16 | 7 | 11 | 23 | 5349 |
| 568 | 6 | 16 | 7 | 11 | 23 | 5006 |
| 569 | 6 | 16 | 7 | 11 | 24 | 5838 |
| 570 | 6 | 16 | 7 | 11 | 24 | 5465 |
| 571 | 6 | 16 | 7 | 11 | 24 | 5172 |
| 572 | 6 | 16 | 7 | 11 | 24 | 4947 |
| 573 | 6 | 16 | 7 | 11 | 24 | 5739 |
| 574 | 6 | 16 | 7 | 11 | 24 | 5517 |
| 575 | 6 | 16 | 7 | 11 | 24 | 5650 |
| 576 | 6 | 16 | 7 | 11 | 24 | 4972 |
| 577 | 6 | 16 | 7 | 11 | 24 | 5475 |
| 578 | 6 | 16 | 7 | 11 | 25 | 5596 |
| 579 | 6 | 16 | 7 | 11 | 25 | 5518 |
| 580 | 6 | 16 | 7 | 11 | 25 | 5173 |
| 581 | 6 | 16 | 7 | 11 | 25 | 5553 |
| 582 | 6 | 16 | 7 | 11 | 25 | 5010 |
| 583 | 6 | 16 | 7 | 11 | 25 | 5025 |
| 584 | 6 | 16 | 7 | 11 | 25 | 5367 |
| 585 | 6 | 16 | 7 | 11 | 27 | 6121 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 586 | 6 | 16 | 7 | 11 | 27 | 7640 |
| 587 | 6 | 16 | 7 | 11 | 27 | 7676 |
| 588 | 6 | 16 | 7 | 11 | 27 | 6461 |
| 589 | 6 | 16 | 7 | 11 | 27 | 7365 |
| 590 | 6 | 16 | 7 | 11 | 27 | 5742 |
| 591 | 6 | 16 | 7 | 11 | 27 | 7145 |
| 592 | 6 | 16 | 7 | 11 | 27 | 7447 |
| 593 | 6 | 16 | 7 | 11 | 27 | 6311 |
| 594 | 6 | 16 | 7 | 11 | 28 | 6178 |
| 595 | 6 | 16 | 7 | 11 | 28 | 6670 |
| 596 | 6 | 16 | 7 | 11 | 28 | 5778 |
| 597 | 6 | 16 | 7 | 11 | 28 | 6628 |
| 598 | 6 | 16 | 7 | 11 | 28 | 6313 |
| 599 | 6 | 16 | 7 | 11 | 28 | 5681 |
| 600 | 6 | 16 | 7 | 11 | 28 | 6560 |
| 601 | 6 | 16 | 7 | 11 | 28 | 6063 |
| 602 | 6 | 16 | 7 | 11 | 29 | 6240 |
| 603 | 6 | 16 | 7 | 11 | 29 | 5937 |
| 604 | 6 | 16 | 7 | 11 | 29 | 5074 |
| 605 | 6 | 16 | 7 | 11 | 29 | 5861 |
| 606 | 6 | 16 | 7 | 11 | 29 | 5473 |
| 607 | 6 | 16 | 7 | 11 | 29 | 5524 |
| 608 | 6 | 16 | 7 | 11 | 29 | 5092 |
| 609 | 6 | 16 | 7 | 11 | 29 | 4990 |
| 610 | 6 | 16 | 7 | 11 | 29 | 5631 |
| 611 | 6 | 16 | 7 | 11 | 30 | 4936 |
| 612 | 6 | 16 | 7 | 11 | 30 | 5203 |
| 613 | 6 | 16 | 7 | 11 | 30 | 5851 |
| 614 | 6 | 16 | 7 | 11 | 30 | 5639 |
| 615 | 6 | 16 | 7 | 11 | 30 | 5626 |
| 616 | 6 | 16 | 7 | 11 | 30 | 4875 |
| 617 | 6 | 16 | 7 | 11 | 30 | 5070 |
| 618 | 6 | 16 | 7 | 11 | 30 | 4939 |
| 619 | 6 | 16 | 7 | 11 | 30 | 4666 |
| 620 | 6 | 16 | 7 | 11 | 31 | 4935 |
| 621 | 6 | 16 | 7 | 11 | 31 | 4883 |
| 622 | 6 | 16 | 7 | 11 | 31 | 6283 |
| 623 | 6 | 16 | 7 | 11 | 31 | 5156 |
| 624 | 6 | 16 | 7 | 11 | 31 | 4973 |
| 625 | 6 | 16 | 7 | 11 | 31 | 5871 |
| 626 | 6 | 16 | 7 | 11 | 31 | 5440 |
| 627 | 6 | 16 | 7 | 11 | 32 | 5544 |
| 628 | 6 | 16 | 7 | 11 | 32 | 5308 |
| 629 | 6 | 16 | 7 | 11 | 33 | 6027 |
| 630 | 6 | 16 | 7 | 11 | 33 | 7457 |
| 631 | 6 | 16 | 7 | 11 | 33 | 7738 |
| 632 | 6 | 16 | 7 | 11 | 33 | 6553 |
| 633 | 6 | 16 | 7 | 11 | 33 | 6313 |
| 634 | 6 | 16 | 7 | 11 | 34 | 7583 |
| 635 | 6 | 16 | 7 | 11 | 34 | 7295 |
| 636 | 6 | 16 | 7 | 11 | 34 | 6124 |
| 637 | 6 | 16 | 7 | 11 | 34 | 6474 |
| 638 | 6 | 16 | 7 | 11 | 34 | 7130 |
| 639 | 6 | 16 | 7 | 11 | 34 | 5987 |
| 640 | 6 | 16 | 7 | 11 | 34 | 6258 |
| 641 | 6 | 16 | 7 | 11 | 34 | 5907 |
| 642 | 6 | 16 | 7 | 11 | 34 | 7433 |
| 643 | 6 | 16 | 7 | 11 | 35 | 5786 |
| 644 | 6 | 16 | 7 | 11 | 35 | 7557 |
| 645 | 6 | 16 | 7 | 11 | 35 | 6494 |
| 646 | 6 | 16 | 7 | 11 | 35 | 5949 |
| 647 | 6 | 16 | 7 | 11 | 35 | 5554 |
| 648 | 6 | 16 | 7 | 11 | 35 | 6268 |
| 649 | 6 | 16 | 7 | 11 | 35 | 5616 |
| 650 | 6 | 16 | 7 | 11 | 35 | 5289 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 651 | 6 | 16 | 7 | 11 | 35 | 5298 |
| 652 | 6 | 16 | 7 | 11 | 36 | 6007 |
| 653 | 6 | 16 | 7 | 11 | 36 | 5753 |
| 654 | 6 | 16 | 7 | 11 | 36 | 5299 |
| 655 | 6 | 16 | 7 | 11 | 36 | 4794 |
| 656 | 6 | 16 | 7 | 11 | 36 | 5609 |
| 657 | 6 | 16 | 7 | 11 | 36 | 5408 |
| 658 | 6 | 16 | 7 | 11 | 36 | 5537 |
| 659 | 6 | 16 | 7 | 11 | 36 | 5714 |
| 660 | 6 | 16 | 7 | 11 | 37 | 4889 |
| 661 | 6 | 16 | 7 | 11 | 37 | 5505 |
| 662 | 6 | 16 | 7 | 11 | 37 | 5152 |
| 663 | 6 | 16 | 7 | 11 | 37 | 5677 |
| 664 | 6 | 16 | 7 | 11 | 37 | 5006 |
| 665 | 6 | 16 | 7 | 11 | 37 | 4994 |
| 666 | 6 | 16 | 7 | 11 | 37 | 5093 |
| 667 | 6 | 16 | 7 | 11 | 37 | 5352 |
| 668 | 6 | 16 | 7 | 11 | 37 | 4956 |
| 669 | 6 | 16 | 7 | 11 | 38 | 5057 |
| 670 | 6 | 16 | 7 | 11 | 38 | 5667 |
| 671 | 6 | 16 | 7 | 11 | 38 | 5734 |
| 672 | 6 | 16 | 7 | 11 | 38 | 5435 |
| 673 | 6 | 16 | 7 | 11 | 38 | 6154 |
| 674 | 6 | 16 | 7 | 11 | 39 | 6935 |
| 675 | 6 | 16 | 7 | 11 | 39 | 7130 |
| 676 | 6 | 16 | 7 | 11 | 40 | 6481 |
| 677 | 6 | 16 | 7 | 11 | 40 | 6949 |
| 678 | 6 | 16 | 7 | 11 | 40 | 7266 |
| 679 | 6 | 16 | 7 | 11 | 40 | 8846 |
| 680 | 6 | 16 | 7 | 11 | 40 | 6165 |
| 681 | 6 | 16 | 7 | 11 | 40 | 6691 |
| 682 | 6 | 16 | 7 | 11 | 40 | 7223 |
| 683 | 6 | 16 | 7 | 11 | 40 | 7465 |
| 684 | 6 | 16 | 7 | 11 | 41 | 6978 |
| 685 | 6 | 16 | 7 | 11 | 41 | 8312 |
| 686 | 6 | 16 | 7 | 11 | 41 | 7335 |
| 687 | 6 | 16 | 7 | 11 | 41 | 7285 |
| 688 | 6 | 16 | 7 | 11 | 41 | 6797 |
| 689 | 6 | 16 | 7 | 11 | 41 | 7507 |
| 690 | 6 | 16 | 7 | 11 | 41 | 7211 |
| 691 | 6 | 16 | 7 | 11 | 41 | 6036 |
| 692 | 6 | 16 | 7 | 11 | 41 | 5973 |
| 693 | 6 | 16 | 7 | 11 | 42 | 7583 |
| 694 | 6 | 16 | 7 | 11 | 42 | 5971 |
| 695 | 6 | 16 | 7 | 11 | 42 | 5046 |
| 696 | 6 | 16 | 7 | 11 | 42 | 5722 |
| 697 | 6 | 16 | 7 | 11 | 42 | 5957 |
| 698 | 6 | 16 | 7 | 11 | 42 | 5495 |
| 699 | 6 | 16 | 7 | 11 | 42 | 5495 |
| 700 | 6 | 16 | 7 | 11 | 42 | 5586 |
| 701 | 6 | 16 | 7 | 11 | 43 | 5768 |
| 702 | 6 | 16 | 7 | 11 | 43 | 5957 |
| 703 | 6 | 16 | 7 | 11 | 43 | 5595 |
| 704 | 6 | 16 | 7 | 11 | 43 | 4810 |
| 705 | 6 | 16 | 7 | 11 | 43 | 4994 |
| 706 | 6 | 16 | 7 | 11 | 43 | 5712 |
| 707 | 6 | 16 | 7 | 11 | 43 | 5258 |
| 708 | 6 | 16 | 7 | 11 | 43 | 5406 |
| 709 | 6 | 16 | 7 | 11 | 43 | 5600 |
| 710 | 6 | 16 | 7 | 11 | 44 | 5337 |
| 711 | 6 | 16 | 7 | 11 | 44 | 5104 |
| 712 | 6 | 16 | 7 | 11 | 44 | 6170 |
| 713 | 6 | 16 | 7 | 11 | 44 | 5920 |
| 714 | 6 | 16 | 7 | 11 | 44 | 6109 |
| 715 | 6 | 16 | 7 | 11 | 44 | 5723 |

| Survey Point | Month | Day | Year | Hour | Minute | Gross CPM |
|---|---|---|---|---|---|---|
| 716 | 6 | 16 | 7 | 11 | 44 | 5194 |
| 717 | 6 | 16 | 7 | 11 | 44 | 5813 |
| 718 | 6 | 16 | 7 | 11 | 45 | 5625 |
| 719 | 6 | 16 | 7 | 11 | 46 | 5451 |
| 720 | 6 | 16 | 7 | 11 | 46 | 7316 |
| 721 | 6 | 16 | 7 | 11 | 46 | 6257 |
| 722 | 6 | 16 | 7 | 11 | 46 | 6641 |
| 723 | 6 | 16 | 7 | 11 | 46 | 7364 |
| 724 | 6 | 16 | 7 | 11 | 46 | 6157 |
| 725 | 6 | 16 | 7 | 11 | 46 | 7041 |
| 726 | 6 | 16 | 7 | 11 | 47 | 5680 |
| 727 | 6 | 16 | 7 | 11 | 47 | 6551 |
| 728 | 6 | 16 | 7 | 11 | 47 | 7038 |
| 729 | 6 | 16 | 7 | 11 | 47 | 7134 |
| 730 | 6 | 16 | 7 | 11 | 47 | 6397 |
| 731 | 6 | 16 | 7 | 11 | 47 | 7751 |
| 732 | 6 | 16 | 7 | 11 | 47 | 7280 |
| 733 | 6 | 16 | 7 | 11 | 47 | 6539 |
| 734 | 6 | 16 | 7 | 11 | 47 | 5296 |
| 735 | 6 | 16 | 7 | 11 | 48 | 6239 |
| 736 | 6 | 16 | 7 | 11 | 48 | 5786 |
| 737 | 6 | 16 | 7 | 11 | 48 | 4637 |
| 738 | 6 | 16 | 7 | 11 | 48 | 5957 |
| 739 | 6 | 16 | 7 | 11 | 48 | 6135 |
| 740 | 6 | 16 | 7 | 11 | 48 | 5626 |
| 741 | 6 | 16 | 7 | 11 | 48 | 5865 |
| 742 | 6 | 16 | 7 | 11 | 48 | 5032 |
| 743 | 6 | 16 | 7 | 11 | 48 | 6258 |
| 744 | 6 | 16 | 7 | 11 | 49 | 5927 |
| 745 | 6 | 16 | 7 | 11 | 49 | 5694 |
| 746 | 6 | 16 | 7 | 11 | 49 | 5916 |
| 747 | 6 | 16 | 7 | 11 | 49 | 6030 |
| 748 | 6 | 16 | 7 | 11 | 49 | 5942 |
| 749 | 6 | 16 | 7 | 11 | 49 | 6650 |
| 750 | 6 | 16 | 7 | 11 | 49 | 5044 |
| 751 | 6 | 16 | 7 | 11 | 49 | 5691 |
| 752 | 6 | 16 | 7 | 11 | 50 | 5826 |
| 753 | 6 | 16 | 7 | 11 | 50 | 5618 |
| 754 | 6 | 16 | 7 | 11 | 50 | 4658 |
| 755 | 6 | 16 | 7 | 11 | 50 | 4975 |
| 756 | 6 | 16 | 7 | 11 | 50 | 5738 |
| 757 | 6 | 16 | 7 | 11 | 50 | 5240 |
| 758 | 6 | 16 | 7 | 11 | 50 | 5502 |
| 759 | 6 | 16 | 7 | 11 | 50 | 5759 |
| 760 | 6 | 16 | 7 | 11 | 50 | 5601 |
| 761 | 6 | 16 | 7 | 11 | 51 | 6096 |
| 762 | 6 | 16 | 7 | 11 | 51 | 6560 |
| 763 | 6 | 16 | 7 | 11 | 51 | 6188 |
| 764 | 6 | 16 | 7 | 11 | 51 | 6538 |
| 765 | 6 | 16 | 7 | 11 | 51 | 6534 |
| | | | | | **Minimum:** | **4442** |
| | | | | | **Maximum:** | **8846** |
| | | | | | **Average:** | **5644** |
| | | | | | **Standard Deviation:** | **671** |
| | | | | | **Action Level:** | **9352** |


Area B Gamma Scan Survey Map
Lane 17
Lane 15
Lane 13
Lane 11
Lane 9
Lane 7
Lane 5
Lane 3
Lane 1
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45
Yards
Gross CPM
4000-8000
8000-12000
12000-16000
16000-20000
20000-24000
24000-28000
28000-32000
32000-36000

# Appendix K

# Area B Soil Sample Laboratory Data

STL

**STL St. Louis**
13715 Rider Trail North
Earth City, MO 63045

Tel: 314 298 8566 Fax: 314 298 8757
www.stl-inc.com

# ANALYTICAL REPORT

Dahlgren

Lot #: F7F190283

Dan Spicuzza

New World Technology
448 Commerce Way
Livermore, CA 94551

SEVERN TRENT LABORATORIES, INC.

Ivan Vania
Project Manager

June 22, 2007

## Case Narrative

LOT NUMBER: **F7F190283**

This report contains the analytical results for the 22 samples received under chain of custody by STL St. Louis on June 19, 2007. These samples are associated with your Dahlgren project.

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

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

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

**Observations/Nonconformances**

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

There were no nonconformances or observations noted with any analysis on this lot.

# METHODS SUMMARY

**F7F190283**

| PARAMETER | ANALYTICAL METHOD | PREPARATION METHOD |
|---|---|---|
| Gamma Spectroscopy - Cesium-137 & Hits | EML GA-01-R MOD | |
| Isotopic Uranium by Alpha Spectroscopy | EML A-01-R MOD | |

**References:**

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

# SAMPLE SUMMARY

**F7F190283**

| WO # | SAMPLE# | CLIENT SAMPLE ID | SAMPLED DATE | SAMP TIME |
|---|---|---|---|---|
| J1A26 | 001 | APA-1 | 06/15/07 | 15:45 |
| J1A3A | 002 | APA-2 | 06/15/07 | 15:50 |
| J1A3E | 003 | APB-1 | 06/15/07 | 15:55 |
| J1A3G | 004 | APB-2 | 06/15/07 | 16:00 |
| J1A3K | 005 | AB-A1 | 06/16/07 | 13:55 |
| J1A3L | 006 | AB-A2 | 06/16/07 | 13:45 |
| J1A3N | 007 | AB-A3 | 06/16/07 | 13:50 |
| J1A3R | 008 | AB-B1 | 06/16/07 | 14:00 |
| J1A3V | 009 | AB-B2 | 06/16/07 | 14:05 |
| J1A3X | 010 | AB-B3 | 06/16/07 | 14:10 |
| J1A34 | 011 | AB-C1 | 06/16/07 | 14:25 |
| J1A4N | 012 | AB-C2 | 06/16/07 | 14:20 |
| J1A4P | 013 | AB-C3 | 06/16/07 | 14:15 |
| J1A4Q | 014 | AB-D1 | 06/16/07 | 14:30 |
| J1A4T | 015 | AB-D2 | 06/16/07 | 14:35 |
| J1A4W | 016 | AB-D3 | 06/16/07 | 14:40 |
| J1A44 | 017 | AB-E1 | 06/16/07 | 14:55 |
| J1A46 | 018 | AB-E2 | 06/16/07 | 14:50 |
| J1A49 | 019 | AB-E3 | 06/16/07 | 14:45 |
| J1A5C | 020 | AB-F1 | 06/16/07 | 15:00 |
| J1A5E | 021 | AB-F2 | 06/16/07 | 15:05 |
| J1A5L | 022 | AB-F3 | 06/16/07 | 15:10 |

**NOTE(S):**

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

# New World Technology

## Client Sample ID: AB-A1

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F190283-005
Work Order: J1A3K
Matrix: SOLID

Date Collected: 06/16/07 1355
Date Received: 06/19/07 1450

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | pCi/g | Batch # 7171412 | | Yld % |
| Uranium 238 | 0.34 | U | 0.70 | 4.00 | 1.2 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: AB-A2

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F190283-006 | Date Collected: | 06/16/07 1345 |
| Work Order: | J1A3L | Date Received: | 06/19/07 1450 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| Gamma Cs-137 & Hits by DOE GA-01-R MOD. | | | | pCi/g | Batch # 7171412 | | Yld % |
| Uranium 238 | 1.45 | J | 0.70 | 4.00 | 1.3 | 06/20/07 | 06/20/07 |

**NOTE(S)**

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: AB-A3

### Severn Trent Laboratories - Radiochemistry

| | | | | |
|---|---|---|---|---|
| Lab Sample ID: | F7F190283-007 | | Date Collected: | 06/16/07 1350 |
| Work Order: | J1A3N | | Date Received: | 06/19/07 1450 |
| Matrix: | SOLID | | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | pCi/g | Batch # 7171412 | | Yld % |
| Uranium 238 | 0.63 | U | 0.48 | 4.00 | 1.4 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: AB-B1

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F190283-008
Work Order: J1A3R
Matrix: SOLID

Date Collected: 06/16/07 1400
Date Received: 06/19/07 1450

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | pCi/g | Batch # 7171412 | | Yld % |
| Uranium 238 | 1.51 | J | 0.59 | 4.00 | 1.0 | 06/20/07 | 06/20/07 |
| **Iso URANIUM (SHORT CT) DOE A-01-R MOD** | | | | pCi/g | Batch # 7171191 | | Yld % 90 |
| Uranium 233/234 | 0.66 | J | 0.19 | 1.00 | 0.05 | 06/20/07 | 06/21/07 |
| Uranium 235/236 | 0.048 | U | 0.052 | 1.00 | 0.054 | 06/20/07 | 06/21/07 |
| Uranium 238 | 1.80 | | 0.35 | 1.00 | 0.05 | 06/20/07 | 06/21/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: AB-B1 DUP

### Severn Trent Laboratories - Radiochemistry

| | | | | |
|---|---|---|---|---|
| Lab Sample ID: | F7F190283-008X | | Date Collected: | 06/16/07 1400 |
| Work Order: | J1A3R | | Date Received: | 06/19/07 1450 |
| Matrix: | SOLID | | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Iso URANIUM (SHORT CT) DOE A-01-R MOD** | | | | **pCi/g** | **Batch # 7171191** | | **Yld % 92** |
| Uranium 233/234 | 0.50 | J | 0.16 | 1.00 | 0.05 | 06/20/07 | 06/21/07 |
| Uranium 235/236 | 0.008 | U | 0.030 | 1.00 | 0.062 | 06/20/07 | 06/21/07 |
| Uranium 238 | 1.67 | | 0.34 | 1.00 | 0.03 | 06/20/07 | 06/21/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: AB-B2

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F190283-009
Work Order: J1A3V
Matrix: SOLID

Date Collected: 06/16/07 1405
Date Received: 06/19/07 1450

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| Gamma Cs-137 & Hits by DOE GA-01-R MOD. | | | | pCi/g | | Batch # 7171412 | Yld % |
| Uranium 238 | 1.47 | J | 0.56 | 4.00 | 1.0 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: AB-B3

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F190283-010 | Date Collected: | 06/16/07 1410 |
| Work Order: | J1A3X | Date Received: | 06/19/07 1450 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| Gamma Cs-137 & Hits by DOE GA-01-R MOD. | | | | pCi/g | Batch # 7171412 | | Yld % |
| Uranium 238 | 12.3 | | 2.6 | 4.0 | 2.4 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

# New World Technology

## Client Sample ID: AB-C1

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F190283-011
Work Order: J1A34
Matrix: SOLID

Date Collected: 06/16/07 1425
Date Received: 06/19/07 1450

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| Gamma Cs-137 & Hits by DOE GA-01-R MOD. | | | | pCi/g | Batch # 7171412 | | Yld % |
| Uranium 238 | 0.69 | U | 0.50 | 4.00 | 1.3 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: AB-C2

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F190283-012 | Date Collected: | 06/16/07 1420 |
| Work Order: | J1A4N | Date Received: | 06/19/07 1450 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| Gamma Cs-137 & Hits by DOE GA-01-R MOD. | | | | pCi/g | Batch # 7171412 | | Yld % |
| Uranium 238 | 5.3 | | 1.0 | 4.0 | 1.5 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

# New World Technology

## Client Sample ID: AB-C3

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F190283-013 | Date Collected: | 06/16/07 1415 |
| Work Order: | J1A4P | Date Received: | 06/19/07 1450 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | **Batch # 7171412** | | **Yld %** |
| Uranium 238 | 0.69 | U | 0.49 | 4.00 | 1.2 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: AB-D1

### Severn Trent Laboratories - Radiochemistry

| | | | | |
|---|---|---|---|---|
| Lab Sample ID: | F7F190283-014 | Date Collected: | 06/16/07 | 1430 |
| Work Order: | J1A4Q | Date Received: | 06/19/07 | 1450 |
| Matrix: | SOLID | | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| Gamma Cs-137 & Hits by DOE GA-01-R MOD. | | | | pCi/g | Batch # 7171412 | | Yld % |
| Uranium 238 | 0.19 | U | 0.67 | 4.00 | 1.2 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: AB-D2

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F190283-015 | Date Collected: | 06/16/07 1435 |
| Work Order: | J1A4T | Date Received: | 06/19/07 1450 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | | **Batch # 7171412** | **Yld %** |
| Uranium 238 | 0.66 | U | 0.40 | 4.00 | 1.6 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: AB-D3

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F190283-016 | Date Collected: | 06/16/07 1440 |
| Work Order: | J1A4W | Date Received: | 06/19/07 1450 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| Gamma Cs-137 & Hits by DOE GA-01-R MOD. | | | | pCi/g | Batch # 7171412 | | Yld % |
| Uranium 238 | 6.67 | | 0.97 | 4.00 | 1.3 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

# New World Technology

## Client Sample ID: AB-E1

### Severn Trent Laboratories - Radiochemistry

| | | | | |
|---|---|---|---|---|
| Lab Sample ID: | F7F190283-017 | | Date Collected: | 06/16/07 1455 |
| Work Order: | J1A44 | | Date Received: | 06/19/07 1450 |
| Matrix: | SOLID | | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | **Batch # 7171412** | | **Yld %** |
| Uranium 238 | 0.46 | U | 0.35 | 4.00 | 1.1 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: AB-E2

### Severn Trent Laboratories - Radiochemistry

Lab Sample ID: F7F190283-018
Work Order: J1A46
Matrix: SOLID

Date Collected: 06/16/07 1450
Date Received: 06/19/07 1450

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| Gamma Cs-137 & Hits by DOE GA-01-R MOD. | | | | pCi/g | Batch # 7171412 | | Yld % |
| Uranium 238 | 0.49 | U | 0.32 | 4.00 | 1.3 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: AB-E3

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F190283-019 | Date Collected: | 06/16/07 1445 |
| Work Order: | J1A49 | Date Received: | 06/19/07 1450 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | pCi/g | Batch # 7171412 | | Yld % |
| Uranium 238 | 7.3 | | 1.1 | 4.0 | 1.6 | 06/20/07 | 06/20/07 |
| **Iso URANIUM (SHORT CT) DOE A-01-R MOD** | | | | pCi/g | Batch # 7171191 | | Yld % 89 |
| Uranium 233/234 | 1.66 | | 0.34 | 1.00 | 0.05 | 06/20/07 | 06/21/07 |
| Uranium 235/236 | 0.24 | J | 0.12 | 1.00 | 0.07 | 06/20/07 | 06/21/07 |
| Uranium 238 | 10.0 | | 1.4 | 1.0 | 0.06 | 06/20/07 | 06/21/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

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

# New World Technology

## Client Sample ID: AB-F1

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F190283-020 | Date Collected: | 06/16/07 1500 |
| Work Order: | J1A5C | Date Received: | 06/19/07 1450 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| Gamma Cs-137 & Hits by DOE GA-01-R MOD. | | | | pCi/g | Batch # 7171412 | | Yld % |
| Uranium 238 | 0.48 | U | 0.60 | 4.00 | 1.0 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: AB-F2

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F190283-021 | Date Collected: | 06/16/07 1505 |
| Work Order: | J1A5E | Date Received: | 06/19/07 1450 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | **Batch # 7171413** | | **Yld %** |
| Uranium 238 | 0.31 | U | 0.77 | 4.00 | 1.4 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: AB-F2 DUP

### Severn Trent Laboratories - Radiochemistry

| | | | |
|---|---|---|---|
| Lab Sample ID: | F7F190283-021X | Date Collected: | 06/16/07 1505 |
| Work Order: | J1A5E | Date Received: | 06/19/07 1450 |
| Matrix: | SOLID | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| Gamma Cs-137 & Hits by DOE GA-01-R MOD. | | | | pCi/g | Batch # 7171413 | | Yld % |
| Uranium 238 | 0.3 | U | 1.3 | 4.0 | 2.3 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# New World Technology

## Client Sample ID: AB-F3

### Severn Trent Laboratories - Radiochemistry

| | | | | |
|---|---|---|---|---|
| Lab Sample ID: | F7F190283-022 | | Date Collected: | 06/16/07 1510 |
| Work Order: | J1A5L | | Date Received: | 06/19/07 1450 |
| Matrix: | SOLID | | | |

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | Prep Date | Analysis Date |
|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | **pCi/g** | | **Batch # 7171413** | **Yld %** |
| Uranium 238 | 0.7 | U | 1.4 | 4.0 | 2.4 | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U  Result is less than the sample detection limit.

# METHOD BLANK REPORT

## Severn Trent Laboratories - Radiochemistry

Client Lot ID: F7F190283
Matrix: SOLID

| Parameter | Result | Qual | Total Uncert. (2 σ+/-) | RL | MDC | | Prep Date | Lab Sample ID / Analysis Date |
|---|---|---|---|---|---|---|---|---|
| **Iso URANIUM (SHORT CT) DOE A-01-R MOD** | | | pCi/g | Batch # | 7171191 | Yld % | 88 | F7F200000-191B |
| Uranium 233/234 | 0.028 | U | 0.040 | 1.00 | 0.053 | | 06/20/07 | 06/21/07 |
| Uranium 235/236 | 0.0 | U | 0.0 | 1.0 | 0.04 | | 06/20/07 | 06/21/07 |
| Uranium 238 | -0.002 | U | 0.023 | 1.00 | 0.046 | | 06/20/07 | 06/21/07 |
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | pCi/g | Batch # | 7171412 | Yld % | | F7F200000-412B |
| Uranium 238 | -0.02 | U | 0.49 | 4.00 | 1.0 | | 06/20/07 | 06/20/07 |
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | pCi/g | Batch # | 7171413 | Yld % | | F7F200000-413B |
| Uranium 238 | -0.3 | U | 1.6 | 4.0 | 1.0 | | 06/20/07 | 06/20/07 |

NOTE(S)

Data are incomplete without the case narrative.

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

U Result is less than the sample detection limit.

# Laboratory Control Sample Report

## Severn Trent Laboratories - Radiochemistry

Client Lot ID: F7F190283
Matrix: SOLID

| Parameter | Spike Amount | Result | Total Uncert. (2 σ+/-) | MDC | % Yld | % Rec | Lab Sample ID QC Control Limits |
|---|---|---|---|---|---|---|---|
| **Iso URANIUM (SHORT CT) DOE A-01-R MOD** | | pCi/g | | A-01-R MOD | | | F7F200000-191C |
| Uranium 233/234 | 19.6 | 20.3 | 3.6 | 0.4 | 88 | 104 | (78 - 125) |
| Uranium 238 | 19.6 | 21.5 | 3.8 | 0.4 | 88 | 110 | (76 - 122) |
| | Batch #: | 7171191 | | Analysis Date: | 06/21/07 | | |
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | pCi/g | | GA-01-R MOD | | | F7F200000-412C |
| Americium 241 | 103 | 107 | 8.5 | 1.5 | | 103 | (87 - 121) |
| Cesium 137 | 40.0 | 43.0 | 2.8 | 0.6 | | 107 | (90 - 120) |
| Cobalt 60 | 62.7 | 64.1 | 3.9 | 0.2 | | 102 | (90 - 113) |
| | Batch #: | 7171412 | | Analysis Date: | 06/20/07 | | |
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | pCi/g | | GA-01-R MOD | | | F7F200000-413C |
| Americium 241 | 103 | 106 | 8.4 | 1.6 | | 102 | (87 - 121) |
| Cesium 137 | 40.0 | 42.7 | 2.7 | 0.5 | | 107 | (90 - 120) |
| Cobalt 60 | 62.7 | 65.4 | 3.9 | 0.3 | | 104 | (90 - 113) |
| | Batch #: | 7171413 | | Analysis Date: | 06/20/07 | | |

**NOTE(S)**

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

# DUPLICATE EVALUATION REPORT

## Severn Trent Laboratories - Radiochemistry

Client Lot ID: F7F190283
Matrix: SOLID

Date Sampled: 06/15/07
Date Received: 06/19/07

| Parameter | SAMPLE Result | | Total Uncert. (2σ +/-) | % Yld | DUPLICATE Result | | Total Uncert. (2 σ +/-) | % Yld | QC Sample ID Precision | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | pCi/g | GA-01-R MOD | | | | F7F190283-001 | |
| Uranium 238 | 2.66 | J | 0.80 | | 2.56 | J | 0.92 | | 4 | %RPD |
| | Batch #: | | 7171412 (Sample) | | 7171412 (Duplicate) | | | | | |
| **Iso URANIUM (SHORT CT) DOE A-01-R MOD** | | | | pCi/g | A-01-R MOD | | | | F7F190283-008 | |
| Uranium 233/234 | 0.66 | J | 0.19 | 90 | 0.50 | J | 0.16 | 92 | 28 | %RPD |
| Uranium 235/236 | 0.048 | U | 0.052 | 90 | 0.008 | U | 0.030 | 92 | 144 | %RPD |
| Uranium 238 | 1.80 | | 0.35 | 90 | 1.67 | | 0.34 | 92 | 8 | %RPD |
| | Batch #: | | 7171191 (Sample) | | 7171191 (Duplicate) | | | | | |
| **Gamma Cs-137 & Hits by DOE GA-01-R MOD.** | | | | pCi/g | GA-01-R MOD | | | | F7F190283-021 | |
| Uranium 238 | 0.31 | U | 0.77 | | 0.3 | U | 1.3 | | 1 | %RPD |
| | Batch #: | | 7171413 (Sample) | | 7171413 (Duplicate) | | | | | |

NOTE(S)

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

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

# Chain of Custody Record

SEVERN TRENT **STL**
**Severn Trent Laboratories, Inc.**

Cur 1813

STL-4124 (0901)

| Client | Project Manager | Date | Chain of Custody Number |
|---|---|---|---|
| NWT | Daniel Spicuzza | 6/16/07 | 318641 |

| Address | Telephone Number (Area Code)/Fax Number | Lab Number | Page |
|---|---|---|---|
| 448 Commerce Way | (412) 824-2333 | | Page 1 of 2 |

| City | State | Zip Code | Site Contact | Lab Contact |
|---|---|---|---|---|
| Livermore | CA | 94551 | Daniel Spicuzza | Tammy Ramirez |

Project Name and Location (State): Dahlgren VA

Carrier/Waybill Number: Fed Ex 8614 6401 4119

Contract/Purchase Order/Quote No.: GA00627

| Sample I.D. No. and Description (Containers for each sample may be combined on one line) | Date | Time | Matrix: Air | Aqueous | Sed. | Soil | | Containers & Preservatives: Unpres. | H2SO4 | HNO3 | HCl | NaOH | ZnAc/NaOH | | Analysis: Gamma Spec U-238 | [illegible] | Special Instructions/ Conditions of Receipt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| APA-1 | 6/15/07 | 1545 | | | | X | | X | | | | | | | X | | |
| APA-2 | 6/15/07 | 1550 | | | | X | | X | | | | | | | X | | |
| APB-1 | 6/15/07 | 1555 | | | | X | | X | | | | | | | X | | |
| APB-2 | 6/15/07 | 1600 | | | | X | | X | | | | | | | X | | |
| AB-A1 | 6/16/07 | 1355 | | | | X | | X | | | | | | | X | | |
| AB-A2 | 6/16/07 | 1345 | | | | X | | X | | | | | | | X | | |
| AB-A3 | 6/16/07 | 1350 | | | | X | | X | | | | | | | X | | |
| AB-B1 | 6/16/07 | 1400 | | | | X | | X | | | | | | | X | X | Alpha Spec |
| AB-B2 | 6/16/07 | 1405 | | | | X | | X | | | | | | | X | | |
| AB-B3 | 6/16/07 | 1410 | | | | X | | X | | | | | | | X | | |
| AB-C1 | 6/16/07 | 1425 | | | | X | | X | | | | | | | X | | |
| AB-C2 | 6/16/07 | 1420 | | | | X | | X | | | | | | | X | | |

**Possible Hazard Identification:** ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☒ Unknown

**Sample Disposal:** ☐ Return To Client ☒ Disposal By Lab ☐ Archive For ______ Months (A fee may be assessed if samples are retained longer than 1 month)

**Turn Around Time Required:** ☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☒ Other 72 hours

**QC Requirements (Specify):** IV

| | Date | Time | | Date | Time |
|---|---|---|---|---|---|
| 1. Relinquished By: [signature] | 6-19-07 | 1500 | 1. Received By: Angela Brown | 6-19-07 | 14:50 |
| 2. Relinquished By | | | 2. Received By | | |
| 3. Relinquished By | | | 3. Received By | | |

Comments

**DISTRIBUTION:** WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

# Chain of Custody Record

SEVERN TRENT **STL**
Severn Trent Laboratories, Inc.

STL-4124 (0901)

| | | | |
|---|---|---|---|
| Client: NWT | Project Manager: Daniel Spicuzza | Date: 6/16/07 | Chain of Custody Number: 318642 |
| Address: 418 Commerce Way | Telephone Number (Area Code)/Fax Number: (412) 824-2333 | Lab Number: | Page 2 of 2 |
| City: Livermore; State: CA; Zip Code: 94551 | Site Contact: Daniel Spicuzza; Lab Contact: Terry Romanko | | |
| Project Name and Location (State): Dahlgren VA | Carrier/Waybill Number: Fed Ex 8614 6401 4424 | | |
| Contract/Purchase Order/Quote No.: GA00627 | | | |

| Sample I.D. No. and Description (Containers for each sample may be combined on one line) | Date | Time | Matrix: Air | Aqueous | Sed. | Soil | Containers & Preservatives: Unpres. | H2SO4 | HNO3 | HCl | NaOH | ZnAc/NaOH | Analysis: Gamma Spec U-238 | [illegible] | Special Instructions/ Conditions of Receipt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AB-C3 | 6/16/07 | 1415 | | | | X | X | | | | | | X | | |
| AB-D1 | 6/16/07 | 1430 | | | | X | X | | | | | | X | | |
| AB-D2 | 6/16/07 | 1435 | | | | X | X | | | | | | X | | |
| AB-D3 | 6/16/07 | 1440 | | | | X | X | | | | | | X | | |
| AB-E1 | 6/16/07 | 1455 | | | | X | X | | | | | | X | | |
| AB-E2 | 6/16/07 | 1450 | | | | X | X | | | | | | X | | |
| AB-E3 | 6/16/07 | 1445 | | | | X | X | | | | | | X | X | Alpha Spec |
| AB-F1 | 6/16/07 | 1500 | | | | X | X | | | | | | X | | |
| AB-F2 | 6/16/07 | 1505 | | | | X | X | | | | | | X | | |
| AB-F3 | 6/16/07 | 1510 | | | | X | X | | | | | | X | | |

NA

**Possible Hazard Identification:** ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☒ Unknown

**Sample Disposal:** ☐ Return To Client ☒ Disposal By Lab ☐ Archive For ____ Months (A fee may be assessed if samples are retained longer than 1 month)

**Turn Around Time Required:** ☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☒ Other 72 hours

**QC Requirements (Specify):** IV

| | Date | Time | | Date | Time |
|---|---|---|---|---|---|
| 1. Relinquished By: Dan Spi | [illegible] | 1500 | 1. Received By: Angela Busson | 6-19-07 | 14:50 |
| 2. Relinquished By | | | 2. Received By | | |
| 3. Relinquished By | | | 3. Received By | | |

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

# STL

Lot #(s): F7F190283

- 1813 -

Condition Upon Receipt Form

Client: NWT
Quote No: 74472
COC/RFA No: 318641/318642
Initiated By: AB
Date: 6-19-07
Time: 14:50

**Shipping Information**

Shipper Name: FE
Shipping # (s):*
1. 8624 6201 4212
2.
3.
4.
5.
6.
7.
8.
9.
10.

Multiple Packages Y N
Sample Temperature (s):**
1. Ambient
2.
3.
4.
5.
6.
7.
8.
9.
10.

*Numbered shipping lines correspond to Numbered Sample Temp lines

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

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

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

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

Notes:

Corrective Action:
☐ Client Contact Name:
☐ Sample(s) processed "as is"
☐ Sample(s) on hold until:

Informed by:
If released, notify:

Project Management Review: [signature] Date: 6-20-7

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

ADMIN-0004, REVISED 04/18/07\\Slsvr01\QA\FORMS\ST-LOUIS\ADMIN\Admin004 rev11.doc